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Process Improvement in Software Companies: A Live Study at Motorola

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Abstract

Purpose – The study aims to show the successful application of Six Sigma in software companies for process improvement.

Research design, data and methodology – A mixed methodology has been used which include both qualitative and quantitative research. In the qualitative research methodology part, a detailed and comprehensive literature study have been carried out. The literature study consists of articles, books, web materials, discussion forms and others. In the quantitative research methodology part, interviews have been conducted.

Results – Six sigma is the practical application of a theoretical statistical measurement that equates to 3.4 defects per million opportunities -a position of practically zero defects for any process or service. Initially originating in Motorola Inc. in 1985 as a response to drastic quality improvement pressures from the threat of Japanese competition, it quickly gained many followers particularly G.E., Allied Signal, Ford Motor Company etc. and more recently attentions have shifted to service environments. There are still some problems and misconceptions existed about the applicability of Six Sigma in software companies.

Conclusions – The paper concludes that Six Sigma can bring large benefits for software companies too. Furthermore, software companies have already started to implement Six Sigma approach, like Ericsson, Tata Consultancy Service, etc.

Keywords: DMAIC Model, Manufacturing, Performance, Quality, Six Sigma.

JEL Classifications: L60, M00, M10.

1. Introduction

Six Sigma is a structured quantitative method which is originally invented for reducing defects in manufacturing by Motorola in 1986. Its aim is using statistical analytic techniques to enhancing organization s performances, and to improving quality. Since Six Sigma has evolved over the last two decades, its definition is extended to three levels:

- Metric
- Methodology
- Management system

1.1. The acceptance and motivation of six sigma in software companies

1.1.1. Binder's View

Binder has pointed out three main difficulties. Based on the three difficulties, Binder claimed that Six Sigma is not applicable in software companies. The three difficulties are:

1.1.1.1. Processes

Software processes are fuzzy as compare to the manufacturing processes. So the application of Six Sigma is easily established and documented in manufacturing, not in software.

1.1.1.2. Characteristics

There are difficulties in meaningful measurements of software characteristics. Software cannot be measured as weight, distance, width, etc. Total number of faults cannot be measured in software.

1.1.1.3. Uniqueness

Manufacturing products are generally mass produced but software products are one-off. Binder s view is doubtable because only on the basis of three differences, he denied the applicability of Six Sigma in software. In order to identify the real situation, we need a comprehensive understanding about the differences between manufacturing and software.

1.1.2. Two Misconceptions Debunked by Tayntor

Managers cannot deny the importance of reducing defects, increasing customer satisfaction and operating more efficiently. Many software companies are now adopting Six Sigma. Claimed by Tayntor, there are two misconceptions associated with Six Sigma in software companies. The first is that, Six Sigma is a statistical analysis, so it is applicable for manufacturing and engineering processes and it has very little or no relevance to

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software. The second is that Six Sigma cannot be adopted in just a few areas of the company. It should be applied to the entire company. Both these misconceptions should be debunked.

1.2. Why Software Companies Choose Six Sigma Approach?

After the above discussion there is a question that does Six Sigma make sense in software companies. The answer is yes, Six Sigma is good for software companies especially for the following situations.

1.2.1. Legal Responsibility

Six Sigma approach helps to fulfill the legal responsibility. Now-a-days if something goes wrong people go to the lawyers according to Human Rights Act. Up to now disasters are not blamed on software s but software s can cause huge disasters. Software has many identical copies. These copies are installed in different companies. If there is some defect in the software then all the companies are at great risk of failure. Even the most powerful companies like Microsoft are fearful to such failures.

1.2.2. Mission Critical Systems

Now a day s software s are developing for mission critical systems. The failure of a mission critical results in a great loss to society. Here comes Six Sigma which means 3.4 defects per million opportunities, it can prevent the software from failing. In 1988, American Airlines lost 59 million dollars in ticket sales. The problem was the discount ticket was mistakenly blocked in the ticket reservation system. As a result travelers moved to their competitors. These weaknesses can be removed by Applying Six Sigma which provides near defect free performance.

1.2.3. Complex Systems

The application of Six Sigma is very effective in case of complex systems. For example there a complex system with like 1000 modules if all the parts are designed according to Six Sigma than there is a higher probability of getting a defect free system.

