ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIII, Issues– I/A Jan – Feb, 2024

OPEN ACCESS Original Research Article

A REVIEW: SIX SIGMA EXECUTION PRACTICE IN MANUFACTURING INDUSTRIES

*** Dr. K.S. Raja Shekar Reddy**

** Associate Professor, KGR Institute of Technology and Management.*

Abstract

Education has helped in achieving higher productivity is a critical component for the industrial industry. Modern trends in manufacturing industries, in addition to high productivity, other aspects need to be taken into account as the education system is reaching its new hieghts. These include worldwide rivals, product diversity, lead times, and consumer demand regarding quantity and quality. To address each of these needs, a brand-new standard known as Six Sigma has been developed. Six sigma is a quality program that lowers process and product costs by reducing variability in the process. In order to identify the essential tools for each stage of a successful Six Sigma project execution, this article will study and analyze the experiences and advancements of six sigma methods in the global manufacturing industries. The lessons from successful six sigma initiatives are also integrated into the study, along with their potential applicability in a range of manufacturing industries. Currently, a large number of international manufacturing sectors run their operations at two to four sigma quality levels.

Keywords : *Six Sigma, DMAIC, review, Tools and Techniques*

Introduction:

Quality has a long history that predates civilization. For many years, a variety of quality management techniques have been used, and these techniques are constantly involved in improving quality for the happiness of the client. There exist multiple interpretations of the Quality Concept and divergent views regarding the scope of what constitutes a high-quality product. "The quality of a product is its ability to satisfy and preferably exceed the needs and expectations of the customers".

The success of the Six Sigma quality improvement program can be seen in the more recent history of quality development. At Motorola, Six Sigma was developed in the 1980s. Motorola was able to save expenses associated with subpar products and minimize variation across numerous processes thanks to Six Sigma. Consequently, in 1988, Motorola was the first company in America to receive the Malcolm Baldrige National Quality Award. One of the most recent developments in the fields of business process improvement and/or quality improvement techniques is Six Sigma. Even though it has been in place for a long time mostly at major manufacturing firms, such as GE, Honeywell, and Motorola, etc

Six Sigma mostly results in lower costs associated with subpar quality. The DPMO idea is a lot more practical approach to gauge how well Six Sigma goals are carried out than merely a catchphrase.

Six Sigma Definition:

The Greek letter "sigma," which stands for the standard deviation—that is, the divergence of the data from the mean average—is where the term "six sigma" originated in statistics. The approved level of quality,

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIII, Issues– I/A Jan – Feb, 2024

OPEN ACCESS Original Research Article

which is six times the standard deviation, is expressed by number six. For the most part, Six Sigma is thought of as a strictly statistical process. The phrase "Six Sigma level" refers to a success rate of 99.999660 percentage points or 3.4 faults per million opportunities in methodological practice. The goal of Six Sigma is to lower process variance and variability so that the company can offer its clients and consumers more dependable goods and services with fewer mistakes. Additionally, some businesses attempt to achieve or apply the Seven Sigma level, which results in even fewer errors and happier clients.

The six sigma approach focuses on customer problems, employs project management tools and techniques, measures and reports financial results, and makes use of extra, sophisticated data analytic tools.

Six Sigma is TQM (CQI) plus a greater emphasis on the customer plus more data analysis tools. Project management plus financial results

DMAIC Process:

The Define-Measure-Analyze-Improve-Control, or DMAIC, paradigm is a basic performance improvement framework in which Six Sigma methods are most frequently used. Figure 1 summarizes DMAIC. When a project's objective can be achieved by enhancing an already-existing good, procedure, or service, DMAIC is applied.

Table 1 Key steps of six sigma DMAIC process

Steps	Key processes
Define	Describe the needs and expectations of the clients. Establish the project's limits. Map the business flow to define the process.
Measure	To meet the needs of the consumer, measure the process. Create a plan for gathering data. Gather and contrast data to identify problems and weaknesses
Analyze	Examine the origins of variation and the reasons behind defects. Ascertain the process variation. Give possibilities for future development top priority.
Improve	Enhance the procedure to get rid of variance. Create original ideas and carry out the improved plan.
Control	Manage process changes to satisfy client needs. Create a plan for keeping an eye on and managing the enhanced procedure. Put into practice the system and structure upgrades.

DFSS Process as depicted in picture 1. The goal of Design for Six Sigma (DFSS) is to help organizations design products and processes that can be delivered at Six Sigma quality standards while meeting customer expectations. It does this by using a systematic methodology that includes tools, training, and measurements

Research Methodology:

This study's primary goals are to outline the advantages and identify specific six sigma trends. The study report that demonstrated and documented the effective application of six sigma was chosen as the basis for the research strategy. The instances under consideration are selected from reputable journals and publications. Just nine examples are taken into consideration due to a lack of information.

Following a comparison, the analysis of each instance is presented in the order shown below.

