Quality Improvement in Manufacturing Industry Using D^3 Quality Tools

Nagasuresh Babu[1], Chethan N[2] , Gajendra K C[3], Hithesh S[4], N Shirideeshwar[5]
[1]Assistant Professor Dept of Mechanical Engineering
[2, 3, 4, 5]Dept of Mechanical Engineering

Abstract- *To secure a competitive edge in their respective industries, organisations are seeking ways to increase efficiency and guarantee successful execution of critical business processes. In today's global business environment, the importance of customer service, cost-competitiveness, and quality are the key factors in determining an organisation's success. The purpose of this paper is to demonstrate how organisations are able to achieve sustainable and effective process improvement by identifying how the combination of project management best practices with certain six sigma methodologies provides the structure and discipline required to identify process improvement opportunities, develop sustainable solutions, and lead the organisation through the strategic change process.*

This project focuses on developing and applying Quality toolset in manufacturing process to reduce the rejection rate and rework. The present work has been conducted in one of the manufacturing industries in Bengaluru which manufactures flanges, shafts, bearing products etc. To supply components to aerospace companies. A systematic study has been made to improve the quality and cost by decreasing rejection rate and rework. Different quality tools namely Pareto chart, cause and effect diagram, etc. Were used in collecting, analysing and improving quality issues. The rejection rate of the damage on outer diameter has reduced from 56.06% to 40% of the total defect

Keywords- Quality toolset, rejection rate, Pareto chart, cause and effect diagram.

I. INTRODUCTION

Lean is a method of streamlining a process, resulting in increased revenue, reduced cost and improved customer satisfaction. A lean process is faster, more efficient and delivers satisfactory quality at economical cost. Lean is achieved by removing "waste", which is activity not required to complete a process. After removing waste, only the steps required to produce a product or service that is satisfactory to a customer end.

Six sigma is a method of improving quality by reducing the defect rate very minimum value i.e 3.14 DPM (defects per million opportunities) It is successfully implemented in many companies and resulted in huge financial benefits. Using six sigma reduces the number of defective products manufactured or services provided, resulting in increased revenue and greater customer satisfaction. The present work is carried out in manufacturing company which manufacturers all kinds of precision machine components, auto parts, and complicated fixtures as per designs and supplies to aerospace industry. There have been substantial rejections in the existing process. Resulting in rework, scrap which in turn delaying the delivery commitments and leads to poor customer satisfaction. A systematic study was conducted to measure the current rejection rate and applied D3 methodology to find out the root cause for the rejections and improved the existing process by reducing rejection rate and damage on outer diameter has reduced from 56.06% to 40% of the total defect.

II. OBJECTIVE OF WORK

The basic objective of this project is to increase quality of the product by optimising various processes involved in the manufacturing unit and by decreasing rejection rate. A new methodology (D3 methodology) is developed and is used to optimise process in short span of time by eliminating wastages.

The various areas under consideration for improvement are as follows:

- To suggest best method to improve productivity by reducing waste.
- To identify the root cause by using Pareto chart, Ishikawa diagram.
- To improve the quality by educating the labourers with proper handling techniques.

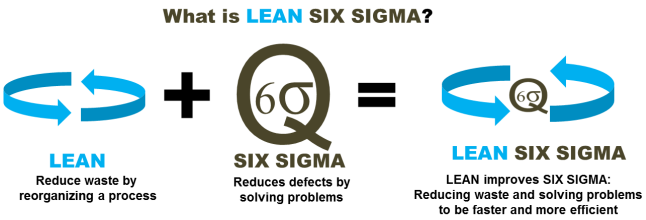

Figure 1: lean six sigma

III. METHODOLOGY

To address the above challenges an exclusive methodology designed for manufacturing sector named D3 (Describe, Develop , Deliver) is employed. Several tools are categorised under each D and these are used to identify problems and represent data, find solutions and provide suggestions to optimise various processes. With this, the motto of the project is to improve the customer satisfaction by reducing rejections and rework thereby reducing waste and educating the labours with proper handling techniques.

Though there exists various methodologies and techniques to optimise the process there

Is no uniform solution or a single technique to address the problem completely. Hence it leads to the development of an exclusive methodology called D3 which stands for Describe , Develop and Delivery. It consists of various tools handpicked from both lean thinking , six sigma and their tools. The significance of this methodology is that no much statistics is required , can provide common solution to multiple problems , it can be implemented within a short span of time and can address up to 95% of any problem.

