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Six Sigma Approach – A Review

Soham M. Gangal*, Mukund R. Mali[1], Yogesh K. Jadhav [2,] Sneha A. Pachore[3,] Dr. Manure Md Javeed Md Yakub[4]

*** [1] M. Pharm Student, Department of Pharmaceutical Quality Assurance,**

Appasaheb Birnale College of Pharmacy, Sangli 416416.

[2 3] M. Pharm Student, Department of Pharmaceutics,

Appasaheb Birnale College of Pharmacy, Sangli 416416

[4] Assistant Professor, Department of Pharmaceutical Chemistry,

Appasaheb Birnale College of Pharmacy, Sangli 416416.

ABSTRACT –

Six Sigma is a quality-improvement method that uses statistics to analyze data. As a result, the goal of this research is to look into the existing literature on Six Sigma philosophy in process industries, as well as provide an overview of the future of the Six Sigma method in manufacturing. In recent years, the manufacturing industry and others have seen a considerable increase in the adoption and development of the Six Sigma approach. This article examines the methodology, challenges, and benefits of six sigma methods, as well as the critical aspects that influence successful six sigma project implementations. Emerging trends and concerns in Six Sigma can be emphasized in a structured and thematic manner using the systematic literature review approach utilized in this research, allowing future work to improve as Six Sigma continues to evolve.

Keywords:- Six sigma, Statistical perspective, DMAIC, DFSS, Financial Industry

INTRODUCTION –

Since Motorola University's Design for Manufacturing training program introduced the six-step process in 1988 Six Sigma has evolved to become an extension of Total Quality Management (TQM). The Six Sigma method is a project-driven management approach to continuously reduce defects in the organization's products, services, and processes. It is a business strategy that focuses on identifying and eliminating causes of process faults or failures by focusing on variables that are important to the customer.

Six Sigma ideas have also been adopted in service sectors in the context of supply chain as well as hospitals in the recent two decades.

The goal of this study is to look at the evolution, benefits, and problems of six sigma methods, as well as the important elements that influence successful six sigma project implementation. The study also addresses future improvements to the approaches used to manage six sigma projects, as well as lessons learned from successful six sigma initiatives and their possible applicability in managing regular projects.

Senior management engagement, organizational commitment, cultural change, and excellent project management will help organizations use six sigma principles more broadly. (Dhiraj and Deepak, 2014)

What exactly is Six Sigma?

Six Sigma is a business improvement technique that aims to increase profitability, eliminate waste, minimize low-quality prices, and improve the effectiveness and efficiency of all processes in order to meet or even surpass the demands and expectations of customers.

Six Sigma tactics aim to enhance production quality by identifying and eliminating flaws as well as reducing variability in manufacturing and business processes. This is accomplished by the application of empirical and statistical quality management approaches, as well as the appointment of Six Sigma professionals. Each Six Sigma project follows a set of guidelines and has specific value objectives, such as lowering pollution or improving customer happiness.

Six Sigma is a concept that refers to statistical modelling of manufacturing processes. A sigma rating representing the yield or percentage of defect-free goods produced by a manufacturing process can be used to describe its maturity—specifically, how many standard deviations of a normal distribution the fraction of defect-free outcomes matches.

SIX SIGMA METHODOLOGY -

Six Sigma is a statistical unit of measurement that gauges a process' ability to achieve defect-free performance. Six Sigma is capable of producing products with only 3.4 flaws per million, which is considered world-class.

Six Sigma is also known as a high-performance data-driven strategy to assessing and addressing business challenges.

LEVEL OF SIGMA	DEFECTS PER MILLION	YIELD
1	6,90,000	30.85%
2	3,08,000	69.15%
3	66,800	93.32%
4	6,210	99.38%
5	230	99.977%
6	3.4	99.9996%

Table no. 1 - Sigma Levels and DPMO

(Adapted from http://leansixsigmadefinition.com/glossary/six-sigma/)

THE FUNDAMENTAL IDEA -

Because Six Sigma is considered a novel initiative initiated by Motorola in the late 1980s, several early 1990s studies focus on describing the development of Six Sigma using the Motorola case study. (Tennant G., 2001).

