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An Overview of Lean and Education Sector

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Abstract: Education sector is facing a lot of challenges and among many making balance between delivering quality education and involvement of cost is a big issue. This type of challenge analogues to manufacturing industry has already been faced in the recent past. To overcome the challenges various organization started practicing Lean Six Sigma and 5S technology and these practices had shown very good results. These practices can also be followed in the education sector. In this study, we first discuss various challenges in the education sector including education modules and teaching methodologies. We then illustrate Lean creation, Six Sigma and 5S technology. Further, we present literature review to suggest that how these practices have helped the various universities to improve teaching skills, administrative process based on the existing available resources.

Key words: Lean, 5S, Six Sigma, education, improve teaching, resources

INTRODUCTION

Education is confronting a bigger number of difficulties than before due to the globalization of merchandise, administrations, assets market and globalized issues. These difficulties require globalized arrangements given by entire frameworks thinking and eco-manageable arrangements. Further making balance between the quality education, good infrastructure and cost due to the salaries of employees, management leaders, thinkers and strategist is a challenging job. Recently in India the government had also directed all the premier higher education institutes such as IIMs (Indian Institute of Managements), IITs (Indian Institutes of Technology), NITs (National Institutes of Technology) and central universities to increase the intake to accommodate more students and also to offer diverse degree programs and specialization. At the same time, these higher education institutes were suggested to pay more attention to the quality of teaching and research. One may also refer to Bhattacharya (2010) for some more details regarding the management studies and management institutes in India. Many educational institutes are trying their best to make this balance and make a profit based on the existing resources. The existing resources may include all the employees designated at the various posts and to utilize them at most is the one way to survive in the competition and become a leading institute. However, from management aspect the question how to utilize all the available resources plays an important role and it is not easy task to bring a change in the existing system within a short span of time. The change should be in culture, so the output in terms of efficiency can be maintained for a long time period not only for a short span of time. To bring the changes a systematic approach with a good knowledge of existing resources, challenges and solutions is required. Such type of problems analogues to manufacturing industries had also seen in the recent past and the good initiatives taken by the various organizations have already shown very good results in the form of cultural change, making profit and becoming a leader in the respective industry. Nowadays, the good initiatives have taken the form of some standardized process as well and have a set of rules and practices to be followed to enhance the efficiency. The practices are better known as Lean Six Sigma or 5S technology. The word Lean has origin from Toyota Production System in which the goal of the company was to accomplish more with less. The company successfully implemented some practices and it lead them to become leading player and motivation for the other industries. Since, then the practices of Lean Six sigma in various organizations have been followed by many organizations (Womack and Jones, 1996; Wong *et al*., 2009; Boniva and Marin, 2006).

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The education sector can also be seen as an industry and such practices can also be applied to enhance the efficiency of employees and quality education. The objective of this study is to discuss the education system, some loopholes in education modules and Lean in detail.

Educational modules and practices: The objective of this study is to discuss a gap between educational modules and professional practices. In the current system following are some of the points that can be considered as a base to change the traditional engineering educational modules and Engineering professional practices.

- Building educational module are excessively cantered around designing science and specialized courses without giving adequate joining of these points or relating them to modern practice. Projects are content driven
- Current projects don't give adequate outline encounters to understudies
- Graduates still need relational abilities and collaboration experience and projects need to consolidate more open doors for understudies to build up these and other capabilities
- Projects need to grow more mindfulness among understudies of the social, natural, monetary and Lawful issues that are a piece of the truth of present day designing practice
- The current educating and learning methodologies or culture in building projects is absolute and necessities to turn out to be more understudy focused
- The need of educational modules and methodologies so the knowledge can be applied to the respective industry

One may also refer to Factories and Treagust (2003) for more details in this regard. The research by Froyd *et al.* (2012) also illustrates the change in engineering education through five major shifts in the recent 100 years: a shift to engineering sciences and analytical emphasis, outcome based education and accreditation, emphasizing engineering design, social behaviour sciences research and integration of information, communication and computational technology. The shifts to the first two phases have already been occurred but continuously implicating the engineering education, however, the latter three are still in process. Researchers have presented a very useful discussion on the importance of design, analytical, modelling and professional skills to achieve the goals for undergraduate engineering education. Based on extensive literature survey researchers observed that the cooperative, problem and inquiry based learning techniques are very much useful to the lecture delivery through presentation. As the new technologies are emerging, achieving education goals are also growing but the growth is slower than expected. However, in most of the cases the success rate is high when the involved technology and adopting methodology are not much expensive but very easy to use. The research also discusses the role of Accreditation Board for Engineering Technology, Scholarly Articles, Journals and Conferences.

