

Six Sigma in Educational Institutions

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(Abstract) Higher educational institutions are exposed with global competition for the sustainability for a long run such as low graduation rates, less employability and rising questions of relevance of college education for public good etc., Some institutions in India have successfully implemented ISO 9001:2008. The quality of education is more important to the customers of the educational institutions such as students, parents and the organizations where they are getting employment. Educational Institutions require an innovative supporting tool which helps in improving the quality of processes pertaining to the important functions particularly teaching, research and service [1]. The administrative functions and supporting activities in an institution help to coordinate and improve the effectiveness of the Academic Delivery Process [1]. Institutions can also improve their chances of attracting students by improving the levels of service. To find success, institutions of higher education must demonstrate that they can offer what others cannot. This paper narrates the implementation of six sigma in a technical institution, the benefits of implementation and how six sigma may be used to improve the performance of all institutional operations from student graduation to recruitment, including all the processes.

Keywords: Academic Performance Analysis; Black Belt; DMAIC; Green Belt; Higher Education; Six Sigma.

1. Introduction

The Greek symbol σ (sigma) denotes “standard deviation” - a statistical symbol and metric of process variation and it has several meanings. The literature on six sigma reviews that, in the late 1800s, Carl Frederick Gauss introduced the concept of a normal curve. In 1920s, Walter Shewhart proved that three sigma from the mean is the point where a process requires correction. During the mid of 1980s, Bill Smith, a Motorola engineer, explained that Six Sigma is the optimum level to balance quality and cost.

Six Sigma is a continuous modern quality improvement philosophy that has been provided some well documented improvements for the products and profits in many business organizations [1]. One, six sigma is a performance level. For a six sigma process, 6 standard deviations each may be fitted between the mean and the upper and lower specification limits. Six sigma is also a disciplined and data-driven approach that repetitive work processes function in the best possible manner. The primary goal of six sigma is to minimize defect levels in the outcome of a work process; a defect being anything that causes customer dissatisfaction. Maximizing customer satisfaction leads to improved bottom-line performance and global competitive position [1].

Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data and statistical analysis, improving and reinventing business process [1]. This is a data-driven method for dealing with defects, waste and

quality problems in manufacturing, service delivery and other business activities. Six Sigma is a management philosophy focused on eliminating mistakes, waste and rework. It is often used as a scale for levels of 'goodness' or quality. Six Sigma is a business improvement methodology that focuses an institution on:

- Understanding and managing students requirements
- Aligning key business processes to achieve those requirements
- Utilizing rigorous data analysis to minimize variation in those processes
- Driving rapid and sustainable improvement to educational processes.

Each Six Sigma project has five phases, in which each phase requiring a review. The review may result in one of the three outcomes: continue to next phase, stop project, or continue study in current phase [2]. Within each phase, data is collected and analyzed statistically to aid decision-making. Six Sigma may be a data driven approach that uses reviews at the end of each phase. The five phases are: Define Scope, Measure, Analyze, Improve, and Control (DMAIC). This DMAIC methodology is designed specifically for improvement of existing processes. Similar Six Sigma methodologies are Define scope, Measure, Explore, Develop, and Implement (DMEDI) and Design, Measure, Analyze, Develop, and Verify (DMADV). Both methodologies used specialized tools for designing or improving products and services.

One key area where higher educational institutions seek to improve efficiency is that of implementing electronic

document and digital image repository to simplify and streamline document-intensive business processes. Imaging and document repository solutions include scanning, organizing, and storing backup files incoming documents to be readily available and instantly accessible to people who need them most. Institutions often look to experts in the industry to help them to implement transformation and affording them the ability to concentrate on their core mission—providing life-long learning to their students. Since many institutions look at image enabling, but not in process improvements. These institutions does not attain its goals of improving communication and information flow. Many institutions take a departmental, rather than a holistic enterprise, approach and create silos of information, resulting in information that can't be leveraged by everyone. The institutions also focus on the administrative side, but not the academic side of capturing documents, missing on opportunities to collaborate, share knowledge and improve course work.

The deployment of Six Sigma [1] consists of Champions, Master Black Belts (MBB), Black Belts (BB), Green Belts (GB) and Team members (TM).

Champion is a Head of the institution who is the leader and is responsible for promoting and directing the development of an institutions. The Champion provides leadership and commitment and work to implement Six Sigma throughout their institution and lead to the success of Six Sigma. He/she approves all Six Sigma projects, review progress on a regular basis and ensure that the improvements are sustained.

Master Black Belts (MBB): The MBB is a head of the department. MBBs are fully trained quality leaders responsible for Six Sigma implementation, training, mentoring and results. They are the people most responsible for creating, lasting, fundamental changes in the way the institution operates from top to bottom. They act as internal coaches to Black Belts to reach their the project goals. They are generally a statistical and change management experts who regularly deal with resistance to change and resolve team conflicts.

Black Belts (BB): The BB is a Asst. Professor, Lecturer and Teaching Assistant. BBs are the key functionaries and fully trained experts who are experienced in leading improvement teams. They are the project leaders and posses both management and technical skills. Black Belts are fast trackers who have credentials for accomplishments. They are the people who turn Six Sigma vision into reality. The BB's should provide leadership and create a vision, provide necessary resources, in given time and review the progress.

