International Journal of Trend in Research and Development, Volume 6(2), ISSN: 2394-9333
www.ijtrd.com

Overview of "SIX SIGMA "and its Methods

[1]Vishal Kandalgaonkar and [2]Arun Kumar,
[1]Lecturer, [2]Principal,
[1,2]Department of Mechanical Engineering, University of Mumbai, Mumbai, India

***Abstract*—** A Vision and Philosophical commitment to our consumers to offer the highest quality at lowest cost product. A practical application of statistical Tools and Methods to help us measure, analyze, improve, and control our process. For this paper, first reviewed the current literature on Six Sigma, and then performed an analysis of Six Sigma in light of the management literature. The review and analysis suggested that Six Sigma is best tool to quality management. Consequently, Six Sigma provides a new context for a number of research questions. This study could laid a foundation for future research on Six Sigma. It's a Metric that set quality levels at 99.9997% performance of products and processes. Six Sigma is uniquely driven by understanding the needs of customers, disciplined use of facts, data and statistical analysis, and special attention to improving, managing and reinventing business processes.

Keywords *— Six Sigma;Future research; Quality tool; Management tool; Minimizing defect; Increases productivity; Quality management tool*

I. INTRODUCTION

Six Sigma is a disciplined, statistical-based, data-driven approach and also it is a continuous improvement methodology for reducing defects in a product, process or service. The roots of Six Sigma as a measurement standard can be found back with the name of Carl Friedrich Gauss who introduced the concept of the normal curve. Six Sigma as a metric standard in product variation could be found back to the 1920's when Walter Shewhart showed that three sigma from the mean is the point where a process requires correction. Many different measurement standards (such as Cpk, Zero Defects, etc.) came later but the credit for "Six Sigma" goes to a Motorola engineer named as Bill Smith. (Incidentally, "Six Sigma" is a federally registered trademark of Motorola).In 1980s with Chairman Bob Galvin, Motorola engineers decided that the traditional quality levels — measuring defects in thousands of opportunities; instead, they wanted to measure the defects per million opportunities.

Motorola developed this new methodology and needed cultural and other changes associated with it. Six Sigma helped Motorola realize powerful bottom-line results in their organization – in fact, they documented more than $16 Billion in savings as a result of our Six Sigma efforts.

Since then, thousands of companies around the world have adopted and Six Sigma as a way of doing business. Leaders such as Larry Bossidy of Allied Signal (now Honeywell), and Jack Welch of General Electric Company also implemented this concept later on.Six Sigma has evolved over time. It is just simply more than just a quality system like TQM or ISO. It's a way of doing business.

Six Sigma is disciplined, focused and scientific problem solving technique, which uses statistical and non statistical tools integrated with methodology to bring down number of defects to 3.4 defects per million opportunities in any process. Six Sigma is a quality management tool to achieve "Six Sigma" levels of quality.

Six Sigma represents the population standard deviation, which is a measure of the variation in a data set collected about the process. If a defect is defined by specification limits separating well from bad outcomes of a process, then a six sigma process has a process mean (average) that is six standard deviations from the nearest specification limit. This provides enough buffers between the process natural variation and the specification limits. Goal is to achieve "zero defects"

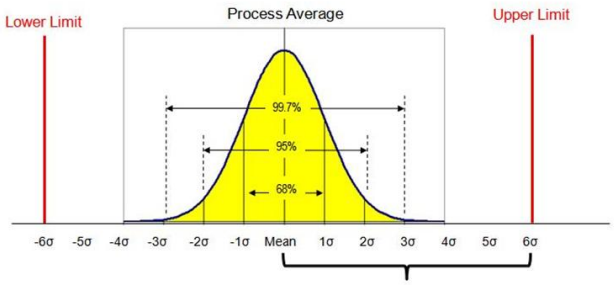
Six Sigma is a system of statistically management quality tools and techniques aimed at eliminating defects and reducing process variability. The p1rocess includes measurement, improvement and validation activities. The designation, or title of Six Sigma relates to the connection between the numbers of defects per million opportunities (DPMO) and the number of standard deviations or fluctuations in values found within a process specification. In statistics, sigma is a reference to the intervals under a "Normal" or "Gaussian" or "Bell" curve. Each interval is equal to one standard deviation or sigma. Therefore, Six Sigma refers to the plus or minus three sigma from the mean of the data under the curve. In the case of a normal distribution pattern, 68.26% of the data points are within plus or minus one sigma from the mean, 95.46% are within two sigma and 99.73% are within three sigma. A process variation exceeding ± 3 sigma should be improved for six sigma. With the use of Six Sigma quality tool, only a very small finite number of possible failures could fall outside specification limits.

