INCORPORATION OF SIX-SIGMA IN ORGANIZATIONS AND ITS ROLE AND IMPACT UPON OPERATIONAL PERFORMANCE: A REVIEW OF EXISTING LITERATURE

Jashandeep Singh & Meenakshi Malhotra

Abstract

Almost similar to quality management in common, Six-Sigma has penetrated most of the sectors of business world these days. Although Six-Sigma originated in industry, it has stirred a substantial amount of academic literature. This paper reviews the existing literature describing the trends, sources, and findings. The paper also tries to amalgamate the literature, with an emphasis on establishing its relationship to quality management theories and topics for further research.

Key words*: Six-Sigma, statistical process control, quality management, TQM*

1. INTRODUCTION

Motorola's Bill Smith invented Six-Sigma more than two and a half decades ago building on the philosophy, principles, and methods of Deming's Total Quality Management (TQM). Six Sigma has been adopted by numberless companies in such a short span of time by adopting specific training and project management practices. Basically originated by Motorola in 1986 and adopted by GE in 1995 (Linderman, Schroeder, Zaheer, & Choo, 2003), Six-Sigma has roots in the work and research of W. Edwards Deming and Joseph Duran. The term Six-Sigma refers to its goal of no more than 3.4 defects for every million activities. Described as both a management strategy (Sanders & Hild, 2000) and a statistical tool (Hahn et al, 2000), Pande, Neuman, and Cavanagh liken it to a toolbox (2000). They characterize its capability as reducing errors to almost none through measuring and understanding, getting tasks accomplished more quickly, engaging people in understanding, applying creative solutions, and maintaining control over processes while increasing profits.

Sigma: A term used in statistics to represent standard deviation, an indicator of the degree of variation in a set of measurements or a process.

Six-Sigma: A statistical concept that measures a process in terms of defects at the Six-Sigma level, there are only 3.4 defects per million opportunities. Six-Sigma is also a philosophy of managing that focuses on

eliminating defects through practices that emphasize understanding, measuring, and improving processes.

Linderman et. al. emphasized the need for a common definition of Six-Sigma and proposed: "Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates."

Probability of defects of different sigma levels is shown below:

Process Capability	Defects per Million Opportunities
2	308,537
3	66,807
4	6,210
5	233
6	3.4

Table 1: Probability of defects of different sigma levels

Essentials of the Six-Sigma Methodology

The Six-Sigma methodology uses statistical tools to identify the vital few factors, the factors that matter most in improving the quality of processes and generating bottom-line results. It consists of five phases:

1. *Define* the projects, the goals, and the deliverables to customers (internal and external both).
2. *Measure* the current performance of the process.
3. *Analyze* and determine the root cause(s) of the defects.
4. *Improve* the process to eliminate defects.
5. *Control* the performance of the process.

2. OBJECTIVES OF THE STUDY:

I. To understand the meaning of Six-Sigma.

II. To figure out its impacts on operational performance.

3. APPLICATION OF SIX-SIGMA

Clifford (2001) says that Six-Sigma has a mere repackaging of old quality management approaches. Schroeder, Linderman, Liedtke, and Choo (2008) positively annotate its ability to bring about quality improvements through incremental innovation. It appears to bring about quantifiable improvements and savings, whereas, Del Angel and Pritchard (2011)

disagree with previous statement, indicating that some 60 percent of corporate Six-Sigma projects fall short of anticipated goals. However, many companies, after experiencing process improvement success and reduced expenses, attempt to push Six-Sigma into their Research & Development (R&D) efforts as well (Hindo, 2007). Tushman noted that Six-Sigma's focus on reducing variability is inversely associated with the exploratory nature of R&D innovation (Dodge, 2007). Six-Sigma seems to be most successful in larger companies, where greater opportunities exist for reducing bureaucracy and streamlining processes (Dusharme). Smaller companies, with their tighter control over processes, may find Six-Sigma less profitable. Companies may also be misusing Six-Sigma for projects that lack the complexity for which Six-Sigma is designed, Linderman (2003) employing Six-Sigma for simple tasks does not create substantial benefit, and in fact tends to decrease performance.

