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Re-engineering materials management

A case study on an Indian refinery

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Keywords *Business process re-engineering, Warehousing, Materials handling*

Abstract *Materials management function is always a major concern to the management of any industrial organisation as high inventory and an inefficient procurement process affect the profitability to a great extent. Problems multiply due to a very current business environment in India. Hence, existing materials planning and procurement processes and inventory management systems require a re-look with respect to a changing business environment. This study shows a radical improvement in materials management function of an Indian petroleum refinery through business process re-engineering (BPR) by analysing current processes, identifying key issues, deriving paradigm shifts and developing re-engineered processes through customer value analysis. BPR has been carried out on existing processes of "materials planning and procurement" and "warehousing and surplus disposal". The re-engineered processes for materials management function trigger a few improvement projects that were identified by the group of executives who took part in the re-engineering exercise. Those projects were implemented in an integrated framework with the application of the state of art information technology tools.*

Introduction

Materials costs constitute approximately 60 percent of the total working capital of any industrial organisation. There is a great deal of evidence of loss of productivity due to inefficient materials management. The common issues that are associated with materials management functions are:

- receiving materials before they are required, causing more inventory cost and chances of deterioration in quality;
- not receiving materials at the time of requirement, causing loss of productivity;
- incorrect materials takeoff from drawing and design document;
- subsequent design changes;
- damage/loss of items;
- failure on installation;
- selection of type of contract for specific materials procurement;
- vendor evaluation criteria;
- piling up of inventory and controlling of the same;
- management of surplus materials; and
- any one of the above or all of the above, or combinations.

Silver (1998) also illustrated various issues and concerns of materials management of large scale projects.

A constant challenge faced by today's management is change. On one hand change represents growth, opportunity and development. On the other hand, it represents threat, disorientation and upheaval. In such a context, restructuring alone is proving to be increasingly inadequate in achieving and sustaining the improvements needed to remain competitive. The business world today has acquired an aggressive momentum and has entered into an era of fundamental and accelerated change. Sustaining growth and remaining competitive are the greatest problems to management. In today's business environment, customer needs to evolve at an extremely quick pace due to increased mobility of the resources and development of media and technology. In this circumstance, slow improvement in an organisation's system is not sufficient even just to keep it in existence. Much of the motivation for this rethinking seems to arise from the observation that many current business practices are outdated and are no longer either suited to today's competitive situation or match the capabilities offered by current technology.

Conventional materials management is no longer effective with respect to today's business perspective. An overall organisational approach is necessary for successful material within management function the organisation. This study proposes the application of business process re-engineering for radical improvement of materials management function of the organisation under study. Many authors (Bell and Stukhart, 1986; Tavakoli and Kakalia, 1993; Back and Lansford, 1996) suggested re-engineering of materials management function through information technology (IT) and quantitative methods.

As organisations strive to be more competitive in today's challenging business environment, more of them are taking a radical look at what makes them successful. Business process re-engineering (BPR) as introduced first by Hammer and Champy (1993) is becoming the philosophy for success. According to Hammer, BPR is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measure of performance, such as cost, quality, service, and speed.

Davenport and Short (1990) have defined BPR as the analysis and design of work flows and processes within the organisations.

According to Talwar (1993) it is to rethink, restructure and streamline the business structures, processes, methods of working, management systems and external relationships through which we create and deliver value.

In summary, therefore, BPR can be seen to represent a range of activities concerned with the improvement of processes. While some authors appear to suggest that tools and techniques are the key, other authors suggest that a strategic approach to BPR, and the development of a BPR strategy is the key to success. There seems little doubt that efforts on the scale of BPR must be strategically driven and supported by senior management if they are to succeed.

While the exact methodologies to be used are the source of some discussion, it can be seen that BPR, as a strategic cross-functional activity, must be integrated with other aspects of management for success as suggested by Davenport and Short (1990). This is particularly true since it is not the methodologies themselves, but rather the way that they are used which is unique in BPR as highlighted by Earl and Khan (1994).

