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Minimizing Errors in Education Systems Using Six Sigma And Tqm Tools

Education

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ABSTRACT

Service segment stands for a substantial share in UAE economy and among the service industries, the education sector is evolving as a major commercial activity in the nation.

Higher educational institutions are exposed with global competition for sustainability for a long run such as low graduation rates, less employability and rising questions of relevance of college education for public good etc.

Globalization, demographical changes, growing competition among institutions, emergence of new technologies, changing socio-economic profiles of nations and knowledge driven economies have created a scenario where quality in education is beginning to lodge the center stage. Now the quality is no more a required tactic – it has turn out to be a survival plan. In such a scenario, Education systems require an groundbreaking supporting tool, which helps in improving the quality of education.

In industry, a company may look at defects in its final manufactured products, but in engineering education, these defects are related to falling pass percentage among students or capabilities of the students. The administrative functions and supporting activities in an institution help to coordinate and improve the effectiveness of the Academic Delivery Process. Institutions can also improve their chances of attracting students by improving the levels of service.

In this paper, we will explain what six sigma is, how it is implemented, and what the benefits of implementation are. We will show how six sigma may be used to improve the performance of all university operations, from student recruitment to graduation, including all the processes in between. We also explain how six sigma can transform higher education.

INTRODUCTION

The organization of this paper is as follows. We begin with an operational definition of six sigma. Then, a synopsis of how six sigma implementation is presented. Next, we discuss how six sigma may be applied to improving the performance of all university processes followed by an outline of how six sigma may be used to transform higher education. We conclude the paper with some thoughts on how societies could use six sigma not just in higher education but also in all the other sectors.

What is Six Sigma?

The Greek letter sigma (σ) is sometimes used to denote variation from a standard. The philosophy behind Six Sigma (6σ) is that if you measure how many defects are in a process, you can figure out how to systematically eliminate them and get as close to perfection as possible.

Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects (driving toward six standard deviations between the mean and the nearest specification limit) in any process – from manufacturing to transactional and from product to service.

The statistical representation of Six Sigma describes quantitatively how a process is performing. To achieve Six Sigma, a process must not produce more than 3.4 defects per million opportunities. The following table 1 shows the number of maximum defects per million transactions/services:

Table 1.

Sigma	Percent Defective	Defects per Million
1	69%	691,462
2	31%	308,538
3	6.7%	66,807
4	0.62%	6,210
5	0.023%	233
6	0.00034%	3.4

A Six Sigma defect is defined as anything outside of customer specifications. A Six Sigma opportunity is then the total quantity of chances for a defect.

According to Harry and Schroeder (1999), Six Sigma is a powerful breakthrough business improvement strategy that enables companies to use simple and powerful statistical methods for achieving and sustaining operational excellence. It is a business strategy that allows companies to drastically improve their performance by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction.

Park (2002) described that Six Sigma implies three things: Statistical measurement, management strategy and quality culture. It is a measure of how well a process is performing through statistical measurement of quality level. It is a new management strategy under leadership of the top management that creates quality innovation and total customer satisfaction. It is also a quality culture. It provides the way to do things right at the first time and to work smarter by using data information. It also provides an atmosphere to solve many CTQ (critical-to quality) problems through team efforts. Statistical representation of Six Sigma describes quantitatively, how a process is performing.

Service sector has experienced significant growth over the past several decades and it accounts for a substantial share in UAE economy. Education has multiplying effects on all facets of development in a society and among various educational resources; engineering education holds the key to economic viability of a nation (Ho and Wearn, 1995). All over the world, engineering education has been intensified in the universities during the past four decades. On this front, UAE has recognized the importance of higher education on science and technology and committed itself to the development of science and technology manpower by providing full policy support and substantial platform to create one a large network of higher education system.

On the basis of this structure, the Six Sigma methodology can be easily linked to the passing rate of the students or more precisely the overall quality of education being imparted in any institute.

However, a debatable question arises; is passing rate an important factor that reflects the quality of an institute? The answer is – yes; it reflects the quality of any institute significantly, though there are many other factors also. But by increasing the passing rate of the students, these factors can easily be dealt with.

Six Sigma professionals exist at every level – each with a different role to play. While implementations and roles may vary, here is a basic guide to who does what.

At the **project** level, there are black belts, master black belts, green belts, yellow belts and white belts. These people conduct projects and implement improvements.

Black Belt: Leads problem-solving **projects**. Trains and coaches project teams.

Green Belt: Assists with data collection and analysis for Black Belt **projects**.

Master Black Belt: Trains and coaches Black Belts and Green Belts.

Yellow Belt: Participates as a project team member. Reviews **process** improvements that support the project.

White Belt: Can work on local problem-solving teams that support overall projects, but may not be part of a Six Sigma project team.

Every project needs **organizational** support. Six Sigma executives and champions set the direction for selecting and deploying projects. They ensure, at a high level, that projects succeed, add value and fit within the organizational plan.

In United Arab Emirates six sigma has gained extreme popularity and is used by many service sectors such as Banking, Healthcare, Aviation, etc. But implementing a six sigma process in higher education institutions are the next step for UAE to compete globally.