The architect's part in the public arena is accentuated by a report from UNESCO that reinforces building instruction part in preparing admirably youthful specialists. It also suggests a few changes for colleges such that college courses can be made more intriguing through the change of educational program and teaching methods. It is observed that such methodologies having student's involvement in greater action, extend and issue based upon adapting in the nick of time methodologies and hands-application and less equation based methodologies that turn understudies of science and designing can change the world. However, most of the adopted methods in school and colleges are traditional and require a change. The imaginative cases of schools and colleges around the globe that have lead movement in such territories as issue based learning are also a motivation for the change (NIST., 2010). In their research, Graham (2012) from Royal Academy of Engineering exhorted the need to sidestep the resistance to change and to construct systemic change rather than detached cases of achievement in individual projects and one person grounds. In the their research, Felder *et al.* (2000) have discussed the difficulties confronted by the architects in the start of the century as: the expansion of data; requirement for multidisciplinary for innovative improvement; globalization of business sectors; endangered condition; developing of social duty; need to participate in corporate societies and requirement for the fast change in instructive adjustment. Researchers examined how they could be instructed to build up the basic aptitudes keeping in mind with the end goal to confront these difficulties (Felder *et al.*, 2000) and the need to instruct the foundation with a specific end goal to figure out how to educate (Stice *et al.*, 2000). One may also refer to NID (2015) and Felder *et al.* (2000) for visions

and roadmaps for the future of engineering education. In their research by Deshpande and Huang (2011) have presented a rigours review on how the simulation games in engineering education can enhance the ability of student's knowledge to understand the subject and the transferability of the engineering education to the industry. Researchers have also given the details of the organizations involved in the simulation games, applications of the games in various subjects like architecture, mathematics, civil engineering, electrical engineering, mechanical engineering, chemical engineering and computer science and technology etc. virtual reality, essence of effect but not in fact, also can play a huge role to enhance the learning skills through games in virtual environment. Byrne and Furness (1994), also suggest to teach the students in a simulated environment to get good results in academic as well as in the field of programming.

Lean: The objective of this study is to discuss Lean creation. The name Lean was first utilized by Womack *et al*. (1990) in his book to portray the Toyota Production System (TPS). Researchers depicted the TPS as a framework, based on a key thought: "accomplishing more with less", less includes less space, less assets, less stock, less individuals, less exertion, etc. In fact, utilizing resources more than the required quantity is assumed as waste, so, the idea is to take out waste to accomplish profitability increments and reduce the cost. Toyota Instruction Model was the name received by the learning framework elevated by Toyota to changes theirs workers in a group of researchers taking after the logical strategy. By utilizing a "learning by doing" framework, the workers were permitted to test and learn with their coaching importance (Spear, 2004). In particular, Lean concentrates on taking out all non-esteem included exercises and waste from procedures. Lean apparatuses vary from applications to applications and the objective is constantly incremental and leaps forward change. Lean tasks may concentrate on disposing of or lessening anything a last client would not have any desire to pay for: scrap, improve investigation, stock and lining or hold up time, transportation of materials or items, repetitive movement and other non-esteem included process steps. Individuals is the most vital resource in the Lean model and since first distribution in 1977 about TPS this was clear (Sugimori *et al*., 1977). National Institute of Standards and Technology (NIST) characterized Lean Generation as a progression of devices and methods for dealing with an association procedures (NIST., 2010).

Likewise, Lean different ideas have taken birth to enhance the productivity in different organisations. Next, we first discuss 5S techniques.

MATERIALS AND METHODS

5S techniques: Osada invented the first idea of 5S in the mid of 1980. 5S is the acronym for five Japanese words. Table 1 presents all the five words in Japanese as well as in English and translation with their meanings. 5S has been presented in Japan primarily in the assembling and administration ventures. 5S standards concentrates on compelling working environment association, disentanglement of workplace and minimization of waste while enhancing quality and security. Toyota, the real auto maker is one the lead to accept the 5S standards. In fact, Japanese trust that 5S standards are profitable at their work environments as well as enhance their psychological sense. The key advantages of 5S are: less waste (Enhanced effectiveness), decreased space utilized for capacity, improved maintenance, improved safety, improved quality and better, more committed employees. One may further refer to Shaikh (2015) for a review on 5S techniques, Deshpande *et al*. (2015) for the implementations of 5S techniques in manufacturing organization and Michalska and Szewieczek (2007) for illustration of 5S methodology as a tool for improving an organization.

Six Sigma: In middle 1980's, under the administration of Robert W. Galvin, Six Sigma came into existence in Motorola company. The objective of Motorola was to decrease the quantity of imperfections to close to 3.4 parts per million in assembling the electronic items. At last accomplishing the objective with their systems the company saved a billion dollars and selection by general electric and associated flag. It is to be said that the majority of the associations work at around a 3-4 sigma resulting in 2700-63 defect parts for every million. The word sigma originates from statistics which measure the variety about a procedure average. Six Sigma is a disciplined system that uses information and factual investigation to quantify and enhance an organization's operational execution. It focuses on recognizing and taking out "imperfections" in forms and has delivered countless dollars in new benefit in a wide variety of ventures. Six Sigma commonly has five stages DMAIC; define (identification of problem), measure (automatic measuring and monitoring), analyze (constant data

Table 1: Acronyms and meaning of 5S

Japanese	English	Translation	Meaning
Seiric	Sorting	Organise	Making a distinction between required and non-required item and removing unnecessary item
Seiton	Storing	Order	Arranging the item in a system within the reach of the user
Seiso	Shining	Clean	Clean the working space
Seikesta	Standardizing	Standardized	Maintain above 3S
Shitsake	Sustaining	Personal discipline	Make a habit to follow 4S

analysis), improve (continuous improvement) and control (frequent and improved communications at all levels of the organization) (Sleeper, 2006).

