APPLYING SIX SIGMA TECHNIQUES TO REDUCE THE NUMBER OF DEFECTS OF SOFTWARE

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ABSTRACT

In the software industry most of the software's are not meeting the customer's expectation which leads to lots of rework and sometimes loss in the business. These rework is due to lack of proper process in the software development life cycle. In the current scenario most of the software companies adopt the six sigma process to locate the weak spots in software development process. Six Sigma helps to find effective way out for the located problems and improve the development processes in order to achieve company's business goals. The proper implementation of Six Sigma makes the customer to involve in each and every activity of the development process. As the result of the customer's active participation the software quality increases and also fulfills the needs of the customer. In this paper a project is selected in order to prove that implementation of six sigma improves the software quality by changing the existing process of the software development.

Keywords*: *CTQ, DMAIC, DMADV, DFSS, Fishbone, Six Sigma

I. INTRODUCTION

In any software development, quality of the software is very important to meet the customer satisfaction. The good quality of the software increases the company's businesses and also to retain the customers.[4] Software quality can be increased by performing a proper testing of the software. But testing cannot assure 100% defect free software. Testing is a phase where the software defects are identified which increases the software quality. There are many international standards like Total Quality Management (TQM), Compatibility Maturity Model Integration (CMMI)[2], International Standard Organization (ISO) etc. available for improving the software quality[5]. Sometimes software can not be able to meet the customer requirements because of the poor output of the process followed in the software development. Six Sigma is a method which helps in improving the process. It helps to compare performance of different processes. Based on the Business Philosophy, companies uses the Six Sigma methods to ensure that customer's requirements are understood well and its key processes improve over period of time [7].The goal of this paper is to look at the reduction of the defects of software by implementing Six Sigma DMAIC process. Process maps of the software development were created, data was collected and analyzed. Recommendations were drawn from the analyzed data and shown the amount of reduction of the defects in the project after implementing the recommendations [6].This research paper is divided into three sections. In these sections we cover brief overview of Six Sigma, its goal, need, and its

methodology. In the subsequent section we presented a case study and through Pareto Chart we show significant improvement in terms of product Quality.

II. OVERVIEW

In this section the emphasis is on the objective of using Six Sigma and its implementation on software product.

2.1 Six Sigma:

Six Sigma's goal is to eliminate the deviation of the process from its ideal one. The main idea of Six Sigma is systematically figure out how to remove the defects to get defects free product. Six Sigma is a highly disciplined method that focuses on developing and releasing the just right products and services. It was stated that the accuracy of Six Sigma is 99.99966% i.e. 3.4 Defects Per Million Opportunities (DPMO).

"Six Sigma is not an improvement program. It is instead a business philosophy that employs a step by step approach to reducing variation, increasing quality, customer satisfaction, and in time, market share*"* [7] .

2.2 Need of Six Sigma

In this section we tried to identify the most commonly asked question by Quality personal , Why do we adopt Six Sigma?

- Decreases dependency on "Age old Knowledge"
- Assessments based on facts and data instead of estimation
- Aims high-hanging fruit
- Removes chronic / recurring problems
- Makes better customer satisfaction
- Offers a correct approach to eliminate problem
- Transforms the company ethics
- Generates a competitive lead

2.3 Project Methodologies of Six Sigma:

In use of Six Sigma Project follow two methodologies, DMAIC and DMADV. Each method consists of five phases.

2.3.1 DMAIC

DMAIC (Define, Measure, Analyze, Improve, Control) process of Six Sigma. If the requirement of the customer is not fulfilled by the existing software process then DMAIC process is suitable [3].

Define: There are 3 steps in this phase

Preparation of Charter which includes identification of Business Case, Problem and Goal statements, Scope of the project, Milestones and Roles of the team members. Critical to Quality (CTQ)'s Determination includes

collecting the voice of the customer, organizing customer's data, defining the CTQ elements and validating with the customer.[1]

Process mapping defines the process definition, benefits of Process mapping and the levels of Process.

Measure: Data collection plan is developed and implemented for the project and process sigma value is calculated.

Analyze: Possible causes are identified first, and then narrowed down to identify root causes of the problem. Tools like Pareto chart, Fishbone diagram are used.

Improve: Based on the root causes identified in the analyze phase a test solution is identified. Then refine that solution and justify it.