These writers highlight how Motorola's new quality improvement program, Six Sigma, has improved their quality performance and, as a result, recommend Six Sigma as a fresh option for any firm looking to enhance quality. Other authors attempt a descriptive investigation and explanation of the Six Sigma approach without empirical proof or any commercial experience. These publications are useful for

researchers who are new to Six Sigma since they provide background information and evidence of the methodology's growing usefulness.

Two significant conceptual studies also look at the big picture, seeking to analyze Six Sigma's evolution and explain its statistical base. Bothe proposes a new capability index, dynamic Cpk, based on statistical evidence for adding a 1.5 Sigma shift before evaluating process capability (Bothe D., 2001). He also makes recommendations for future [G.J. E.D.T., Vol.3(4):1-5 (September-October, 2014) ISSN: 2319 – 7293 2] research projects investigating the influence and behavior of the shift in diverse situations. Antony delves into the benefits and drawbacks of Six Sigma and connects it to statistical reasoning (Antony J. and Banuelas R., 2004). He claims that Six Sigma has a strong statistical base and, as a result, is likely to remain relevant in the future.

SIX SIGMA PROCESSES FROM TWO VIEWS -

A.) Business perspective -

Six sigma is a business approach that aims to increase profitability by improving the effectiveness and efficiency of all processes in order to meet or exceed customer wants and expectations (Antony and Banuelos, 2001). Once firms understood the benefits, the six-sigma approach was quickly expanded to other functional areas like as marketing, engineering, purchasing, service, and administrative support. The widespread adoption of six sigma was made feasible in part because firms were able to describe the benefits of six sigma in financial terms by tying process improvement to cost reductions.

B.) Statistical perspective -

There are two major perspectives on the six-sigma process. Six sigma has its roots in statistics and statisticians. From a statistical, probabilistic, and quantitative standpoint, (Hahn et al. 1999), (Hoerl and Snee 2002), and (Montgomery 2001) address the six-sigma method. Six sigma is described as having less than 3.4 errors per million opportunities or a success rate of 99.9997 percent from a statistical standpoint, where sigma is a term used to represent variation about the process average (Antony and Banuelas, 2002). When a company achieves a three-sigma level of quality control, it means it has a success rate of 93 percent, or 66,800 defects per million opportunities. As a result, the six-sigma approach is a useful tool.

Principles & Strategies	Methods
Management of process	Control of statistical process
Decision-making based on data	Analysis of process capability
Discovery of knowledge	Analysis of measurement systems
Planning of process control	Experimental design
Techniques and instruments for data collecting	Robust design
Reduction of variables	Deployment of quality functions
Belt system	Analysis of the failure mode and effects
DMAIC procedure	Analysis of regression
Tools for managing change	Means and variances analysis Root cause analysis hypotheses testing Process diagramming

Table No. 2 – Principles, Strategies and Methods

2.3 DMAIC PROCESS -

DMAIC is a closed-loop method that eliminates inefficient procedures, focuses on new metrics, and uses technology to improve continuously. Some articles concentrate on explaining the DMAIC contents, while others go into great depth about each DMAIC phase (Snee R. D., 2004). (Rasis et al.), for example, use a fake application to give self-learning training material for DMAIC. This document instructs readers on how to conduct a small-scale Six Sigma project, including tool application guidelines. It demonstrates a perceived demand for training materials and recommends that developing training materials to address a broader range of applications and larger-scale projects is an avenue for further research. Other publications focus on specific areas of DMAIC, such as project selection in the Define phase or process control in the Control phase, and explain crucial Six Sigma metrics like project metrics and Roll Throughput Yield (RTY). For example, in the Define phase, Snee emphasizes the necessity of project selection, and in the Control phase, Mason advises adopting multivariate statistical process control. Rather than critically evaluating or improving DMAIC, these works tend to explain its features. Future research should look into whether components of DMAIC need to be tweaked to broaden its application, for as for the service industry or non-profits. If this is the case, further research to improve the process may be required.

