Analysis of Barriers of Six Sigma Practices in Delhi NCR Manufacturing SMEs

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Abstract- This research paper is to analyze and present the results from the online survey conducted in various Delhi NCR manufacturing Small and Medium Enterprises (SMEs), mainly to focus barriers for implementing Six Sigma in Delhi NCR manufacturing SMEs and identified most crucial barriers for Six Sigma implementation in SMEs of manufacturing sector in Delhi NCR. The study is based on survey questionnaire relevant for Delhi NCR manufacturing SMEs and the result investigation of the present study is based on descriptive statistics and exploratory factor analysis using SPSS 20. The results are investigated by the both factor analyses and reveal the impact of different barriers on the Delhi NCR manufacturing SMEs.

Keywords: Six Sigma, EFA, Barriers, Delhi NCR Manufacturing SMEs, Factor Analysis

INTRODUCTION

Six-Sigma is one of the most important tools of quality in large sized organizations, but, its application in SMEs (Small and Medium Enterprises) is still at the early stage of development (Antony et al., 2005; Kaushik et al. 2012; Antony 2008b; Kumar et al., 2008). The limited number of Small and Medium Enterprises to adopt Six Sigma worldwide is somewhat discouraging. The present work is an attempt to explore the facts about Delhi NCR manufacturing SMEs. A conceptual model is developed to draw attention to Barriers and Benefits achieved by implementation of Six Sigma.

RESEARCH BACKGROUND

Small and Medium Enterprises (SMEs) comprise the mass of businesses around the world and, therefore, play a key role in the growth of the national economy of any country (Soti et al., 2012; Antony et al., 2005; Kureshi, et al., 2010; Kim, et al., 2008). For example, Small and Medium Enterprises are the major contributors to employment and economic output (Husband et al., 1999; Antony et al., 2005). The government of India has enacted the Micro, Small and Medium Enterprises Development (MSMED) act, 2006 in terms of which the Micro, Small and Medium Enterprises are classified as under (Deshmukh et al, 2012; Singh et al., 2015; Raghuvanshi, et al., 2017).

Table: 1: Classification of Enterprises into Different Categories

Enterprises	Investment in Plant and Machinery	
	Manufacturing	**Service**
Micro	Up to Rs 25 lakhs	Up to Rs 10 lakhs
Small	Between 25 lakhs to Rs 5 crores	Between 10 lakhs to Rs 2 crores
Medium	Between Rs 5 crores to 10 crores	Between Rs 2 crores to 5 crores

Keeping in mind the significance of Small and Medium Enterprises (SMEs) and the challenges of globalization, it is essential to study the existing methodologies, philosophies and frameworks for running competent operations by Small and Medium Enterprises so that innovative paths can be developed to deal with the above mentioned challenges.

REVIEW OF LITERATURE

Six Sigma philosophy has been usually concerned with large scale organizations but some growing medium scale organizations have also achieved financial benefit from Six Sigma technique. These organizations are realizing satisfaction, growth and huge amount of financial savings from Six Sigma implementation. However, application of Six Sigma technique is less documented in the published literatures in Small and Medium Enterprises because there are a lot of Barriers for implementing Six Sigma methodology by Small and Medium Enterprises include lack of guidance from top executives, lack of knowledge, lack of resources, poor training from executive, cost issues, poor projects selection and cultural change (Mallick et al., 2012; Raghunath, A. et al., 2013; Desale et al., 2013; Cherrafi, et al., 2016). Aboelmaged (2011) presented different issues that were acting as Barriers for implementing Six Sigma and classified them as soft and hard impediments which included knowledge and support as a soft impediments, whereas financial and professionals were placed into a category under hard impediments. Further, a similar study was conducted for SMEs in Australia, and to investigate performance of organizations, the relationship between hard and soft QM factors were analyzed (Gadenne, et al., 2009). Gadenne, et al. (2009) highlighted that SMEs overall performance were extremely influenced by hard factors or impediments such as Continuous Improvement (CI), benchmarking, efficiency improvement and Quality Management (QM) and Soft factors or impediments included supplier relationships, top management philosophy, internal and external communication and training.

Kumar, et al. (2009) have highlighted some reasons for not implementing Six Sigma in UK SMEs such as Lack of resources, Lack of knowledge, Lack of proper awareness, approach relevance issues and Cost issues. From the published literature, survey in UK SMEs (Kumar, et al., 2009) identified that lack of resources was crucial Barrier for implementing Six Sigma in Small and Medium Enterprises followed by some others such as lack of executive commitment, lack of knowledge, internal resistance, lack of training, poor participation of employee, etc. also played key role for implementing Six Sigma by SMEs (Antony, et al., 2005; Kumar 2007). In addition, other factors may include lack of support from large scale business partners, lack of vision and the ISO 9000 standard

is considered as the ultimate QM methodology to accomplish quality requirements (Antony, et al., 2005).