BPR emerges as a management philosophy like total quality management (TQM). Like many other authors Yeo (1996) suggested that TQM and BPR are not mutually exclusive. Both TQM and BPR emphasised customer-focus, teamwork and empowerment. The basic difference has to do with the nature of change and the quantum of consequential improvements. If TQM is primarily good for gradual, continuous and incremental improvements of "Kaizen", then BPR is supposed to bring about "radical" changes and "dramatic" improvements. Hammer and Champy (1993) define re-engineering as "the fundamental rethinking and radical redesign of business processes to bring about dramatic improvements in performance". Both radical and dramatic improvements are found in performance. TQM therefore addresses quantitative change and BPR causes qualitative change of "revolution".

BPR has been used for organizational benefit by many researchers. Ascari *et al.* (1995) applied it at an organisational level for radical improvement of business functions. Dey (1999) used BPR for effective implementation of projects.

This paper uses BPR as a tool for radical improvement in materials management function of the organisation under study.

Methodology for BPR

The following steps are proposed to be carried out for effective process re-engineering:

- (1) fixing a stretched target;
- (2) mapping of current processes;
- (3) preparing cost-time profile;
- (4) determining customer (external/internal/outside suppliers) value structure;
- (5) identifying and prioritising key issues;
- (6) analysing root causes of key issues;
- (7) deriving paradigm shifts;
- (8) mapping re-engineered process;
- (9) preparing cost-time profile;
- (10) determining customer (external/internal/outside suppliers) value structure;
- (11) identifying assumptions;
- (12) determining benefits;
- (13) deriving few projects from identified assumptions;

- (14) preparing time bound action plan for implementation of above projects;
- (15) following up the implementation;

Figure 1 depicts the flow chart for carrying out process re-engineering

Application

The organisation under study operates a petroleum refinery in an eastern part of India. This refinery has a materials management function for an uninterrupted supply of raw materials, spares for operation and maintenance of the plant and equipment and project materials for constant capacity augmentation. However, the refinery suffers from a large procurement cycle time, a huge inventory carrying cost and ineffective warehousing and surplus disposal methods for spares and project materials.

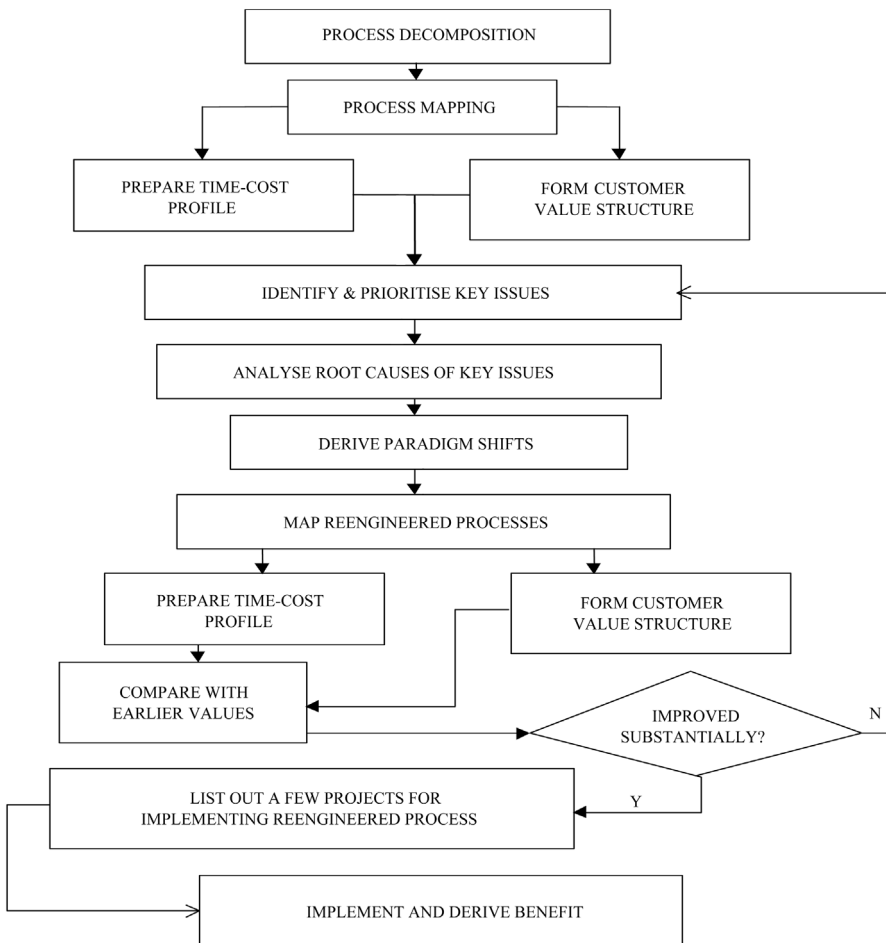


Figure 1.
Methodology for process
re-engineering

Process re-engineering was proposed for improving the materials management function of the refinery under study for spares and project materials. The following two processes were considered for the study:

