Minimization of Defects in Manufacturing Industry by Using Six Sigma Tool – A Review

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***Abstract*- Now a days manufacturing service providing corporations are remarkably interested in improving their processes and products quality by decreasing the variation. As competitive environment leaves no room for errors and defects. Variation is the biggest enemy of quality which is defined by the customers. For the good customer satisfaction we must deliver the services at the ideal targets demanded by the customers. In this article, we will study various literatures related to quality improvement in manufacturing service industries by using six sigma. The aim of this project is to reduce the number of defects of a service provided by Dulocos moulds and conveyors Pvt. Ltd and to increase the quality of product by using six sigma. In present study, we perform identification of the problem and study of literatures. following this stage accumulating the primary and secondary informations by company and finding defect opportunities. Further the data will be analyzed to measure the initial six sigma level. By implementing solutions to reduce the defect opportunities final sigma level will be measured with DMAIC process.**

***Index Terms*- Six Sigma, DMAIC.**

1. INTRODUCTION

Six Sigma is usually related to the magic number of 3.4 defects per million opportunities. People often view Six Sigma as yet another rigorous statistical quality control mechanism. Pioneered at Motorola in the mid-1980s, Six Sigma was initially targeted to quantify the defects occurred during manufacturing processes, and to reduce those defects to a very small level. Motorola claimed to have saved several million dollars. Another very popular success was at GE. Six Sigma contributed over US $ 300 million to GE's 1997 operating income.

Today Six Sigma is delivering business excellence, higher customer satisfaction, and superior profits by dramatically improving every process in an enterprise, whether financial, operational or production. Six Sigma has become a darling of a wide spectrum of industries, from health care to insurance to telecommunications to software.

Six Sigma is a technique and tool for process improvement. It was first implemented by engineer Bill Smith while working at Motorola in 1986. Today, it is used by many industrial sectors. Six Sigma seeks to improve the quality of product or process by identifying and removing the causes of defect and minimizing variability in manufacturing and business process.

It uses a set of quality management, mainly statistical methods, and creates a special infrastructure of team within the organization, who are experts in these methods. Every Six Sigma project carried out within an organization follows a defined steps and has specific value targets. i.e. reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits.

The term Six Sigma (it was written in this way when registered as trademark on December 28, 1993 by Motorola) derived from terminology associated with statistical modeling of manufacturing processes. The quality of a manufacturing process can be described by a sigma rating which indicates the percentage of defect-free products. A six sigma process is one in which 99.99966% of all opportunities to produce some feature are statistically expected to be free of error (3.4 defects per million opportunities). Motorola set a target of "six sigma" for all of its manufacturing operations, and this target became a by-word for the management practices used to achieve it.

2. OBJECTIVES

- Study the existing service process of Industry.
- Identifying the source of defects while providing the services.
- Reducing the defects by applying six sigma tool.
- Implementing six sigma technique in service industry
- To improve the productivity
- To prove the quality of the product

3. LITERATURE REVIEW

APPLICATION OF SIX SIGMA METHOD TO EMS DESIGN- By Miroslav RUSKO, Ružena KRÁLIKOVÁ[1] In this research article author has given a brief introduction to six sigma techniques with common implementation techniques. The paper study focus on the understanding and implementation process of the six sigma tool by reducing error factors. The fundamental idea of Six Sigma is that if performance is improved, quality, capacity, cycle time, inventory levels, and other key factors as reduction waste, energy sources and environment will also improve. Thus, when these factors are improved, both the provider and the customer experience greater satisfaction in performing business transactions. Lack of technical capacity to effectively utilization of Six Sigma tools can potentially decrease the effectiveness of the strategy, and/or result in unexpected waste if incorrectly applied.

A Case Study of Defects Reduction in a Rubber Gloves Manufacturing Process by Applying Six Sigma Principles and DMAIC Problem Solving Methodology – By Ploytip Jirasukprasert [2] This paper demonstrates the empirical application of Six Sigma and DMAIC to reduce product defects within a rubber gloves manufacturing organisation. The paper follows the DMAIC methodology to investigate defects, root causes and provide a solution to reduce/eliminate these defects. The analysis from employing Six Sigma and DMAIC indicated that the oven's temperature and conveyor's speed influenced the amount of defective gloves produced. In particular, the design of experiments (DOE) and two-way analysis of variance (ANOVA) techniques were combined to statistically determine the correlation of the oven's temperature and conveyor's speed with defects as well as to define their optimum values needed to reduce/eliminate the defects. As a result, a reduction of about 50% in the "leaking" gloves defect was achieved, which helped the organisation studied to reduce its defects per million opportunities (DPMO) from 195,095 to 83,750 and thus improve its Sigma level from 2.4 to 2.9. it concludes that the Six Sigma's problem solving methodology DMAIC has been one of several techniques used to improve quality.

