



Methodology, Implementation and Future Research on Six Sigma Approach

Vijayendra Singh Sankhla*, Saurabh Tege

Department of Mechanical Engineering, Geetanjali Institute of Technical Studies, Udaipur, Rajasthan, India-310022

Abstract Six Sigma is a loom that improves quality by analyzing data with information. In recent years, there has been a momentous enhancement in the use and expansion of the Six Sigma methodology in industrialized and others. It is high time to have a reassess on the Six Sigma advance. This paper reviews some allied literatures to illustrate methodology, implementation and future researches. The present paper summaries four issues within the sub-category of the early Six Sigma concepts: basic concept, DMAIC, DFSS and exploitation. Then, some sectors that assistance from the execution of Six Sigma are listed out, and the key factors influencing the successful Six Sigma project functioning are identified. At last, some topics for future investigation are offered.

Keywords Six Sigma, methodology, implementation, future research, quality management.

1. Introduction

Statistically, Six Sigma refers to a progression in which the series between the mean of a method of excellence measurement and the adjacent specification edge is at least six times the standard deviation of the process, shown as Figure 1 and 2.

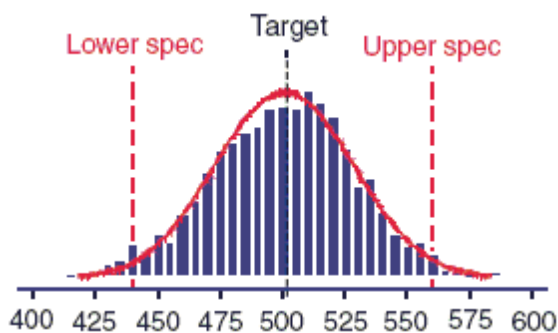


Figure 1: Graphic of centered 3 Sigma

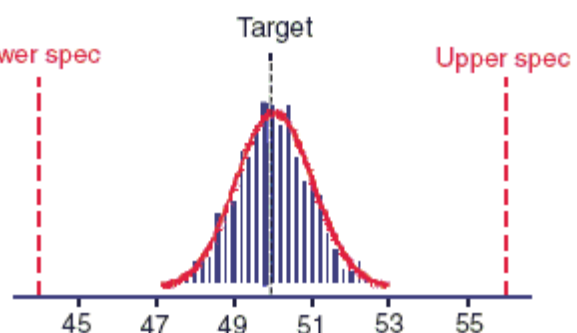


Figure 2: Graphic of Six Sigma process

The conventional quality management approaches, counting Statistical Quality Control (SQC), Zero Defects and Total Quality Management (TQM), have been key players for many years, while Six Sigma is one of the more topical quality perfection initiatives to grow esteem and approval in many industries athwart the sphere. Six Sigma differs from other quality programs in its top-down constrain in its scrupulous methodology that hassle complete examination, fact-based decisions, and a rule preparation to certify fragmentary quality control of a process. Since its beginning at Motorola in the 1980s, many companies including GE, Honeywell, Sony, Caterpillar, and Johnson Controls have adopted Six Sigma and obtained sizeable reimbursement. Six Sigma is a



long-standing dedication. It won't effort glowing without full commitment from higher administration. Six Sigma changes the way a company thinks by instruction fact-based verdict creation to all levels.

In modern duration, curiosity from the studious hamlet has augmented radically. However, to appointment barely few papers can be recognized as a fiction reassess concerning Six Sigma focusing on the crucial perception, performance and prospect of Six Sigma [1-3]. Therefore, it is the high time to have a broad re-evaluate on the associated literatures. The present paper synthesises four issues inside Six Sigma basic concepts. It aims to recognize the key factors influencing the victorious functioning of Six Sigma projects. Finally, the areas of future research are succinct

2. Methodology of Six Sigma

Six Sigma has been distinct as the statistical item of measurement, a sigma that measures the potential of the method to attain a defect liberated performance. Six Sigma has the knack to produce goods and services with only 3.4 defects per million, which is a outstanding feat. Six Sigma has also been described as a high routine information ambitious approach in analyzing the core causes of dealing exertion and solving them.

2.1. Fundamental Concept

Six Sigma is measured to be an innovative proposal introduced by Motorola in the late 1980s, hence several papers from the early 1990's contemplate on amplification the growth of Six Sigma using the Motorola case [4]. These authors discuss the new Motorola quality improvement program, namely Six Sigma, which has led to improvements in their quality presentation and subsequently suggested Six Sigma as an innovative prospect for any association that needs to advance quality. Other authors endeavour to examine and clarify the Six Sigma attitude in an evocative comportment without experiential proof or any connected commerce. These papers are priceless to researchers new to Six Sigma in providing background in order, and giving confirmation of the budding significance of the methodology.

Two key intangible papers also deem the largely theory, attempting to examine the development of Six Sigma and describe its algebraic foundation. Both presents a statistically based motive for adding a 1.5 sigma moves previous to estimate process wherewithal, proposing a new ability index, called active Cpk [5]. He also suggests outlook study on the blow and behaviour of the alter in diverse situation. Antony studies the strengths and the weaknesses of Six Sigma in aspect and associates Six Sigma to statistical thinking [6]. He suggests that Six Sigma has a sturdy statistical foundation and subsequently is liable to carry to be of consequence in the future. Table 1 summarizes Six Sigma trade strategies, equipment, techniques, and ethics.

