

QUALITY IMPROVEMENT IN FORGING INDUSTRY BY USING DMAIC PROCESS

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Abstract— *Quality is a very essential of any organization. Our project seeks in quality improvement in bearing manufacturing industry. DMAIC process (Define, Measure, Analysis, Improvement, and Control) is used in our project. This project is undertaken for improvement in quality by using different quality tools like, pareto analysis, cause and effect analysis, why analysis and brain-storming are used for finding the poor quality. Based on this data quality improvement will be done and further improvement will be suggested.*

Index Terms—pareto analysis, cost & cause analysis and data quality maintain.

I. INTRODUCTION

SYNERGY FORGE PVT. LTD. is a private company registered on 12/09/2007. This organization is manufacturing of inner and outer bearing rings as per the customer the customer drawings and specifications. Their specialization is in forging, rolling and CNC turning. The company supplies it's product to reputed organization SKF bearings. Company is continuously trying to increase its productivity and quality level to satisfy customer needs.

Plant is situated at GIDC, Rajkot (Gujarat), India. The facilities available in organization includes forging shop, machining shop, inspection shop, NDT testing, storage section, heat treatment furnaces, dispatch section and warehouse.

DMAIC approach is the most common and well known methodology for problem solving in six-sigma. DMAIC is an abbreviation, which stands for Design-Measure-Analyze-Implement-Control. Its aim is to reduce number of possible defects in an organization by letting the process with high efficiency level. DMAIC is a systematic and statistical approach to implement in a controlled plan.



Fig. 1.1 Basic DMAIC Process Chart

In today's scenario, the business cell going down has become a common problem. Its fact that the companies demand their employees for better performance. Every industries strives for better production and they implement their best efforts.

II. OBJECTIVES OF DMAIC APPROACH

The DMAIC approach is a classical six sigma problem solving methodology. Much amount of variation is undesirable from customer point of view as well as any organization. Overall variation results into increase in rejection rate. DMAIC approach is implemented to reduce the variation in different parameters.

Basic objectives of DMAIC approach are:

- Quality improvement
- Reduction in rejection rate
- Analyze the cause of defects
- Reduce excess cost
- Reduce excess time

DMAIC identifies key requirements, deliverables, tasks and standard tools for a project team to implement while resolving a task.

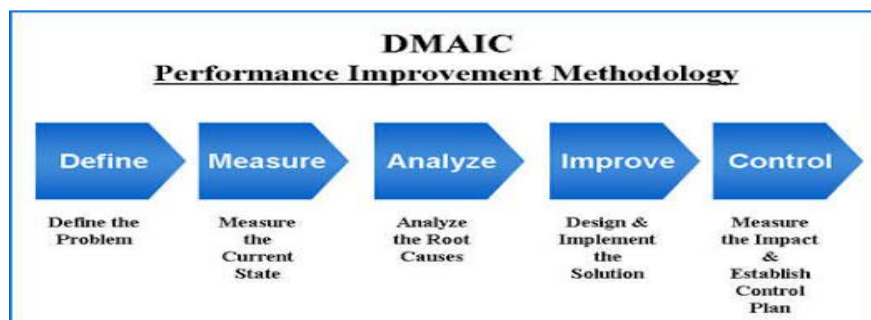


Fig. 2.1 Phases of DMAIC Approach

Five steps of DMAIC process are:

Step-1: DEFINE the problem and scope the work efforts of the project team. In this phase the customer requirement, project goals and time for completion are estimated.

Step-2: MEASURE the current process or performance. Identify the current situation data and summarize it. This phase usually involves the collection of data's in graphical or tabular form.

Step-3: ANALYSE the current performance to isolate the problem. In this phase different methods can be implemented such as Pareto chart analysis, cause-effect diagram, why analysis, etc. By implementing this phase we can get idea about the root cause of the problem.

Step-4: IMPROVE the problem by selecting a solution. Based on the previous phase we can define the root cause and methods to reduce this problems are implemented in this phase. Collect the possible ideas to improve the condition and prioritize it on base of customer requirement. And improvement of ideas by re-evaluating it.