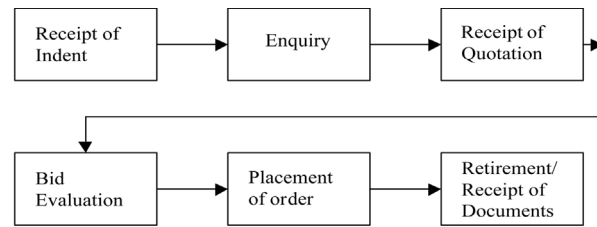
- (1) materials planning and procurement process;
- (2) warehousing and surplus disposal method.

A five day workshop was conducted with the executives from different functional groups including materials management for carrying out process re-engineering. They have worked together to determine the re-engineered process, applying the above methodology.

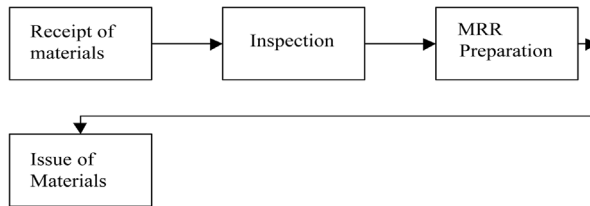
Figure 2 shows macro level process maps of the above two processes of materials management function of the organisation under study.

The following targets were made for improving effectiveness of materials management function:

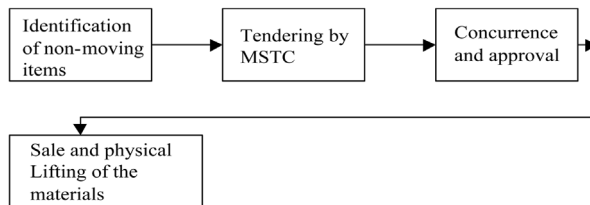
- (1) *Materials planning and procurement process:*
 - reduce cycle time of receipt of indent to placement of order;



(a) Material Planning and Procurement Process



(b) Warehousing



(c) Surplus Disposal

Figure 2.
Macro level process maps

- reduce lead time (time between placement of order and receiving materials);
- establish long term relationship with suppliers to create a reliable vendor base;
- reduce current inventory;
- rationalisation and standardisation of spare parts amongst different plants;
- introduce dynamic system for review and procurement of insurance spares and inventory holdings for various groups of items.

(2) *Warehousing and surplus disposal method:*

- System to eliminate/minimise inventory build up of surplus material;
- disposal procedure for surplus material;
- inventory of non-moving items (not issued for more than five years) to be reduced to zero and suitable process to be implemented for monitoring the same.

Detailed current processes were identified and mapped. A time-cost profile and customer value structure were formed. Time-cost profile was formed by listing all tasks in sequence, determining time and cost for each task and plotting time vs cumulative cost against milestone activities. The customer value structure was formulated by identifying all customers of the process the concerned and identifying the attributes on which customer values are to be determined. Table I shows a typical customer value structure for the “materials planning and procurement process”. These lead to the identification and prioritisation of a few key issues as listed in Table II. Root cause analysis of issues leads to the formation of re-engineered processes through a few paradigm shifts. For designing re-engineered processes, the following stretched targets were made

SNo	Needs (identified by customer)	Score (weights)	Performance		
			Value	Gap	
1.	Placement of order within validity period of offers	20	50	10	10
2.	Raising minimum techno-commercial queries to vendors during evaluation (appropriate tender specification)	10	50	5	5
3.	Inviting for price negotiation irrespective of position of the offer	10	20	2	8
4.	Timely payment and no bank guarantee	40	50	20	20
5.	Transparency in evaluation	10	40	4	6
6.	Forming long term relationship with client	10	20	2	8
	Total	100		43	57