The furthermost Barrier for implementing Six Sigma in Small and Medium Enterprises has become lack of guidance and training for success of Six Sigma project, employees training should be started by organization but the cost of training for particular program was too greater for Small and Medium Enterprises (Kumar, et al., 2009; Fouweather, et al., 2006).

In particular, small enterprises, lack of human resources (Grando, et al., 2006; Yusof, et al., 2000) to assign roles and delegate the typical Six Sigma program hierarchy required (Kumar et al. 2008) for its effective implementation. However, Mader (2008) presents that, when Motorola Company decided for implementing Six Sigma, at that time, they did not have any Champions and Black Belts; what they needed was the top management's involvement and commitment combined with wide employee training. Higher costs of consultancy are another repressive factor and a big challenge highlighted by small enterprises. For these reasons, Antony (2008b) placed special or excessive emphasis on the role of academicians or academic institutions to build up a cost effective (Kumar et al. 2008) Six Sigma methodology for SMEs.

Medium enterprises lack the essential Quality Improvement awareness and the lack of appropriate vision can be considered as a crucial challenge. Financial matters also play an important role but this issue act as a Barrier could be address with the help of appropriate strategic planning. Huq (2006) presented that top levels of Quality Improvement can be achieved by implementing Six Sigma through arising a unique resources combination and competencies to realize the benefits achieved from Six Sigma implementation.

In present research, list of issues that are acting as Barriers for implementing Six Sigma in SMEs, are identified for analysis in the context of Delhi NCR as shown in table 2.

Table: 2: List of Barriers

Sr. No.	Barriers
1	Lack of education of value of Six Sigma
2	Lack of knowledge
3	Insufficient interdepartmental communication
4	Poor supplier involvement
5	Insufficient organizational alignment
6	Misunderstanding of process and sub-processes
7	Insufficient financial resources
8	Internal resistance
9	Inadequate process control techniques
10	Lack of leadership from top executives
11	Lack of supportive organizational culture
12	Difficulty in identifying process parameters
13	Large investment in Six Sigma training
14	Poor delegation of authority
15	Insufficient time to work on Six Sigma projects
16	Changing business focus
17	Poor project selection
18	Lack of top mgmt commitment
19	Poor employee participation
20	Lack of resources
21	Lack of training
22	Satisfaction with other quality programs

Source: Published literatures

RESEARCH OBJECTIVES

The main objective of this paper is to "analyze the barriers of Six Sigma within Delhi NCR manufacturing SMEs to which Six Sigma is being implemented", the objective is further classified into various number of specific research questions as follows:

- To study of the status of Six Sigma implementation in Delhi NCR manufacturing SMEs.
- To study barriers of Six Sigma implementation in Delhi NCR manufacturing SMEs.
- To suggest most crucial barriers for better implementation of Six Sigma in Delhi NCR manufacturing SMEs.

RESEARCH METHODOLOGY

A survey questionnaire was prepared with the help of literature for achieving above objectives. It consists of three parts:

(1) SMEs demographic information.
(2) SMEs experience with Six Sigma implementation.
(3) Barriers for implementation of Six Sigma in Delhi NCR manufacturing SMEs.

An online questionnaire survey of Delhi NCR manufacturing SMEs was conducted to understand the status of Six Sigma implementation and also this study can help to explore the barriers for implementation of Six Sigma.

The list of organizations included for the survey refers to Delhi NCR 500 manufacturing organizations list, which is identified on the basis of implementation of Six Sigma. The questionnaire was mailed to 500 respondents and requested them to read the questions and respond as early as possible. Responses were collected from 136 organizations within six month by taking three follow-ups and response rate was 27.2%.

The questionnaire focused on barriers for implementation of Six Sigma as well as it included demographic information of organization. Barriers are measured by seven point likert type scale (1 = Not at all important, 7 = Crucial).

RESULTS AND DISCUSSION

Demographic Information of SMEs

Data were collected from 136 organizations. Out of 136 organizations, 56 organizations were found to be small, while 80 organizations fulfilled the criteria of medium enterprises. As Figure 1 shows that the type of SMEs considered for this study.

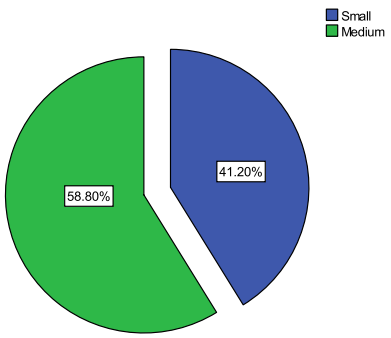

Figure: 1: Size distribution of NCR manufacturing SMEs where Six Sigma is operational

Further, the research findings showed that management was extensively shown their involvement in quality matters, as

more than 50% of the respondents were a general manager/director/CEO. Quality is more important for SMEs than others, figure 2 showed that the current position of the respondents.