1.2.4. Software Company

Software companies have a bad reputation of buggy and late. Today software size is very large like more than thousands of lines. It has more probability of having many defects. In this situation Six Sigma can help us to get a near defect free product.

According to a survey conducted in software companies by, the following results are found. Most software companies have completed five to ten Six Sigma projects and their bottom-line saving per project is over £100k on average. In most companies the Six Sigma level varies from 2.54 to 4 Sigma. The following criteria were used by most companies in survey to find the success of Six Sigma.

- Impact on bottom-line
- Reduction of defect rate.
- Reduction in cost of poor quality.
- Improvement in a process.
- Reduction in customer complaints

2. Review of literature

Customer satisfaction is a multistage process where levels of satisfaction are multiplied as different facets of the service are exposed to the customer. These facets cover a broad range from ethical practices of the business to timely response to knowledgably staff etc. So for instance no matter how fresh and tasty a McDonald's burger is, for a customer who has moral issues with the low wages of their employees, fulfillment will never be attained. The key notion is that different customers have different patterns of expectations for the components involved and so, is it possible to have zero customer defection? Not everyone likes the same things and thinks in the same way and thus the service provider must focus on the elements that will please the majority only (Behara et al., 1994).

The findings suggest that one should try to identify as many X-type root causes as possible. However, in case of service and transactional processes one finds it difficult to do so. Much more research is necessary in the area of service process design before the path of continuous improvement of such processes can be embarked on effectively (Mandal, 2012).

Considers the application of structured process improvement for construction environments (SPICE) as a process improvement technique and its extension into the context of facilities management (FM). SPICE is a research project that developed a step-wise process improvement framework for the construction environment, utilizing experience from the software industry, and in particular the capability maturity model (CMM), which has resulted in significant productivity improvements (Amaratunga et al., 2002).

Companies today must continuously improve their processes in order to meet the ever changing needs of the consumer. In the past, most utility providers (telephone, natural gas, etc.) paid little attention to improving processes in order to improve customer service, due to their monopolistic hold on the consumer. However, due to past and current utility deregulation, many of these companies face the possibility of losing their customers to new competitors. This means these companies are being forced to leave their old ways behind and embrace new ideas (Hayes & Helms (1999).

A lot of literature and consulting approaches deal with the restructuring and improvement of business processes. The author finds that even so-called BPI approaches do not describe the act of improvement itself. And if they do, they lack a methodological structure that can be reused (Zellner, 2011).

The stepwise regression and simulation have been found to yield identical results. However, from the perspective of application, stepwise regression has been found to be a preferred

option. The roadmap thus evolved for the selection of the critical sub-processes will be of great value to the practitioner, as it will help them understand the ground reality in an unambiguous manner, resulting in a superior strategy for process improvement (Sarkar et al., 2011).

3. Research methodology

A mixed methodology has been used which include both qualitative and quantitative research. In the qualitative research methodology part, a detailed and comprehensive literature study have been carried out. The literature study consists of articles, books, web materials, discussion forms and others. In the quantitative research methodology part, interviews have been conducted.

Aims and Objectives: The main aim of the paper is to provide Steps for software companies who want to implement Six Sigma for process improvement. To achieve that, following objectives shall be reached:

- Screen out the suitable Six Sigma tools and techniques for software companies.

4. Analysis and findings

4.1. Six Sigma at Motorola

Motorola is the original inventor of Six Sigma approach. Six Sigma approach is declared by Bill Smith who is the Quality Engineer in Motorola in 1986. The original purpose is to improve the manufacturing process. Now it is applied to all business process.

The purpose is to show how Six Sigma approach is used for software quality improvement. The details of project activities are presented below.

4.1.1. DMAIC Model

DMAIC model is selected as the main improvement model. In following sections, main activities are summarized according to different phases.

4.1.1.1. Define Phase

Four activities are carried out in defined phase. The first one is to create a project charter. A project charter is very crucial for the project. A successful project charter help project to specify the right resources and boundaries. The necessary parts in this activity are to define project purpose, opportunity statement, project scope, project plan, project benefits and team selection. The project charter is used to get the commitment of all the team members and to facilitate the communication between them.

