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Improvement in production rate by reducing the defects of injection moulding by DMAIC approach

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ABSTRACT

Six Sigma is a well-structured methodology that concentrates on decreasing variation, measuring defects and beneficent the quality of products, processes, and services. Six Sigma methodologies were primarily progressing by Motorola in the 1980s and it targeted a difficult aim of 3.4 parts per million defects. Six Sigma has been on an unbelievable run over 25 years, manufacture important savings to the under the most line of many large and small organizations. This work presents the step-by-step application of the Six Sigma (acquaint, Measure, Analysis, progress, and monitoring) approach to eliminate the defects in injection moulding process this has helped to decrease defects in the process and thereby progress productivity.

Keywords: Defects, Productivity, Quality, DMAIC approach, Cause and Effect analysis.

1. INTRODUCTION

The DMAIC is both a philosophy and a methodology that improves quality by analyzing data to find the root cause of quality problems and to implement controls. Although DMAIC implemented to improve manufacturing and business, processes such as product design and supply chain management. It is a business improvement strategy used to improve profitability to drive out waste in the business process and to improve the efficiency of all operation that meets customer's needs and expectation. DMAIC is a customer-focused program where cross-functional teams work on a project aimed at improving customer satisfaction. It is a scientific method to improve any aspect of a business, organization process.

DMAIC is a methodology to

- Identify improvement opportunities.
- Define and solve problems
- Establish measures to sustain the improvement.

Six- Sigma is a statistical measurement of only 3.4 defects per million. Six-Sigma is a management philosophy focused on eliminating mistakes, waste and rework. It establishes a measurable status to achieve and embodies a strategic problem-solving method to increase customer. Satisfaction and dramatically reduce cost and increase profits. Six-Sigma gives discipline, structure, and a foundation for solid decision making based on simple statistics. The real power of Six Sigma is simple because it combines people power with process power. The Six Sigma is a financial improvement strategy for an organization and now a day it is being used in many industries. Basically, it is a quality improving process of the final product by reducing the defects; minimize the variation and improve capability in the manufacturing process. The objective of Six Sigma is to increase the profit margin, improve financial condition by minimizing the defects rate of the product. It increases the customer satisfaction, retention and produces the best class product from the best process performance.

If an organization is focused on customer satisfaction, then Six Sigma will offer a method and some tools for the identification and improvement of both internal and external process problems to better meet customer needs by identifying the variations in organization's processes that might influence the customer's point of view, negatively.

Six Sigma is the powerful force by which leading corporations such as GE, Motorola and Ford are delivering staggering results to their bottom line and customer satisfaction through fundamental changes in the way they operate and an overall improvement in the products and services they deliver. These leading companies believe so much in Six Sigma that they are willing to invest 100's of millions of dollars in Six Sigma with the expectation to receive billions of dollars in return.

Six Sigma places the emphasis on financial results that can be achieved through the virtual elimination of product and process defects. Gone are the days of quality at any cost. Today's quality improvement programs must deliver measurable results, short and long-term, to operational effectiveness and the bottom line. The logical end of this approach is that as product and process defects are driven out, value for the customer goes up, customer satisfaction increases, the company captures the market with higher quality at lower price, and profits and company stakeholder value is maximized.

2. INJECTION MOULDING

Injection moulding is the most commonly used manufacturing process for the fabrication of plastic parts. A wide variety of products are manufactured using injection moulding, which varies greatly in their size, complexity, and application. The injection moulding process requires the use of an injection moulding machine, raw plastic material, and a mould. The plastic is melted in the injection moulding machine and then injected into the mould, where it cools and solidifies into the final part.

3. INJECTION MOLDING DEFECTS

Making injection moulded prototypes is both an art and a science. High levels of technical expertise and attention to detail are required to prevent small mistakes from costing companies big money when it comes to mass-production of novel parts.

