LEAN SIX SIGMA TO REDUCE TURN AROUND TIME

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Abstract- During these days various organizations are focusing to increase the Turn Around Time (TAT) in order to improve their organizational structure effectively. Lean Six Sigma is one of the approach to achieve it. Although it is mainly for manufacturing sectors, yet it has been proven that this methodology can be applied to any Sector successfully. This proposed research focuses the use of this business improvement methodology of Lean Six Sigma within a software development Industry. In other words the proposal is to apply a break through strategy to affect management objectives in recruitments so as to improve the Turn Around Time (TAT) and to increase the overall organizational revenue.

Index Terms- DMAIC, Lean, Lean Six Sigma, Six Sigma, Turn Around Time, Value Stream Mapping.

I. INTRODUCTION

In this paper researchers are discussing about the two business improvement approaches i.e. Lean and Six Sigma and then the implementation of combined approach of lean and six sigma with the help of real case study. Proposed work is divided into three sections. The first section describes about the Lean and Six Sigma and their various tools which are applied in DMAIC framework and the later section describes its implementation. In The end researchers conclude the results with their implementation remarks.

During brainstorming sessions in one of the leading software development organizations, Hiring Managers expressed their concerns to the business heads that they are not able to meet the requisition target as per defined by an organization. So in order to meet their targets, management further decided to adopt a business improvement methodology which is beneficial for their organization.

The adopted methodology by an organization is Lean Six Sigma. Lean Six Sigma is a combination of Lean thinking originated from Lean Manufacturing and Six Sigma approaches to reduce process variation and to improve organizational structure. Lean focuses on solving simple, minor problems which require common sense to resolve. Tools like the Value Stream Map and Five S are used to identify and eliminate waste [2].

Six Sigma on the other hand is defined both in business and statistical terms. In business terms, Six Sigma is a business improvement strategy used to improve profitability, minimize waste and to improve the effectiveness and efficiency of all operations [3]. In statistical terms, Six Sigma refers to 3.4 defects per million opportunities (DPMO), where sigma is a term used to represent the variation in the process [4].

II. LEAN SIX SIGMA FRAMEWORK

Lean Six Sigma approach consists of the same steps as that of traditional Six Sigma (DMAIC) steps, each of the DMAIC phases are divided into two steps. For every phase, a list of deliverables is defined. Various Lean analysis tools and standard improvement approaches and models are projected in this approach. The Lean Six Sigma phases are outlined as following [5]:

A. Define Phase - Project definition

The define phase is for the team so that they have clear goals and refine their understanding of the value of a project. Define phase is used for identifying the problem correctly and effectively, and also for justifying the revenue and resources used for maximum returns. Also, it is ensured that the causes and potential solutions are not documented in this phase.

The change management Framework is set up for choosing the right team to participate in the project. The team needs a project charter or a business charter that documents the business case, Goal statement, Project scope, Projects Team and Timeline associated with the project. Define phase is usually about creating the Charter, Communication plans, Roles and Responsibilities and Process maps [6]. Various tools associated with define serve the function of information documentation namely: Process flowcharts – SIPOC or COPIS, project charter, value stream mapping, and 5s [1].

B. Measure Phase - Define CTQ's and collection of data

Measure phase gathers data that describes the nature of the problem statement. This phase starts with the identifying the Critical To Quality (CTQ) characteristics which project intends to improve and

also data collection plan is set up to ensure all the project team members have common understanding related to problem metric of the project. A tool like brainstorming techniques, process mapping tools and measurement system analysis (MSA) can be used in this phase for its tollgate review. Process baseline is setup and each process is monitored to identify its opportunities for improvements [6]. The defined output of this phase is sigma level. The data can be reused in next phase i.e., analyze phase to validate the reasons of problems.

C. Analyze Phase– Identify the potential causes

Analyze phase uses the data and information gathered in the measure phase for the identification of potential causes of problem. The goal is to use all information to track down the cause and effect relation that produces the targeted defect and process delays [1].The data observations, points towards the causes of variation and waste. The tools to be used in this phase are; Cause and effect diagram, Kaizen, Hypothesis, Correlation, Anova, regression analysis and other statistical tools [7].