The second activity is to draw SIPOC which stands for Supplier, Input, Process, Output, and Customer. SIPCO uses a table to describe the suppliers of the resources, the inputs required by the process, the process description, the outputs from the process, and the customers. From SIPCO, we can easily identify the processes which need to be improved.

The Voice of customers is the following activity. During this activity, the needs and expectations of the customer are analyzed. Kano analysis is used for this purpose. The analysis result shows customer requirements and expectations which is also the main purpose of improvement.

The last activity in this phase is Quick Wins, in which the process under consideration is decomposed. The scope of the project is further narrowed according to a particular division. Then tackle the first division. After that, the same process is repeated for other divisions. In this way lot of time is saved.

In this phase, not only project plan, scope and purpose are identified, but also they analysis customer's indeed requirements and expectations. That can validate the results in some extent. The chosen process (which is decided to be improved) is complex sometimes. Then they need to decompose it into smaller divisions. After all above, the project team can be formed. There is a very important condition, project goals and the chosen process must be clearly understood by each team member. Once the team is organized, the project can move to the next phase.

4.1.1.2. Measure Phase

The main activities in this phase are: identify what to measure, evaluate the measurement system, data collection, sources of variation, and sigma level calculation.

In first activity, the current inputs, the process, and the outputs are documented. This activity helps to measure the problem in quantitative terms.

The second activity is to evaluate the measurement system. The measurement system is evaluated by looking at the following issues. The plan has to show works that have to be done, added or removed tasks which are handled as the project progress, and changes in project requirements.

The next activity is data collection in which the required data is collected. Once they have the data, they can display it graphically. The graphical display of data helps to find the sources of variation in the process.

The last activity of measure phase is the calculation of the sigma level. This phases main task s to measure the chosen process. Firstly they make sure what needs to be measured. Then answer the question – is the measurement system good enough? If not, then it needs to be improved first. After that, the measurement is started. The aim of measurement is to identify the sources of variations. At last, the sigma level of chosen process is calculated. This level is used for the result comparison.

4.1.1.3. Analyze phase

Once the source of variations are measured, the analyze phase is started. The main activity in this phase is to inves-

tigate the sources. This is done with Pareto Analysis's help. In Pareto Analysis, the relation of input and output variables is analyzed. That is to find out the areas that need to improve. The next activity is to find the co-relation between factors and defects, i.e. the correlation between release software size and defect injected. The last activity is to measure the quality from the customer point of view. This activity is very important for the test management, in order to plan the test time to reach the quality goals. It also helps to estimate when the goal is met. The variations and their sources are identified.

The following analyze phase focuses on discovering the relations which includes the relations between input and output, factors and defects, etc. This helps the project team to conduct the related solution.

4.1.1.4. Improve phase

In improve phase the first activity is to identify solution alternatives. For this activity either the team involved in planning is trained, or the mentors or people from project office are approached. Then each of the solution alternatives is evaluated with respect to the required criteria. They are statistically analyze, the identification for relationships between input and output variables. The effectiveness of the solutions and the cost will mainly influence the consideration. After evaluation, the most suitable solution is selected, and finally the selected solution is implemented.

Several solutions are conducted to solve the specific problem. The first work is to select the best one and its backups. The main selection criteria are solution effectiveness and cost. Because it is hard to balance them, so sometimes the best one which is chosen firstly may not fit the situation perfectly. That is why they need backup solutions.

4.1.1.5. Control phase

Control phase's aim is to gain a long-term good performance. The first activity in this phase is the assignment of responsibilities. The solution is made part of normal practices. And responsibilities are given to team members for execution, evaluation and standardize the solution. The next activity is performance reviews. The performance reviews are very important to track the project and to evaluate the project success. Metrics are chosen for the review purpose, i.e. Fault Prediction Model, Defect Removal Model. The monthly performance reviews are done, which results in evaluating the long terms gains.

Good improvement result does not mean good long-term performance. Responsibility assignment and performance review protect the improvement result from two different ways.

5. Conclusions

Six Sigma is considered for business continuity management, since it deals so actively with process analysis and improvement, and it has benefits in a business process. The main challenges of Six Sigma in software are to identify the CTQs (critical to quality) and to establish cost efficient project that can be used to identify root cause, and measure improvements. Another challenge is that the processes used have quite long life span (a development project can take 2-3 years) and the processes are furthermore not to be classified as stable and repeatable.

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