Lean Six Sigma Implementation in Engineering Institutions

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Abstract: *Lean Six Sigma has found wide spread applications in Industry with many benefits. However, its use in academics is limited. In this paper, we propose how Lean Six Sigma can be applied in University environment and many benefits can be observed in cost savings, quality and performance. The application of DMAIC approach of Lean Six Sigma to academics is illustrated with examples and case studies. The processes and practices in Universities and Educational Institutions are identified which can directly benefit from Lean Six Sigma.*

1. Introduction:

Lean Six Sigma is a revolutionary methodology which systematically aids in improving the performance in production and service industry. It was introduced by Motorola [1]. Since introduction, Lean Six Sigma has helped many organizations become competitive through dramatic performance improvements and cost reductions[2]. Lean Six Sigma combines Lean methods with Six Sigma tools and techniques in order to achieve reduction in non-value added activities through uncovering process wastes[3]. Lean Six Sigma extensively uses statistical techniques to analyse the data and derive process improvements.

Lean six sigma methodologies have been successfully applied in Manufacturing, Information Technology(IT) Industry, Health-care, Finance, Supply-chain etc. Companies such as GE, Motorola, Toyota etc have extensively applied the Lean Six Sigma and made savings to the tune of Billions of Dollars[1]. ISO has standardized the Six Sigma methodology through the standard ISO 13053 Part1 and Part 2[4].

While, Lean Six Sigma has been applied in many types of industries and service sectors, it has not made headway in academics and university environments. Its direct applications in Universities and Educational Institutions have not been reported extensively in literature. In this paper, several problems in Academic institutions which can be approached through lean Six sigma are reported. We list the benefits and challenges in using Lean Six Sigma in University environment.

This paper is organized as follows: In the next section, we proved a detailed introduction to Lean Six Sigma methodology. In section 3, application of lean six sigma tools and techniques for academic excellence is presented. The implementation details are discussed in the section 4. In section 5, summary and conclusions are presented.

2. Overview of Lean Six Sigma

The Lean Six Sigma projects comprise the Lean's waste elimination projects and the Six Sigma projects based on the critical to quality characteristics.Lean Six Sigma utilises the

DMAIC phases similar to that of Six Sigma. Lean Six Sigma is a methodology that relies on a collaborative team effort to improve performance by systematically removing waste; combining lean manufacturing/lean enterprise and Six Sigma to eliminate the eight kinds of waste : **D**efects, **O**verproduction, **W**aiting, **N**on-utilized talent, **T**ransportation**, I**nventory, **M**otion, **E**xtra-processing ("DOWNTIME“)

Lean is centered on *making obvious what adds value by reducing everything else*. Lean manufacturing is a management philosophy derived mostly from the Toyota Production System (TPS) and identified as "lean" only in the 1990s **Lean manufacturing** or **lean production**, often simply "**lean**", is a systemic method for the elimination of waste within a manufacturing process. Lean also takes into account waste created through overburden and waste created through unevenness in work loads

The goals of Lean are:

- **Improve quality**: To stay competitive in today's marketplace, a company must understand its customers' wants and needs and design processes to meet their expectations and requirements.
- **Eliminate waste**: Waste is any activity that consumes time, resources, or space but does not add any value to the product or service.
- **Reduce time**: Reducing the time it takes to finish an activity from start to finish is one of the most effective ways to eliminate waste and lower costs.
- **Reduce total costs**: To minimize cost, a company must produce only to customer demand. Overproduction increases a company’s inventory costs because of storage needs.

Six Sigma is a set of techniques and tools for process improvement. It was developed by Motorola in 1986. Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organization ("Champions", "Black Belts", "Green Belts", "Yellow Belts", etc.) Each Six Sigma project carried out within an organization follows a defined sequence of steps and has quantified value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits. A six sigma process is one in which 99.99966% of all opportunities to produce some feature of a part are statistically expected to be free of defects (3.4 defective features / million opportunities)

Lean Six Sigma is a methodology that relies on a collaborative team effort to improve performance by systematically removing waste; combining lean enterprise and Six Sigma to eliminate the eight kinds of waste : defects, overproduction, waiting, non-utilized talent, transportation, inventory, motion, extra-processing.

