A Review on Six Sigma Methodology in Manufacturing Industries

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Abstract

Six Sigma has evolved into a powerful business improvement methodology in many Indian industries and its importance is growing. This paper presents the concept of Six Sigma, DMAIC methodology is used to implementation of Six Sigma especially for manufacturing industries and also some factors that are acting as a barriers for adoption of Six Sigma by manufacturing industries have been discussed. This paper describes the methodology, implementation and benefits of Six Sigma. At last some topics for future research are presented.

Keywords: VTOL Barriers, Benefits of Six Sigma, DAMIC Methodology, Normal Distribution, Process capability.

1. Introduction

Six Sigma differs from other quality programs in its top-down drive in its rigorous methodology that demands detailed analysis, fact-based decisions, and a control plan to ensure ongoing quality control of a process.[7] Six Sigma was started in Motorola by engineer Bill Smith in the late 1980s in order to address the company’s chronic problems of meeting customer expectations in a cost-effective manner[2]. Six Sigma within manufacturing industries has been providing significant benefits, but there is no clear consensus regarding the exact parameters for six sigma implementation in Indian or approaches for its implementation [1]. All the organizations need to improve their production, product, services and management processes in order to survive long time in the market.[7] This can be achieved by minimizing defects, improving processes, reduction in process variability, increasing customer satisfaction, reduction in costs, increased profits, improve product quality and enhance productivity.[12]

Firstly, Six Sigma program places a main focus on bottom-line impact in savings of hard dollar. Six Sigma project will be approved when the team of experts determines the savings generated from the project. Second, Six Sigma has been implemented very successful in both human aspects (training, culture change, customer focus, etc.) and process aspects (variation reduction, process stability, capability, etc.) of continuous improvement. Third, Six Sigma methodology (define-measure-analyze-measure-control or DMAIC) links the customer, tools and techniques in a successive manner. Finally, Six Sigma develops a great infrastructure for training of champions, black belts, master black belts, green belts and yellow belts [6,8].

Six Sigma process capability is equivalent to only 3.4 defects in every million possible defects in manufacturing or service processes. This has been accepted as a standard for world-class manufacturing. The average level in modern industrial applications is between three and four sigma, which means somewhere between 6200 and 67000 defects per million. Six Sigma uses facts and data obtained from production and service processes and determines how to improve them. Small and medium manufacturing sector must adopt proven business improvement program like Six Sigma to meet the global competition.[17]
Antony stated that the Six Sigma is a business performance improvement strategy that aims to reduce the number of mistakes/defects to as low as 3.4 occasions per million opportunities. According to Antony and Banuelas, Six Sigma is a philosophy that employs a well-structured continuous improvement methodology to reduce process variability and drive out waste within the business processes using statistical tools and techniques.[16] Banuelas and Antony stated that the Six Sigma is a business improvement strategy that is used to improve profitability, drive out waste, reduce quality costs and improve the effectiveness and efficiency of all operations that meet or even exceed customers’ needs and expectations. [18] Chakrabarty and Tan defined the Six Sigma as a quality improvement program with a goal of reducing the number of defects to as low as 3.4 parts per million opportunities or 0.0003 percent. [16] Hongbo Wang stated that the Six Sigma is an approach that improves quality by analyzing data with statistics.[11] Daulat Singh, Dr. Tusar N Desai coated improvement of quality by using six Sigma DAMIC methodology.[4]

2. Problem identification

The key barrier to the implementation of Six Sigma in small medium enterprises has become lack of training and guiding for successful completion of project, training program for each employee should be started by company but training program was too costly for SMEs [7]. Now a day, it is very easier in SMEs to get better external resources for guidance without paying more cost [17].

The critical barrier to Six Sigma implementation in SMEs followed by others such as:

- poor participation of employee,
- lack of training and knowledge,
- internal resistance,
- Lack of resources,
- lack of executive commitment
- poor training
- Poor six sigma project selection etc.

Also played very important role in Six Sigma implementation by SMEs.[13,15].

