Harikrishnadas Raut et al. 2019, 7:6
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology

An Open Access Journal

Survey on Implementation of Quality Control Tools in Gear Manufacturing

M.Tech. Scholar Harikrishnadas Raut
Department of Mechanical Engineering,
SDITS, Khandwa

Asst. Professor Yogesh Ladhe
Department of Mechanical Engineering,
SDITS, Khandwa

Abstract
The aim of study is to find out the effective way of improving the quality and productivity of a production line in manufacturing industry. The objective is to identify the defect of the company and create a better solution to improve the production line performance. Various industrial engineering technique and tools is implementing in this study in order to investigate and solve the problem that occurs in the production. However, seven quality control tools are the main tools that will be applied to this study. Also this work highlights the concept of seven quality tools and its application in manufacturing industry.

Keywords: Product Quality Control, Statistical Quality Control, Six Sigma, Total Quality Management.

I. INTRODUCTION

The art of meeting customer specifications, which today is termed as "quality". Quality is the symbol of human civilization, and with the progress of human civilization, quality control will play an incomparable role in the business. It can be said that if there is no quality control, there is no economic benefit. In the current world of continually increasing global competition it is imperative for all manufacturing and service organizations to improve the quality of their products [1].

In today highly competitive scenario the markets are becoming global and economic conditions are changing fast. Customers are more quality conscious and demand for high quality product at competitive prices with product variety and reduced lead time. It is a data-driven quality strategy used to improve processes.

It is an integral part of a Six Sigma initiative, but in general can be implemented as a standalone quality improvement procedure or as part of other process improvement initiatives such as lean [2].Any enterprises that cannot manage the quality of its methods and products have a tendency to fall apart. Quality is crucial to sales, price control, productivity, risk control and compliance. As essential as quality is, there's little agreement as to its definition. The following definitions observe

Excellent from a control, high-quality guarantee, product, advertising and marketing, production and economic point of view [3].

II. QUALITY CONTROL

Because of the negative consequences of poor quality, organizations try to prevent and correct such problems through various approaches to quality control. Broadly speaking, quality control refers to an organization's efforts to prevent or correct defects in its goods or services or to improve them in some way.

Some organizations use the term quality control to refer only to error detection, whereas quality assurance refers to both the prevention and the detection of quality problems. Organizations must have a department or employee devoted to identifying defects and promoting high quality. In these cases, the supervisor can benefit from the expertise of quality-control personnel [4].

1. Product Quality Control

An organization that focuses on ways to improve the product itself is using product quality control. Computer technology can greatly improve product quality control [1].

2. Process Control

An organization might also consider how to do things in a way that leads to better quality. This focus is called process control. The spur gear

© 2019 Harikrishnadas Raut et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited.

manufacturing company might conduct periodic checks to make sure its employees understand good techniques for setting up the machines. A broad approach to process control involves creating an organizational climate that encourages quality [2-3].

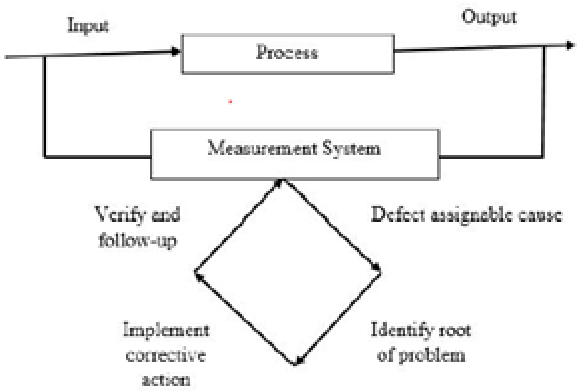

Figure 1: Process improvement using the control chart.

Process control techniques can be very effective. At Accurate Gauge and Manufacturing, process control is an important part of the company's efforts to plan for quality and correct the causes of defects in the precision parts it manufactures for heavy equipment and commercial and automotive vehicles.