- A summary of the case industry and publications in general
- The overall Six Sigma deployment methodology as well as the case industries' methodology
- The instruments and methods they employed at

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIII, Issues– I/A Jan – Feb, 2024

OPEN ACCESS Original Research Article

different stages 4) The advantages enjoyed by each of the case industries.

General Overview of Case Industries:

The publication name (i.e., research paper title), the case industry's product, and the nation to which it belongs are listed in table II below. The name by which the publication has been referred to throughout the review article is indicated by the referred name in the leftmost column. The table also provides details about the journal, names of the authors, and publication year of the chosen cases. The cases that are published viewed through a specific historical lens (e.g., 21st century).

- Improving the Quality ofAsbestos Roofing at PT BBI Using Six Sigma Methodology, International Congresson Interdisciplinary Business and Social Science,2012 Jonny and Jessika Christyanti asbestos roofing (Indonesia)
- Process improvement in farm equipment sector (FES): a case on Six Sigma adoption International Journalof Lean Six Sigma,2014 Anupama Prashar. Farm Equipment(India)
- Study of feasibility of six sigma implementation in a Manufacturing industry : a case study International Journal of Mechanical and Industrial Engineering,2013 Mehdiuz zaman,sujit kumar pattanayak and arun chandra paul Welding Electrode (India)
- Right- First- Time dyeing in Textile using Six Sigma methods International Journal of Scientific & Engineering Research,2013 Dr. Anupama Prashar fabric dyeing process (India)

Although the author has provided other strategies that are modified versions of the aforementioned strategy, these two methods/approaches are general approaches. Other DMAIC modified versions are P-DMAIC (Project DMAIC), E-DMAIC (Enterprise DMAIC), and DMAICR (DMAIC report), while other DFSS modified versions are DMADV (Define Measure Analyze Design Verify) and DCOV (Define Characterize Optimize Verify). DMAIC is typically utilized for process enhancements, while DFSS is employed for the creation of new goods and services. [10] The general technique employed by the case industry in this instance is DMAIC. Table III displays the list of procedures and methods that the case industry uses at each stage, which is described in Table III methodology and process under implementation.

Name	Method Adopted	Process
A	DMAIC	Side Flat Rejection
B	DMAIC	To reduce field failures of its tractor assembly.
C	DMAIC	Reducing the rejection in Welding Electrode.
D	DMAIC	To improve the RTF % in fabric dyeing process.
E	DMAIC	Reducing electronic component losses in lean electronics assembly.
F	DMAIC	Improving the process of Rolling mill.
G	DMAIC	Reduction of defects in a rubber gloves.
H	DMAIC	Reduction in defects in manufacturing of circuits.
I	DMAIC	Reduce the number of Vehicle engine rejection.

Tools and Techniques Used By Case Industries:

Businesses have added a variety of tools to the Six Sigma methodology throughout time in an effort to increase its efficacy and close any potential gaps that may have arisen from its implementation. Statistical and analytical techniques from the domains of operations research and industrial engineering are among these toolkits. In this case, these tools provide a

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIII, Issues– I/A Jan – Feb, 2024

OPEN ACCESS Original Research Article

firmer theoretical foundation for the industrial and practical approach, resulting in better equipment and resource utilization.

Several tools and strategies are available for implementing Six Sigma in different stages of the DMAIC methodology. Furthermore, a large number of the tools and methods utilized in the Six Sigma implementation process were referenced and classified according to the phase of define-measure-analyze-improve-control (DMAIC) in which they are employed. According to suggestions from the ISO 13051-1 standard, there was an additional classification for the use of each tool or technique. The application of methods and instruments for investigating causes, analyzing data, and reaching decisions is thought to be crucial. These tools are not limited to statistics; they also include analytical and managerial skills like process mapping and brainstorming.

Here is a list of some other helpful resources and methods.

Table IV. List involves the tools that are mostly used by the different case industries.

Phase	General tools and techniques
Define	Brainstorming, Pareto diagram,Pie, bar chart, SIPOC diagram and Critical to Quality matrix.
Measure	Pareto diagram, Control charts,Gauge R & R, Process map and Statistical process control.
Analyze	Pareto diagram, Histogram,Hypothesis testing, Analysis ofvariance, Brainstorming, Cause & Effect diagram, Process map, FMEA.
Improve	Pie, bar chart, analysis of variance, Design of experimentsand brainstorming.
Control	Control charts, Flow Chart and descriptive statistics.

Benefits Reaped by Case Industries:

In order to demonstrate the effectiveness of its implementation, SS employs performance measurement techniques once it is applied. Benefits in terms of money and sigma level are examples of how to demonstrate SS performance.

Many sectors have adopted Six Sigma over the past three decades, and the majority of them have seen positive results. The advantages realized indicate a change from their previous and present situation. Their bottom line is affected by these advantages. The advantages realized in the example industries are displayed in the table VI.