Step-5: CONTROL the improved process to ensure the targets are met. Define the validate system and standardize the process plan. The ongoing implemented process must be regularly monitored and further plans to improve the ongoing process are carried out.

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III. INDUSTRY PLANT LAYOUT

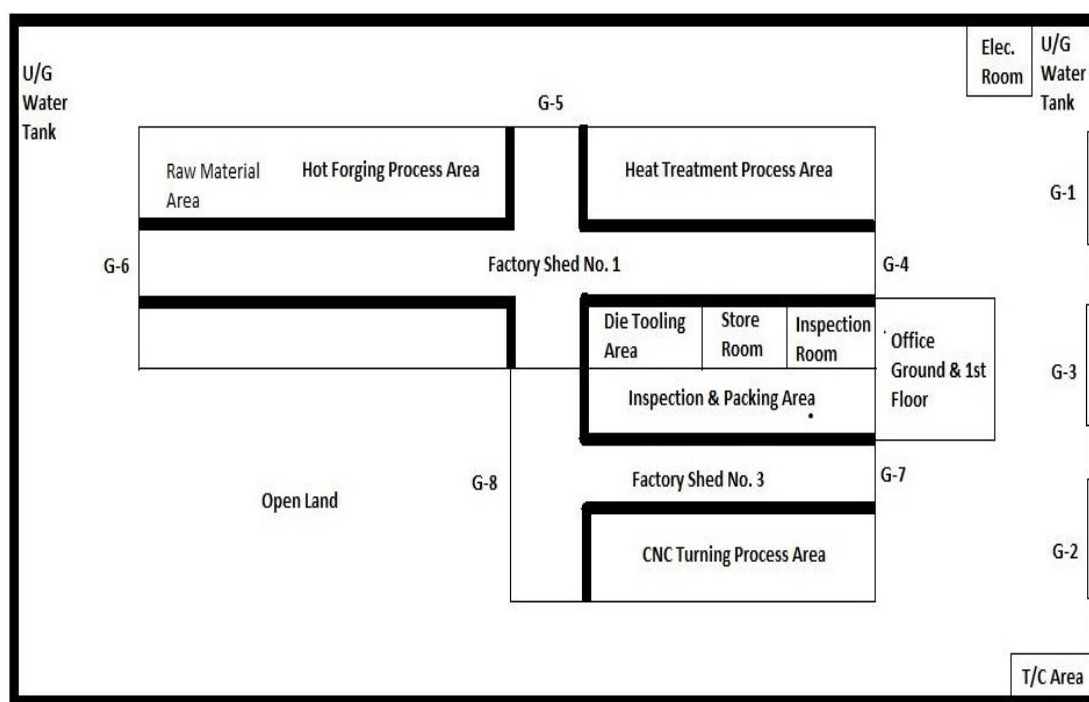


Fig. 3.1 Layout Plan of Synergy Forge PVT. LTD.

IV. DATA COLLECTION

Check sheets are used for collection of data. The check sheet is one of the tools used in 7 basic tools of quality. It is used to collect data in real time at the location where the data is generated. According to DMAIC approach this is considered as the main phase. The regular data of the ongoing process are being gathered during this phase.

There are broadly two types of rejections i.e. forging rejection and machining rejection. Accordingly we have prepared two work sheets for collection of the scrap data.

- 1) Forging rejection report.
- 2) Machining rejection report.

Forging rejection report includes the rejections due to forging. Following are the defects occurs due to forging:

1. Overheat
2. Surface crack
3. Pane-cake oversize
4. Burns on cup
5. Oversize at ring rolling
6. Bend at ring rolling
7. Grooving defect at ring roller
8. Lapping of face due to shearing

Machining rejection report includes the rejection due to machining. Following are the defects occurs due to machining:

1. Forging defect
2. Groove position displace
3. RS groove diameter
4. Eccentricity
5. 3-point error

V. DATA ANALYSIS

Data analysis is very essential and important part of DMAIC approach. For elimination of the defects, most important tasks or factors are identified. To find out the reason for scraps, various testing and design of analysis is carried out. It includes the analysis of the available data which are collected from the previous process. And it is also important that all the data must be analysed by different types of analysis because different types of analysis gives the results of different parameters which are very important to focus.

