

Implementation of Six Sigma in India

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Abstract Today Higher Productivity achievement is very important factor for the production field. With the Higher productivity other various factors must be taken in to consideration in manufacturing industries such as global competitors, lead time and customer need in terms of quality and quantity. A new Technique Six Sigma has been developed for dealing with all these needs. Six Sigma visions to improve the quality output of a process and product by identifying the causes in the process and removing the causes of defects and minimizing the variability in manufacturing process. Since Motorola gave birth to Six Sigma in the late 1980s, these concepts have been implemented worldwide in firms striving for quality improvement in their processes. This concept was brought in by engineer Bill Smith while working at Motorola in 1986, it is continuous quality improvement process and created from the concepts of Total Quality Management. The main objective of this paper is to review and examine the advancement of six sigma practices in Global manufacturing Industries and identify the technique and key tools of each step in successful of Six Sigma project execution. In this paper the Six Sigma role has been examined through the case study of manufacturing industries. It is perceived through the study that Six Sigma has been contributed to the improved the financial status, productivity and customer satisfaction. (Thakore and Dave, 2014 and Berhman and Klefsio 2001) In today's scenario, many Global manufacturing industries operate their processes at the 2 to 4 sigma quality levels.

Keywords: Six Sigma, DMAIC, Tools and Techniques, Critical success factors.

Introduction

Most industries are focusing on quality as a way of increasing productivity, reducing costs, and meeting customer demands. Industries managers are beginning to understand the importance of continuously improving the quality of their services and products as a way of achieving the business goals. Various quality management strategies have been applied for continuously quality

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improvement for the customer's satisfaction. There are several different Quality Concept and many different opinions of what should be encompassed in the concept of product quality. "The quality of a product is its ability to full fill the customer's needs and expectations.

Quality needs to be defined firstly in terms of parameters or characteristics, which vary from product to product. Quality is a necessary characteristic for Industrial Engineers to observe, study, and understand. Process improvements often begin at an analysis of the level of quality in a system or organization. In the more recent history of the quality development, the quality improvement program Six Sigma has been successful. Six Sigma was created at Motorola in the 1980s. As a result, Motorola became the first recipient of America's Malcolm Baldrige National Quality Award in 1988. Six Sigma is one of the last additions in the field of quality improvement methods and (or) business process improvements methods.

Although it has been implemented for many years mainly in large manufacturing companies, like Motorola, GE and Honeywell etc. Motorola started Six Sigma (6σ) in the late 1980s, the concept has been a key game changer worldwide in firms having trouble with quality improvement in their business processes. Six Sigma, is a quality strategy, based on customer-focus and driven by data rather than assumptions and experience. It is a systematic and rigorous methodology that reduces defect rate, measures and improves performance by utilizing gathered information and statistical analysis tools (Thakore and Dave, 2014 and Berhman and Klefsio, 2001).

Six sigma definition

Six Sigma at many organizations simply means a measure of quality that strives for near perfection. Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects in any process – from manufacturing to transactional and from product to service. The fundamental objective of the Six Sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction through the application of Six Sigma improvement projects. The term Six Sigma level, means 3.4 defects per million opportunities or success rate of 99.999660 percentages. Some companies implement or try to adopt Seven Sigma level, which means even fewer defects and more satisfied customers.

Six Sigma = TQM (CQI) + Stronger Customer Focus + Additional Data Analysis Tools+ Financial Results+ Project Management.

Six Sigma is a useful problem-solving methodology and provides a valuable measurement approach. It has a statistical base and with proper utilisation of methodologies can help to improve the quality of both product and process. In addition to providing data-driven statistical methods for improving quality, Six Sigma also focuses on some vital dimension of business processes, reducing

the variation around the mean value of the process. At many companies, Six Sigma simply mean a measure of quality that strives for near perfection. It is a disciplined, for eliminating defects in any process, covering manufacturing and transactions, as well as products and services. The fundamental objective of the Six Sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction through the application of specific projects. This is accomplished through the use of two Six Sigma sub-methodologies:

- a. DMAIC
- b. DMADV

The DMAIC (define- measure- analyze- improve- control) is an improvement system process for existing processes falling below specification and looking for incremental improvement, and the DMADV (define- measure- analyze- design- verify) apply to the product development and design at Six Sigma quality levels. Six Sigma has evolved into a business strategy in many large companies and its importance in small and medium- sized enterprises (SMEs) is growing everyday. In fact, the results are quicker and much more visible in smaller companies than in larger corporations.