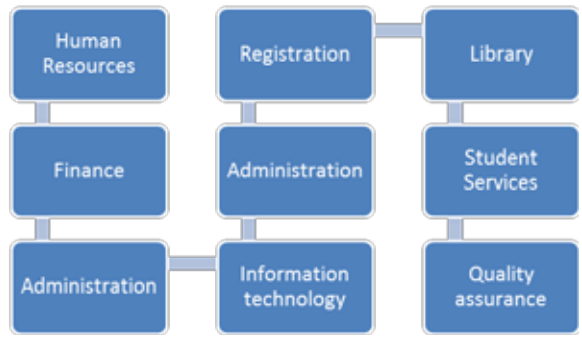
Problem:
In this paper the problem areas are the following:

Firstly if **Six Sigma can be implemented to the learning process of the students?** In this category the entire process of six sigma should be focused on the KNOWLEDGE of the students during their studentship in a higher educational institution which means we treat students' knowledge as the "**PRODUCT**" in the process. If the product of the process is "**KNOWLEDGE**"; then the process becomes more complex in terms of setting a minimum quality level and maximum quality level for knowledge. For example there has to be specific standards set for each course learning outcome and program learning outcome so that measuring the quality level of knowledge becomes attainable. At the same time there would be a lot of concentration on quality costs while implementing Six Sigma in the learning process.

Secondly if **Six Sigma is implemented only in the operations process** would it affect the learning process and knowledge? And can costs cover the long term benefits of the process implementation?

With regards to the operational process of higher educational institutions, Process will be designed in a way to integrate the entire Non-Academic units together such as the following in table 2:

Table 2.



In table 2all the units are integrated in such a way that any error or mistake in each unit will affect the rest of the process and also any error elimination from the process will lead to a more efficient and effective process as a whole.

Thirdly if Six Sigma is implemented to the learning process or "Knowledge"; the **quality cost** would result in hike in the tuition fees of the students. And as far as there is a huge competition between the higher educational institutions in the country, the students might find other alternatives to pursue their higher education rather than bearing the higher costs of a six sigma implemented university or college.

According to Ministry of Higher Education and Scientific Research in UAE expressed that from 2009 to 2013 the number of licensed higher education institutions in the UAE has increased sharply during the last two decades and now stands at 71. Another seven institutions are currently in the establishment stage.

Fourthly **Six Sigma is a continuous improvement process** and it requires constant process engagement activities to make sure the errors and defects are minimized at all levels. While implementing this minimizing error process, we should keep in mind that six sigma is not a program that once the program finished the quality remains excellent; but it is a continuous improvement process which means the higher educational institutions should engage in the following activities constantly:

1. **Define** errors and defects in process,
2. **Measure** the desired quality level,
3. **Analyze** different alternative and cause-effect relations,
4. **Improve** the process standards, and
5. **Control** the process outcome which is a better quality level.

And finally referring to the higher quality costs and competitiveness factor between higher educational institutions, the question arises **of possibility of integrating the entire six sigma process with a government authority such as the ministry of higher education in UAE**. This will upgrade the entire education system in UAE.

Methodology:
In order to implement six sigma in any educational institution; the focus of the project should be the top managers who are the decision makers and their commitment to implementation of six sigma is essential and always necessary. Therefore the first step is to introduce the top management or the decision makers to the concept of six sigma and its possible results after implementation. The decision makers should be motivated and be able to look at the implementation from a cost/benefit point of view.

The next important step is the "Define" stage where we need to define a measurable output to the learning process. As explained before, the product of learning process is "Knowledge". So the knowledge of students would be the target of standard devia-

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tion while implementing six sigma. As far As we are dealing with "Knowledge" as the product of the process; therefore the knowledge should be kept under a measurable standard.

In this research a measurable knowledge can be assessed and achieved through formative assessment and breakdown of all learning outcomes into practical knowledge. So in order to make sure that the students' knowledge about a particular learning outcome is meeting the quality limits, the institutions must apply all possible formative assessment strategies to the learning activities such as classroom interactions, assignments, presentation, research and projects.

At the same time practical knowledge in terms of "up to date knowledge" should be considered as essential. The question about practical knowledge arises from the facts that many students end up graduating but most of them still do not have the required knowledge in their working environment. Therefore after the graduation, students start training themselves to get qualified. However this gap could be filled if formative assessment strategies are applied by instructors and lecturers. These formative assessment strategies vary from:

1. Student work. (e.g. Ungraded Quizzes, Presentations, Summarizing, Doodle It, Metacognition, Tic-Tac-Toe/Think-Tac-Toe)

2. Self-reporting strategy. (e.g. Exit slip, Thumbs language up-middle-down, Likert Scale)

3. Technology. (Activities like test yourself quiz, chat, polls, ... etc.)

4. Peer assessment. (Jigsaw Groups, Think-Pair- Share, Group work)

5. Teacher observations.

6. Teacher feedback.

7. Self-assessment.

The other important factor for implementing six sigma in higher educational institutions in UAE, is the measurement of students learning ability. As each student's mental/intellectual ability is different, therefore the implementation process becomes more complex. And the other fact that UAE is a highly diverse country will affect the education system more increasingly due to more barriers such as language preferences. So considering that we are dealing with highly heterogeneous groups, measuring intellectual ability is highly required. In this research I considered the ability measurements through students School Reports, GPAs, Language Speaking Skills, aptitude tests and other psychometric tests were also helpful in shaping diverse learning groups in university.