The first step is to collect the data from the literature and categorising the defects such as dent on outer diameter, damage on face, damage on outer diameter, drill break, operation missing. Second step is to improve the quality by using quality tools that is Ishikawa diagram and Pareto chart analysis . Third step is to analyse the existing results and implementing the problems that is proper training to be given to the operator, proper bins should be provided from one operation to other operation. Final step is to suggest the action plans to reduce wastage and increase the productivity. Figure 1 shows Methodology flow chart

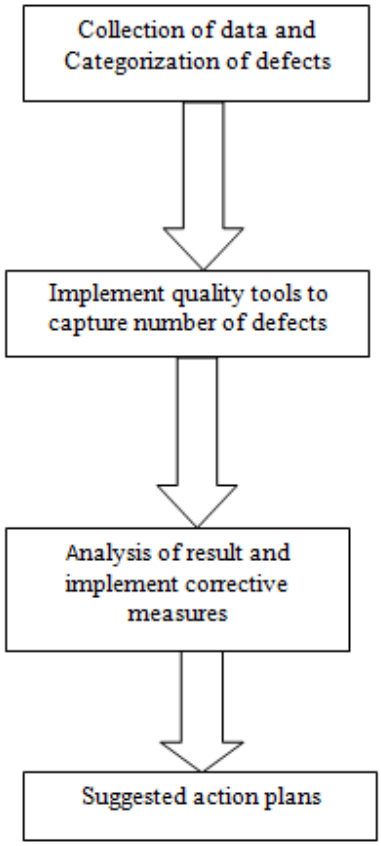

Figure 2: Methodology flow chart

Data Collection

The following are the major defects occurring in the industry during the process

- Dent on outer diameter
- Face damage
- Outer diameter damage
- Missing Operation
- Drill break
- Crack

Figure 3: Defects such as Dents and cracks

Pareto Analysis

Pareto chart contains both bars and line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line. This chart helps us to identify the causes of most of the problems the process is facing.

Pareto principle states that a large part of the problem may be caused by small number of possible causes. It is known as 80-20 rule that is 80% of the problem are caused by 20% of causes.

The primary purpose and use of Pareto diagram is to focus improvements efforts on the most important causes by identifying the vital few and trivial many causes.

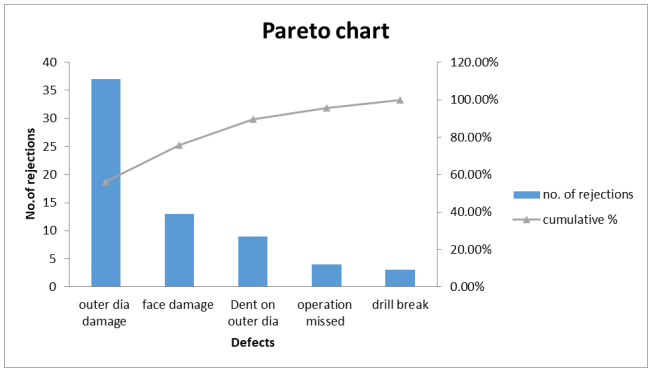

Figure 4: Pareto chart for the defects before implementing D^3 tool

Observation from Pareto Analysis is listed as:

- Damage on outer diameter is the most frequent defect with as much as 56.06% of the total defect.
- Face damage are the second most frequent defect with 19.69% of the total defect.
- Among other defect contribution dent on outer diameter is 13.63%, missing operation is 6.06%, drill break is 4.9% of the total defect.
- The top three defects which contribute to 89.39% of total defects.

Cause and Effect Diagram

Cause and effect diagram also called as Ishikawa diagram, is a graphical demonstration or pictorial representation of the cause of the problem which are supposed influence an effect.