Table I.
Customer value structure

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Table II.
Prioritised key issues

SNo	Description	Score
<i>Materials planning and procurement process</i>		
1.	Non-release of payment within stipulated time to vendor	42
2.	Too many techno-commercial queries to vendors during evaluation	26
3.	Incomplete enquiries forwarded to vendor	23
4.	Incomplete indents	21
5.	Weak follow-up system with vendors	21
6.	Too many management approvals	20
7.	Lack of infrastructure (fax, e-mail, Internet, telephone, computer)	15
8.	Mismatch of physical stock with computer system	14
<i>Warehousing</i>		
9.	Delay in inspection	30
10.	Non-availability of inspection certificates/documents	20
11.	Identification of space of storage	14
12.	Poor mobilisation of transport labour	12
13.	Non-availability of material handling equipment	11
<i>Surplus disposal</i>		
14.	Lower delegation of power (DOP) for write off approval	25
15.	Improper database	15
16.	Time constraints in physical verification of surplus	15
17.	Non-receipt of offers for spares	15
18.	Too much hierarchy for approval	14
19.	Lack of follow up with Materials and Scrap Trading Corporation (MSTC)	13

by the groups in order to achieve a quantum improvement with respect to quality, cost and delivery:

- process time reduction – 50 percent.
- cost reduction – 30 percent.
- customer value enhancement – 90 percent.

Re-engineered processes were mapped with a few key assumptions. Time-cost profile and customer value structures were derived for reengineered processes.

Participants quantified total improvement that could be achieved with the implementation of re-engineered processes, which are shown in Table III.

Re-engineered processes

The re-engineered processes have been designed with the following salient features:

(1) *Materials planning and procurement process:*

- single window clearance;
- more IT oriented system;
- standardisation of materials specification and categorisation;
- dynamic vendor performance rating;

	Total no. of steps	Total hands on time (days)	Total elapsed time (days)	Total processing cost (Rs)	Total no of approvals	Customer value
<i>Current process</i>						
Planning and procurement	54	6.4	162	8,708	158	53
Warehouse	13	7.0	44.5	5,700	8	63
Surplus	22	53.5	201	33,900	16	59*
Total	89	66.9	407.5	48,308	182	58.3*
<i>Re-engineered process</i>						
Planning and procurement	13	4.4	41	5,235	43	90
Warehouse	6	5.5	11	5,350	3	87.4
Surplus	4	4.3	68	8,000	5	89
Total	23	52.9	120	18,585	51	89*
Difference	66	14	287.5	29,723	131	31
Improvement (%)	74	21	70	61	72	53

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Table III.

Total improvement

Note: Rs 45 = US\$ 1; * = average

- streamlining of indenting system;
- memorandum of understanding with vendors;
- development of long term vendor relationship;
- dynamic review and updating of insurance items.

(2) *Warehousing and surplus disposal process:*

- payment through bank to be discouraged;
- on-line information to users for pending inspection and mandatory visit of indentors twice a week;
- items with third party inspection certificate and proprietary items not to be inspected by indentor;
- a task force shall recommend for corrective action against anomalies in quantities;
- vendor to write/attach metallic tag indicating description and code number on individual items;
- additional storage space creation;
- amenities to transporter;
- automatic identification of surplus for items not moved for more than five years;
- circulation of surplus item list through Internet;
- full delgation of power (DOP) to unit head for writing off of differential amount (loss);

- surplus to be disposed of at the first attempt only.
- in case of proposal of procuring new equipment for replacement of old one, existing spares for the old equipment to be declared surplus and disposed off at first attempt;
- one time procured items to be drawn by user immediately on receipt.

These trigger a few action projects (Table IV) (implementation of) which would ensure practising of re-engineered processes in the system.

The above projects are implemented in an integrated way to form a materials management system for the entire refinery based on IT.