He should take the responsibility to ensure that everyone gets involved in the implementation effort.

Green Belts (GB): The Green Belts are the supporters of Black Belts in a Six Sigma project. Their role is to assist and follow the Black Belt while implementing the tools of Six Sigma within their confined projects.

Team Members (TM): TMs are individuals in supporting specific projects, working in teams in their areas for continuously improving and controlling quality of all curricula offered by our institution. They are the employees who carry on with improvements together with their regular work.

2. Why Six Sigma in Education?

In the contest of globalization, education systems have gone through radical changes. Today higher education has become commercial enterprise and is treated as marketable commodity. Many institutions and universities throughout the world are preparing for marketing their educational products and services. Day by day the competition from various institutions and universities is mounting up. Quality of education is going to be of foremost importance in all further higher education [1]. Apart from quality there are other challenges faced by institutions.

This paper focuses on the teaching function in an institution. Teaching in any area involves multiple activities such as course plan design, curriculum development, learning objectives of individual courses, classroom instruction, laboratory exercises and student learning assessment etc. The Six Sigma methodology can be utilized in all the above listed activities to improve the teaching function.

From the past decade, there has been an increasing in the number of technical institutions in India. The quality of education and overall performance are not satisfactory in most of the institutions due to student failures in university examinations, less employability/placement opportunities and other factors. To improve the quality of education and placement activities, the AICTE has to monitor the institution to improve in the field of higher education as per the following tasks.

- To decide mission and goals of a private higher education institutions. The measurements are obtained and verified after every academic semester/year by the AICTE.
- To determine the accreditation requirements of private higher education institution, and follow-up quality assurance measures in every year
- To adopt universal standards for licensure and accreditation
- To establish measures of accreditation and validation of academic degrees issued by the private institutions.
- To oversee the sustainability of private institutions and provide advice.

The institutions implement the control actions and the process is repeated. This is the basic steps of the Six Sigma

methodology: Define Scope, Measure, Analyze, Improve, and control. The process is illustrated in figure 1 and the DMAIC explanations in educational institutions are given in Table 1 and 2.

Table 1: The Customers

Customers	Students Parents Organizations, Industries, Employers, Principal, Dean, Professors, Asso Professor, Asst.Professors, Lecturers, Instructors, Technicians Administrative and Supporting staff
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Table 2: DMAIC Brief explanation in Educational Institutions

Term	Explanation	Deliverables	Tools used
Define	The institution’s purpose and scope are well defined during this phase. To identify problems, form a team, identify customers, identify required outputs, to prioritize students requirements, document the current process and complete requirement definition	Project chart Data collection plan Analysis Quality outline Cost of poor quality Overview of the process to be improved	MS-Word/EXCEL, Flowchart, Gantt Chart / Timeline Suggestions / Complaints, and Surveys / Interviews
Measure	It evaluates the "as is" process, and creates a current-state assessment of the current service delivery. This phase will help the organization rank the potential causes, to identify what is to be measure, types of variations, accuracy of measurements, conduct the measurement, calculate current sigma level, determine process capability	Process capability and performance Critical input and proves variables that can affect output quality Service delivery defects Critical Success Factors summary chart.	Data Gathering Plan, Surveys / Interviews, Check sheets, Control chart, Measurement system analysis, Flowchart, and Gantt Chart / Timeline
Analysis	It produces the baseline performance of the service delivery process. In this phase the collected data in the measure phase have been examined to generate a ranking list of the sources of variation, to identify the root cause of problems, to determine brainstorm ideas for processing students’ improvements, determine which improvements have the greatest impacts on students requirements, develop proposed process map and assess risks associated with revised process.	Cause and Effect Diagram Frequency plots “As is" data and information flow diagram Critical Success Factors (CTQs) benchmark To identify opportunities for improvement Regression analysis; Scatter plots; Treats and opportunities.	Interrelationship diagram, Histogram, Correlation Analysis, Confidence intervals, Regression, Response surface method, and Flowcharts
Improvement	This phase is to identify options for solutions which can be useful for the identified problems during the analysis phase. Recommendation and implementation, to gain approval for the proposed changes , the impact of assessment , finalize the implementation plan, implement the approved changes and the solutions are the most important objectives of this phase.	"To be" data and information flow diagram Design of experiments Risk Assessment Rank the solutions Improve the planning.	Hypothesis testing, Confidence intervals, Trial/Error Simulation, Flowchart, Implementation and validation Plan
Control	Obtained knowledge in the improvement project can be published in other areas to help accelerate improvements of service delivery. To establish the key metrics is to develop the control strategy, celebrate and communicate success, implement the control plan, measure and communicate improvements.	Control charts Quality control process charts Standardization Process metrics defined Full solution implemented Control/Response Plan implemented Risk mitigation actions complete.	Control charts, Process/Monitor / Response Plan, Standardization Process Dashboards, Capability studies, Documentation, Final Report, and Presentation