D. Improve Phase - Establish the effect of the potential causes and design improvement actions

Improve phase starts with identification of potential solutions and then take required actions to reduce variation and waste from the process. The activities lead to the development of the robust action plan around the critical causes. Various statistical and non statistical tools can be used in order to achieve the target. Tools that are often used include; pull system, setup reduction, Total Productive Maintenance, Design of Experiments (DOE) to identify causes, Quality Function Deployment (QFD) diagram, and comparative experiments to validate process changes [1].

E. Control Phase - Improve process control and completion of the project

Control phase make sure that the gains made will be preserved, until and unless new knowledge, observations and data show that there is an even better way to operate the process [1]. The right thinking must be inspired among the team members about the process. The following factors contribute to implement control phase [8]:

Tools like control charts, ongoing monitoring, check sheet, work instructions and visual aids are used in this stage in order to monitor the process continuously [6].

III. IMPLEMENTATION

The team started by working on Define Phase by identifying the problems as per Lean Six Sigma guide lines for problem formulation, based on the requisition data of the organization of July'2013 to Jan'2014, the study was done and the data was used for this Lean Six Sigma project. The requisitions were traced till the project closing date and samples are used to calculate sigma level and current Turn Around Time of the project.

Below is the problem statement formulated by the team members:

With reference to requisition data from 1st October 2013 till 31st January 2014, it has been observed that the sample median for closing a requisition is 48 days. However, as per the SLA, the target for closing a requisition is 40 days. As SLA is not met, the organization is generating a revenue loss per project. Therefore, it is very critical to address this issue on priority to run our business process effectively with increased profitability and sustain client relationship.

The next phase is Measure phase; here the collection of relevant data is done throughout the organization. Requisition data collected from the manager is used. The collected data was not present in a desired form so in order to make it desirable for analyze phase, measurement system analysis (MSA) was done to make sure that the data that was collected is valid and also it can be used for statistical purposes [5]. Since the data was discrete, Effectiveness and Efficiency tool was used. Effectiveness measures the internal calibration which means all points are at the same level and Efficiency measures the external calibration which has the master calibrator.

$$\text{Effectiveness} = \frac{\text{Total number of times all the operators agree}}{\text{Total number of observations}} * 100$$

$$\text{Efficiency} = \frac{\text{Total number of times all the operators agree with standard}}{\text{Total number of observations}} * 100$$

Agree	128
Disagree	4
Total Agree/Disagree	132
Effectiveness & Efficiency	97%

In this, Efficiency can never be greater than Effectiveness and every organization has its own internal calibration %. MSA was conducted to ensure

that data which is collected by team members is accurate and reliable. The accuracy of the data analysis relies on the accuracy of the collected data and Input determines the output. Analysis results proved that the accuracy of collected data in the form of measuring and reading by the team members are in the same way as given to them.

Data collection was continued till the end of the project since Six Sigma requires constant data analysis in order to improve the process [8].

In the study it is found that not even a single requisition was closing on the targeted date, thus the project was lying on very initial level of sigma which is zero level. The following formula is used to calculate the Sigma level:
Sigma Level = DPMO + 1.5 sigma capability shift
where,

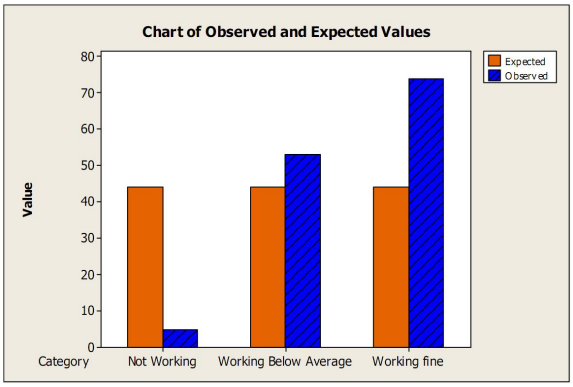
$$DPMO = \frac{defects}{total\ opportunities} * 1000000$$

The objective of the research is to improve Sigma level from 0 to at least 1.5 sigma whereby improving TAT. Now, In Analyze phase potential causes for the problem are searched through the brainstorming session, value stream mapping tool and cause and effect diagrams are used for this purpose. The hypothesis testing was done on all these vital causes for finding those causes which are impacting the most. Among the various causes, internet connection, relocation and delayed due to background check (BCG) are the most vital X's which have p value less than 0.05 due to which they are impacting the overall project.