Figure 3 shows the integrated procurement model for the refinery under study. The centralised indent-processing unit processes on-line indents that are raised by the various functional groups for procuring spares, materials for annual maintenance and augmentation projects. The centralised indent processing unit (CIPU) retrieves specification for each material, which is updated by respective user departments. CIPU maintains an updated vendor database. The inventory, surplus materials and cost database help prepare on-line purchase proposals (tender documents) for receiving offers from prospective suppliers with due approval from the competent authority. The offers are then evaluated through a decision support system (DSS). The DSS has been developed in an AHP framework (Saaty, 1980). Figure 4 shows a typical DSS for vendor evaluation and selection. The DSS also provides information for dynamic vendor/vendors performance rating. The detailed description of the DSS is available elsewhere (Dey, 1997). The successful vendor/vendors then communicate the on-line through the purchase order. Subsequently, they are followed up periodically via Internet/fax/telephone. On receipt of materials from vendor on-site or at a specified warehouse, the inventory database is updated. Inspection of the materials is organised either through third party inspection agencies or indentors.

Figure 5 shows integrated warehousing and surplus disposal model. The anticipated spares requirement for plant operations, materials requirement for annual maintenance and bill of materials for augmentation projects along with the organisation's inventory and procurement policy form the inventory profile of the organisation. Accordingly, the warehousing facilities are reviewed and updated every year. Dynamic monitoring and updating of inventory information (issue, receipt and surplus) keep all concerned well informed about any bottleneck in plant operations due to unavailable materials. Deriving surplus identification parameters and disposal policy and procedure, and linking these with the computerised inventory control system provide the on-line information on surplus materials and inventory accordingly is adjusted. On-line communication with the materials disposal agencies makes the disposal process very fast.

The following process measures were derived for continuous improvement in material management functions:

SNo	Projects	Benefits
1A	Cyclic inventory verification and stock reconciliation	Elimination of over-stocking
1B	Develop and implement procedure for inclusion and deletion of items in stores with dynamic on-line system for replenishment of stocks	Proper monitoring of inventory Ensuring high service level to customer
2.	Develop and implement procedure for inclusion and deletion of insurance and non-moving items through on-line process for balancing requirement	Improved plant reliability by eliminating down time due to non-availability of insurance spares Avoiding stocking of unwanted insurance spares, resulting in inventory reduction
3.	Develop and implement procedure for planning, scrutinising, procurement and accounting of annual maintenance and project requirements	Timely completion of maintenance and projects resulting in improved number of on-stream days and early return on investment
4.	Review and implement process for preparation of technical specification for all items and developing system for updating	Reduction of lead-time in procurement due to elimination of technical queries Standardisation of items resulting in interchange – ability, better spaces management and inventory reductions
5.	Develop and implement on-line system for vendor master item wise including rationalisation of master code (categorisation of vendor's suitably)	Reduction of lead-time due to better source selection Source selection on cyclic basis reduces over-loading on a particular supplier
6.	Develop and implement on-line system for indenting, enquiry, ordering, follow-up and documentation	Lead time reduction and increase in customer satisfaction level
7.	Review and develop system for updating of authority and responsibility manual on periodic basis	Lead-time reduction Better utilisation of time by senior management for development activity
8.	Develop a system for addressing the issues of materials planning and procurement, warehousing and scrap disposal for plant and corporate level	Compliance of procedural requirements, meeting market requirements in changed scenario
9.	Study and provision of on-line facilities (e-mail/Internet/fax) to users	Faster information sharing Better availability of materials
10.	Study, develop, implement vendor evaluation and feed back appraisal system to have long term relationship with suppliers and create reliable vendor base	Long term vendor Relationship and involvement in our progress
11.	Develop and implement on-line system for stores receipt/storage/MRR preparation/issue for project and maintenance of items	Improve traceability of items

(continued)

Table IV.
Project evolved *vis-à-vis*
benefits to be accrued
through re-engineering

SNo	Projects	Benefits
12.	Develop and implement stores layout so as to optimise space utilisation and eliminate multiple handling and ensuring physical control replenishments	Improve handling time Improve traceability of items Provide overall economy
13.	Study develops and implements system for identification and quick disposal for surplus items to optimise value realisation approval and accounting policies	Reduce inventory

Table IV.

(1) *Material planning and procurement:*

- indent release to purchase order release duration;
- number of technical queries to vendors;
- variation in indent receipt schedule from work plan.