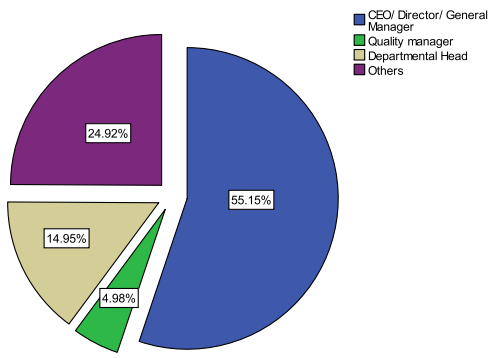

Figure: 2: Profile of the respondents

Barriers Analysis

To meet the objective of barriers for implementation of Six Sigma in Delhi NCR manufacturing SMEs as whole the respondents were asked to rank the barriers in a scale of 1 to 7 as mentioned above. Accordingly respondents have provided their rating of all barriers and then evaluated all barriers by running EFA (Exploratory Factor Analysis).

Normality a group of statistical tests need that data are normally distributed and therefore we should always ensure if this assumption is violated. Cronbach's alpha is a measure of reliability. Coefficient of reliability should be 0.70 or higher is acceptable.

Table: 3: Reliability Statistics

Cronbach's Alpha	N of Items
.923	22

Scree test is used to identify the optimum number of factors that can be extracted before the amount of unique variance begins to dominate the common variance structure. Graphically, the plot has shown a steep slope between the large factors and the gradual trailing off of the rest of the factors. The point at which the curve first begins to straighten out is considered to indicate the maximum number of factors to extract (Robert, H., 2006).

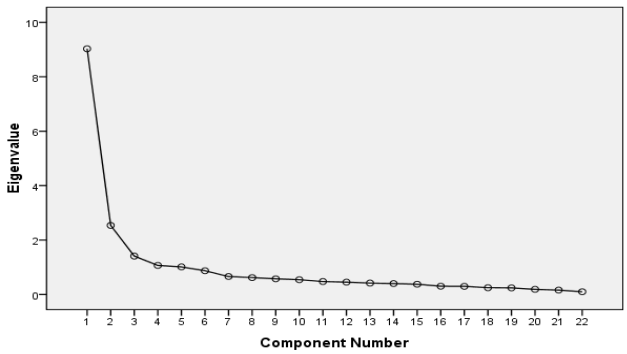

Figure: 3: Scree Plot

Factor Analysis to reduce the data size and form the families of similar dimensions based on the Correlation Coefficient and their factor loadings. Analysis revealed that five factors extracted and Cronbach's alpha for each factor is calculated with factor loadings. Value of Cronbach's alpha for each factor were found more than 0.80.

Table: 4: Factor Extracted

Factor	Factor label
Factor 1	Lack of quality focus *(CRONBACH'S ALPHA= 0.862)*
Factor 2	Lack of support and communication *(CRONBACH'S ALPHA= 0.863)*
Factor 3	Lack of process understanding *(CRONBACH'S ALPHA= 0.820)*
Factor 4	Lack of resources and Knowledge *(CRONBACH'S ALPHA= 0.858)*
Factor 5	Lack of leadership and Mgt. Involvement *(CRONBACH'S ALPHA= 0.865)*

CONCLUSION

In this study 22 issues and factors that are acting as Barriers for implementing Six Sigma by small medium sized enterprises have been discussed.

Although, Barriers are being used for implementing Six Sigma in various organizations but still the Six Sigma practitioners are not significantly able to categories Barriers as per their suitability. The categories of Barriers are following;

[1] Lack of quality focus

[2] Lack of support and communication

[3] Lack of process understanding

[4] Lack of resources and Knowledge

[5] Lack of leadership and Management Involvement

Explorative Factor Analysis (EFA) has identified the factor loadings to show the relationship strength for the above Barriers. Thus, the most significant Barriers as per highest loadings under all categories have been identified to start reaping the benefits. Three Barriers (Lack of knowledge, Lack of top management commitment and Lack of leadership from top executives) have been found strong factor loadings which indicate these are the critical Barriers for implementing Six Sigma in Delhi NCR manufacturing SMEs. Hence, it concluded that;

- **The above mentioned three barriers are identified as crucial for implementing Six-Sigma in Delhi NCR manufacturing SMEs.**