In short, Six-Sigma is not a universal tool. It has relevance for some applications, but not for all.

4. IMPACT OF SIX-SIGMA

Pushing Six-Sigma tools into R&D operations may bring about short term financial gains (Hindo, 2007), but in the long run appears to suppress creativity and innovation (Goh, 2002) for the very organization where it is needed the most. Although it appears that companies that adopt Six-Sigma in their innovation centers tend to consistently reduce R&D spending, the literature is mostly circumstantial or is limited to only those organizations that are publicly held, and therefore essential to report corporate expenses. Further, it is difficult to infer from earnings reports alone the extent to which development creativity is impacted by Six-Sigma processes. Hindo's 3M Six-Sigma case study (2007) stands alone as a representation of Six-Sigma's impact on R&D. And although 3M's R&D workers have indicated that they thought company declines in innovation and creativity were due entirely to Six-Sigma practices (Hindo, 2007; Chakravorty, 2009), their undependable statements aren't sufficient to conclusively state that Six-Sigma is necessarily detrimental for innovation organizations.

5. THE QUALITY PERFORMANCE MODEL

Much research has focused on the relationship of quality management practices with the various aspects of firm performance (Sousa and Voss). Garvin introduced a

quality performance model to set up an empirical examination of the separate effects of management practices on internal process quality and product quality performance and their effects on operational performance and business performance. In reviewing the literature on Six Sigma, it was felt that it is helpful to place Six Sigma into this diagram. In our definition of Six Sigma, we identified principles and methods associated with 'Six-Sigma infrastructure' and 'Six-Sigma core' quality management practices. It was argued that the method of Six Sigma is itself a quality practice while sharing some characteristics with a core method. Figure 2 shows the placement of these specific core practices and infrastructure in the Garvin model.

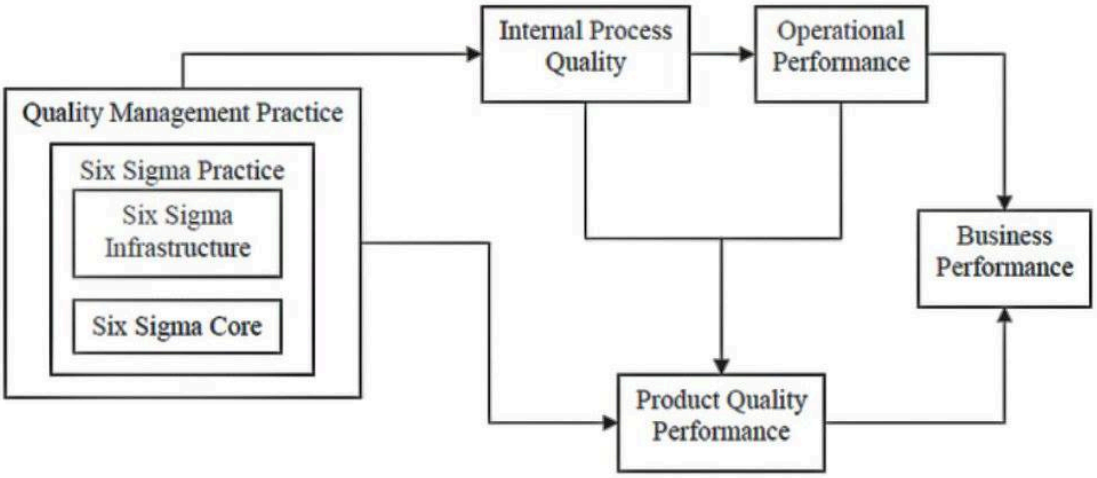

Figure 1: Extended quality performance model of Garvin (1884).

6. SIX-SIGMA MYTHS

There are many myths and misunderstandings about Six-Sigma and as one participates in it, he will probably hear at least one of the following:

Six-Sigma:

- ⊗ works only in manufacturing settings.
- ⊗ doesn't include customer requirements.
- ⊗ is repackaged TQM.
- ⊗ uses difficult-to-understand statistics.
- ⊗ is an accounting game without real savings.
- ⊗ is just training.
- ⊗ is a "magic pill" with little effort.

