"PROCESS IMPROVEMENT IN SOFTWARE COMPANIES: A LIVE STUDY AT ERICSSON"

Ms. Neeraj Kumari*

ABSTRACT

The study aims to show the successful application of Six Sigma in software companies for process improvement. 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. Its attainment is one of the highest measures of quality and is based on the ideology that practically all errors are preventable. 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. 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 . However, there are still some problems and misconceptions existed about the applicability of Six Sigma in software companies.

* Assistant Professor (Humanities & Management), Faculty of Engineering & Technology, Manav Rachna International University, Faridabad, India

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

The acceptance and motivation of six sigma in software companies

Different Views on Applying Six Sigma in Software Companies:

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:

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.

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.

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.

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 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.

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.

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.

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.

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.

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

REVIEW OF LITERATURE

- As illustrated by Behara et al (1994, p12) 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.
- Six Sigma is undeniably more complicated to apply in some service situation than those in manufacturing. Even where a process and goal exists some may argue that the setting of the specification limits can be somewhat a subjective issue and sometimes organizations spend time and money adding a specification value where one is not appropriate (Breyfogle et al, 2001, p196). This may be overcome by implementing a measurement systems analysis (MSA), however it must be noted that due to such issues, in services primary tasks may take longer than

anticipated due to determining the appropriate measurement systems. (Breyfogle et al, 2001, p196).

- The extent of six sigma use and thus difficulty is dependent on company objectives. The methodology can be used to bring quick financial savings early on by tacking what Breyfogle coins the obvious 'low hanging fruit' problems in an organization. By contrast it can also serve as a model for organizational culture "whereby everyone at all levels has a passion for continuous improvement with the ultimate aim of achieving virtual perfection" (Basu & Wright, 2003, p3)
- Despite its scientific approach towards quality improvement, there are criticisms against Six Sigma. The most vocal one is the viewpoint that there is nothing new about Six Sigma as it imitates already existing and proven techniques. To a certain extent, this argument has some credibility. But proponents of Six Sigma believe that as long as 6 sigma achieves more predictable results with far lower effort, there is no harm in accepting and implementing it. Criticisms notwithstanding, what Six Sigma does is apply concerted efforts at utilizing existing techniques with new approaches. (Tom Smith)

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 this 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.

ANALYSIS AND FINDINGS

i)SIX SIGMA AT ERICSSON

Ericsson is a worldwide provider of telecommunications equipment and related services to both mobile and fixed network operators. In Ericsson, there is a special department which is responsible for directing Six Sigma projects. Two kinds of characters are involved in this department – Black Belts and Green Belts. Both of them are full-time work. And also in middle management, 80% of managers have took Six Sigma courses, 40% of them have got the Green Belt certification. Company's aim is to raise the percent up to 100%.

Define Phase

The main reason which leads to improvement is that the product has a high yield (9 million per month) with a low quality. The defects highly reach to 54420 PPM (parts per million). The SAP data from August to October has shown that the main cause of the low quality situation is because of part D . By identification, the source of problems is the CUTTING machine.

After the problems are identified, we develop a Project Charter which includes overall commitment, such as Champion, Black Belt, and project team. Other information shall be involved too: project purpose, problem description, customer, goal statement, project scope & plan, project benefits, team selected, schedule, etc.

Group text	Good Qty	Defects Qty (PPM)	Defects Number
A	13958447	42122	3009
B	30249063	6145	203
C	25534200	1448855	53695
D	23286000	1267213	54420

Table 1 :SAP data from August to October(2004) in Ericsson.

Measure Phase

In this phase, the causes of product defects are measured by using quality tools. In Figure, the main problem and its causes are demonstrated (Y s and X s). From that we can discover all the related factors. However, which factor has a stronger influence cannot be measured according to this figure.