Quality teams meet weekly to prevent problems, but some process improvements are responses to problems. Even when a failure occurred in a product line the company was preparing to phase out, engineering manager led efforts to correct the process by setting up procedures for operators to check the parts were being produced. In addition to impressing the customer with this extreme commitment to quality, the effort established a process that became the standard procedure for making other defect-free parts [5].

III. LITERATURE REVIEW

Jitendra A Panchiwala et al (2015) reviewed the research work made by several researchers and an attempt to get technical solution for minimizing various casting defects and to improve the entire process of casting manufacturing.

Vivek V. Yadav and Shailesh J. Shaha (2016)presented research work carried out in foundry to minimize casting rejection due to major defect. A problem is facing with the single cylinder head. Study focuses on analysis of Blow hole defect which contributes more in total rejection percentage. Quality analysis is carried out which includes the Root cause analysis to find out actual reasons behind occurring the blow holes. Quality control tools such as Pareto analysis, Cause and Effect (Ishikawa) diagram, and why-why analysis are used for analysis. Accordingly corrective actions and preventive measures are suggested and implemented. Central gas vent cleaning practice is added as a check point in process control check sheet and Pasting of wet green sand on central gas vent during mould box assembly is added as process compliance. Evaluation of effectiveness after implementation of these changes hows significant reduction in rejection due to blow hole as well as in total rejection. Rejection due to blow hole is minimizes from 7.74% to 1.81%. It turns into considerable reduction in total revenue loss as well as productivity improvement by 8.60%.

Suraj Dhondiram Patil et al (2016)study carried out for a green sand casting manufacturing industry. Here Six Sigma methodology is used for the part: Transmission Case. DMAIC (Define–Measure–Analyses–Improve–Control) methodology along with Taguchi method is used to minimize the defects in the Transmission Case. The major tools used in this work are the project charter, process map and cause-and-effect diagram. Use of design of experiments (DOE) and analysis of variance (ANOVA) techniques are combined to determine statistically the correlation of defects with the mould hardness, green strength, and pouring rate also to find their optimum values needed to reduce/eliminate the defects. The experimental results were statistically analyzed and modeled through Taguchi analysis. Based on the findings, the optimized process parameters are taken for experiment and better performance obtained in the production process was confirmed. The comparison between the existing and the proposed process has been attempted in this paper and the results have been discussed in detail.

Harvir Singh and Aman Kumar (2016) investigated the casting defects like pinholes, scabs, sand holes, slag, mould shifting, parting line defects, runner & riser defects which mainly occurs in valve casting in foundry. The research on controlling the casting defects in foundry shop which comes in various check valves -PN 10 and these causes may results the reduction of quality of casting. Here we have studied minimize the casting defects using Taguchi's method through change in various parameters like as pouring temperature, green strength, mould hardness and permeability. These experiments were conducted based on standard acceptable and foundry men experience in this casting organization for casting check valves -PN 10 of various sizes & type's significant changes are taken during controlling the parameters. First we collected the data as casting defects from AV VALVE Pvt Ltd, Agra. Identify the major defects which are scab, cold shut and shrinkage. Complete this task we analyze the cause of this casting defects with the help of fish bone diagram. So we conclude that there are four parameters responsible for these casting defects. 1. Pouring Temperature (oC) 2. Sand Particle Size (AFS) 3.Mould Hardness Number 4. Permeability Number First we define the range of these parameters and then we perform the casting process at different trial and find that average percentage rejection is 6.25 of the casting product. Then we apply the Taguchi's method and use of MINITAB 17 software to find out the optimum solution. These optimum solutions were applied on casting process and the calculated the percentage rejection 4.416 of the products. Thus we could improve 1.25% in casting defects.

Singh and Kumar (2016) Analyzed defects of check valve namely cold shut, scab and shrinkage. Reduction of causes of these defects like pouring temperature, permeability, mould hardness and sand particles optimized through Taguchi's method. In their work L9 orthogonal array is used for the trial purpose. The response of the S/N Ratio, contribution of different process parameters and relation between S/N ratio and the levels of different process parameters is studied and analyzed to obtain optimum process parameters. After implementation various experiments and Testing techniques they concluded that the optimum value of Pouring temperature is 13400c, Permeability is 150(No) , Sand particle Size is 42 AFS and Mould Hardness Number is 91.132.