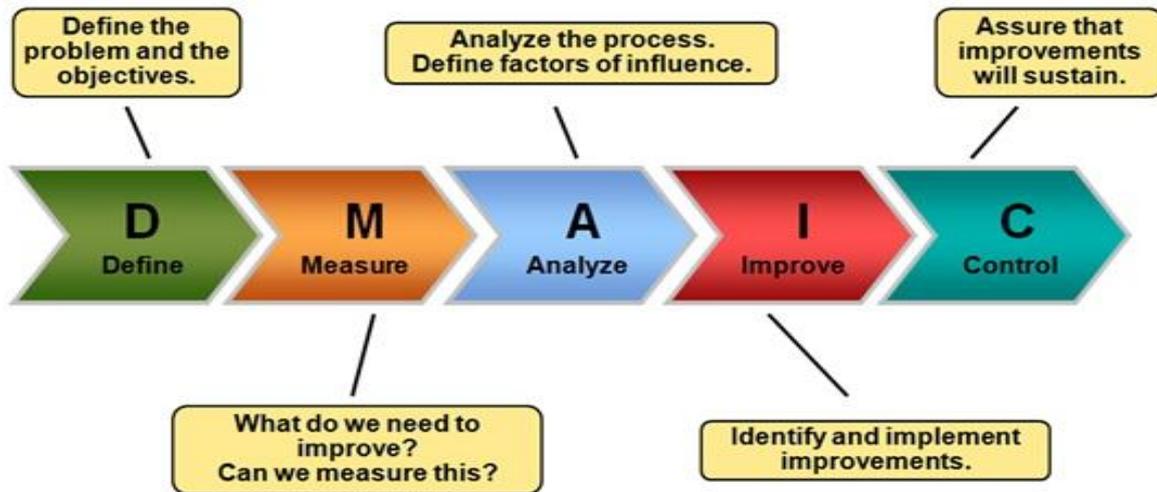
DMAIC Process

The Six Sigma tools are most often applied within a simple performance improvement model known as DMAIC (Define-Measure-Analyze-Improve-Control). DMAIC is refers to a data-driven improvement cycle used for improving, optimizing and stabilizing of existing product, process, or service. The DMAIC improvement cycle is the core tool used to drive Six Sigma projects.

Table 1 Key steps of Six sigma DMAIC process

Steps	Key processes
Define	Define the problems , improvement activity , define project goals , the customer (internal and external) requirements
Measure	Measure the process performance to satisfy customer’s expectations. Develop a data collection plan. Collect the data and compare it to determine problems.
Analyze	Analyze the root causes of variations and poor performance (defects). Prioritize the opportunities for future improvement.
Improve	Improve the process performance by eliminate root cause of variation. Develop creative plans and implement the plan.
Control	Control process variations to meet customer needs. Develop a strategy to monitor and control the improved process and future process.