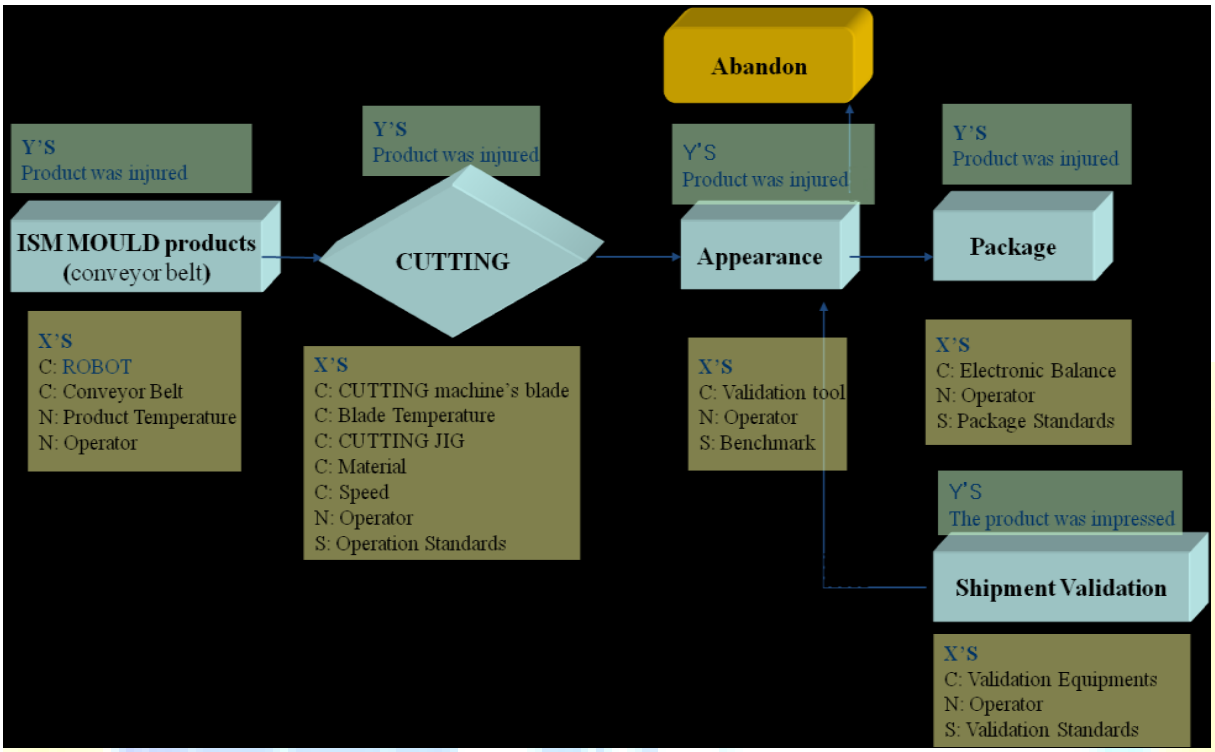

Figure 1: Process Mapping for Six Sigma project at Ericsson.

XY Matrix can help to prioritize the causes. Furthermore, it can help to figure out which factors or Xs need to be put efforts for improving. In above Figure, the top six Xs of project xxx are calculated. They are:

- Conveyor Belt's work is not accurate.
- The problem of CUTTING machine's blade.
- The orientation of CUTTING JIG is not accurate.
- The orientation of material JIG is not accurate.
- Operation standards need to be perfected.
- Benchmarks are not clear which need to be unified.