Table 1: Strategies, Equipment, Techniques and Ethics [1]

Strategies and ethics	equipment and Techniques
Project management	Statistical process control
Data-based decision making	Process capability analysis
Knowledge discovery	Measurement system analysis
Process control planning	Design of experiments
Data collection tools and techniques	Robust design
Variability reduction	Quality function deployment
Belt system	Failure mode and effects analysis
DMAIC process	Regression analysis
Change management tools	Analysis of means and variances Hypothesis testing Root cause analysis Process mapping

2.2. DMAIC Process

DMAIC is a closed-loop process that eliminates uncreative steps, often focuses on new measurements, and applies technology for incessant enhancement. Some papers spotlight on Illumination the DMAIC contents, with some authors discussing each stage of DMAIC in detail [7]. For example, Rasis et al. present self-learning



training material for DMAIC, using an invented appliance [8]. This paper helps the readers to learn how to bear out a small-scale Six Sigma projects, counting guidance on the application of equipment. It indicates a apparent need for training material and suggests that an avenue for further research is to develop training material to cover a wider range of applications and outsized scale projects.

Other papers focus on precise aspects of DMAIC, such as the project assortment process in the Define phase or process control in the control part, explaining some key measures in Six Sigma, such as project metrics and Roll Throughput Yield (RTY). For example, Snee emphasizes the significance of the project medley process in the Define phase for the unbeaten implementation while Mason suggests using multivariate algebraic process control in the Control phase [9-10]. These papers lean to explain the features of DMAIC rather than critically appraising or enhancing it. Future research should investigate whether aspects of DMAIC need to be adapted to augment its scope, for example for the overhaul zone or non-profit organizations. If so, research to develop the methodology may then be needed. Table 2 presents the key steps of Six Sigma using DMAIC process.

Table 2: Key Steps of DMAIC Process [1]

Steps	Key processes
Define	Define the requirements and expectations of the customer Define the project boundaries Define the process by mapping the business flow
Measure	Measure the process to satisfy customer's needs Develop a data collection plan Collect and compare data to determine issues and shortfalls
Analyze	Analyze the causes of defects and sources of variation Determine the variations in the process Prioritize opportunities for future improvement
Improve	Improve the process to eliminate variations Develop creative alternatives and implement enhanced plan
Control	Control process variations to meet customer requirements Develop a strategy to monitor and control the improved process Implement the improvements of systems and structures

2.3. DFSS Process Design for Six Sigma (DFSS) is a systematic methodology utilizing tools, training and measurements to permit the association to design products and processes that meet customer expectations and can be produced at Six Sigma quality levels [8].

3. Manufacturing Business

Cases of successful companies that have adopted Six Sigma are obtainable in many papers. The authors illustrate how the relevant companies' execute Six Sigma, giving insights into issues of professed best practices. Motorola was the first organization to use the term Six Sigma in the 1980s as part of its quality performance measurement and enhancement program. Six Sigma has been productively functional in other manufacturing organizations such as Boeing, DuPont, Ford Motor, Seagate, Texas Instruments, GE, etc. All of these papers are categorized as evocative papers, giving details of business cases, but without a precise case study loom.

As a result of Six Sigma being initiated in the USA, all the above success stones describe US companies. Very few papers have been found regarding successful implementation strategies for whole businesses in other parts of the world. Therefore, scholarly research outside USA could be a good area for future study to determine any comparative differences in implementation issues, such as those caused by cultural issues.

3.1. Non-manufacturing business

3.1.1. Healthcare sector

Healthcare services are one of the major active nonmanufacturing contexts in which Six Sigma has been adopted, with the majority of papers studying implementation issues in the USA. Six Sigma principles and the healthcare sector are very well matched because of the healthcare nature of zero tolerance for mistakes and



potential for reducing medical errors. Some papers explain how Six Sigma improves healthcare service quality by reducing medical errors and increasing patient safety.