The Chi- Square – goodness for fit test was conducted on these vital X's with the help of Minitab tool. Using this tool the difference between expected and observed value is shown.

Below are the results showing various deviations.
Internet connection: The internet connection used for all requisitions has three basic categories. These are not working, working below average and working fine. Various requisitions were delayed and some of the requisitions were not even filled due to the lack of internet connectivity.

Chi-Square Goodness-of-Fit Test for categorical variable : Internet Connection				
Category	Observed	Test Proportion	Expected	Contribution to Chi-Sq
Not Working	5	0.333333	44	34.5682
Working Below Average	53	0.333333	44	1.8409
Working Fine	74	0.333333	44	20.4545

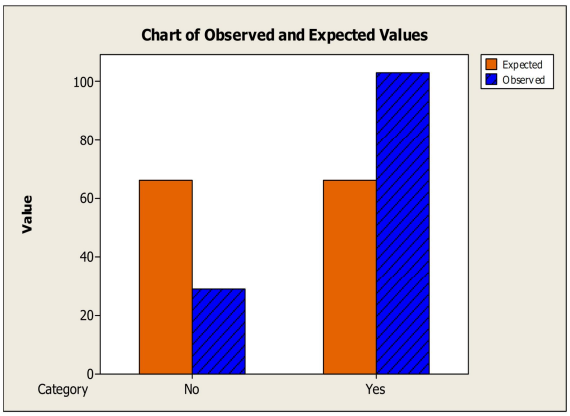


N	N*	DF	Chi-Sq	P-Value
132	0	2	56.8636	0.000

The result of the chi-square test statistic is 56.8636 and the p-value of the test is 0.000. Since this p-value is less than α=.05, we reject null hypothesis and accept the alternative hypothesis. This show the data does not fit the generic model.

Chi-Square Goodness-of-Fit Test for categorical variable : Relocation				
Category	Observed	Test Proportion	Expected	Contribution to Chi-Sq
No	29	0.5	66	20.7424
Yes	103	0.5	66	20.7424

Relocation: Candidate's relocation is mandatory for an organization. Some of the candidates does not approve for relocation, so the requisitions are left blank due to this cause. Candidates can accept or reject to relocate nearby their organization.

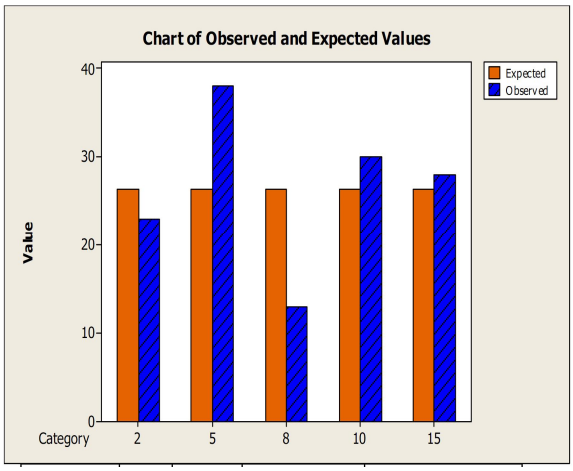


N	N*	DF	Chi-Sq	P-Value
132	0	1	41.4848	0.000

The result of the chi-square test statistic is 41.4848 and the p-value of the test is 0.000. Since this p-value is less than α=.05, we reject null hypothesis and accept the alternative hypothesis. This show the data does not fit the generic model.

Chi-Square Goodness-of-Fit Test for categorical variable : Delayed due to BGC				
Category (Days)	Observed	Test Proportion	Expected	Contribution to Chi-Sq
2	23	0.2	26.4	0.43788
5	38	0.2	26.4	5.09697
8	13	0.2	26.4	6.80152
10	30	0.2	26.4	0.49091
15	28	0.2	26.4	0.09697

Delayed due to BGC: Background Check is one the vital cause due to which the requisitions are left blank. Due to Background check, Candidates are delayed to join the organization at the specific date. Requisitions are delays of 2, 5, 8, 10, and 15 days respectively.