(2) *Warehousing:*

- service level;
- cycle time for inspection/receipt of material inspection (MRR);
- utilisation of space/traceability and preservation;
- inventory turns.

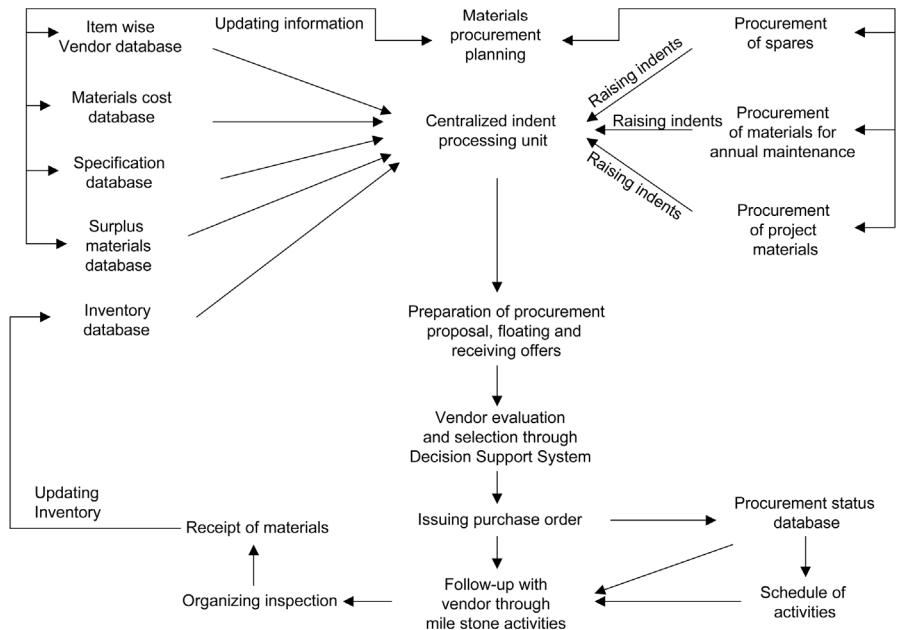


Figure 3.
Integrated procurement model

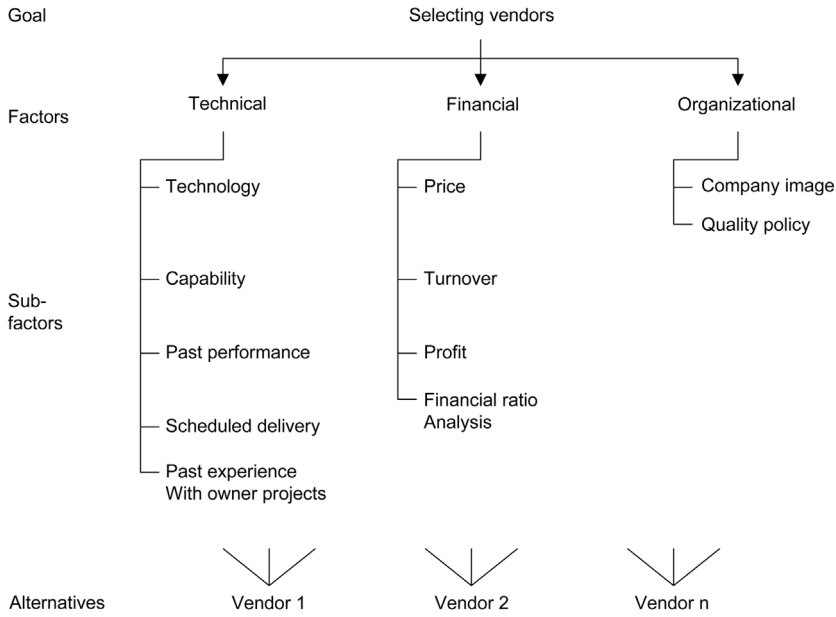


Figure 4. Vendor selection model in AHP framework

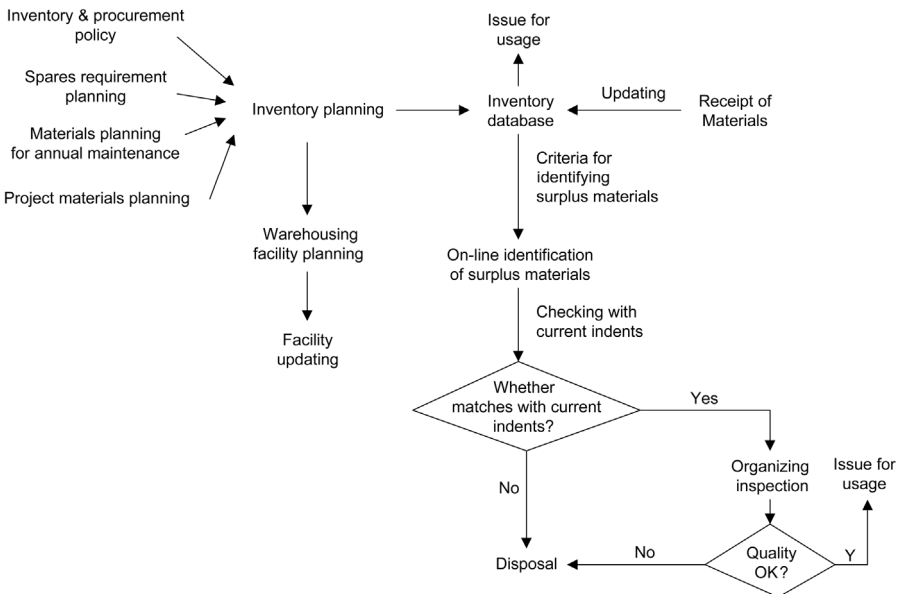


Figure 5. Integrated warehousing and surplus disposal model

(3) *Surplus disposal:*

- value of the surplus materials;
- age profile;
- cycle time – from identification to disposal.

Re-engineered materials management resulted considerable benefit to the organisation under study by reducing the inventory and procurement cycle considerably.

Conclusions

The organisation under study is the market leader in the petroleum sectors working in a closed economy and under an administered pricing mechanism. Due to sudden changes in the industrial policy and economic scenario in the country, the organisation is expected to face an open economy, competition from multinational companies, free pricing systems and public participation in equity. This changed scenario demands a competitive edge and quick response to the dynamic environment. From the analysis and dynamic trend of globalisation, the study has led to a philosophy of applying radical changes through BPR to achieve success in the global economy. This study demonstrates application of BPR on materials management function of one of the refinery unit. Two important activities, “material planning and procurement process” and “warehousing and surplus disposal” were re-engineered for radical improvement of the materials management function.

The Table V depicts the following tangible benefits of this BPR project.

It is estimated that the implementation of the integrated materials management system for the refinery under study will reduce the inventory carrying cost by more than 30 percent and improve profitability by 15 percent within the next two years.

