

Lean Six Sigma Frameworks “An Improvement in Teaching-Learning Process”

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Abstract: Teaching-Learning Process improvement is an important key process area in the education sector for project implementation. Lean Six Sigma approaches have been constantly used for shortening the lead time and the waste from products or services to achieve quality. Lean and Six Sigma techniques are popularize in almost every industries. This paper focuses on how the Lean Six Sigma approach can be valuable for educational institutes to improve the teaching learning process. In this paper the author uses methodology and tools to achieve quality without having any wastes in the student’s project implementation processes under the proper guidance of the higher faculties in software engineering.

Keywords: Lean, Six Sigma, Teaching-Learning, DMAIC etc.

1. INTRODUCTION

In education sector, most of the Universities have been facing problem in administrating the new technology due to some human, monetary and physical factors. Teaching-Learning process is a basic element for the Universities. The Teaching-Learning process is just the most imperative exercises in the colleges. An unhealthy teaching process framework means less students being accepted into a college in terms of errors or an incorrect way of providing knowledge to students.

Although significant exertion is generally applied in teaching at higher educational organizations, the conclusions toward the end may not be in-accordance with the effort exerted at the primary place. The nature of the learning outcomes does not exactly measure the positive effort used in teaching. In this research the author tries to investigate teachers experience to teach students of software engineering in large groups and survey the results. Based on the result we implement an intelligent methodology to enhance learning and teaching of software engineering in sufficient large group. First the author present the approach supported by the amalgam of two approaches: Lean and Six Sigma, then we present observation based on the conclusions obtained from examination, group- project coursework took after by discussions on informal assessment of feedback from students and mentors, administration of group project, and a motivation for a reflective instructor/mentor.

Lean Six Sigma provides a methodology through which we can remove the waste associated with the existing process and improve the quality of the process. Improving process

in the every department is the primary goal of this paper. Inefficient procedures lead to higher response time, so to make them efficient through development is fierce.

Most of the Universities as well as some other education institutions have on demands for human, technology, physical and money related assets and these imperatives should be managed and processed. Evaluation of this is done at each level of process and the tasks and activity associated with it is considered. All the task and activity which are driving the process have its impact in constructive as well as in unconstructive way. Each and every department of a particular education institution involves many activities like maintaining notes, creating LMS(Learning management system), providing slides on lecture basis, transfer of resources, communicating with the geographically scattered students, reducing the time of teaching process and also to centralize data handling. Our lot of time will be waste in waiting, therefore waiting is simply refers to the waste and it could be defined by the lean six sigma methodology. Recognizing methods, tasks, activities and proposing an enhanced process will prompt a society of constant change. Reduction in cycle time for teaching-learning process has been done in every departments of the university which will direct increase the Student’s satisfaction.

2. LITERATURE REVIEW

Teneraa.et.al [1] proposed the project improvement model with the DMAIC cycle and large number of statistical tools. The proposed model used to setting which extend administration forms framework is focused around Project Management Institute (PMI) benchmarks. The model

permitted recognizing organization's principle venture administration issues and related reasons and the determination of the reasons to be initially gone to.

Porres.et.al [2] proposed that how LSS tools can be used to improve the process. Lean methodology was an exceptionally valuable tool to distinguish each Kaizen in every process, because it gives the fitting tackle to handle this sort of circumstances introduced at the Imaging Office. This system is consistently emulated for each of the three methodologies (Reception, XR and CT) formerly said to make enhancements at all level.

Wang.et.al [3] proposed DMAIC model for quality improvement and quality management. DMAIC model act as logical process cycle, each stage has its activity points and the corresponding tools. DMAIC tool used to reduce the waste and variation associated with equipment maintenance process.

Pamfilie.et.al [4] proposed the lean six sigma approach can be used by any organization and has the purpose to develop strategic business objectives and to highlight the importance of personal improvement. The data obtained from the questionnaire are analyzed through the SPSS statistical package software. To show that associations can acquire individual and authoritative execution by utilizing decently prepared pioneers concentrated on consistent change which uses Lean Six Sigma in driving worker cooperative energy.

Yingchun.et.al [5] proposed Lean Six Sigma methodology can be beneficial for the early notification process used in supplier recovery management. It concentrates on the subtle creation and the key management at the same time. Lean six sigma administration in the supplier recovery administration can bring more practical profit. Lean Six Sigma can be used to demonstrate that how the performance of supplier recovery can be improved practically and effectively.