In this research the learning & teaching resources play a very important role in implementing six sigma. Students should feel at ease while acquiring knowledge and resources should be available to them by universities or colleges. As the technology has advances, so did the people. Therefore students who are diverse in terms of: technology, social media, electronic resources, e-books, software applications knowledge, text books, videos, seminars, workshops, etc; the higher educational institutions should make all these resources accessible.

The following fishbone diagram represents the factors of focus while implementing six sigma:

ACTION PLAN: (CONTROL & IMPROVE PHASE)

Critical System	Key Critical Factors	Recommendation Proposed
INFRUSTRUCTURE	Campus Building	Hire professionals and curb unplanned expansion
	Laboratories & Equipment	Enough space to be provided and laboratories to be fully equipped
	Library	Provide all soft wares for ordering books and subscribe new books and journals as required by faculty members
	Computer & Internet	Separate internet labs in specific departments
	Hostel Facility	Construction & Extension of hostel facilities
FACULTY	Experience of Faculty	
	Level of knowledge	Scheduling of FDP (Faculty development program) in every six month
	Teacher-student Ratio	To maintain fair ratio of teachers and students
	Teaching Style	Provision for modern teaching aids
	Degree of motivation by faculty members	Constitution of career advancement cell for guidance and motivation of students.
	Parent-Lecturer Interaction Parents teacher's interactions to be	made mandatory for all branches
MANAGEMENT	Amount of Investment	Management proposed to be liberal in spending more for the welfare of the college/ university.
	Efficiency administration	To recruit senior and experienced clerical staff.
	Scholarships	Scholarship and cash prizes to be given to meritorious students in annual prize distribution function.
	Provision of financial help for students from weak classes	Students from weaker section of society to be helped by a guidance cell made by management.
	Provision of adequate power to faculty	To grant more power to principal and staff regarding discipline of students in college.
	Accreditation of College	Proposal for accreditation of college

STUDENT – FACULTY RELATION-SHIP	Opportunity of informal interaction	Faculty advised to make students feel free even after classes regarding their problems.
	Student perception of faculty	To distribute and collect students' feedback forms regarding faculty per semester.
	Counseling session for weak students.	Maintaining the record of poor students by guidance cell made by management.
	Coaching /Extra classes	To conduct extra classes for the students who fails in sessional examination
	Attitude of students	Guest lectures by people of different fields for a positive frame work of mind of students.
EXAMINATION PATTERN	Pattern of question papers	Strictly in accordance of final term examinations
	Predefined syllabus	Academic calendar duly formed to let the students know the distribution of syllabus per sessional.
	Adequate time between sessional exams	Only one sessional per day
	Evaluation Criteria	Proper evaluation based on actual performance of student
	transparency	Maintaining and submitting weakly performance and attendance sheets
ADMINISTRATION	Effectiveness	To ensure smooth functioning in administration and clerical block.
	Discipline and decorum	Discipline and decorum to be maintained by administration with full authority.
	Placement cell with qualified TPO	Training and placement officer (TPO) with technical background and experience to be recruited
	Emphasis on industrial training	TPO to help the students for their Industrial Training. And Industrial tours to be scheduled yearly by every department
	Feedback from alumni	Alumni meet to be organized every year
	d. Provision for qualified counselors	To give TPO, the charge of student counseling

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. Fundamental perspectives on six sigma in transforming higher education have been presented in this paper. Six Sigma has produced many positive results for many world class companies. An attempt has been made to highlight a relationship between the applications of Six Sigma in corporations and in higher education. Six Sigma provides a philosophy to meet the diverse needs of highlight a relationship between the applications of SixSigma in corporations and in higher education. Six Sigma provides a philosophy to meet the diverse needs of industry with improved customer satisfaction and similarly, in academics, an institute can also be experimented with Six Sigma strategy to improve productivity.

The project results reveal a need for better faculty, good infrastructure, more financial aid, better student faculty relationship and well planned curricula. The study could be a paradigm initiative for bringing in improvements on different aspects in existing education system. Technical education institutes should strategically plan to implement Six Sigma for continuous improvement and to achieve more customer satisfaction.

Six Sigma improvement methodology offers a helpful framework for organizing research projects and communicating project information and results with team members and other constituents. This study illustrates that Six Sigma's data-driven, process-oriented framework can be implemented in an academic environment with some customizations and modifications to the typical applications in industry. Although there are unique challenges facing academic institutions when implementing Six Sigma such as defining key customers or process metrics, observing and adapting relevant and similar practices from service organizations should be beneficial for exploring and identifying opportunities to further develop and refine the tool sets for quality and process improvement in academia.

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