This study further reveals:

- application of the integrated information management system for both the activities (i.e. from raising the materials) indent to installation at site or disposal;
- monitoring of the on-line inventory position for management information to enable the correct decision to be made at the correct time;
- designing an effective vendor evaluation system for ensuring product quality correct timing and optimum cost;
- forming a network through the Internet/intranet with other units for exchange of information related to materials procurement and inventory;
- providing appropriate authority and responsibility to the unit personnel for effective handling of issues and concerns of materials management.

Sl. No.	Activities	Benefits
1.	Formulation and updating of various database	Availability of information Easy retrieval of information Fast decision making
2.	Processing all indents centrally	Effective procurement processes Generation of less surplus Utilization of surplus materials
3.	DSS for vendor evaluation	Appropriate selection of vendors Fast selection process
4.	On-line communication with vendors	Fast communication and decision making Easy follow-up Fast clearing of the payment Making the materials available on time
5.	Inventory planning	Reduction of inventory carrying cost Identification and fast disposal of surplus items
6.	Warehouse facility planning	Easy and fast retrieval of items Optimum space utilisation Reduction of inventory carrying cost
7.	On-line identification of surplus materials	Utilization of surplus materials Fast disposal

Table V.
The tangible benefits
of the BPR project

Although the study depicts the application of BPR to materials management function in a specific organisation and demonstrates its effectiveness in identifying key areas for radical improvement, the same methodology can be used by any organisation across various functions for achieving substantial improvement in productivity.

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