Tools and Techniques	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Pareto Chart	D	A	A,I,C	A	A		M	A	A
Cause and Effect Diagram	A	A		A	A	M	A	A	M,A
SIPOC/COPIS	D	D	D	D		D			D
Process map		M	D	M	M				D
Control Chart	D,M,C	C	C		C	C			C
Control plan		C		C					

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIII, Issues– I/A Jan – Feb, 2024

OPEN ACCESS Original Research Article

Project charter	D	D		D			D		
Measurement System Analysis		M		M					
Process capability			M						

Table V Tools and Techniques Used by the Case Industries

Name	Benefits
A	Improved sigma level to 5.02 sigma and DPMO level at 180.
B	Cost savings of INR 4.366 million /annum.
C	Reduce the Defect Per Million Outputs (DPMO) from 28356.96 to 1666.67.
D	cost saving of INR 2.951 million per month
E	Average weekly saving of $1280
F	The cycle time was reduced from 47 days to 20 days.
G	reduction in defects per million opportunities (DPMO) from 195,095 to 83,750
H	reduction in the electrical failures of around 50%
I	Cost of poor quality (COPQ) has been reduced from $ 30, 000 to $ 9, 000 per annum

Conclusion:

Based on research conducted on the manufacturing sector in the twenty-first century, we can infer that Six Sigma is a viable business strategy for achieving breakthrough improvements in a highly competitive market. The industry adopting Six Sigma must adhere to a proper methodology and employ tools and techniques in a way that effectively solves the relevant problem. This is the key to the implementation of Six Sigma's success. Therefore, using the right set of tools and procedures can have a big impact. Manufacturing organizations will benefit greatly from this study's motivation and application of Six Sigma. The existing situation indicates that there is potential for improvement and for the company to become a world-class one by achieving Sigma point above 5.

Reference:

Chandrupatla T.R., “Quality Concepts”,Quality and reliability in Engineering, Cambridge University Press.

Berhman, B. & Klefsjo B. (2001) Kvalitet fran behov till anvandning (3rd Ed.) Lund: Studentlitteratur. ISBN: 91- 44-01917-3.

Karin Scho n, Bjarne Bergquist and Bengt Klefsjo.,2010 The consequences of Six Sigma on job satisfaction: a study at three companies in Sweden‖ International journal of lean Six Sigma, 2010 pp. 99-118.

Vasileios Ismyrlis and Odysseas Moschidis,. 2013‖ Six Sigma’s critical success factors and toolbox‖ International Journal of Lean Six Sigma Pg no 108-113.

Young Hoon Kwak, Frank T. Anbari, 2004. —Benefits, obstacles, and future of six sigma approach‖ P.n 1–8.

Andrea Chiarini .,2011 —Japanese total quality control, TQM, Deming’s system of profound knowledge, BPR, Lean and Six Sigma‖2011, pp. 332- 355.

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIII, Issues– I/A Jan – Feb, 2024

OPEN ACCESS Original Research Article

Hongbo Wang, "A Review of Six Sigma Approach: Methodology, Implementation and Future Research", IEEE Xplore. February 1, 2009.

Masoud Hekmatpanah, Mohammad Sadroddin, Saeid Shahbaz, Farhad Mokhtari, Farahnaz Fadavinia, "Six Sigma Process and its Impact on the Organizational Productivity", World Academy of Science, Engineering and Technology 19, 2008.

Kwak, Y .H. and Anbari, F. T., "Benefits, obstacles, and future of six sigma approach", Technovation, Vol. 26, 2006, pp.708-715.

B. Tjahjono, P. Ball, V.I. Vitanov,C. Scorzafave, J. Nogueira, J. Calleja, M.Minguet, L. Narasimha,A. Rivas, A. Srivastava, S. Srivastava and A. Yadav. 2010 Six Sigma: a literature review‖, International Journal of Lean Six Sigma, Vol. 1, No. 3, pages 216-233.

Bunce, M.M., Wang, L. and Bidanda,B.(2008), "Leveraging Six Sigma with industrial engineering tools ins crateless retort production", International Journal of Production Research, Vol. 46 No. 23, pp. 6701-19.

Maciel Junior, H., Batista Turrioni, J., Cesar Rosati, A., Garcia Neto, D., Kenji Go to, F.,Fujioka Mologni, J. and Machado Fernandes, M. (2008), "Application of design for Six Sigma (DFSS) on an automotive technology development process", SAE Technical paper series, SAE International, Warrendale, PA.

Cite This Article:

Dr. K.S. Reddy. (2024). *A Review: Six Sigma Execution Practice in Manufacturing Industries. In Aarhat Multidisciplinary International Education Research Journal: Vol. XIII (Number I, pp. 51–56).* ***AMIERJ.*** ***https://doi.org/10.5281/zenodo.10565881***