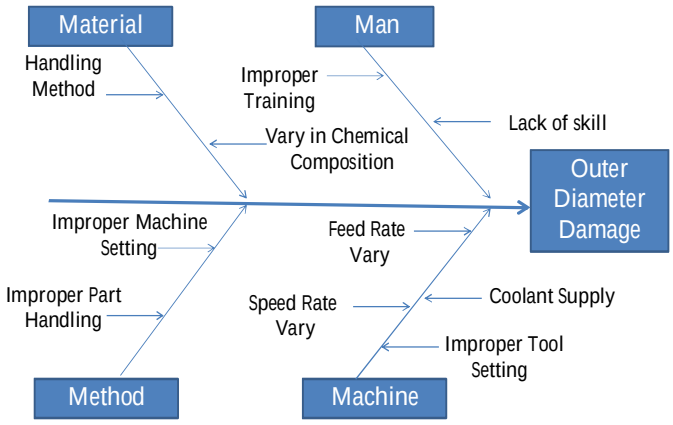

Figure 5: Cause and effect diagram (Ishikawa diagram) for Outer diameter damage

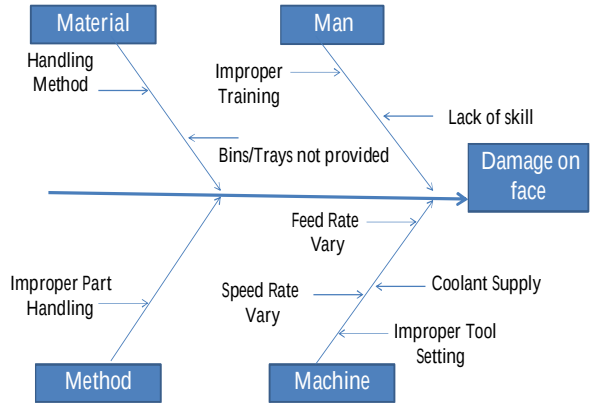

Figure 5: Cause and effect diagram (Ishikawa diagram) for damage on face

Suggestions:

- Training should be given for new operator.
- Standard operating procedure for material handling that is
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Sign boards are used for example
Note:

1) Arrange the part in the steel bins properly.
2) Use proper space for brittle parts.

- Proper bins and trays should be provided for carrying the parts during machining.
- Proper mesh should be provided for placing the parts.
- Chemical composition should be checked early.
- Magnetic particle inspection should be done to checks cracks in depth.
- Missing of operation should be checked as early as possible before going to further operation.

For comparing the past results it is again analysed the Pareto chart for the next six months from the production line of the quality inspection department. From this analysis, major defect is identified. Here horizontal axis represents defect type, vertical axis represents total number of rejections and right vertical axis represents defect percentage

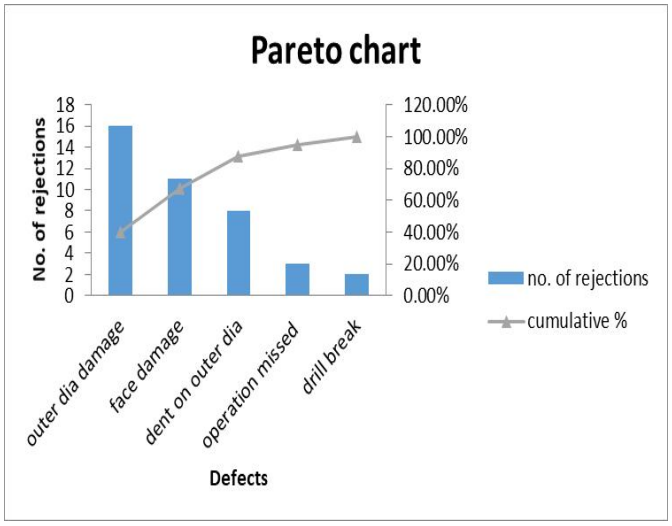

Figure 6 : Pareto chart for after implementing D3 tool
Observations from Pareto Analysis for Top Defects

- After giving and implementing the suggestions ,damage on outer diameter has reduced from 56.06% to 40% of the total defect.
- Face damage is the second most frequent defect with 27.5% of the total defect.
- Among other defect contribution of dent on outer diameter is 20%, operation missing is 7.5%,drill break is 5% of the total defect.
- These three top defect positions are the vital few which contribute to 88% of total defects occur.

IV. RESULT

It is found that overall 25% rejection rate can be reduced by mainly concentrating on three areas of defect that is damage on outer diameter , damage on face and dent on outer diameter. We have provided some suggestions related to defect types. So by taking corrective and effective measure it is possible to meet nearer to zero defects.

V. CONCLUSION

The analysis of data was done through tables and Pareto diagram showing the number of defects and their rejection percentage & cumulative percentage. The inference from Pareto diagram is mentioned in Ishikawa diagram showing the root causes for the defects. Again the inference from the analysis are mentioned as the suggested improvements. By implementing those the industry will be benefited as follows:

- Increases revenue of the industry.
- Decreases costs of the products.
- Improves efficiency.
- Develops effective labour /employees.
- Decreases rejections and rework thereby decreasing waste/scrap.

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