3. LEAN SOFTWARE DEVELOPMENT IMPROVED QUALITY BY REDUCTION OF WASTES

TABLE I: LIST OF 8 WASTES ASSOCIATED WITH THE TEACHING-LEARNING PROCESS

WASTE	DESCRIPTION
DEFECTS	<ul style="list-style-type: none"> Lack of standards followed by large groups. Weak or missing processes
OVERPRODUCTION	<ul style="list-style-type: none"> Long set up time for exam, lab and presentation.
WAITING	<ul style="list-style-type: none"> Insufficient staffing and absenteeism of either faculty or students participating in particular group project Inappropriate substitution of lectures Resource absences Work absences
NON-UTILIZED TALENT	<ul style="list-style-type: none"> Less training provided to students. Lack of teamwork. Poor management skills. Poor communication between teaching staff. Student present in college but do not participate in practical session completely.

Lean concept was firstly introduced in 1980's by a research team headed by the Jim Womack, Ph.D., at MIT's International Motor Vehicle Program [4]. Earlier lean methodology was used for the manufacturing industries but now lean can be applied in almost every business and every process. Lean Flow is a method of acting and thinking for entire organization.

The core idea is to amplify client worth while minimizing waste. Basically, lean means making more esteem value clients with fewer assets. A lean association comprehends client value and focuses its key methodologies to constantly expand it. The best objective is to give perfect value to the customer by method for a perfect quality creation process that has zero waste.

To endeavor, Lean flow changes the center of organization from improving separate advances, possessions, and vertical offices to advancing the stream of items and administrations through whole value streams that streams that flow horizontally over assets, technologies and departments to customer. Reducing waste along whole value streams, rather than at isolated focuses, makes forms that need less human exertion, less space, less time to make items, less capital and administrations at significantly less expenses and with much defects, weighed against conventional business frameworks [5][9]. Organizations can answer changing client wishes with high mixture, high caliber, modest, and with amazingly quick throughput times. Additionally, data administration gets to be much less demanding and more exact. Lean Flow specialists have observed that the best achievement can be attained to by systematically looking for out inefficiencies and supplanting them with "leaner", more streamlined procedures. Sources of waste usually infecting generally teaching-learning process include as shown in table1. :

TRANSPORTATION	<ul style="list-style-type: none"> • Excessive or Un-necessary handling. • Unequal distribution of information. • Less availability of resources such as printer.
INVENTORY	<ul style="list-style-type: none"> • Incorrect adjustment of workflow among teacher and students.
MOTION	<ul style="list-style-type: none"> • Shared resources such as printer. • Isolated communication among a particular project team. • Lack of standardize document.
EXCESS PROCESSING	<ul style="list-style-type: none"> • Excess meeting between group of students and with mentors. • Avoiding institution standard procedures. • Re-handling of work. • Permission seeking.

4. SIX SIGMA STASTICAL METHOD FOR QUALITY IMPROVEMENT

The Six Sigma concept was introduced MOTOROLLA in 1986. Further in 1995 General Electric made this approach central of their business strategy [8]. Six Sigma is typically identified with the number of 3.4 defects for every million opportunities. The word Six Sigma is statistically depends on the basis of the provision of things and service at a rate of 3.4 (DPMO). Individuals frequently view Six Sigma as quality control mechanism; Today Six Sigma is conveying business magnificence, higher client fulfillment, and prevalent benefits by drastically enhancing each procedure in a venture, whether budgetary, operational or creation. Six Sigma has turned into successful methodology of a wide range of businesses, from medicinal services to protection to information transfers to programming. The driving force behind any Six Sigma project originates from its essential center - "acquiring breakthrough enhancements a precise way by managing variation and diminishing deformities". The goal is to stretch and stretch rationally not physically [6] [7].

In today's complex and sophisticated higher education services, the methodology is "pulled" to satisfy the individual needs of the college. In any case regardless of how it is sent, there is a generally speaking structure that drives Six Sigma to progressing execution. Normal Six Sigma characteristics include [12]:

- A methodology of enhancing quality by get-together information, understanding and controlling variety, also enhancing consistency of a university's business forms.
- A formalized Define, Measure, Analyze, Improve, Control (DMAIC) handle that is the outline for Six Sigma changes. (The DMAIC methodology will be depicted in more prominent detail later in this paper.)
- A solid accentuation on quality. Six Sigma undertakings concentrate on exceptional yield zones where the best advantages can be picked up.
- Internal social change, starting with the help from administrator and champions

V.

5. LEAN SIX SIGMA PROCESS IMPROVEMENT MODEL

Lean Six Sigma is really a managerial principle mixing Lean and Six Sigma that effect in the removal of the eight types of wastes / muda (classified as Defects, Overproduction, Waiting, Non-Utilized Skill, Transport, Inventory, Action, Extra-Processing) and an improved convenience of performance. The word Six Sigma is statistically on the basis of the provision of things and service at a rate of 3.4 (DPMO). A mnemonic for the wastes is "DOWNTIME".