Preventing such a circumstance is all about highly competent design. This article discusses some of the moulding defects that can occur in a part during injection moulding, and ways to fix and avoid them. Design shortcomings we will discuss include:

- Flow Lines
- Sink Marks
- Vacuum Voids
- Surface Delamination
- Weld Lines
- Short Shots
- Warping
- Burn Marks
- Jetting
- Flash

4. LITERATURE REVIEW

Mohit Chhikara (2017) presented the literature-assessment of the works already carried out inside the discipline of Six Sigma Implementation by using the various authors till now. The findings of this paper might be the premise of my similar research in this field with the aid of developing suitable research technique needed to achieve the targets set via me for my research work. [1]

Rajat Ajmera and Valase K.G. (2017) explore using DMAIC methodology of six sigma to decrease the defect in a specific textile industry. That is a scientific technique in the direction of defects minimization thru 5 stages of DMAIC technique named define, measure, analyze, improve and control. Special six sigma equipment were utilized in different levels. The pareto analysis was done to identify the predominant kinds of defects. Root causes of those defects were detected via cause and effect analysis. In the end, a few ability answers are counseled to conquer those causes. The result determined after implementation of the solutions is very large. Enhancements within the satisfactory of strategies result in cost reductions in addition to service upgrades. The defect percent has been reduced from 7.4 to 5.08 % and therefore the Sigma stage has been progressed from 2.9 to a 3.2. [2]

Jitendra A Panchiwala (2015) carried out the research work made by using several researchers and a try to get a technical solution for minimizing numerous casting defects and to enhance the entire process of casting production. [3]

C. Manohar and A. Bala Krishna (2015) discusses the quality and productivity development in a manufacturing industry through defect analysis and offers with an application of Six Sigma DMAIC (define-degree-analyse-improve-manipulate) method in wheel production plant which offers a framework to become aware of, quantify and remove assets of variant in an operational system in question, to optimize the operation variables, enhance and maintain performance viz. process yield with well completed control plans to reduce defects occurring in cast wheel manufacturing. [4]

Ghazi Abu Taher & Md. Jahangir Alam (2014) reveals out the effective manner of enhancing the great and productivity of a manufacturing line in production enterprise. The goal is to perceive the disorder of the company and create a higher answer to enhance the manufacturing line performance. Various commercial engineering technique and gear is implementing on this examine so as to research and solve the trouble that happens inside the production. But, 7 excellent manipulate equipment are the primary tools in an effort to be carried out to this observe. Records for the chosen assembly line manufacturing facility are amassed, studied and analysed. The illness with the very best frequency will be the primary goal to be stepped forward. Various reasons of the defect can be analysed and various solving technique might be present. The high-quality fixing approach can be chosen and recommend to the agency and examine to the preceding result or production. But, the implementation of the solving techniques is depending at the employer whether or not they wanted to apply or not. [5]

Darshan D. Patel (2014) presented a Six Sigma project, undertaken within the company for production in bearings, which deals with identification and reduction of production cost & process. [6]

S. Chandra (2014) determined that continuous improvement is one of the prime factors for effective implementation of Total Quality Management in an organization. Continuous improvement encompasses the involvement of human beings and systematic technique for tackling the problems related to the great of product /offerings and the processes. There are numerous methods and strategies to be had for systematic analysis of the troubles and additionally result in an answer of the equal. This paper offers with the problem of low yield / higher stage of rejection in Glass Neck (used as part of picture Tube in tv enterprise) forming method and development of the yield of output through the systematic involvement of humans as a group and adopting Six- Sigma methodology. [7]

Pramod A. Deshmukh & A. B. Humbe (2014) decreased tool changing time at grinding wheel station. This problem became rectified to an excellent extent the usage of Metrics, why? Why? Analysis and root cause analysis strategies. This work is expected to growth wide variety of Six Sigma users after the impact of this end result at the performance of the firm. The work is carried out at Tulja Engineering Aurangabad, a Medium scale manufacturing unit. [8]