RESULTS AND DISCUSSION

Lean and education: The practices of Lean, Six Sigma 5S have already produced many good results for various organizations (Womack and Jones, 1996; Wong *et al*., 2009). The objective of this study is to present a relationship between the education sector and these practices. It is to be noticed that in industry the interest may be to watch the defects in the final manufacturing process. In a similar way in engineering education defect can be seen as a loss of students. Agarwal (2006) observed that in India there are four times the number of universities and colleges in formal system of higher education than the both USA and Europe have and the total number of student enrolment has also doubled from the year 2002-2007. Still, the education sector is facing many challenges to make a balance between the quality education and cost involved in running the institutes. This is one example that analogous to the scenario in manufacturing industry. In their research, Hargrove and Legand (2002) discussed that a higher consistency standards may expand graduation rates and more income for a college and therefore, Six Sigma philosophy may help to improve the involvement of alumni and subsequently to recruit more students. Some government and non-government organizations also suggest that with more financial assistance and pre-college programs retention can be improved in engineering colleges. The strategies of Six Sigma and Lean philosophy may help to improve retention rate with currently enrolled students and increasing graduation rates. These practices can also improve the academic and administrative process. This fact was also supported by Comm and Mathaisel (2003) in which researchers suggested the nine practices to help college and universities. Researchers consider these practices very important for the institute's sustainability in future as well apart from the improvement in quality education and infrastructure. However, the work lacks in providing a roadmap to guide an institute throughout the process of implementation of the practices. The issue of measuring the performance achieved using the practices were also not discussed. Later, Comm and Mathaisel (2005a, b) collected the data on the adoption of the suggested nine practices from 18 public and private universities. Among many elements behind the Lean practices and performance, measures were based on budget allocation, customer feedback, institutional culture, philosophy, structure and involved technology. One may further refer to Comm and Mathaisel (2005a, b) for the best Lean practices at the institutional level. The research by Maguad (2007) also suggests to use the Lean practices to reduce the cost and improve the quality of teaching and learning skills in schools. It also includes 5S implementations in supply or storage rooms. Furterer (2009) suggested the Lean practices to improve the discipline. Researcher has the view that discipline process may further have sub-processes that can help to create a quality learning environment. For an instance minimizing classroom disruptions, school discipline referrals and sound knowledge of the student code of conduct play an important role to make a learning based environment. Langer (2011) studied three UK universities for the adoption of Lean practices to a higher education. researchers had used three methods: qualitative methods, semi-structured interviews and document analysis in their research. It was observed that Lean practices can be applied to the institutes with less spectacular results than in manufacturing and the impact was measured through the performance in terms of cost savings, employee satisfaction, staff time savings, culture change, etc. Lean practices were also implemented by Jin and Kachroo (2010) in the admission office to improve the efficiency. The admission office was responsible for the admission of graduate and undergraduate domestic as well as international students and the modification in the catalogues, load balancing and suggestion to conduct the surveys for students satisfaction were some of the suggested changes. Lean practices also helped in upgrade the university library process by minimizing book search time from 5-15 min (Vijaya-Sunder and Vijaya-Sunder, 2016). Researchers had suggested failure mode and effect analysis, training, student centric approach and engagement of the students and a critical root cause analysis to improve the efficiency. Suggestions and analysis that whether the Lean practices can be implemented in higher education to

improve the efficiency by using secondary data from the institutions were discussed (Antony *et al*., 2012). Later, Antony (2014) identified the pre-requisites such as available resources and management commitment, vision and leadership to select the right persons. The way of teachings has also been suggested using the Lean practices. In his research, Cookson (2013) discussed five core values for network-based distance education systems for the improvement and evaluation purposes. One may also refer to Doman (2011) for the suggestions in universities grade process. The practices like process mapping, good knowledge of background and current situation, analysis of cause, implementing a plan and follow up with modifications were used to identify four wastes: over and incorrect processing, correction and knowledge disconnection. Researchers measured the performance based on the cycle time, number of grade changes and disapprovals from administrator and instructor.

CONCLUSION

In this study, we have presented an overview of the practices of Lean, Six Sigma and 5S technology. These practices can also be applied in the education sector. In this study, we have presented some challenges in the education sector to highlight the need of such practices to be followed. We have also presented a literature review of various universities who followed the practices and achieved good results measured on the different parameters.

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