STEP	PROCESS
Design	Define the customer's requirements and expectations. Define the project's parameters. Map the business flow to define the process.
Measure	To meet the demands of customers, measure the process. Make a data gathering strategy. Collect and evaluate data to identify problems and gaps
Analyze	Examine the sources of variation and the causes of faults. Determine the process's variants. Prioritize future improvement possibilities.
Improvise	To eliminate variances, improve the process. Develop innovative ideas and put them into action.
Control	Control process variances in order to suit consumer needs. Develop a monitoring and control strategy for the enhanced process. Improvements to systems and structures should be implemented.

Table No. 3 - Steps involved in DMAIC process

2.4 DFSS PROCESS DESIGN FOR SIX SIGMA (DFSS) -

Process Design for Six Sigma (DFSS) is a systematic methodology that uses tools, training, and measurements to enable an organization to design products and processes that meet customer expectations and can be produced at Six Sigma quality levels (Mader D.M., 2002). Because the implementation of DFSS is in the early stages of new product/process development, it has the potential to be significantly more effective than DMAIC; hence, the articles in this category try to explain DFSS and how it differs from DMAIC. Mader, for example, describes the DFSS technique, its essential features, and how it improves the design process and New Product Development (NPD). Antony explains DFSS utilizing the IDOV (Identify, Design, Optimize, and Validate) method.

(Treichler et al.) explore the usage of DFSS in large US firms' design functions, whereas Koch et al. explain DFSS in depth, using the use of DFSS in car crashworthiness in an engineering design context as an example. All of these DFSS investigations have been conducted in an industrial environment. As a result, further research is needed to investigate new areas of DFSS use, such as how DFSS might be used in nonmanufacturing processes.

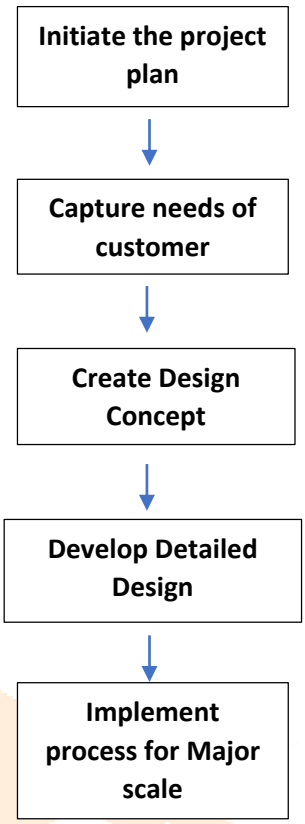

Figure 1 - 5 step process of DFSS

3. OBSTACLES OF SIX SIGMA

3.1 Issues in training (Belt Program) -

Training is a critical component of effectively executing six sigma initiatives and should be part of an integrated strategy. The belt program should begin at the top and spread across the corporation. The belt program's curriculum should be tailored to the goals and requirements of the company. It must be tailored to include financial and management advantages. Leadership, project management, and qualitative and quantitative measurements and metrics should all be included in training. Formal training is a crucial aspect of the growth plan for developing different belt level specialists. Participants must be up to date on the newest six sigma trends, tools, and approaches, as well as communicate with actual data analysis. The authors discovered that assigning Black Belt assignments to less qualified individuals was linked to six sigma project problems.

3.2 Strategic issues –

Six sigma has been the subject of criticism and debate in the quality world, according to Hammer and Goding (2001), who described it as "Total Quality Management on Steroid." One of the most common critiques is that six sigma is really a repackaging of existing quality ideas and methodologies (Catherwood, 2002). Six sigma is not the universal solution to all business problems, and it may not be the most critical management technique for which a company feels a sense of urgency to comprehend and apply. Organizations must examine and embrace the six sigma method's strengths and shortcomings, as well as effectively use six sigma ideas, concepts, and tools, to maintain its long-term viability.

3.3 Organizational culture issues -

Rather than only monitoring quality at the production level, quality principles must be integrated into the design process (McClusky, 2000). The more pressing issue is a shift in corporate culture that prioritizes excellent planning. It is just deceptive to say that the six-sigma approach is a huge success by addressing difficulties and concerns that are simple to fix. Organizations who do not have a

thorough change management strategy or a clear awareness of the true hurdles to six sigma initiatives are likely to fail. Dealing with any cultural difficulties or differences linked to six sigma adoption requires the strong commitment, support, and leadership of senior management.