3.Lean Six sigma for academic Excellence:

Six Sigma strategy places a clear focus on achieving measurable and quantifiable financial returns to the bottom-line of an organisation Six Sigma strategy places an unprecedented importance on strong and passionate leadership and the support required for its successful deployment. Six Sigma methodology of problem solving integrates the human elements (culture change, customer focus, belt system infrastructure, etc.) and process elements

(process management, statistical analysis of process data, measurement system analysis, etc.) of improvement.
Six Sigma methodology utilises the tools and techniques for fixing problems in business processes in a sequential and disciplined fashion. Each tool and technique within the Six Sigma methodology has a role to play and when, where, why and how these tools or techniques should be applied is the difference between success and failure of a Six Sigma project.

Six Sigma creates an infrastructure of champions, master black belts (MBBs), black belts (BBs) and green belts (GBs) that lead, deploy and implement the approach. Six Sigma emphasises the importance of data and decision making based on facts and data rather than assumptions and hunches! Six Sigma forces people to put measurements in place. Measurement must be considered as a part of the culture change. Six Sigma utilises the concept of statistical thinking and encourages the application of well-proven statistical tools and techniques for defect reduction through process variability reduction methods

Here we list a number of Critical to Quality (CTQs) parameters:

- Student Success rate in examinations
- Graduating percentage of students
- Percentage of students with distinction
- Percentage of Syllabus completed
- Percentage of classes conducted
- Student attendence in the class
- Student feedback rating for faculty
- Defects in Question papers
- Defects in Valuation/Marking/Grading
- Faculty-Student ratio
- Placement of graduating students
- Computers/Lab/ Network

The faculty members play a vital role in rolling out the Lean Six sigma. From the perspective of teachers and instructors, Lean Six Sigma can be applied as follows:

- Activities: Teaching, Research, Administration
- Knowledge, Skills and Abilities
- Teaching: Instructions, Syllabus, Classes, Evaluation, Question Papers, Assigments, Student Feedback
- Research: Research Methodology. Publications, Patents, Graduating PhD and Mtech students
- Administration: Faculty co-operation, Communication, etc
- Organization: Workshops, Seminars, Conferences

4.Implementation

There are many publications which guide in Lean Six Sigma implementation in academic institution[6-9]. The Lean six Sigma implementation in academic institution can be achieved by first stage of training faculty members in Lean Six Sigma. Some of the leading faculty can take up yellow belt, Black belt and Green Belt certifications. The implementation tasks for quality enhancement and costs savings are identified by the team entrusted with lean six

sigma. The implementation is carried out in stages and measurements are collected. The collected data is analyzed and effectiveness of the design is assessed. Any modification required are inferred from the analysis through rigorous statistical techniques. The changes are effected and further next cycle of DMAIC is started. This is an iterative process and over a period of time, significant improvement can be observed.

Lean Six Sigma can be combined with six techniques discussed in the book Good to Great[10] to achieve better results. The techniques are: First Who, Stockdale Paradox, Hedgehog Concept, Culture of Discipline, Technology Accelerators, and Buildup breakthrough Flywheel.

5.Summary and Conclusion:

Six Sigma as a powerful business strategy has been well recognised as an imperative for achieving and sustaining operational and service excellence. While the original focus of Six Sigma was on manufacturing, today it has been widely accepted in both service and transactional processes. Although the total package may change as part of the evolutionary process, the core principles of Six Sigma will continue to grow in the future. Six Sigma has made a huge impact on industry and yet the academic community lags behind in its understanding of this powerful strategy. In this paper, we have proposed how Lean Six Sigma can be adapted in the academic environment. Such an implementation will enhance the quality of the educational processes and also cut down on the costs.

6.References

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