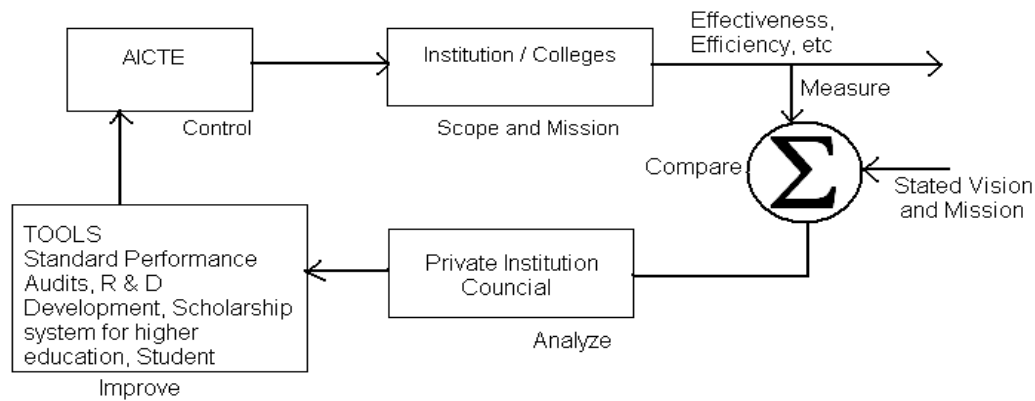


Figure 1: Six sigma methodology in Educational Institution

The Six Sigma methodology principles can be used in designing engineering courses in a manner that highlights the significance of data and data analysis in an organization. The program emphasizes gathering requirements that help meet users' needs in their work environment. Students can use Six Sigma principles for better understanding of the data which are useful (Measure) when gathering requirements and how to avoid collecting data that distracts rather than help a user.

When an institution wants to introduce Six Sigma for its management strategy, the author would like to recommend the following procedures.

- The institution should ensure that the students are to be competent with a full understanding of theory and have the diligence to guarantee that deadlines are met
- To run laboratories with latest equipments and licensed softwares which are shown to be sufficient when compared with other organizations.
- The philosophy of the education curriculum is to produce good graduates who could teach several courses to develop computer assisted teaching software and to develop a computer programs with a positive attitude and could systematically utilize computers in the workplace.

For that purpose, the institution should also do the following:

- Organize a team and set up the long-term management vision for an institution
- Start Six Sigma education for Champions first.
- Select the area for which Six Sigma is introduced first.
- Strengthen the infrastructure for Six Sigma such as Statistical Process Control (SPC), Knowledge Management (KM), Data Base Management System (DBMS) and so on.
- Designate the Six Sigma day each month, and check the progress of Six Sigma from the top management. If necessary, presentation/reward of Six Sigma results can be implemented.

Here, we report two cases according to the Six Sigma initiatives: i) The students should be admitted based on +2 marks and an entrance examination, ii) The teaching environment should be implemented through the class room

and laboratory sessions, which will provide research work, giving lecture notes, teaching materials and others etc., to improve teaching.

The core of Six Sigma is defined as $Y = f(x)$, where Y is the product or service that has to be improved and ' x ' is a set of factors that influence Y . ' f ' is the function that defines the relationship between ' Y ' and ' x '. Six Sigma is all about finding the critical ' x ' which affect the ' Y ' or output of the process (Product or service).

Six sigma offers institutions of higher education a powerful mechanism which is to examine the efficacy of their offerings and to improve them. At present most of the manufacturing sectors are gaining more benefits by adaptation of quality concepts like TQM, Six Sigma, Kaizen, 5S and others. Once Six Sigma is successfully deployed on all existing work processes on an institution campus, the next task is to determine the outcomes of these existing work processes align with the justifiable needs and requirements of the society.

An institution is in full operation for only ten months of the academic year, i.e., from June to April. A company operates for 12 months annually and it also can be more outcomes oriented. On the other hand, in an academia institution may have shared governance which means much slower decision making process. Students are also partially responsible for their own learning. This factor complicates the problem significantly. Measures used with Six Sigma in the corporate world sometimes cannot be used in academia.

3. Outcome of Accreditation

There are many important outcomes of the accreditation system for ensuring quality in higher education. All the higher education institutions have obtained positive quality assurance and hence they are awarded the institutional accreditation by AICTE. The accreditation benefits are measured in the unit time of three/five year. Longer term improvements are noticed during the institutional accreditation process for all participating departments.

4. Conclusion

Six Sigma is a process that brings additional benefits and helps institutions to adopt best practices for service delivery through a quality process which ensure its success. This paper has discussed two approaches which are highly complementary and can be used in combination effectively for the continual quality improvement of an educational process. Fundamental perspectives on the role of six sigma for transforming higher education have been presented in this paper. Based on first principle, we have outlined how Six Sigma may be used to operate all the existing work processes in an institution in the best possible way. This paper also has dealt with Six Sigma and its role in quality management, since many aspects are based on current scenario in an educational institution. However, the author believes that the general trend is right and believes that Six Sigma is the best strategy for quality education system for its quality improvement.

5. References

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