3. Design Methodology

Six Sigma has been defined as the statistical unit of measurement, a Sigma that measures the capability of the process to achieve a defect free performance. Six Sigma has the ability to produce products and services with only 3.4 defects per million, which is a world-class performance. The methodology used to carry out the structured philosophy of Six Sigma in places that include but are not limited to manufacturing, design, engineering, human resources, and purchasing and customer service. Although PDCA could be used for process improvement, to give a new thrust Six Sigma was introduced with a modified model, i.e., DMAIC. The methodology is revealed phase wise (Figure 2). [15]
This contains number of management and statistical tools and techniques in its respective phases (Gijo and Scaria, 2010). There are five steps in the conventional Six Sigma process:[3]

1. Define – a business team first identifies suitable projects based on business objectives, customer needs, and feedback. The team identifies the critical to quality (CTQ) issues and other items that have an impact on quality and customer satisfaction.

2. Measure – a problem-solving team then identifies and classifies likely internal processes influencing CTQ performance. Measurement system analysis, capability studies, and finding performance gaps dominate the work in this phase.

3. Analyze – the team then works to find root cause and identify the underlying physics of the issue. This phase is not finished until root cause is found.

4. Improve – the team then confirms key variables by measuring their effect on the CTQ characteristics. Actions are piloted and real tolerances established to deliver desired performance.

5. Control – plans and actions are implemented to sustain the gains.

Table shows the objective and tools of Six Sigma methodology.

Table 1: Tools used in Six Sigma Methodology.

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<tr>
<th>DEFINE Objective: Define the opportunity</th>
<th>MEASURE Objective: MEASURE current performance</th>
<th>ANALYZE Objective: ANALYZE the root causes of problems</th>
<th>IMPROVE Objective: IMPROVE the process to eliminate root causes</th>
<th>CONTROL Objective: CONTROL the process to sustain the gains</th>
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4. Benefits of The Six Sigma Implementation

Many organizations have taken benefits by implementing Six Sigma in small medium enterprises such as reduction in process variability, reduce cost of operation, increase in profitability, minimize cost of poor quality, improved productivity, reduce cycle time, reduce customer complaints and sales improvement etc. [7,6,10]. Mostly Six Sigma programs have implemented to distinguish the organization from others by accounting net benefits from Six Sigma.
projects [19, 6]. Six Sigma implemented carefully in SMEs, to assure that benefits generated from project of Six Sigma are sustained for long time [9]. Most of the benefits achieved by Six Sigma implementation related to prevention and reduction of the defects which affects both processes and products quality [18]. It was found that huge amount of money can be saved and profit may be increased by controlling rejection rate of chain bush in its manufacturing organization [12].

5. Conclusion

Many literatures show that the top management commitment is a key factor which plays very important role in critical to success in implementation of Six Sigma methodology and also enables to have a sound realization of six sigma implementation within the SMEs. Given that Six Sigma methodology has been around in industry for over a decade, it now seems unimportant to determine whether Six Sigma is better than other approaches. It is more important to learn how to enhance the Six Sigma methodology and improve implementation issues for the growing number of firms that are choosing to adopt it as a means of process improvement. The primary focus should be on improving overall management performance, not just pinpointing and counting defects. Researchers and practitioners are trying to integrate Six Sigma with other existing innovative management practices that have been around to make Six Sigma methodology even more attractive to different organizations that might have not started or fully implemented the Six Sigma method. The previous authors are not performed analysis related to weightage to be given to barriers in implementation of Six Sigma in Indian manufacturing Industries. Analysis is not preferred related to critical success factors to implement Six Sigma methodology.

This Paper present the DAMIC methodology and statistical tools which give the fundamental idea of Six Sigma is that if performance is improved, quality, capacity, cycle time, inventory levels, and other key factors as reduction waste, energy sources and environment will also improve. Successful implementation and growing organizational interest in six sigma method have been exploding in the last few years. However, there is still the need for more empirical research into the Six Sigma concept on, using rigorous research methods to validate the many uncorroborated Six Sigma claims and to test new theories or models that have been proposed to strengthen the methodology.

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