After that opinions from the different experts are taken on possible suggested solutions.

Different methods of data analysis are as follows:

- Pareto Analysis
- Why why analysis
- Brainstorming activity
- Fishbone diagram
- Cause and effect diagram
- Statistical Method
- Prioritization matrix

We have used Pareto Analysis, why analysis and cause and effect diagram to solve the problem.

1. Pareto Analysis

Pareto analysis is very effective tool for analysis of past collected data. Pareto Analysis is mostly used in all type of industries which follows six sigma standards.

Following fig. shows pareto charts for lots of part no 6310 and 6311 for forging and machining rejection data.

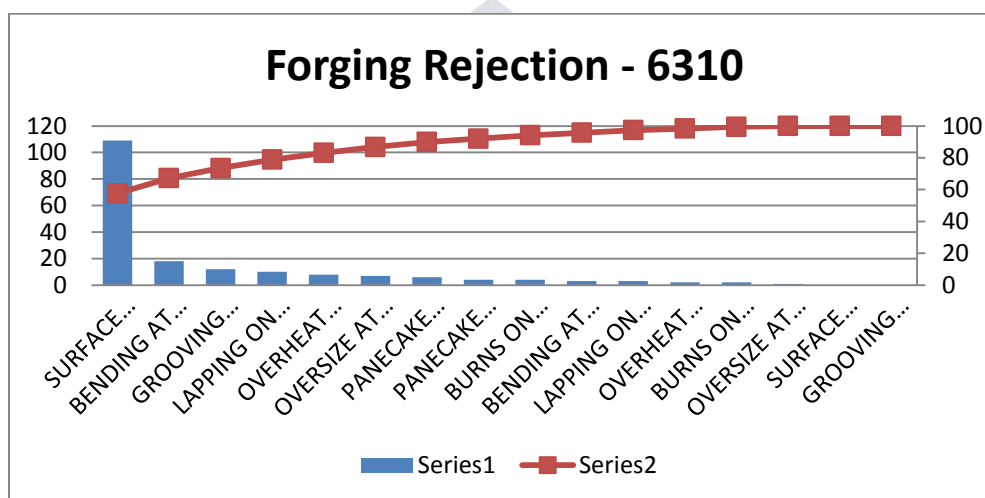


Fig. 5.1 Pareto chart for forging part type 6310

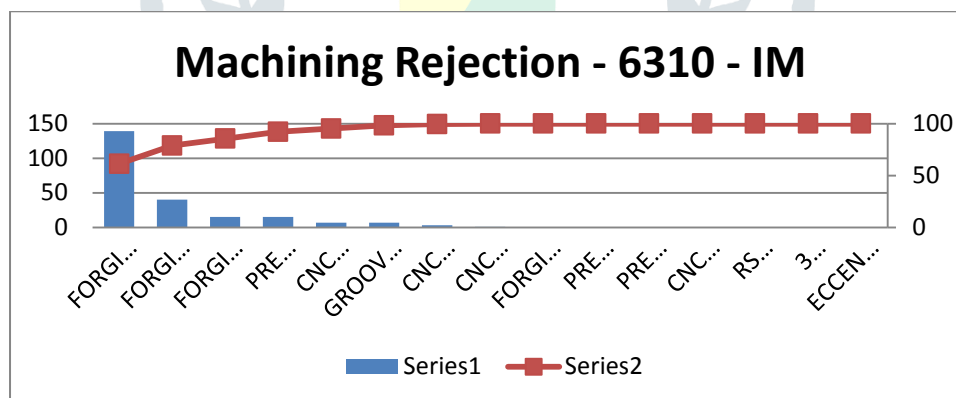


Fig. 5.2 Pareto chart for machining (IM) part type 6310

From the above Pareto charts is observed that the maximum rejection found in following type:

In forging process:-

- Surface Crack (OM)
- Bending at ring roller machine
- Overheat (OM)
- Grooving defect at ring roller machine (OM)
- Lapping on face due to shearing machine (IM)

In machining process:-

- Forging Defect (ID)
- Pre-machining (face)
- Forging defect (TK)
- CNC machining (width)
- Forging defect (width)

VI. IMPLEMENTATION

A. Implementation in forging department

In forging department mainly the rejection was due to surface crack, this was basically due to uneven impact load (i.e. machine defect). Presently the older power press machine is replaced and new power press machine is installed.