Nimbulkar and Dalu (2016) worked on gating system design to know last solidifying region in casting and eliminate these defects. They simulate old gating system for productivity and defect and modified the present gating system in new gating system by using Auto-CAST X1 simulation software. They found that initial vertical gating system was not suitable for thick casting components hence proposed horizontal gating and feeding system so that molten metal flow becomes uniform, gases escape easily in to atmosphere. Feeding related defects had been reduced by 30%.

Rohit Chandel and Santosh Kumar (2016) focuses on analyzing and elimination of in process variations causing rejection and rework at different stages of production by using Define-Measure-Analyze-Improve-Control (DMAIC) approach. By implementing DMAIC approach as a problem solving technique the rejection rate was reduced from 8.79 % to 5.30 % and rework rate from 12.8 % to 8.2 %. Also, a significant enhancement in sigma level was obtained from 2.85 to 3.13.

Harvir Singh and Aman Kumar (2016) described the Minimization of the Casting Defects Using Taguchi's Method. The author used Taguchi's method for experimental purpose and used Minitab 17 to find the optimum solution. Three-month data has been collected from the foundry after analysis it has been found that the 80% rejections were only because of cold shut, scab, and shrinkage. The major cause of defects was analyzed through the fish bone diagram and the main cause is Pouring Temperature (℃), Sand Particle Size (AFS), Mould Hardness Number and Permeability Number. Taguchi L9 orthogonal array method is used for the experiments. MINITAB 17 is used to find the optimum solution which is for pouring temperature is 1340℃, for Permeability number is 150, for Sand particle Size is 42 AFS and for Mould Hardness Number is 91.132. By applying the optimum solution the rejections level reduced from 6.25% to 4.416%.

Chatrad B et al (2016) studied various defects influencing parameters like melting of the metals, alloy agents, pouring temperature, pouring process and pouring time, impurities present in the ladle, etc. Finally conclude the optimized parameters with minimum casting defects with economic impact of the critical manufacturing operations related to some specific case studies and possible goals have been identified. Percentage of rejections is less at 14200c-14800c. Percentages of rejections are increasing at least temperature 14000c and maximum temperature14800 c. As the pouring time increases the rate of rejection also increases. As increased handling time which lead to increase in defective component. Porosity and inclusions increased due to the impurity in the ladle and mould due to improper cleaning.

Anuj kumar et al (2017) studied on local foundry shop in Haryana and objective of my study are:1. To identify the root factors causing casting defects in Brake drum. 2. To improve the quality by reducing the casting defects in Brake drum.3. Compare the defects in Brake drum with and without DMAIC.

Jaykar Tailor and Kinjal Suthar (2017)presented a review on reducing defects in various areas by Six sigma DMAIC Methodology. In modern era, the Six Sigma tools and techniques have been implemented in various sectors, which strive to ameliorate continuous improvement in achieving less variation, cost and high quality of end products. Six Sigma emerged as a natural evolution in business to increase profit by eliminating defects. Six Sigma is a powerful world class improvement business strategy that enables companies to use simple but powerful statistical methods to define, measure,analyse, improve and control (DMAIC) processes for achieving operational excellence. In this paper, DMAIC approach is carried out that has been reviewed from different research papers.

Patil Sachin S and Naik Girish R. (2017)prescribed comprehensive review of work pertaining to process improvement techniques used for defect minimization in casting. In India many foundries have followed conventional and manual operations. Foundry industries suffer from poor quality and productivity due to large number of process parameters combined with lower penetration of automation and shortage of skilled worker. Mould shifting, sand inclusions, poor surface finish, shrinkage, porosity, cold shut and flash are common casting defects in casting. Since casting process involves complex interaction among various parameters and operations related to metal composition, method designs, melting, pouring, shake-out, fettling and machining and hence need to improve.

