Key Benefits of Implementing Lean Six Sigma approach in Indian Manufacturing industries

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The objectiveofLean manufacturing is to eliminate the waste from manufacturing process and Six Sigma is grasping the variations within the process. Lean manufacturing or Six Sigma alone cannot improve the quality and reduce the overall production cost of the organization. Lean Six Sigma is a combined approach which maximizes the overall value and minimizes the production cost by applying their tools and techniques such as VSM, JIT, 5S, Kaizen, Kanban etc. The objective of this paper is to identify the benefits of implementing Lean Six Sigma approach in manufacturing organization. The data are collected through convenient sampling approach and analyzed through different tools and techniques. Total 10 benefits were identified from the literature review and experts opinion. The findings of the study contributed to manufacturing industries and lay down few suggestions to implementing Lean Six Sigma in the Indian context. The study concluded that the implementation of Lean Six Sigma supports the case industries to improve their quality, production capacity, savings, customer satisfaction and reduce their defects, inventory, cycle time and machine breakdown.

***Keywords*:** Lean Manufacturing; Six Sigma; Lean Six Sigma; Manufacturing Process

1. **Introduction**

In recent competitive market all manufacturing companies are rapidly moving towards quality improvement methodologies such as Lean manufacturing (LM), Six Sigma (SS), Total Quality Management etc. to improve their quality [1]. These methodologies are not new in the nature. Every organization need to adopt such quality improvement approach which provides long term benefits with maintaining their product quality to achieve lead position in the market. Continues improvement (CI) is a main factor for any organization to achieve quality and enhance organization performance [2]. LM is a strategy which eliminate wastes from manufacturing process and Six Sigma reduces the defects from product by identify the variation occurred within the process with the help of their tools and techniques. In fact the adaptation of Lean manufacturing alone cannot control the manufacturing process statistically and also Six Sigma cannot remove different types of waste occurred in process. Lean Six Sigma is a combined methodology which provides the combined benefits and improves the bottom line results of organizations faster than single process implementation. The objective of this study is to identify and analyse the key benefits of Lean Six Sigma implementation in manufacturing organization. In this context, the study has been selected the LSS attributes from literature review and industrial experts opinion and based on the selected attributes prepared structured questionnaire and placed among the different category of professionals. The questionnaire has been developed in such a manner that provided the actual data related to LSS implementation benefits from the professionals working in the LSS implemented industries situated in India. The reliability analysis has been performed in collected response to check their validity and consistency. Then the finally ranking of those LSS attributes has been done through Relative Importance Index (RII) technique. This study could help to provide the valuable insight to practitioners to understand the LSS implementation benefits in manufacturing organization.

1. **Literature Review**

A systematic literature review has been performed in the context of LSS implementation in manufacturing organizations and identifies their benefits. This regards 25 Lean six Sigma literatures has been reviewed from the Scopus database and found that the benefits received from case industry. In literatures clearly showed that the case studies have been performed in the various manufacturing organizations, in seven different regions, such as USA, India, UK etc. The significant benefit observed in the literatures during LSS implementation is shown in Table 1.

Table. 1. Benefits of Lean Six Sigma implementation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl. No. | LSS implemented Industry | Reason of LSS implementation | Tools and techniques used | Identified benefits | Reference |
| 1 | Honeywell International Inc. (USA) | To improve the productivity, quality and reduce cost | SPC, FMEA, C&E analysis, Process map | Reduction in manufacturing cost by 50% | [3] |
| 2 | Proprietary military products | To reduce cost of production and cycle time | DOE, C&E, SPC, SIPOC, Brain storming | 50% reduction in overall cost | [4] |
| 3 | Automobile Component mfg. (India) | To reduce the defects occurring in product | CVSM, VOC, TPM, Pareto chart, DOE, | Significant improvement in key metrics | [5] |
| 4 | Tire production comp. (India) | To reduce defect occurring in production | Root cause analysis, VSM, 5S, C&E | Reduction in overall defects by 15% | [6] |
| 5 | Small engineering comp. (UK) | To examine the validity of new integrated LSS | VSM, 5S, DOE, TPM, SPC, QFD | Increase OEE and production performance | [7] |
| 6 | PCB manufacture (China) | To change the manufacturing process | ANOVA, 5S, FMEA, TPM, C&E | Increase the production rate | [8] |
| 7 | Touch Panel Manufacturing (Taiwan) | To improve the quality of touch panel | SIPOC, CVSM ANOVA, VOC, C&E, SPC, | 32.4% Reduction in defects | [9] |
| 8 | Automotive valve industry (India) | To reduce the defects and FTR | SIPOC, VOC, 5S, VSM, DOE, C&E | Increase the FTR by 99.8% | [10] |
| 9 | Rotary switches industry(India) | To reduce rework cost and defects | VSM, 5S, Kanban, DOE, Poka yoke | Reduction in key metrics | [11] |
| 10 | Home furnishing industry (USA) | To improve the process performance and product quality | SIPOC, SMED, ANOVA, VSM, Pareto chart | Improved performance & production capacity | [12] |
| 11 | Automotive Ind.(Malaysia) | To reduce the production cost | 5S, SPC, VSM, brainstorming | Significant reduce cost | [13] |
| 12 | Gas and Engineering industry(USA) | To eliminate non value adding activities and defect | CVSM, 5S, Poka yoke, Spaghetti | Increase productivity by 18-48% | [14] |
| 13 | Valve manufacturing organization (India) | To reduce the defects occurring in final product and improve bottom line | VSM, Pareto chart, C&E, FMEA, Kanban, SMED | Reduction in overall defects and improve performance | [15] |