Implementation of Six Sigma in a Manufacturing Process: A Case Study– By Adan Valles and Jaime Sanchez [3] This paper presents a Six Sigma project conducted at a semiconductor company dedicated to the manufacture of circuit cartridges for inkjet printers. They are tested electrically in the final stage of the process measuring electrical characteristics to accept or reject them. Electrical failures accounted for about 50% of all defects. Therefore, it is crucial to establish the main problems, causes and actions to reduce the level of defects. With the implementation of Six Sigma, it was possible to determine the key factors, identify the optimum levels or tolerances and improvement opportunities. The major factors that were found through a design of experiments 3 factors and 2 levels were: abrasive pressure (90-95 psi), height of the tool (0.06-0.05) and cycle time (7000-8000 msec.). The improvement was a reduction in the electrical failures of around 50%. The results showed that with proper application of this methodology, and support for the team and staff of the organization, a positive impact on the quality and other features critical to customer satisfaction can be achieved.

Productivity Improvement by using Six-Sigma– By Md. Enamul Kabir, S. M. Mahbubul Islam Boby [4] This research work has been carried out in a fan manufacturing company to show how to improve its productivity and quality by using Six-sigma. This paper related to work is not only applied to fan manufacturing company but also in any other types of organizations. By implementing Six-sigma a perfect synchronization among cost, quality, production time and control time will be observed. The objectives of this paper are to study and evaluate processes of the case organization, to find out current sigma level and finally to improve existing sigma level through productivity improvement. According to the objectives, current sigma level has been calculated and given suggestions for improvement.

This has been done by using six-sigma DMAIC cycle. Especially in improve phase of DMAIC cycle, different improvement tools are used like 5s, supermarket and line balancing etc. By using these it has been possible to improve productivity by reducing defect rate.

Applying six sigma to manufacturing processes in the food industry to reduce quality cost– By Hsiang-Chin Hung and Ming-Hsien Sung [5] This paper explores how a food company in Taiwan can use a systematic and disciplined approach to move towards the goal of Six Sigma quality level. The DMAIC phases are utilized to decrease the defect rate of small custard buns by 70% from the baseline to its entitlement. At the beginning of this project, the defect rate was 0.45% (Baseline), and after the improvement actions were implemented during a six-month period this fell to below 0.141% (goal). Despite these hurdles, by a systematic application of the Six Sigma system, significant improvements were made, First, a well-organized Six Sigma infrastructure is necessary for an organization to carry out the related improvement projects. Secondly, integrated BB training according to DMAIC stages was prepared and carried out. Thirdly, a project driven management system was also critical for the success of implementing Six Sigma program.

4. PROBLEM FORMULATION

Dulocos Industry is the leading centre of design and manufacturing solutions in the area of Special purpose machining. Special Purpose Machines Equipped with the latest equipment in the market of central India. CNC Vertical Machining Center, CNC EDM Wire Cut, EDM Die Sinking machines are some aids. By conducting the industrial visit in Dulocos industry, M.I.D.C, Nagpur. Consulting with the Manager of the industry it has been observed that the industry wants to reduce the number of defects occurring in turning operations by using six sigma. The company provides Turning services for mass production projects as Dulocos conveyors and Moulds Pvt. Ltd. is a service provider to the many of leafing industries in Nagpur region such as Mahindra and Mahindra etc.

5. RESEARCH METHODOLOGY

5.1 DMAIC Technique

5.2.1 Define

The purpose of this step is to clearly articulate the business problem, goal, potential resources, project scope and high-level project timeline. This information is typically captured within project charter document. Write down what you currently know. Seek to clarify facts, set objectives and form the project team. Define the following:

- A problem
- Voice of the customer (VOC) and Critical to Quality (CTQs) — what are the critical process outputs?

5.1.2 Measure

The purpose of this step is to objectively establish current baselines as the basis for improvement. This is a data collection step, the purpose of which is to establish process performance baselines. The performance metric baseline(s) from the Measure phase will be compared to the performance metric at the conclusion of the project to determine objectively whether significant improvement has been made. The team decides on what should be measured and how to measure it. It is usual for teams to invest a lot of effort into assessing the suitability of the proposed measurement systems. Good data is at the heart of the DMAIC process.