Darshana Kishorbhai Dave (2017) applied DMAIC (Define, Measure, analysis, improve, control) approach. The emphasis was laid down towards reduction in the defects (Blow holes, metal spread out, Surface cracks, uneven metal layer thickness) occurred in the castings by controlling the parameters with DMAIC technique. The results achieved show that the rejection due to defects has been reduced from 31.703% to 12.82%.

Borikar et al. (2017) worked on Optimization of casting components by Minimizing cold shut defect. They observed that 80% of rejections are mainly due to cold shut. The authors carried out different techniques to minimize Cold Shut. This defect also in the moulds which are not properly vented because of the back pressure of the gases. By various control tools, the ranges of temperature, Phosphorous, and Silicon are find out. The temperature range for the minimum defect is 1362 - 1382℃ which reduces Cold Shut from 9% to 5% and Phosphorous percent is 0.06% maximum for minimum defect while Silicon range is 2.4-2.6%.

IV. CONCLUSION

For spur gear manufacturing problem, after observing all the data and analysis we find that its production quality is very close to the six sigma limits. Some variation occurs due to natural causes which can be eliminated. Type-I error occurred. So, if the spur gear manufacturing company continuing their quality research, it will help them to acquire a best product quality and make a highest position in the market. From the observe 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 increase in competitiveness in global market of manufacturing.

REFERENCES

[1]. B.R. Jadhav, Santosh J Jadhav, "Investigation And Analysis of Cold Shut Casting Defect And Defect Reduction By Using 7 Quality Control Tools", International Journal of Advanced Engineering Research and Studies, ISSN: 2249–8974, September 2013.

[2]. Pranay S. Parmar, Vivek A. Deshpande, "Implementation of Statistical Process Control Techniques in Industry: A Review", Journal of Emerging Technologies and Innovative Research, ISSN: 2349-5162, Vol 1, Issue 6, November 2014.

[3]. Varsha M. Magar1, Dr. Vilas B. Shinde, "Application of 7 Quality Control (7 QC) Tools for Continuous Improvement of Manufacturing Processes", International Journal of Engineering Research and General Science, ISSN 2091-2730, Volume 2, Issue 4, June-July, 2014.

[4]. Uday A. Dabade, Rahul C. Bhedasgaonkar,"Casting Defect Analysis using Design of Experiments (DoE) and Computer Aided Casting Simulation Technique", Elsevier

Forty Sixth CIRP Conference on Manufacturing Systems,2013.

[5]. Aniruddha Joshi, L.M.Jugulkar, "Investigation And Analysis Of Metal Casting Defects And Defect Reduction By Using Quality Control Tools", International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Volume- 2, Issue- 4, April-2014.

[6]. Chirag B. Patel, Dr.Hemant R. Thakkar, "Reducing Casting Defects And Improving Productivity In A Small Scale Foundry: A Review", International Journal of Advance Research in Engineering, Science & Management, Volume 3, Issue- 4, April-2014.

[7]. R. B. Heddure, M. T. Telsang, "Casting Defect Reduction Using Shainin Tool In Ci Foundry – A Case Study", International Journal of Mechanical And Production Engineering,Volume- 2, Issue- 6, PP: 70-73.

[8]. Vivek V. Yadav, Shailesh J. Shaha, "Quality Analysis Of Automotive Casting For Productivity Improvement By Minimizing Rejection", International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Volume- 4, Issue-6, PP: 1-8.

[9]. Jitendra A Panchiwala1, Darshak A Desai, Paresh Shah, "Review on Quality and Productivity Improvement in Small Scale Foundry Industry", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 12, PP: 11859-11867.

[10]. Patel Rumana, Darshak A. Desai, "Review Paper: Quality Improvement through Six Sigma DMAIC Methodology", International Journal of Engineering Sciences & Research Technology, Vol. 3, Issue 12, PP: 169-175.