**3. Research Methodology**

In this paper the author has been used both qualitative and quantitative research methodology approach to gather the data related to implementation impacts of Lean Six Sigma approach in various manufacturing industries situated in India. The structured survey has been conducted in manufacturing industries to analysis the impact of adaptation of Lean Six Sigma approach. This regard the structured interview has been conducted and based on the interview outcomes the questionnaire has been developed and shared with the industry experts, suppliers, customers and consultants related to manufacturing industries and having more than 5 years’ experience in such field. The questionnaire has been prepared in simple and easily understandable manner divided in three parts to collect the responses from the respondents. The first part of questionnaire was topic related to general information about industry and person, next part was questionnaire itself and the last part of questionnaire consisted suggestions and feedback. The respondents were instructed to provide their responses based on the questions on defined value of (1 to 5) Likert scale. The methodology adopted in this study is clearly shown in figure 1.

The questionnaire is shared with 150 peoples working with LSS implemented industry in different segments. In this survey total 80 valid responses were collected successfully with the response rate of 53.33%. The collected data were analyzed using relative importance index technique (RII). The (RII) is used in this study to rank the impacted factors. To check the consistency of the collected data Cronbach alpha test was performed and found 0.795 that is good for the study.

Identification and selection of LSS adaptation attributes

Development and distribution of structured questionnaire to industry professionals

Collection and categorization of responses

Checking reliability of collected data through Cronbach alpha test

Ranking LSS adaptation attributes using RII technique

Fig. 1. Detailed research methodology

**3. 1. Relative Importance Index (RII)**

The Relative importance index technique [16] is performed to determine the key benefits of Lean Six Sigma approach implementation in the manufacturing industry. The RII can be calculated using Eq. 1. This equation ‘w’ represents the weighting given by the respondent for each attributes based on 1 to 5 Likert scale. The n1 represent the minimum rating provide by the respondent and n5 represent the higher rating provide by the respondent on given scale. The ‘A’ represent the highest weight (5 for this case) and ‘N’ shows the total no. of response. The valid response data has been summarized in Excel sheet and calculated using Eq. 1.

(1)

**4. Result and Discussion**

This study elaborated the possible benefits of adopting Lean Six Sigma approach in manufacturing environment context. In this regard the author has been selected manufacturing industries situated in India. To identify the actual benefits getting by the manufacturing industries while adopting LSS in their organizations, the study conducted a structured survey from professionals working in various manufacturing industries to collect the responses related to LSS adaptation benefits by their current working organization. The collected responses have been tested for their reliability through Cronbach alpha reliability test than relative importance index technique used to rank LSS attributes. The result is clearly presented in Table 2.

Table. 2. Ranking of attributes based on relative importance index

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Attribute Name | No. of responses | Relative importance index | Total Score | Rank |
| Reduce overall defects in product | 80 | 84.75% | 287 | 1 |
| Reduction in inventory | 80 | 83.50% | 252 | 2 |
| Reduce cycle time of product | 80 | 77.75% | 172 | 3 |
| Reduction in machine breakdown time | 80 | 75.50% | 272 | 4 |
| Improvements in key performance metrics | 80 | 70.75% | 273 | 5 |
| Increase production capacity | 80 | 66.75% | 241 | 6 |
| Improve product quality | 80 | 66.00% | 224 | 7 |
| Reduction in overall production cost | 80 | 64.75% | 214 | 8 |
| Increase customer satisfaction | 80 | 60.50% | 222 | 9 |
| Increase financial savings and profits | 80 | 60.25% | 274 | 10 |

**5. Conclusion**

The findings of this study concluded that the adaptation of Lean Six Sigma approach providing the effective impact in manufacturing organizations to improve their bottom line result. The result shows that the significant improvement has been found in LSS implemented industries based on the responses received from industry professionals. The professionals are having more than 5 years’ experience in LSS implemented manufacturing industries situated in India. The top 4 most significant benefits of implementing Lean Six Sigma approach in manufacturing organization are reduce overall defects in product, reduction in inventory, reduce cycle time of product and reduction in machine breakdown time based on their ranking. The study concluded that the LSS implementation in manufacturing environment has positive and significant benefits to support and improve the bottom-line result. The LSS implementation has also help to grasp leading position in competitive market.

**6. Limitations and Future Scope**

This study has been performed by gathering the initial data related to LSS adaptation key benefits in various manufacturing organization situated in India. The survey has been performed in small data set to identify and analyse the benefits of Lean Six Sigma implementation. To extant this study the similar type of case study is suggested with large data set and with different techniques. The author (s) is currently working on development of Lean Six Sigma framework for manufacturing organization by continues adopting the required Lean and Six Sigma tools and techniques.

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