An Empirical Investigation of Six Sigma Practices in Indian Manufacturing Industry

SYNOPSIS

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by

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Synopsis

Overview

Global competition, rapidly change in technologies and shorter product life cycles have contributed in making the current manufacturing environment extremely competitive. Organizations face significant uncertainties and continuous changes. Traditional quality improvement approaches used by the companies are no longer sufficiently competitive weapons by themselves. Customers are demanding a greater variety of high quality, low cost goods and services. Organizations must consequently develop new methods and perspectives to meet these market needs in a timely and cost effective manner. Embracing practices like six sigma will create world class organizations, produce high quality products and can deal with such challenges. A firm, which is following quality practices like six sigma, possesses a set of different strategic options and can respond effectively to dynamic and volatile environments.

Six sigma is one of the fastest evolving areas of interest to industries and practitioners because it is a powerful business improvement strategy that enables companies to use simple but powerful statistical methods for achieving and sustaining operational excellence and many companies have reported significant benefits of implementation of six sigma. Variety of definitions are available for the said concept. Prominent ones are discussed below.

“Six sigma is a systematic, highly disciplined, customer-centric and profit-driven organization-wide strategic business improvement initiative that is based on a rigorous process focused and data-driven methodology” (Tang et al., 2007). It drives customer satisfaction and bottom-line results by systematically reducing variation in processes and thereby promoting a competitive advantage. “Six sigma is considered a strategic corporate initiative to boost profitability, increase market share and improve customer satisfaction through statistical tools and techniques that can lead to breakthrough quantum gains in quality” (Harry, 1998; Park and Kim, 2000; Lucas, 2002). “Six sigma blends management, financial and methodological elements to make improvement to processes and products concurrently” (Voelkel, 2002). “Six sigma provides business leaders and executives with the strategy, methods, tools and techniques to change the culture of organizations” (Antony et al., 2005). “Six sigma as a philosophy seeks to measure current performance
and determine how desired or optimum performance can be achieved. Any deviation in the performance of any critical-to-quality characteristic may be considered a defect” (Eckes, 2001).

**Need of an empirical investigation of six sigma in Indian industry**

After doing survey of Indian industries about application of six sigma, Antony and Desai (2009), reported that Indian industries need overall operational and service excellence to compete globally and are currently engaged in Quality Circles, Total Quality Management (TQM) and ISO Certifications. The study also reported that, these methods have failed to deliver required performance in Indian industries over the last decade or so (Antony and Desai, 2009). It appears that six sigma is yet not fully explored by Indian industries. Indian industries have experienced periodic impacts of transformation, both, before and after industrial reforms. Initially, the focus has been on large-scale public and private sectors, mainly in core infrastructural production organizations. After globalization and liberalization, quality surfaced as one of the major areas of concern along with productivity. With the reduction of geographical barriers and the pressure of competing in the global market, overall operational and service excellence has become a necessity for the Indian industries to remain globally competitive.

As competition gets more intense, customers demand higher quality products and/or services from organizations. As a result organizations look for ways to improve their operational performance to address customer expectations. In the pursuit of improved operational performance and higher customer satisfaction, six sigma has been recognized as a systematic and structured methodology that attempts to improve process capability through focusing on customer needs (Dasgupta, 2003; Harry, 1998; Linderman et al., 2003). According to Quinn (2003), six sigma has been described as an approach for organizational change, which incorporates elements of quality management and business process re-engineering. There has been a significant increase in the application of six sigma in industry over the past decade. According to Hoerl (1998), GE’s operating margins increased from 13.8% to 14.5%, an increase valued at about $600 Million, which stemmed from six sigma quality initiatives. In 2002, at least 25% of Fortune 200 companies claimed they have the six sigma programme (Hammer, 2002). By focusing on customer needs and defining quantifiable measures for achieving specific goals, six sigma projects result in greater customer satisfaction, and enhance organisational performance
and profitability (Blakeslee, 1999; Goh et al., 2003; Harry, 1998; Kondo, 2001). Antony and Desai (2009), during survey on Indian companies has collected some interesting data on usage, awareness and status of six sigma and stated that, “although many Indian industries have successfully embraced the six sigma business improvement strategy, the adoption of said strategy in Indian industries is not as encouraging as it should be.”

As companies such as Motorola, General Electric, Honeywell, Sony, Caterpillar, and Johnson Controls claimed substantial financial benefits from their investments in six sigma, the adoption of six sigma showed an upward trend in industry (Desai, 2006). However, despite the claimed benefits from TQM and six sigma implementation, there are numerous reports of problems in the process of implementing them (Ahire and Ravichandran, 2001; Gijo and Rao, 2005; Sila, 2007; Szeto and Tsang, 2005). In order to understand better, whether and how quality management approaches affect organizational performance, it is important to study the organizational contexts in which these approaches are implemented (Sousa and Voss, 2002).

Moreover companies such as GE and Motorola have reported huge savings from their six sigma initiatives (Pande et al., 2000). Critics of six sigma argue that many quality-based initiatives will fail because of the intense business competitiveness (Stebbins and Shani, 2002). There is a need to address the issue of effective implementation of six sigma projects. We believe that developing a framework of six sigma implementation will help scholars and practitioners to gain insight into its effective implementation. It will also help organizations to effectively utilize their resources and benefit from this framework.