Control: Implement the justified solution and also check the quality of the product over time.

2.3.2 DFSS/ DMADV

In Six Sigma terminology the term DFSS is defined as "Design For Six Sigma," and is just another name for DMADV [3].

Define: Preparation of Charter which includes identification of Business Case, Problem and Goal statements, Scope of the project, Milestones and Roles of the team members.

Measure: Customers are identified. Needs of the customer is defined. CTQ's are determined.

Analyze: Design concepts is developed. High-Level design is developed. High-Level design capability is evaluated.

Design: Verification plan is prepared.

Verify: Results are analyzed after executing pilot.

III. CASE STUDY

NextGen is a technology framework being developed by OMX Technology to support the development of advanced trading, clearing and transaction management systems for both large and small exchanges and clearing houses. It is constructed using a building block concept, whereby a defined set of functionality is combined into a building block.

NextGen is constructed using a building block concept, whereby a defined set of functionality is combined into a building block that may have more than one instance operating for replicas and partitioning.

One of the biggest challenge that industry faces today that the number of defects have increased due to complexity for test designing and test scripts. This has resulted re-work and an increase in turnaround time which also led to customer dissatisfaction. Six Sigma methodology is implemented in order to reduce the number of defects in test designing and test scripts.

In this case study we implemented DMAIC process because NextGen was already having its own process but it was performing to give expected output as per the customer.

We design our case study in the following phases they are namely,

1. Define
2. Measure
3. Analyze
4. Improvement
5. Control

Define: In the define phase the following areas are decided:

Problem Statement: It has been observed that since last 6 months, the number of defects have increased for Test Designing and Test Scripts by almost 15%.This has resulted in rework and an increase in Turn around Time and this has led to Customer Dissatisfaction.

Goal Statement: Reduce the number of defects in test designing and test scripts from 15% to 5% within 3 months.

Project Scope Includes: Session Manager Building Block (BB), Reference Data Manager BB, Trade Handler BB and Business Operations BB.

Project Scope Excludes: Configuration Management Issues.

Project Story Board

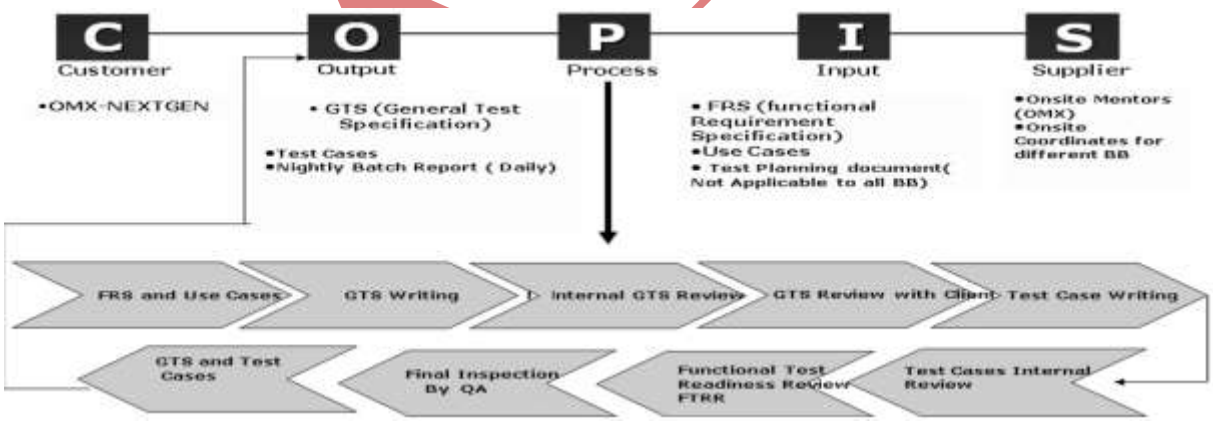

Figure 1 – Project Story Board

Measure:

During the measure phase sample data is collected from each building block for a particular period of time. The data are collected from the defect log sheet with information like defect type, defect location, complexity, Cause of the defect, re-occurrences of the defect etc in the excel sheet and its rework effort is calculated.

The following are the identified details for the data collection phase:

Defects: Number of General Test Specification (GTS) & Test Case Defects (both internal & external)

Data Collection Period: 4 months

Sample Size Taken: GTS Cases: 60

Test Cases: 20

Then sigma value is calculated for the existing process of the NextGen project and sigma value is found to be 2.58 as shown in Table 1.