XY Matrix

Project: 72E&96CV Defects Input/output Analysis

Date: 2007.12.04

		1	2	3	4	5	6	7		
	Output Variables (Y's)	Product defect typeA	typeB	typeC	typeD	typeE	typeF	typeG		
	Output Ranking	9	7	9	6	5	5	2		
No.	Input Variables (X's)	Association Table							Rank	% Rank
1	C: ROBOT	0	0	2	2	3	7	0	80	3.99%
2	C: Conveyor Belt	3	0	5	6	2	7	0	147	7.34%
3	N: Product Temperture	0	0	0	0	3	5	0	40	2.00%
4	N: Operator	2	1	3	5	2	5	0	117	5.84%
5	C: CUTTING Machine's Blade	9	9	5	8	2	3	0	232	11.58%
6	C: Blade Temperture	3	6	2	3	2	4	0	135	6.74%
7	C: CUTTING JIG	9	3	9	7	8	6	0	280	13.98%
8	C: Materal JIG	1	1	7	8	8	6	3	203	10.13%
9	C: Speed	2	6	2	2	1	5	0	120	5.99%
10	S: Operation Standards	5	5	5	6	5	5	0	205	10.23%
11	C: Validation Tools	0	0	0	5	3	5	0	70	3.49%
12	S: Benchmark	6	8	8	7	4	6	1	271	13.53%
13	C: Electronic Balance	0	0	0	0	0	0	7	14	0.70%

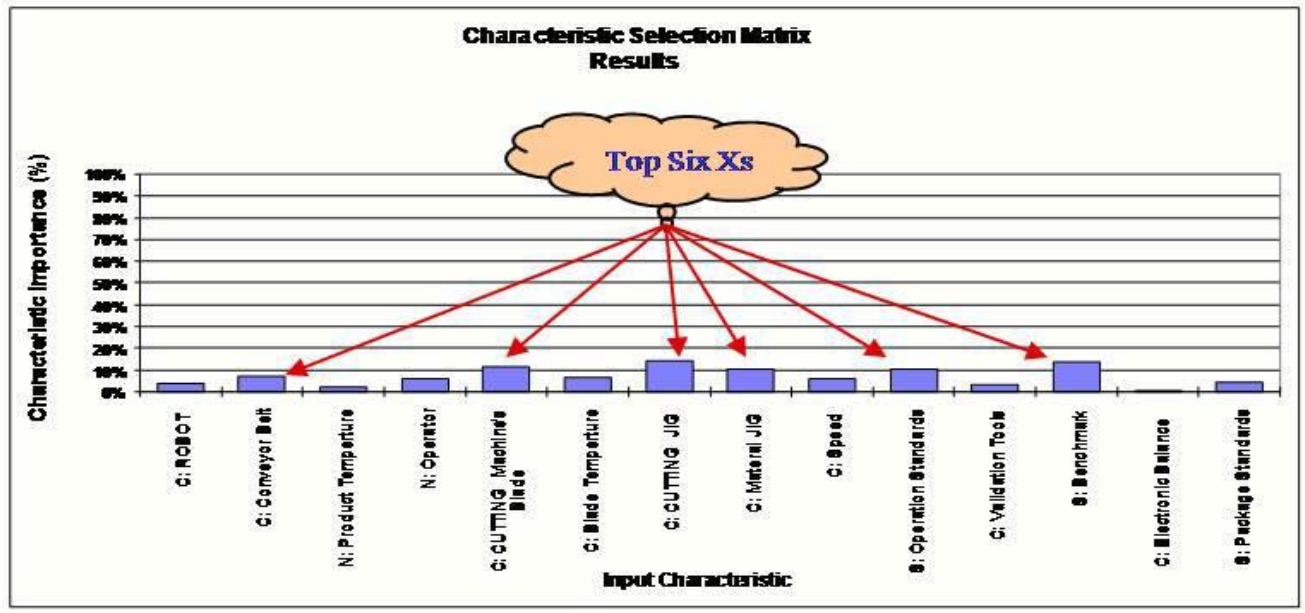

Figure 2: Using XY Matrix for defect causes analysis at Ericsson.

These factors are the main causes which lead to defects. After we figure out the main causes, the related analysis for each cause can be processed. And also the specific improving method will be generated.