4. THE ADVANTAGES OF USING SIX SIGMA -

4.1 The manufacturing industry -

Motorola was the first company to adopt the phrase six sigma in their quality performance assessment and improvement program in the 1980s. Other manufacturing companies including as General Electric, Boeing, DuPont, Toshiba, Seagate, Allied Signal, Kodak, Honeywell, Texas Instruments, Sony, and others have successfully implemented six sigma. (Weiner, 2004); (de Feo and Bar-El, 2002); (Antony and Banuelas, 2002); (Buss and Ivey, 2001); (McClusky, 2000) investigated and provided numerous literatures in six sigma (Weiner, 2004; de Feo and Bar-El, 2002; Antony and Banuelas, 2002; Buss and Ivey).

4.2 Financial industry -

To stay competitive, finance and credit departments have been under pressure in recent years to minimize cash collection cycle time and volatility in collection performance. In financial institutions, typical six sigma projects include improving cash allocation accuracy to reduce bank charges, automatic payments, improving reporting accuracy, reducing documentary credits defects, reducing check collection defects, and reducing variation in collector performance. Bank of America (BOA) was one of the first companies to adopt and execute six-sigma principles in order to streamline processes, attract and keep clients, and gain a competitive advantage against credit unions. Hundreds of six-sigma initiatives in cross-selling, deposits, and issue resolution have been completed. After applying six sigma, BOA claimed a 10.4% improvement in customer satisfaction and a 24% drop in customer issues (Roberts, 2004). To optimize external vendor procedures and reduce non-received renewal credit cards, American Express used six sigma concepts. In each example, the findings revealed an improved sigma level of 0.3. (Bolt et al., 2000). GE Capital Corp., JP Morgan Chase, and SunTrust Banks are among the financial firms employing six sigma to focus on and enhance client requirements and satisfaction (Roberts, 2004).

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4.3 The healthcare industry -

Because of the healthcare industry's zero tolerance for mistakes and potential for reducing medical errors, six sigma principles and the healthcare sector are a great match. Six sigma initiatives that have been effectively implemented include enhancing timely and accurate claims reimbursement (Lazarus and Butler, 2001), optimizing the healthcare delivery process, and lowering surgical equipment

inventory and related expenses (Revere and Black, 2003). The University of Texas MD Anderson Cancer Center's radiology film collection likewise implemented six sigma and significantly enhanced service activities (Benedetto, 2003). Patient preparation times at the same institution's outpatient CT test lab were lowered from 45 minutes to less than 5 minutes in many cases, and exams increased by 45 percent with no extra equipment or shifts.

4.4 Sector of engineering and construction -

Bechtel Corporation, one of the world's largest engineering and construction companies, reported savings of $200 million in 2002 thanks to a $30 million investment in its six-sigma program, which identifies and prevents rework and defects in everything from design to construction to timely delivery of employee payroll. Six sigma was used, for example, to assist expedite the process of neutralizing hazardous agents and to help control costs and timelines in a nationwide telecommunications project (Moreton, 2003)

4.5 Sector of Research and Development -

The goals of applying six sigma in R&D firms are to cut costs, speed up time to market, and enhance R&D processes. Organizations should focus on data-driven evaluations, increased project success rates, and the integration of R&D into routine work processes to gauge the performance of six sigma.

According to one poll, just 37% of respondents had formally integrated six sigma concepts in their R&D organization as of 2003 (Johnson and Swisher, 2003).

CONCLUSION -

The goal of this research was to examine the Six Sigma concept. In terms of system quality and process performance, this quality management concept is critical. Existing Six Sigma literature was examined, and the future of the Six Sigma methodology in manufacturing was discussed. This study focuses on the evaluation of Six-Sigma and the fourth industrial revolution's recommendations for process improvement, assertiveness, and providing predictable judgments at every stage of the Six-Sigma approach. Six Sigma advancements, measurements, and capacities, Six Sigma and quality management techniques; Six Sigma integration and innovation; Six Sigma and organizational sustenance and advantages of Six Sigma ideologies; adversarial issues about Six Sigma are all discussed in this study. The Future of Six Sigma and Improvement Strategies

Future research areas that focus on the Six Sigma philosophy and novel technologies that support the approach have been emphasized, along with helpful suggestions.

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