Project A	Defects	Unit	Opt	Total Opt	DPU	DPO	DPMO	Current Process Capability (Signal)
Period	D	U	OP	TOP	DPU	DPO	DPMO	ZB
GTS	348	739	1	739	0.4709	0.470907	470907	1.57
Test Cases	65	2203	1	2203	0.0295	0.029505	29505	3.39
	413	2942	1	2942	0.1404	0.140381	140381	2.58

Table 1 – Process Performance

Six Sigma = 2.58

Analyze:

In the Analyze phase, the causes of the problem are identified by using the Cause-Effect graph. In this project after analyzing the measured data the high defect rate is caused by People, Material, Method, and Machinery. Each cause has its own micro level causes Which are mentioned in the Cause-Effect diagram as shown in Figure 2.

Below are the Key Findings from the data:

Lack of prior Functional Requirement Specification (FRS) discussion before writing GTS Review efforts not included in total estimation effort

- Unavailability of Business Analyst
- Effort estimation and scope of work not base lined
- Review checklist for GTS and Test cases not executed properly
- Requirements not self explanatory
- Test case code review from OMX not happening regularly

- GTS not frozen before starting Test Case implementation
- Offshore team not participating in Defect Review.

The pictorial representation of Cause-effect diagram identifies the possible causes of the problem