**Objectives of the research**

The previous section has highlighted the importance of six sigma principles to stay in global competitive market. It thus becomes imperative to investigate the six sigma practices being adopted and prescribed by Indian manufacturing industry. The objective of the research in this thesis is to carry out an empirical investigation of six sigma practices in Indian manufacturing industry. It will be achieved by carrying out the following:

1) A thorough review of literature related to six sigma elements/constructs/frameworks
2) Development and testing of a survey instrument.
3) Data collection from different multi-sectional industries in manufacturing sector i.e. automobile, electronics, machines and equipment, process and textile industries.

4) A comparative analysis of six sigma frameworks and frequency analysis of six sigma constructs in these frameworks is carried out in order to identify the prominent constructs (referred as pillars of six sigma), which will eventually lead to development of a conceptual six sigma implementation framework.

5) Evaluation of reliability and validity of six sigma implementation constructs in Indian industry so as to establish a definitive set of pillars and constructs for six sigma implementation framework. It is achieved by performing a survey in five sectors of Indian industry followed by principle component analysis, internal consistency analysis and confirmatory factor analysis to find underlying pillars of six sigma implementation framework.

6) Development of a six sigma framework for Indian industry

7) Validity and reliability analysis of proposed six sigma framework in Indian manufacturing industries with the help of empirical survey.

8) Path analysis of six sigma framework in Indian manufacturing industry.

   It involves:
   - Development of interpretive structural modelling (ISM) for six sigma framework in Indian manufacturing industry.
   - Development of structural equation modelling (SEM) for statistical testing and path analysis.

**Arrangement of the thesis**

The thesis is organized into seven chapters; chapter one includes introduction, background of the research work, objectives, scope and limitations of the study. Chapter two discusses the in-depth literature review about important six sigma constructs and frameworks. Chapter three presents research methodology, questionnaire design and data collection process used for the study.

Chapter four discusses the validity and reliability of existing six sigma implementation frameworks in Indian industries. It also carries out a critical review of six sigma frameworks and frequency analysis of six sigma constructs in these frameworks in order to
identify the prominent constructs (referred as pillars of six sigma), which will eventually lead to development of a conceptual six sigma framework. The development of a framework for six sigma implementation is discussed in the chapter five.

The chapter six describes an empirical investigation of proposed six sigma implementation in Indian industry and demonstrates the applicability of proposed framework. The study also performed path analysis of proposed six sigma framework in Indian manufacturing company.

The summary of the work done, contributions of the research, limitations of the study and scope for future work is presented in Chapter seven.

**Summary of contributions of the research**

The contribution of this research may be summarized in the following manner:

- Extensive review of six sigma literature was carried out to identify various research gaps and existing six sigma frameworks.
- Validity and reliability of the existing six sigma frameworks were carried out using an exploratory survey. In addition, it was found none of the frameworks were suitable in existing form for Indian manufacturing scenario.
- A structured framework of six sigma was proposed. The proposed framework can be helpful to organizations to identify the various initiatives towards implementation of six sigma for manufacturing excellence.
- The managerial implications of six sigma framework can be vastly felt. In India many companies are new to six sigma implementations. The present study thus provides managers an insight as to what are the pillars of six sigma and what are the elements under these pillars. These nine pillars also span across all the crucial areas of business right from project selection and execution to customer relationship management. This can guide managers about the use these pillars within a framework to achieve successful six sigma implementation. The main benefit of the study is that the nine pillars proposed with the help of conceptual analysis as well as group of experts belonging to academics, professionals and
consultants. The elements of the framework are derived with the help of empirical study from Indian manufacturing sector.

- The proposed framework was validated using one more exploratory survey and path analysis. Various statistical analyses were used, which confirmed that the developed framework is legitimate in the Indian scenario. Finally, the applicability of the proposed framework of six sigma is verified in two manufacturing organizations with the help of ISM model.

- The research contribution of the study are far reaching as huge literature on six sigma lacks standardization. The identified pillars of six sigma can be used as standard and important set of elements for future research since these pillars and elements are derived from literature and empirical study from Indian manufacturing industry.

- The proposed framework of six sigma provides a definitive set of elements which present overall picture of six sigma and overcomes the deficiency that exists in the literature with respect to frameworks.

- It was found that there exists a huge gap between theory building and theory verification. Theory building is progressing at faster rate than theory verification. Hence researchers must concentrate on theory verification as well to bring the discipline to maturity phase.

- It is observed that sample size used by various researchers especially in survey research is very much restricted. Hence researcher should try to go for larger sample sizes and try to achieve higher response rates in survey research.

- In the also felt researchers working on empirical studies should report several characteristics of respondents like industry, work experience of respondents, designation etc. Such characteristics is helpful to judge the quality and reliability of the reported facts and theories. However getting complete demographic data is not an easy task but researchers can take help of survey professionals in this context.

**Recommendations for future work**

The work presented in thesis addresses several issues related to six sigma in empirical research literature, Indian manufacturing industry and theory. However there are few
issues that remained unaddressed due to limitation on the scope of work. Hence avenues for further research are suggested, which are given as follows:

- In the present study, only five sectors across the Indian manufacturing domain were considered and the response rate was reasonable good as compared to present empirical research works. However, this study can further be extended to various other sectors and the reliability / validity of the proposed framework in other sectors can also be analysed.

- The five sectors considered for study can further be refined to various sub classification within each sector like for process industries cement, pharmacy, chemical, etc. and their level of six sigma identified.

- Each pillar of six sigma framework can be developed further by identifying their implementation elements individually.

- Further development of this questionnaire can be done so that it can be used for a global survey also. By doing this it will be possible to compare the Indian companies and their global counterparts.

- In the present study relationships amongst various pillars of proposed six sigma pillars were identified using bivariate correlation (Pearson’s Correlation) which indicated positive correlations among the nine pillars. This relationship can be further analyzed using other methods.