A definitive goal of this study is to utilize the Lean Six Sigma approach to remove wastes in the existing process and to enhance the quality. It is planned that this target may be attained by examining the following concerns:

- What was the reason for failure of group projects?
- Were there any regions of disappointment and in what capacity would they be able to be arranged?
- What were the positive results?
- On the off chance that there is any, what are they? Is it true that they are coursework-related, group related, or both?
- Were there any extraordinary perceptions on running group projects?
- Were students quiet with utilizing the product methodology model, demonstrating, and tool?
- Were there normal zones where student performance was comparable in both exam and coursework? In the event that there are any, could the level of student's achievement be connected?
- Was the input feedback during group and practical's session in turn with the results of the above?

Once the results of the above issues have been attained, a case would be planned with recommendations to improve teaching-learning process in computer science engineering. Lean Six

Sigma approach has been used by DMAIC methodology. The methodology followed in this paper stressed on the analysis of process helped with the Lean Six Sigma methodology and LSS tools to recommend a process innovation. Lean Six Sigma methodology is described as follows:

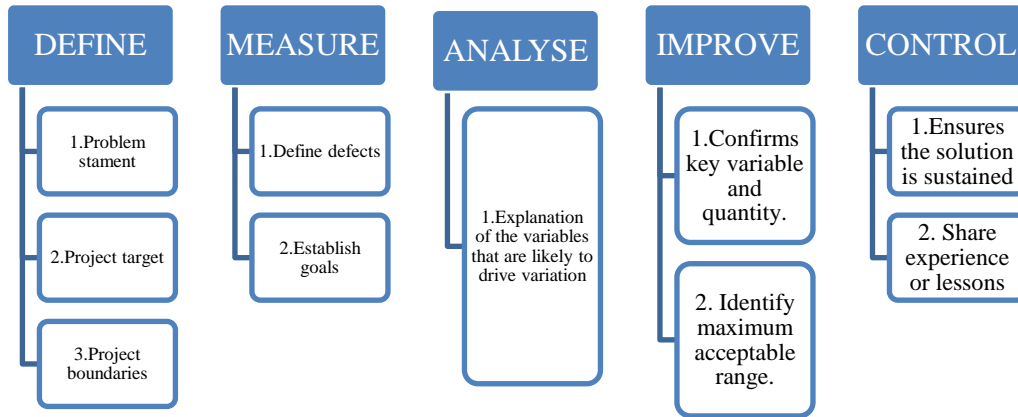


Fig.1. DMAIC Model

A. Define

To attain the goal a survey is conducted within the team members, students and teachers. The first result attained by this methodology was the formal definition from the student's 'point of view' for the objective of the project, project targets and project boundaries.

Project Objective: - Improving the teaching-learning process by achieving the quality without the waste from the student's project and to provide result with enhanced experiences.

Project target: - 97% Project completed on time without incurring any rework and re-handling.

Project Boundaries: Another purpose of this phase was to clearly define what should be extracted and what should not be extracted from the project scope. All the critical points and criteria were identified which could affect the quality such as rewrite data, unavailable data and waiting. As the project advances and more data is gathered in future stages, the issue created in the Define stage was refined [13].

B. Measure

A measure is quantified value or characteristics. In this phase students collected the quantitative and qualitative

data to have a clear view on of the current state. Team established a process performance baseline. The size of the project team is considered to be of 11 students and two mentors. The lead time teaching learning process of the project is considered to be of 3 months. A baseline was set, so that the gap between current performance and the required performance could be filled. Four types of possible errors and defects (specified in table.3) were identified within the requirement [13]. All the errors listed, identified and resolved within the development of product. As this phase is little bit complex so it is always better to consider the measure phase along with the define phase. So, that the some of the problem or errors are known to developer at the beginning of this phase.

C. Analysis

In order to check the correctness, questionnaire is used to obtain the data. The questionnaire obtain from the student feedback form is used to identify the root causes of the process failure. This data helped us to understand the gap between teacher and student. The team member will responds to each statement and evaluate each of the statement by using the software measurement scale known as Likert's Scale which have value from 1 to 5 where 1 is "below average" and 5 is for "excellent"[1]. Tabulation of this questionnaire is shown below in table II:

TABLE II
Feedback collected for performance measurement and process management

Question	# no. of respondent	Likert Score (1to5)	Mean	σ (std. deviation)
Do you believe that LSS significantly improves the process?	11	1-5	5	0
Do you accept that by executing Lean Six Sigma the association has fundamentally expanded its profit?	11	1-5	3.777778	0.440959
Do you accept that Lean Six Sigma has removed all kind of waste?	11	1-5	3.777778	0.440959
Has Lean Six Sigma been effective in meeting the objectives/desire of student's project effectively?	11	1-5	4.111111	0.781736
Do you accept that Lean Six Sigma Venture helps in management skills?	11	1-5	3.222222	0.833333
Do you accept that by using Lean Six Sigma satisfaction level and confidence level of student increases?	11	1-5	3.111111	0.927961

In table II, first column represent the question that has been asked to students in the feedback where second column represent the total number of students and teacher responds to the questionnaire. The fourth column of the table represents the average responses of the students and teacher to the individual questions. As we can see That 7th row of the table has the minimum value which indicates that level of the satisfaction of the students remained a complicated sign. To prove the precision of the result we used a Cronbach's Alpha value analysis using the single Factor [1]. The result is shown in Fig. 2:

ANOVA						
Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	3.474747	8	0.434343	0.247696	0.980245	2.042986
Within Groups	157.8182	90	1.753535			
Total	161.2929	98				
alpha	0.752304					

Fig.2. Reliability measure using ANOVA

To prove the relevant result, Cronbach's Alpha value should always be considered to be greater than or equal to 0.7. From the above result value of alpha (α) obtain is 0.752304. So the results shows that answer are significant for evaluated variable.

The Fig. 3 shows main deficiencies of the process failure during the student's project development. This Pareto diagram has been drawn using information collected through the feedback. The level of concern shows that we have rated by using the likert's scale.

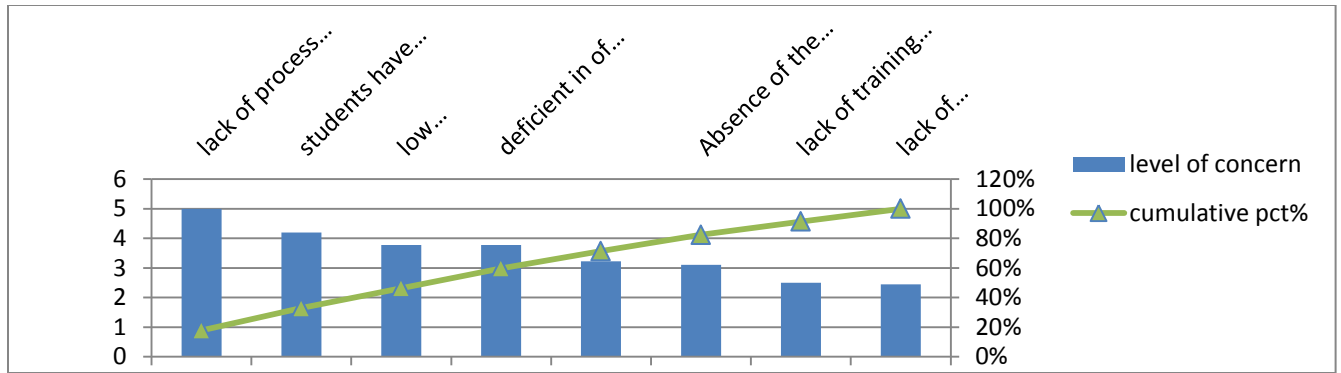


Fig.3. Pareto chart

D. Improve

The motivation behind this step was to recognize, test and actualize an answer for the issue; to some extent. Recognize inventive answers for wipe out the key underlying drivers so as to alter the issues found. As teaching-learning process is iterative process then to control and manage the process PDCA cycle is used in which we iteratively managed the process and control to continuously improving the process. PDCA Cycle helped to come closer to our aim, usually an ideal operation and output [10].

E. Control

Once the change is understood, the objective is to control the enhanced procedures and support the Lean Six Sigma activity. Support quality control information specimens and estimations are booked and dissected to confirm that the procedure change issue characterized in the first stage [13].

The reason for this step was to maintain the benefit. Screen the upgrades to guarantee maintainable achievement. Make a control plan. Redesign report, business process and preparing report as needed. This phase enhanced the confident in the user as at this level were identified and removed. A control plan was prepared and for the entire newly designed task verification [2] [3].

6. CONCLUSIONS

Lean Six Sigma has proven its effectiveness in various application areas. This paper focuses on how Lean Six Sigma can be used to increase efficiency by reducing effort and improving quality. In this paper author tries to reduce the waste associated with the Teaching-Learning Process by using Lean Six Sigma. Various tools and techniques have been used by the students, teachers and experiment shows the fact of Process improvement. The future scope of this paper is to come up with detail implementation of the above said problem with detail data used to improve the various process of education sector using Lean Six Sigma.

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