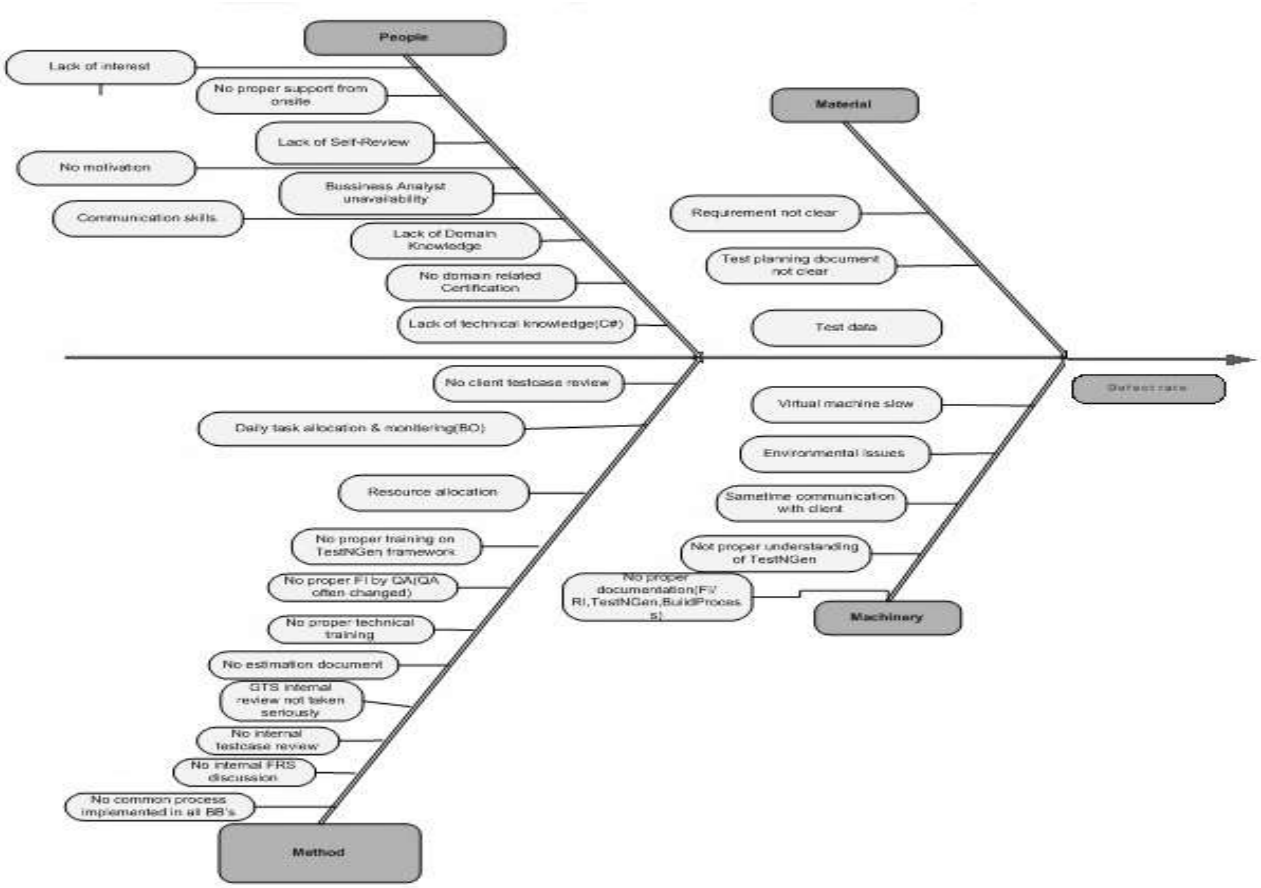

Figure 2 -Fishbone diagram

This work used fishbone Diagram that clearly depicts the cause and its effect at different aspect of Quality Factors at different levels of development as shown in Figure 2. The major categories of the causes of the problem, defect rate, are identified by asking the question Why? and they are Method, Machinery, People and Material. The sub-causes of each specific category are identified as shown in the figure 2

Method – No estimation document, No proper technical training, No internal FRS discussion and testcase review etc.

Material – Requirement not clear, test planning document not clear and no test data

People – Lack of domain knowledge and self-review, Business analyst unavailability, no proper support from on-site etc.

Machinery – No proper understanding of TestNGen framework, no proper documentation, virtual machine slow etc.

Improve:

The purpose of the Pareto chart is to highlight the most important among a (typically large) set of factors. In quality control, it often represents the most common sources of defects, the highest occurring type of defect, or the most frequent reasons for customer complaints

This research work used Pareto chart as a tool that exhibit quantitatively that 20% of the input factors controls 80% of total defect occurs.

After analysing the data the main categories of the causes are found to be Poor GTS self-review, poor GTS internal review, poor testcase self review, business analyst unavailability, lack of domain knowledge, no internal FRS discussion etc. which has the maximum frequency of occurances. To improve on the above mentioned causes following are the key recommendation:

- FRS discussion between offshore and onsite leads before starting with GTS writing.
- GTS self review and internal review checklist to be executed before delivering the same to onsite.
- Test Case self review and internal review checklist to be executed before delivering the same to onsite.
- Monthly cross trainings between BB's team members for sharing key understanding and new leanings
- Include review time in effort estimation for each task
- Business Analyst should be identified

Control

First four points of the key recommendations identified in the improve phase has been implemented and data collection would be done for a period of 1 month – to verify the results of the recommendations implemented.

In the pilot phase i.e. for a period of one month, total Test cases Delivered are 200 and Total GTS delivered are 40. Total Customer Reported Defects for testcases are 6 which give the 3% (6*100/200) of defect rate for that period. Total Customer Reported Defects for GTS are 2 which lead to 5% (2*100/40) of the GTS defect rate.

In the Improve phase data for a month is collected. Only 3 defects are reported for 138 test cases and 2 defects for 45 GTS. The defect rate for test cases and GTS are calculated to be 2.1% and 4.4% respectively.

Project A	Defects	Unit	Opt	Total Opt	DPU	DPO	DPMO	Current Process Capability (Signal) (From table)	Yield	Z value based on yield
Period	D	U	OP	TOP				ZP		
GTS	2	40	1	40	(2/40)= 0.05	(2/40)= 0.05	50000	3.1	(1-0.05)=0.9	3.1
Test Cases	6	200	1	200	(6/50)= 0.12	(6/200) =0.03	30000	3.3	(1-0.03)=0.9	3.38
	8	240	1	183	0.17	0.08	80000	3.2	(1-	3.24

Table 2 – Process Performance
Six Sigma = 3.24

IV. CONCULSION

In this study, we share our knowledge about the gradual improvement in the quality of the NextGen software after implementing Six Sigma method. We have applied DMAIC method in order to improve the existing process of the testing process of the NextGen project and it is proven that it provides a structured and systematic way of reducing the defects in the testing phase. The sigma value is also improved from 2.58 to 3.2 which are calculated in the control phase. Thus six sigma projects to a real project prove its efficiency and effectiveness.

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