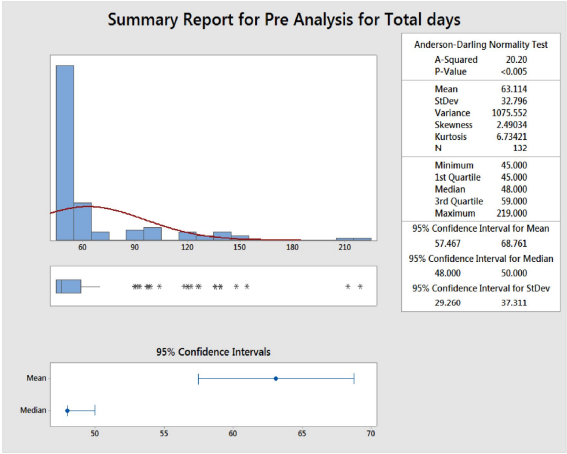


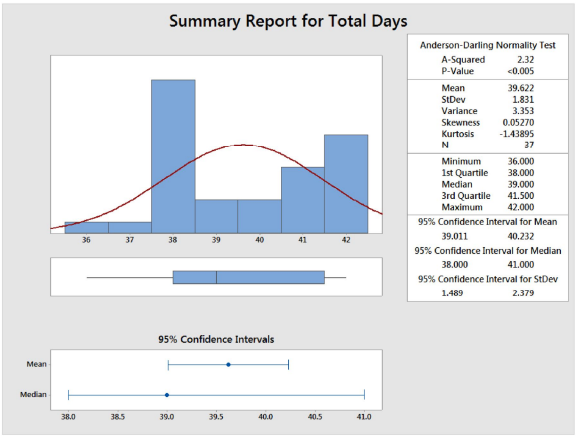
N	N*	DF	Chi-Sq	P-Value
132	0	4	12.9242	0.012

The result of the chi-square test statistic is 12.9242 and the p-value of the test is 0.012. Since this p-value is less than α=.05, we reject null hypothesis and accept the alternative hypothesis. This show the data does not fit the generic model.

In Improve phase, Quality Function Deployment Diagram and Value Stream Mapping are done. Also in improve phase the data is collected again for pre and post analysis.

For this, bar charts, histograms and graphical summary are obtained using Minitab tool.
Now, the graphical summary of pre and post improved data is given below:





The graphical summary shows that as per the new TAT data @ 95% Confidence Interval for Standard Deviations and Variance; the process has improved significantly and statistically. The last step of improve phase is the calculation of the pre and post improved data.

Pre Improve Calculation			Post Improve Calculation	
Median	**48.000**		**Median**	**38.000**
Mean	63.114		Mean	39.011
Std Dev	32.796		Std Dev	1.831
Variance	1075.552	**IMPROVED**	Variance	3.353
Total Opportunities	132	→	Total Opportunities	37
Defects	132		Defects	15
Pass %	0%		Pass %	59.45946%
Fail %	100%		Fail %	40.54054%
DPO	1		DPO	0.4054054
DPMO	1000000		DPMO	405405.4
Sigma Level	**0**		**Sigma Level**	**1.9**

In the control phase, control charts are used for monitoring the data. Also, the Cost benefit Analysis (CBA) is done to show the detail revenue gained due to the lean six sigma project.

IV. RESULTS

The results of the research show the vast improvement in sigma level from 0 to 1.9. The sample median days for closing a requisition are shifted from 48 days to 38

days. Hence, our target is achieved that is to close a requisition in 40 days.

CONCLUSION

Lean six sigma approach is successfully applicable to all organizations whether it is software development, manufacturing sector, healthcare etc. The methodology comprises of the five phases: Define, Measure, Analyze, Improve and Control. In this project, the team had worked throughout the phases to get the desired results. This projects aims to use lean six sigma framework to reduce the Turn Around Time (TAT) by providing tools for professionals to manage and control the process.

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