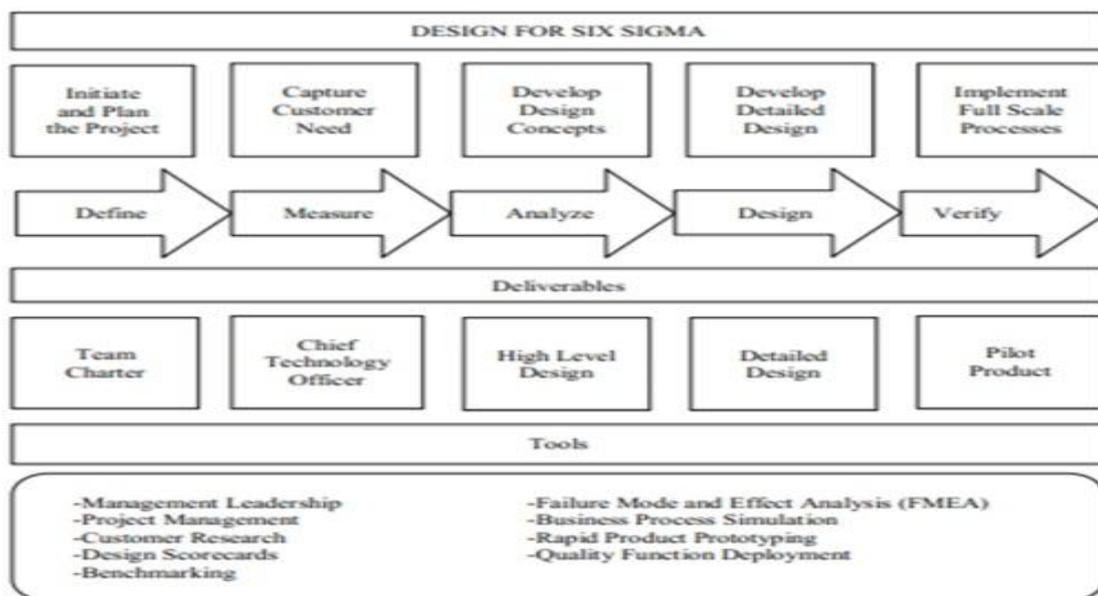
Figure 1 DMAIC Process



DFSS Process

Design for Six Sigma (DFSS) is a systematic approach for utilizing tools, training and measurements to enable the organizations to design the products and processes that meet the customer requirements and can be produced at the Six Sigma quality levels.[1][2][3]

Figure 2 Five Step of DFSS Process



Research methodology

The main purpose of this study is to present the benefits and to discover the various trends of six sigma. The research strategy was made by selecting the research paper in which successful implementation of six sigma was presented and documented. The considered cases are taken up from the well-known journals and publications. Due to lack of Information only 10 cases are considered. The study of all the cases is then compared and is presented in the following sequence.

- 1) General overview of publication and the case industry.
- 2) General methodology of Six Sigma implementation and the methodology adopted by the cases industries
- 3) Tools and Techniques used in various phase by them
- 4) Benefits reaped by each of case industries.

General overview of case Industries

The below table 2 gives us the publications name , the product of the case industry and country it belongs. The table also gives information about the journal, authors' name and year of publication of the selected cases. The publish cases Considered from a set time frame.

Table 2. Overview of the Case Industry

Title	Journal,Year	Author	Country
Improving customer delivery commitments the six sigma way: Case study of an Indian small scale industry	International Journal of Lean Six Sigma, year 2014	Darshak A. Desai	Sanitary Stainless steel vessels (India)
A feasibility study for six sigma implementation in manufacturing industry.	International Journal of Mechanical and Industrial Engineering, year 2013	Mehdiuzzaman sujitkumarpattan ayak and arunchandrapaul	Welding Electrode (India)
Six Sigma practice for quality improvement – A case study of Indian auto ancillary unit	IOSR Journal of Mechanical and Civil Engineering ,2012	Dr. Rajeshkumar U. Sambhe	auto ancillary (India)

with Six Sigma Approach Reducing electronic component Losses in lean electronics Assembly	International Journal of Lean Six Sigma,2012	Tan Ping Yi, Chin Jeng Feng, Joshua Prakash and Loh Wei Ping	Electronic components (Malaysia)
Improvement process for rolling mill using the DMAIC six sigma approach	International Journal for Quality research,2012	Kunal Ganguly	Rolling mill (India)
Study of Productivity Improvement Using Lean Six Sigma Methodology	International Review of Applied Engineering Research , 2014	Dayanand Yadav	BMIT, Solapur University,(ind ia)
Applying Six Sigma Concepts, Techniques for the Service Management: Business and IT Service Management	Rajesh Radhakrishnan International Business Machines (IBM), Global Services,2011	Rajesh Radhakrishnan	USA
Implement six sigma in the manufacturing processes in the food industry to reduce quality cost	Scientific Research and Essays,2011	Hsiang-Chin Hung and Ming- Hsien Sung	I-Shou University, (Taiwan)
Six Sigma Methodology In Telecom Sector	International Journal of Electronics Signals and Systems, 2012	Madhav Khandelwal &Neha Khandelwal	International Institute of Information Technology, Pune, (India)
Reduction of scrap in an electronic assembly line using DMAIC approach	SASTECH, 2012	Afzal Matathil, Ganapatri K N, Kalathil Ramachandran	Electronic Manufacturing Service provider (U.S.A)