5.1.3 Analyze

The purpose of this step is to identify, validate and select root cause for elimination. A large number of potential root causes (process inputs, X) of the project problem are identified via root cause analysis (for example a fishbone diagram). The top 3-4 potential root causes are selected using multi-voting or other consensus tool for further validation. A data collection plan is created and data are collected to establish the relative contribution of each root causes to the project metric, Y. This process is repeated until "valid" root causes can be identified. Within Six Sigma, often complex analysis tools are used. However, it is acceptable to use basic tools if these are appropriate. Of the "validated" root causes, all or some can be

- List and prioritize potential causes of the problem

- Prioritize the root causes (key process inputs) to pursue in the Improve step
- Identify how the process inputs (Xs) affect the process outputs (Ys). Data are analyzed to understand the magnitude of contribution of each root cause, X, to the project metric, Y. Statistical tests using p-values accompanied by Histograms, Pareto charts, and line plots are often used to do this.
- Detailed process maps can be created to help pin-point where in the process the root causes reside, and what might be contributing to the occurrence.

5.1.4 Improve

The purpose of this step is to identify, test and implement a solution to the problem; in part or in whole. This depends on the situation. Identify creative solutions to eliminate the key root causes in order to fix and prevent process problems. Use brainstorming or techniques like Six Thinking Hats and Random Word. Some projects can utilize complex analysis tools like DOE (Design of Experiments), but try to focus on obvious solutions if these are apparent. However, the purpose of this step can also be to find solutions without implementing them.

- Create
- Focus on the simplest and easiest solutions
- Test solutions using Plan-Do-Check-Act (PDCA) cycle
- Based on PDCA results, attempt to anticipate any avoidable risks associated with the "improvement" using the Failure mode and effects analysis (FMEA)
- Create a detailed implementation plan
- Deploy improvements

5.1.5 Control

The purpose of this step is to sustain the gains. Monitor the improvements to ensure continued and sustainable success. Create a control plan. Update documents, business process and training records as required.

A Control chart can be useful during the Control stage to assess the stability of the improvements over time by serving as 1. a guide to continue monitoring the process and 2. provide a response plan for each of the measures being monitored in case the process becomes unstable.

In present study, we have studied various literatures on implementation of six sigma technique in manufacturing industries. first identification of process of services, input factors involved in process and defect opportunities will be performed. then initial sigma level will be calculated. based on experience and discussion modification will be performed to improve the sigma level.Various steps involved in implementation of six sigma in manufacturing industries are:

1. Identifying all the process related with the service.
2. Identifying all the defects opportunities related to the process.
3. Identifying of actual defects in service quality.
4. Measurement of initial six sigma level.
5. Reduction of the defects opportunities.
6. Measurement of defects.
7. Measurement of final six sigma.
8. Improvement and control.

4.1 Identifying all the process related with the service.

- Tapered turning
- Facing
- Parting
- Grooving

4.2 Identifying all the defects opportunities related to the process.

- Programming error
- Burning of material
- Poor surface finish
- Tip formation in parting operation
- Alignment of tool and work piece

6. CONCLUSION

This article involves the brief study of the Literatures on six sigma implementation in manufacturing industries. from the study it is conclude that In order to reduce process variation and the associated high defect rate, Six Sigma focuses on improvement methodology application, then the DMAIC is mentioned most frequently now and a lasting improvement method.

REFERENCES

[1] Application of six sigma method to ems design By Miroslav RUSKO1, Ružena Králiková research papers faculty of Materials Science and Technology in Trnava Slovak University of Technology in Bratislava 2011 number 30

[2] A Case Study of Defects Reduction in a Rubber Gloves Manufacturing Process by Applying Six Sigma Principles and DMAIC Problem Solving Methodology – By Ploytip Jirasukprasert Proceedings of the 2012 International Conference on Industrial Engineering and Operations Management Istanbul, Turkey, July 3 – 6, 2012

[3] Implementation of Six Sigma in a Manufacturing Process: A Case Study– By Adan Valles and Jaime Sanchez International Journal of Industrial Engineering, 16(3), 171-181, 2009.

[4] Productivity Improvement by using Six-Sigma– By Md. Enamul Kabir, S. M. Mahbubul Islam Boby International Journal of Engineering and Technology Volume 3 No. 12, December, 2013

[5] Applying six sigma to manufacturing processes in the food industry to reduce quality cost Scientific Research and Essays Vol. 6(3), pp. 580-591, 4 February, 2011

[6] A Review: Six Sigma Implementation Practice in Manufacturing Industries– By Riddhish Thakore, Rajat Dave and Tejas Parsana Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 11(Version - 4), November 2014, pp.63-69

[7] The role of experience in six sigma project success: An empirical analysis of improvement projects– By George S. Easton and Eve D. Rosenzweig Journal of Operations Management 30 (2012) 481–493