This machine has replaced 3 machines as it can perform 3 operations in single stroke. This new machine is installed in one production channel. As it's beneficial in all terms of cost saving, in future new machine will also be installed in second production channel.

Secondly the rejection was due to overheat, this was due to oiled rod (i.e. raw material defect). Because of oiled rods feeded into the heater there was slippage of feed rollers and so the feed rate was slower and material was overheated. Presently there is removal of oily surface and then it's feeded into heater.

Bending at ring roller machine is mainly due to misaligned rollers and failure of bearings (i.e. machine defect). This can be reduce by implementing periodic maintenance of rollers and machine bearings.

B. Implementation in machining department

In matching department, the rejection was mainly due to forging defects (i.e.ID, TK, Width). These defects are usually the internal defects which can't be recognized during forging inspection. This defects gets appeared while machining. so by implementing the above suggestions it gets automatically reduced.

Pre-machining (face) is reduced by implementing tool grinding at regular intervals.

CNC machining is reduced by implementing replacement of tool inserts at regular intervals.

By controlling the implemented solutions in the firm and continuous monitoring over it rejection can be reduced. By Continuous efforts and effective control one can maintain quality.

VII. CONCLUSION

This chapter includes the result by comparing rejection data before implementation of DMAIC approach with present rejection data after implementation of DMAIC approach.

The result of DMAIC approach is shown by the help of bar chart.

8.2 Comparison charts

The comparison is done by considering the overall production of both the lots (i.e. before and after implementation of DMAIC approach) .

The defects are considered in terms of percentage of particular defect of overall production.

Two types of comparison charts:

1. Comparison chart for forging defect
2. Comparison chart for machining defect

A. Comparison chart for forging & Machining rejection

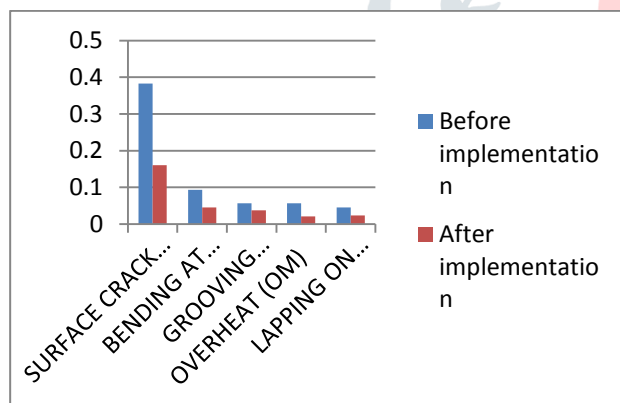


Fig. 7.1 Comparison chart for forging rejection

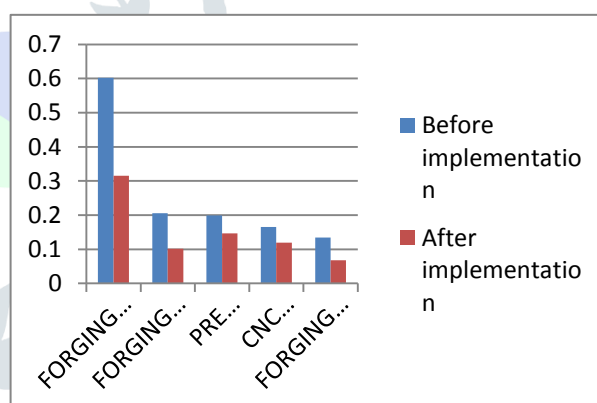


Fig. 7.2 Comparison chart for machining rejection

From the above results, we can conclude that by implementing DMAIC approach in forging industry we can reduce rejections. Further we can conclude that it can improve quality, reduce excess cost, reduce excess time and reduce waste material.

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