These two systematic approaches are general approach but the author has given many methods which have a modified versions of the above mentioned method. These methods are E-DMAIC (Enterprise DMAIC) and P-DMAIC (Project DMAIC) and DMAICR (DMAIC report) are some DMAIC modified versions whereas DCOV (Define Characterize Optimize Verify), DMADV

(Define Measure Analyze Design Verify) are some of DFSS modified versions. DMAIC is generally used for process improvements and DFSS is used for design or re-design a products. The case industries here have used DMAIC as the general methodology (Berhman and Klefsio, 2001; Karin et al., 2010; Vasileios and Odysseas, 2013).

Table 3 Methodology and process under implementation

Method Adopted	Process
DMAIC	Increasing the success rate of meeting customer delivery commitments
DMAIC	Reducing the rejection in Welding Electrode.
DMAIC	Improve the quality of their process and products for embellishing competitive advantage.
DMAIC	Reducing electronic component losses in lean electronics assembly.
DMAIC	Improve the bottleneck activity and reduction in time & increase of accuracy of that activity
DMAIC	Reduction in defects in manufacturing of circuits
DMAIC	Reducing the Process Variation
DMAIC	Produce the sustainable business benefits
DMAIC	Service and Process Improvement and Optimization.

6. Tools and Techniques

Over the years, companies have included number of into the Six Sigma approach to make them more effective and to eliminate possible defects and gaps after using its application. These toolsets are include statistical and analytical tools both from the industrial engineering and operations research fields. There are many tools and techniques for Six Sigma implementation used in various phases of DMAIC methodology.. These tools are not all statistical but there are also analytical or managerial, like brainstorming, process mapping, etc. Here the some other useful tools and Techniques are listed. The use of all this tools and techniques by the case industries in various phases are presented below:

Define Phase (D):= Brainstorming, Pareto diagram, Pie, bar chart, SIPOC diagram and Critical to Quality matrix.

Measure Phase (M):= Pareto diagram, Control charts, Gauge R & R, Process map and Statistical process control.

Analyze Phase (A) := Pareto diagram, Histogram, Hypothesis testing, Analysis of variance, Regression, correlation analysis, Brainstorming, Causes & Effect diagram, Process map, FMEA, Root cause and why -why analysis.

Improve Phase (I):= Pie, bar chart, analysis of variance, Design of experiments and Brainstorming

Control Phase (C):= Control charts, analysis of variance, Flow Chart and descriptive statistics (Young and Frank, 2004 and Andrea, 2011).

Conclusion

From the study done on the manufacturing industries in 21st century we conclude that Six Sigma is indeed a organization strategy that can provide a continuous/breakthrough improvement in this competitive area . The key strategy for successful implementation of Six Sigma is that the industry applying it should follow a correct methodology and use the correct tools and techniques is done in such a way that it provide a effective solution to the respective problem. Thus the proper use of tools and technique give a effective and great benefits to the organizations. Moreover the some critical factor like top management commitment and training on six sigma can make the implementation is smooth. This study will help manufacturing industries to motivate and apply Six Sigma at their organization . every quality improvement methodology is suitable in its own way, the firms should just try choosing the one which will satisfy their requirements, goals and motives most suitably The current status give the future scope of getting better and become a world class level organization by reaching Sigma level above five (Andrea, 2011 and Shweta)

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