We just need to remember that Six-Sigma actively links people, processes, and outcomes in a rigorous and adaptable way to get the results we look for. No matter the industry, business, product, or service, as we

apply Six-Sigma, we shall see the tangible results on our projects.

7. CONCLUSION

Little is done and a lot more to research, after reviewing the existing literature, it was found that a few research articles were found to investigate for the objectives undertaken. Extensive literature surveys and field surveys are required to elaborate the study further. We assume quality management and Six-Sigma as a same thing, which is not true. It's almost similar due to the similar kind of objectives.

REFERENCES

Brady, J. E., Allen, T.T.,(2006). Six Sigma Literature: A Review and Agenda for Future Research. *Quality and Reliability Engineering International* (22). 335–367 Retrieved from: http://onlinelibrary.wiley.com/doi/10.1002/qre.769/abstract

Chakravorty, S.S.(2009). Six-Sigma programs: An implementation model. *International Journal of Production Economics* (119). 1–16. Retrieved from: http://digitalcommons.kennesaw.edu/facpubs/738/

Clifford, L.(2001).Why you can safely ignore Six-Sigma. *Fortune*(142)2. 140. Retrieved from: http://yoske.org/docs/White_paper-Six_Sigma.pdf

Del Angel, C., Pritchard, C. (2011, May 16). What went wrong with Six-Sigma? *Cygnus Supply & Demand Chain.* Retrieved from: http://www.sdcexec.com/web/online/Decision-Support-Trends/Guest-Column--What-Went-Wrong-with-Six-Sigma/16$10463

Dodge, J.(2007, December 9). 3M shelves Six-Sigma in R&D. *Design News.* Retrieved from: http://www.designnews.com/article/12089-3M_Shelves_Six_Sigma_in_R_D.php

Dusharme, D. (n.d.). Six-Sigma survey: Breaking through the Six-Sigma hype. *Quality Digest.* Retrieved from: http://www.qualitydigest.com/nov01/html/sixsigmaarticle.html

En.wikipedia.com

Goh, T.N.(2002). A strategic assessment of Six-Sigma. *Quality and Reliability Engineering International.*(18). 403-410. Retrieved from: http://onlinelibrary.wiley.com/doi/10.1002/qre.491/abstract

Hahn. G.J., Doganaksoy, N., Hoerl, R.(2000). The evolution of Six-Sigma. *Quality Engineering* 12 (3*)*, 317–326. Retrieved from: http://www.tandfonline.com/doi/abs/10.1080/08982110008962595?journalCode=lqen20#.Uy62Pc5EkX4

Hindo, B.(2007, Jun 11). At 3M, a struggle between efficiency and creativity. Bloomberg Business Week. Retrieved from:

http://www.businessweek.com/magazine/content/07_24/b4038406.htm

Linderman, K., Schroeder, R.G., Zaheer, S., Choo, A.S.(2003, March). Six-Sigma: A goal-theoretic perspective. *Journal of Operations Management*(21) 2. 193-203. Retrieved from: http://www.sciencedirect.com/science/article/pii/S0272696302000876

Pande, P.S., Neuman, R.P., Cavanagh, R.R.(2000). *The Six-Sigma way: How GE, Motorola, and other top companies are honing their performance*. New York: McGraw Hill.

Sanders, D., Hild, C.R.(2000). Six-Sigma on business processes: Common organizational issues. *Quality Engineering* 12(4).603-610. Retrived from: http://www.tandfonline.com/doi/abs/10.1080/08982110008962593?journalCode=lqen20#.Uy62e85EkX4

Schroeder, R.G., Linderman, K., Liedtke, C., Choo, A.S. (2008, July). Six-Sigma: Definition and underlying theory. *Journal of Operations Management*(26), 4. 536.554. Retrived from: http://www.sciencedirect.com/science/article/pii/S0272696307000897