S. Arun Vijay (2014) has the goal of his research to reduce the cycle time of the sufferer's discharge manner the usage of Six Sigma DMAIC version in a multidisciplinary hospital in India. He has carried out look at via the five phases of the Six Sigma DMAIC version the usage of distinct first-class tools and strategies. This takes a look at cautioned various development techniques to lessen the cycle time of patients discharge procedure and after its implementation; there is a 61% reduction in the cycle time of the patient's discharge system. Additionally, a control plan check sheet has been evolved to maintain the enhancements acquired. This has a look at could be a watch opener for the fitness Care Managers to lessen and optimize the cycle time of sufferers discharge system in Hospitals using Six Sigma DMAIC model. This study proved the application of Six Sigma DMAIC strategies to implement and optimize the patient's discharge technique with precise attention on a medical and surgical department. Even though the common discharge time reduced from 234 mins to 143 mins demonstrating 61 % decreases. [9]

Mohit Taneja, Arpan Manchanda (2013) has used six sigma approaches to improve productivity in the manufacturing industry. In his paper, he begins with an overview of Six Sigma, accompanied with the aid of thorough literature review on Six Sigma DMAIC phases, application of Six Sigma in small-medium scale industries and additionally in massive production industries. He has also performed literature survey on various Six Sigma quality tools used in the industries. These include Process capability analysis, Fishbone Diagram, two-pattern t-test. [10]

Hemendra Nath Roy (2013) has executed to introduce Six-Sigma philosophy in Bangladesh, specifically in manufacturing enterprise. To expose the technical pathway of enforcing this method in our industries for improving the productivity and first-rate changed into the primary concern of this paper. Present Sigma level is calculated as part of the framework and total factors, that are directly associated with the technique, are taken beneath calculation. At the same time, all the procedure associated with manufacturing are without a doubt examine. As an entire, the entire enhancements of manufacturing system by using enforcing the Six-Sigma tools were our studies goal. A Fan manufacturing company changed into our research vicinity where it has possible to analyzed and implemented. Within the thorough manner, DMAIC is used as a technical gear for developing the procedure. Finally, by using changing the conventional format to balanced format model as in keeping with DMAIC approach, amazing improvements were executed. [11]

Faisal Talib (2013) studied the idea of TQM as applicable to the service system. It also explores the literature on TQM in service agencies as well as reasons for its failure. Ultimately, the study presents systematic tips for powerful implementation of TQM within the service agencies. The findings of examine offer a higher understanding of TQM, its practices and gift the motives for an increase of service corporations. Outcomes additionally highlight some fundamental consequences from the contemporary studies on TQM in service groups. Subsequently, the have a look at proposes a 10 step approach for powerful implementation of TQM in the service companies. This has a look at affords a framework for higher know-how the basics of TQM in carrier agencies and seeks an in-depth knowledge of TQM principle to the provider managers and practitioners. Some managerial implications and scope for future examine are provided on the giving up. [12]

5. PROBLEM STATEMENT

For our study purpose, we select ENN KAY ENGINEERING Pvt Ltd, Govindpura, and Bhopal.

The present company is facing a rejection in injection moulding parts due to some defect. We will observe data of the company of most frequently rejected parts and they will be identified were outer rings, Flingers, Adaptor and Terminal box.

The work on Quality Improvement of injection moulding was carried in the following step:

- Identification of defect and analysis.
- Selection of most defects which frequently occurred and carried out the analysis.
- Identification of root causes and finding the remedial measures.
- Production trials in the company with the remedial measures and validation.

6. CONCLUSION

Six Sigma DMAIC methodologies have been used in the production industries like automotive element production, metal processing, gloves manufacturing, record manufacturing, laser mouse production, semiconductor production, grinding operations, rolling generators. In one of the papers, the Six Sigma is used for safety level development. Six Sigma DMAIC methodologies additionally have been used in the carrier industries like health center and academic institute. The Six Sigma DMAIC technique additionally discovered its application in shipping commitment fulfillment project. There's also thorough literature review completed by means of many authors on the Six Sigma DMAIC methodology.

From the observed of all of the studies paper of six sigma conclude that six sigma is a breakthrough improvement method with the usage of six sigma it is affirm that we get a min. 50% improvement, if we work tough and top control involvement is right. It is able to additionally be concluded that DMAIC method is by and large utilized by the industries for their overall performance development. This study will help small-scale industry to initiate Six Sigma initiatives of their businesses and improve their overall performance in phrases of client satisfaction in addition to monetary advantages with an increase in competitiveness in the global market of manufacturing.

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