Sigma level	Sigma (with 1.5σ shift)	DPMO	Percent defective	Percentage yield
1	−0.5	6,91,462	69%	31%
2	0.5	3,08,538	31%	69%
3	1.5	66,807	6.70%	93.30%
4	2.5	6,210	0.62%	99.38%
5	3.5	233	0.02%	99.98%
6	**4.5**	**3.4**	**0.00%**	**100.00%**
7	5.5	0.019	0.00%	100.00%

II. METHODOLOGIES

Six Sigma projects follow two methodologies inspired by Plan-Do-Study-Act Cycle. These methodologies, composed of five phases each, bear the acronyms DMAIC and DMADV.

- DMAIC focuses on improving an already existing business process.
- DMADV focuses on creating new product or process designs.



A. DMAIC

The five steps of DMAIC, The DMAIC project methodology has five phases:

The DMAIC project methodology has five phases:

- **D**efine the process, system.
- **M**easure important aspects of process and collect relevant data.
- **A**nalyze the collected data and verify cause-and-effect relationships.
- **I**mprove or optimize the currently adopted process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
- **C**ontrol the future process to ensure that any fluctuations from the expected result are corrected before they result in defects.

B. DMADV OR DFSS

The five steps of DMADV

The DMADV project methodology, also known as DFSS ("Design for Six Sigma"), has to features five phases:

- **D**efine design goals that represents customer demands and plan the organization strategy.
- **M**easure and identify characteristics that are Critical to Quality, also measure product capabilities, production process capability, and importantly measure risks.
- **A**nalyze the collected data to develop and design alternatives
- **D**esign an improve alternative, best suited as per the analysis of data done in the previous step
- **V**erify the design done in previous step, implement the production process and hand it over to the process owner(s).

III. IMPLEMENTATION ROLES

One important aspect of Six Sigma involves the absolute "professionalizing" of quality management functions. Prior to Six Sigma, quality management in practice was largely under control of the production floor employees and to statisticians in a separate quality department. Formal Six Sigma programs adopt a kind of elite ranking terminology to define a hierarchy that includes all business functions and levels.

Six Sigma identifies several key roles for its successful implementation.

- Executive Leadership includes the CEO and other top management members. They are the main persons for setting up a vision for Six Sigma implementation.
- Champions take responsibility for Six Sigma implementation within the organization. The Executive Leadership draws them from upper management. Champions also act as mentors to Black Belts.
- Master Black Belts, also known as Champions, act as in-house coaches on Six Sigma. They devote their full time to Six Sigma. They provide assistance to Champions and also guides Black Belts and Green Belts. Along with the statistical tasks, they spend their time on ensuring consistent application of Six Sigma across various functions and departments.
- Black Belts works under Master Black Belts to apply Six Sigma methodology to specific projects. They primarily focus on Six Sigma project execution and leads some special tasks, whereas Champions and Master Black Belts focuses on identifying projects/functions for Six Sigma.
- Green Belts are the employees who do functions related to six sigma along with other works, operating under the guidance of Black Belts.

According to tasks to be executed in the system, special training is needed for all of their practitioners to ensure that they follow the methodology and implement the data-driven approach correctly.