Analysis Phase

In this phase, six Xs are analyzed separately by using statistic and mathematic methods. Several analysis tools are used, such as 2-Proportion, regression analysis, Two-Sample Test, Kruskal-Wallis Test, etc. By analyzing, the sources of those Xs are identified. For example, the main cause of " Conveyor Belt s work is not accurate" is because the position of conveyor belt. The higher position generates a lower defects number. "The problem of CUTTING machine s blade" is related to CUTTING machine s running time. "Benchmarks are not clear" needs the unification of benchmarks and the training for operators. The analysis phase not only requires that the Six Sigma team is familiar with the production processes, but also they need the feedbacks from the actual operators. This is a solid process, because some problems are hard to be identified. Statistic tool can be a good assistant. The whole analysis phase needs all team members to be careful and patient.

Improve phase

In the beginning of this phase, some CUTTING related experiences are designed and implemented. The aim of those experiences is to find an optimal solution. For example, we take an experiment to identify the influence of three factors – blade running cycle, blade running temperature, and JIG temperature. The result shows that the blade running cycle owns the greatest influence (see Figure below). Within the situation which is measured in experience, the optimal solution is to set running cycle equals to 5.3 days, blade temperature equals to 120°C, and JIG temperature equals to 80°C.

Experiment can help to testify the possible situations, and discover the optimal solution. It' s a very good way to examine the result before we apply. All six X s have been improved by different method. The total number of defects is 1238467 from August to October. After the improvement, it reduces to 170397. The decrease percentage highly reaches to 86.34%. This result shows the improvement activities can significant reduce the defect number.

In this phase, firstly experiences are designed and applied to verify the proposed changes. The optimal solution is selected. Then the proposed changes are implemented. In the end, the effect of changes is calculated by tools. This is very valuable for future analysis.

Control Phase

Before the Six Sigma project is terminated, a control strategy is developed which is used to avoid the same problem happen. In this project, several approaches are defined as the control strategy:

- Enhance operator s sense of quality.
- Conduct more training about standard operation.
- Improve CUTTING machine s automation ability.

After the strategy is defined, the Six Sigma project needs to be terminated. A terminate report is generated which contains the project terminate information, sigma calculation, and benefit estimation. It is directly reported to the top management.

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 indentify 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.

REFERENCES :

- Asher, J.M., (1987), "Cost of Quality in Service Industries", International Journal of Quality and Reliability Management, 5:5, pp38-46.
- Behara, R.S., Gundersen, D.E., (2001), Analysis of Quality Management Practices in Services, International Journal of Quality and Reliability Management. 18:6, pp584-603.

- Behara, R.S., Fontenot, G.F., Greysham, A., (1994), "Customer Satisfaction and analysis using six sigma", International Journal of Quality and Reliability Management, 12:3, pp9-18.
- Ghobadian, A., Speller, S., Jones, M., "Service Quality- Concepts and Models", International Journal of Quality and Reliability Management, 11:9, pp43-66.
- Hammer, M., Goding, J., (2001), "Putting Six Sigma in Perspective", Quality, 40:10, pp58.
- Kooy, M.V., Edell, L, Melchiorre-Scheckner, H., (2002), "Use of Six Sigma to improve the Saftely and Efficacy of Acute Anticoagulation with Heparin", Journal of Clinical Outcomes Management, 9:8, pp445-453.
- Lagrasen, S., Lagrosen, Y., (2003) "Management of service quality- differences in values, practices and outcomes", Managing Service Quality, 13:5, pp370-381.
- Linderman, K., Schroeder, R. G., Zaheer, S., Choo, A.S., (2001), "Six Sigma: A Goal Theoretic Perspective", Journal of Operations Management, 21:2, pp193-203.
- Powell, T.C. (1995), "Total Quality Management as competitive advantage: a review and empirical study", Strategic Management Journal, 16:1, pp15-37.
- Reichheld, F., Sasser, W., (1990), "Zero Defections: Quality comes to services". Harvard Business Review, Sept-Oct, pp105-11.