REFERENCES

1. Aboelmaged, M. G. Reconstructing Six Sigma barriers in manufacturing and service organisations: the effects of organisational parameters. International Journal of Quality and Reliability Management. 2011; 28: 519–541.
2. Antony, J. What is the role of academic institutions for the future development of Six Sigma?. International Journal of Productivity and Performance Management. 2008b; 57: 107–110.
3. Antony, J., Kumar, M. and Madu, C. N. Six Sigma in small- and medium-sized UK manufacturing enterprises: some empirical observations. International Journal of Quality & Reliability Management. 2005; 22: 860–874.
4. Cherrafi, A., Elfezazi, S., Chiarini, A., Mokhlis, A. and Benhida K. The integration of lean manufacturing, Six Sigma and sustainability: A literature review and future research directions for developing a specific model. Journal of Cleaner Production. 2016; 139: 828-846.

5. Desale, S., Devdhar, S. V. and Patil, H. Implementation Barriers for Six Sigma in Construction. International Journal of Engineering Trends and Technology. 2013; 4: 175-178.
6. Deshmukh, S. V. and Chavan, A. Six Sigma and SMEs: a critical review of literature. International Journal of Lean Six Sigma. 2012; 3: 157 – 167.
7. Fouweather, T., Coleman, S. and Thomas, A. Six sigma training programs to help SMEs improve. 2nd Intelligent Production Machines and Systems Virtual International Conference. 2006; 39–44.
8. Gadenne, D. and Sharma, B. An investigation of the hard and soft quality management factors of Australian SMEs and their association with firm performance. International Journal of Quality & Reliability Management. 2009; 26: 865–880.
9. Grando, A. and Belvedere, V. District's manufacturing performances: A comparison among large, small-to-medium-sized and district enterprises. International Journal of Production Economics. 2006; 104: 85–99.
10. Husband, S. and Mandal, P. A conceptual model for quality integrated management in small and medium size enterprises. International Journal of Quality and Reliability Management. 1999; 16: 699–713.
11. Huq, Z. Six-Sigma implementation through competency based perspective (CBP). Journal of Change Management. 2006; 6: 277–289.
12. Kaushik, P., Khanduja, D., Mittal, K. and Jaglan, P. A case study: application of Six Sigma methodology in a small and medium-sized manufacturing enterprise. The TQM Journal. 2012; 24: 4–16.
13. Kim, K. S., Knotts, T. L. and Jones, S. C. Characterizing viability of small manufacturing enterprises (SME) in the market. Expert Systems with Applications. 2008; 34: 128–134.
14. Kumar, M. Critical success factors and hurdles to Six Sigma implementation: the case of a UK manufacturing SME. International Journal of Six Sigma and Competitive Advantage. 2007; 3: 333–351.
15. Kumar, M. and Antony, J. Comparing the quality management practices in UK SMEs. Industrial Management & Data Systems. 2008; 108: 1153–1166.
16. Kumar, M. and Antony, J. Multiple case-study analysis of quality management practices within UK Six Sigma and non-Six Sigma manufacturing small- and medium-sized enterprises. Journal of Engineering Manufacture. 2009; 223: 925–934.
17. Kureshi, N., Qureshi, F. and Sajid, A. Current health of quality management practices in service sector SME: a case study of Pakistan. The TQM Journal. 2010; 22: 317–329.
18. Mader, D. P. Lean Sigma's evolution. Quality Progress. 2008; 41: 40–48.
19. Mallick, Z., Ahmad, S. and Bisht, L. S. Barriers and Enablers in Implementation of Lean Six Sigma in Indian Manufacturing Industries. International Journal of Advanced Research in Management. 2012; 3: 11-19.
20. Raghunath, A. and Jayathirtha, R. V. Barriers for implementation of Six Sigma by Small and Medium Enterprises. International Journal of Advancements in Research & Technology. 2013; 2: 1-7.
21. Raghuvanshi, J., Ghosh, P. K., Agrawal, R., and Gupta, H. Hierarchical structure for enhancing the innovation in the MSME sector of India. International Journal of Business Excellence. 2017; 13: 181-199.
22. Robert H. Handbook of Univariate and Multivariate data analysis and Interpretation with SPSS, Taylor & Francis group. 2006; LLC, Boca Raton, Florida.
23. Singh, M. D., Thakur, G. D. and Sharma, P. A Review of Six Sigma implementation Practices in Indian SMEs Particularly in State of Gujarat. Industrial Engineering Journal. 2015; 8: 15-21.
24. Soti, A., Shankar, R. and Kaushal, O. P. Six Sigma in manufacturing for micro, small and medium enterprises in India. International Journal of Productivity and Quality Management. 2012; 9: 61–81.
25. Yusof, S. R. M. and Aspinwall, E. Total quality management implementation frameworks: a comparison and review. Total Quality Management. 2000; 11: 281–294.