Some organizations use additional belt colors, such as “Yellow Belts”, for employees that have basic training in Six Sigma tools and occasionally participate in projects and "White belts" for those who have conceptual knowledge but do not participate in the project team. "Orange belts" are to be given for some special cases submitted as an RGB color file.

A. Certification

General Electric and Motorola developed certification programs as part of their Six Sigma implementation, verifying individuals' command of the Six Sigma methods at the relevant skill level (Green Belt, Black Belt etc.). In 2008, Motorola University along with Vative and the Lean Six Sigma Society of Professionals a set of comparable certification standards for Lean Certification. Criteria for Green Belt and Black Belt certification may vary; some companies just require participation in a course and a Six Sigma project. There is no standard certification body or committee, and different certification services are offered by various quality associations and other providers against a fee. The American Society for Quality for e.g.; requires Black Belt applicants to pass a written exam and to provide a signed affidavit stating that they have completed two projects or one project along with three years practical experience in the body of knowledge.

IV. ANALYSIS

The experiment was carried out at SHRI SATYAM PRINTING WORKS, Bhayander (East), India. The company has been working in printing of saree from last 20 years. And it is considered to be one of the well-known company in its area of interest. The manufacture and the printing of the sarees are done in this company and the data are analyze below in the table for the batch wise production of sarees and the defects obtained in each batch that are found:

Table 4.1

No. of Batch	Total No. of Sarees	No. of Defects
1	400	4
2	200	10
3	300	13
4	200	11
5	500	13
TOTAL	1600	51

Table 4.2

Total No Of Sarees	1600
Defective Sarees	51
Defects Obtained	0.031875
% Defect Obtained	3.19%
Defectives Per Million Opportunities	31875
Yield	96.81%
Sigma	2.12

The results obtained was stated in table 4.2 for the observations from table 4.1. Using six sigma methodology, the company has set the goal to minimize the defects to obtain the highest rate of productivity as shown in table 4.3.

	DPMO	SIGMA
Current	31875	2.12
Goal	15898	2.34

CONCLUSION

1. Six Sigma Advantages

The advantage of Six Sigma is that it is customer driven tool. Six Sigma is defined as a limit of 3.4 defects per one million products (DPMO), where anything not acceptable to the end customer is considered a defect. Six Sigma looks after entire process behind the production of an item or completion of a service, rather than just the final outcome. It sets out to determine how improvements should be made even before defects or shortcomings are going to be found.

2. Six Sigma Disadvantages

Because Six Sigma is applied to all areas of the production and planning process, it may create rigidity and bureaucracy that may lead to delays and stifle creativity. An extremely cheap tool that carries a risk of a slightly higher defect rate may be rejected in favor of a costly tool that helps to achieve Six Sigma, but have an adverse effects on profitability.

References

[1] VirenderNarula, Sandeep Grover, “Six Sigma:Literature Review andImplications for Future Research,” International Journal of Industrial Engineering & Production Research.(references)
[2] https://davidkigerinfo.wordpress.com/2017/06/13/the-advantages-and-disadvantages-of-six-sigma-methodology/
[3] https://smallbusiness.chron.com/advantages-amp-disadvantages-six-sigma-43963.html.
[4] https://www.isixsigma.com/new-to-six-sigma/what-six-sigma/
[5] https://quality-one.com/six-sigma/
[6] http://leansixsigmadefinition.com/glossary/six-sigma/
[7] Nirav Sindha, Kinjal Suthar; “Review on Implementation of Six Sigma DMAIC Methodology in Manufacturing Industries”, IJSTE - International Journal of Science Technology & Engineering (references).
[8] Sri Indrawati, Muhammad Ridwansyah; “Manufacturing Continuous Improvement Using Lean Six Sigma: An Iron Ores Industry Case Application”, Industrial Engineering and Service Science 2015, IESS 2015
[9] Mahesh S. Raisinghani; “Six Sigma: concepts, tools, and applications”, Emerald Research
[10] Hana Tahiri,” A CASE STUDY ON MOTOROLA”