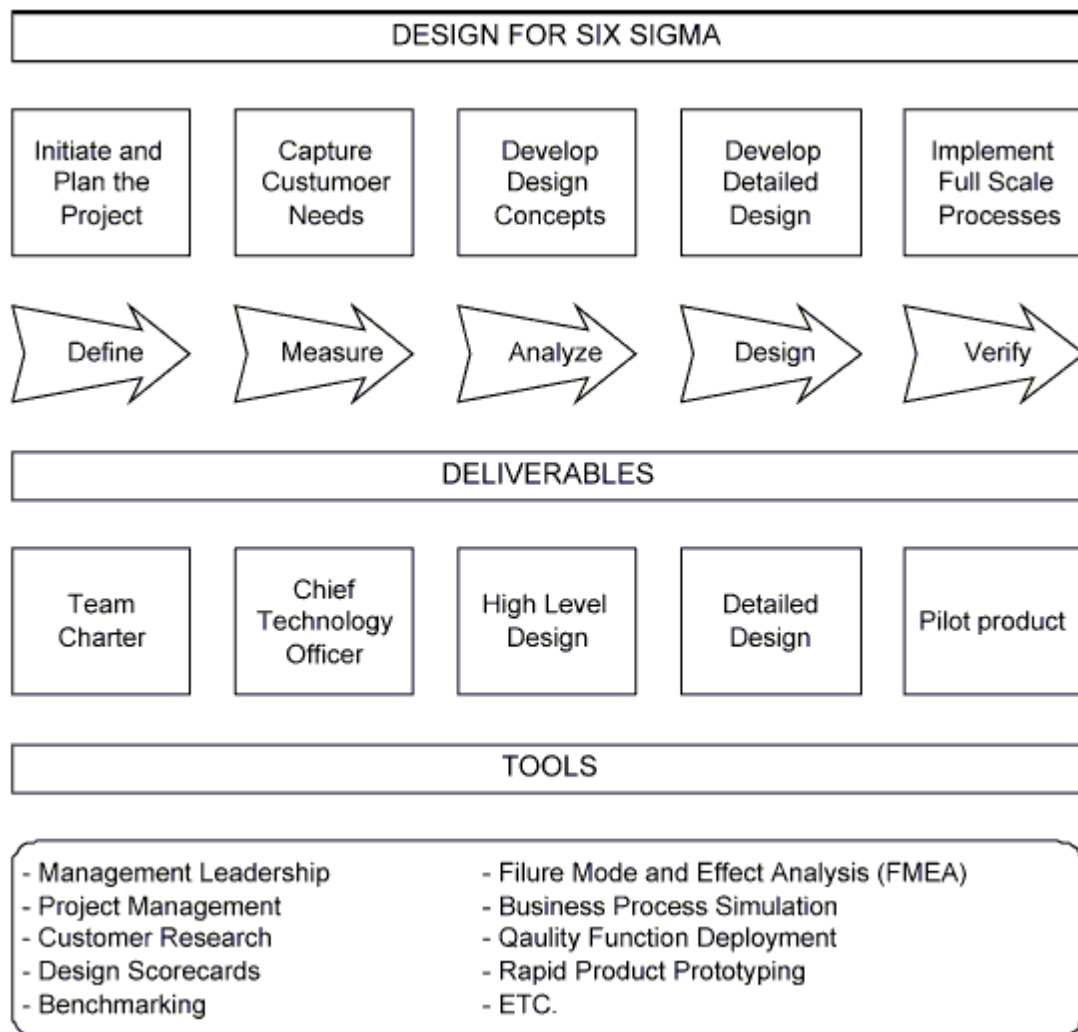


Figure 3: Graphic of DFSS process [1]

3.1.2. Financial services sector

In recent years, finance and credit department is pressured to reduce cash collection cycle time and variation in collection performance to remain spirited. Typical Six Sigma projects in financial institutions include improving accuracy of allocation of cash to reduce bank charges, automatic payments, improving accuracy of reporting, reducing documentary credits defects, reducing check collection defects, and dipping variation in collector performance [19]. Bank of America is one of the pioneers in adopting and implementing Six Sigma concepts to streamline operations, attract and retain customers, and create competitiveness over glory unions. It has hundreds of Six Sigma projects in areas of cross selling, deposits, and problem resolution. Bank of America reported a 10.4% increase in customer satisfaction and 24% decrease in customer problems after implementing Six Sigma [10].

3.1.3. Other Sectors

Still, there are other sectors in Six Sigma implementation, including Civil Engineering and Construction, Research and Development, Supply Chain Management, Human Resource Management, Train and safety.

C. Success factors in Six Sigma functioning

Some papers present the key ingredients for the effective introduction and Six Sigma implementations in manufacturing and services organizations as the following [9-10].



- Management commitment and involvement.
- Understanding of Six Sigma methodologies, tools and techniques.
- Linking Six Sigma to business strategy.
- Linking Six Sigma to customers.
- Project selection, reviews and tracking.
- Organizational infrastructure.
- Cultural change.
- Project management skills.
- Linking Six Sigma to suppliers.
- Training.

4. Future Research of Six Sigma

Six Sigma methodology has been approximately in the industry for over a decade, now a days it 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 method even more attractive to different organizations that might have not started or fully implemented the Six Sigma method. One area of future research is how these Six Sigma practices are adopted in different organizational contexts is needed, since different organizations have dissimilar maturity levels of QM implementation and the strengths and weakness of their alive QM systems vary. a further area suggested for future examine is the examination of how Six Sigma works with other improvement methods such as slant manufacturing. Successful implementation and emergent managerial connotation in six sigma method have been detonation in the last few years. However, there is still the need for more observed research into the Six Sigma phenomenon, using thorough research methods to corroborate many uncorroborated Six Sigma claims and to test new theories or models that have been planned to fortify the tactic. Yet, research territory to date has been only found within the North America region with only a few studies in Europe and Asia. Given the globalization of many companies, including those using Six Sigma, study in other parts of the world is needed to gain insights into cultural issues that may affect the theory and practice of Six Sigma. Valuable Six Sigma principles and practices are more likely to succeed by refining the executive culture continuously.

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