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Application of 8D Methodology for Minimizing the Defects in Manufacturing Process: A Case Study

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Abstract **- This paper has focused on two objectives. The first objective is to study the 8D methodology which is an 8 disciplinary approach. It consist of 8-steps to be followed by quality improvement team for problem solving as well as for product and process improvements. The second objective is to apply the 8D methodology and to analyze its effectiveness. In order to apply the 8D methodology and to analyze its effectiveness a case study was conducted in a small scale manufacturing industry (ISO 9001:2000 certified). The results of the case study show that the 8D methodology is effective. After applying 8D methodology the total rejection for coupling disc part was reduced to 6.57% from 37.95 %.**

Keywords: 8D Methodology, Problem Solving Techniques, Quality Control Tools, Rejection Analysis.

1. INTRODUCTION

Improvement in quality of product and process is necessary for any company in order to survive and to grow in competitive market. Quality plays an important role in an organization to become more efficient and effective in the global market. Also it helps to improve the productivity, customer loyalty along with the market share [1]. To maintain the quality of product or process there is need to solve all the problems systematically which arises during entire manufacturing process and which affects quality of product or process. In order to solve these problems 8D methodology can be used. According to Chen H.R. and B.W. Cheng [4] the 8D method has been widely applied in automotive industries for problem solving regarding manufacturing process deviations, defects, maintenance, customer complaints, returned purchases and for supplier qualification confirmation. Ford made 8 D popular in the automotive manufacturing by introducing standardized set of steps to be followed by quality improvement teams [5]. Basically 8D methodology is 8 disciplinary approach for problem solving. It consist of 8-steps to be followed by quality improvement team for problem solving as well as for product and process improvements. In this paper, first the 8D methodology is studied and then its effectiveness is analyzed through a case study.

The remainder of this paper is structured as follows: After introduction, section 2 reviews pertinent literature on 8D methodology, application of 8D methodology and various quality control tools. Section 3 first introduces 8D methodology and then provides in-depth description of the steps involved in 8D methodology. Section 4 presents the case study which is carried out to analyze the effectiveness of 8D methodology. Section 5 presents the results of the case study. Section 6 concludes with a discussion of the results.

2. LITERATURE REVIEW

This point reviews the past research that serves as the foundation for this work. Following will be the review of literature on 8D methodology, its application in problem solving, and application of various quality control tools to reduce the rejection level in various manufacturing organizations. Wan Ahmad Najmuddin Wan Saidin et al. [2] conducted a case study on application of 8D methodology for defective product named as left hand side mirror at trim assembly line in automotive company. Their study proved that 8D methodology had succeeded to fulfil the expectation of the quality team by reducing the major defect of part at trim assembly line. Through a case study Marjanca Krajnc [3] observed that the 8D methodology is an excellent tool for preventing defects from reoccurring. He supported his observation not only by PPM results but also by related costs. Chen H.R. and B.W. Cheng [4] used 8D methodology and Kanos model in their case study. With the help of these methods they solved the problem and reduced the defect rate from 28% to 0.5%. According to Rambaud [5] 8D methodology was applied to military standards and was referred to as the Army Directive 1520 'Remedies and disposal of non-conforming material. To reduce the rejection level of single cylinder head V.V.Yadav and S.J.Shaha [6] used various quality control tools such as pareto analysis, cause and effect diagram, and why-why analysis. With the help of these quality control tools they reduced the rejection from 7.74% to 1.81% as well as they improved productivity by 8.60%. Ashwini A. and Avinash K.S. [7] carried out rejection analysis of piston with the help of various quality control tools such as check sheet, pareto chart, cause and effect diagram and control charts etc. With the application of these tools they reduced the overall rejection rate in production line from 10% to 7 %. Many researchers have

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studied and implemented various quality control tools to reduce the rejection level in various manufacturing organizations [1], [8]-[12].

3. INTRODUCTION TO 8D METHODOLOGY

8D method was popularized by Ford Motor Company in automotive sector. 8D methodology consists of 8-steps to be followed by quality improvement team for problem solving as well as for product and process improvements. It is structured into 8-disciplines, emphasizing on team synergy. The goal of 8D methodology is to improve the quality and productivity by reducing the cost of manufacturing inefficiencies and to make continuous improvement in products and processes. This methodology helps to identify and correct causes of nonconformance. This methodology can be applied in case of major nonconformance, field complaints, and repeated quality issues where the team based approach is needed.

3.1 Steps of the 8D Methodology

It's the step by step approach to solve the problem. The steps of 8D methodology and its details are as follows.

Step 1: Form the Cross-Functional Team (D1)

The first step of this methodology is to form cross functional team. The team should include the members from various departments such as design department, production department, quality department, industrial engineering department, marketing department etc.

Step 2: Describe the Problem (D2)

This step involves complete assessment of the problem. It should include the details like when and where the problem was encountered, specific description of the failure mode, failure rate, quantity produced and quantity of nonconforming products etc.

Step 3: Contain the Problem (D3)

This step involves identifying and holding the parts which are affected by the problem. Parts present in the factory must be put on hold until their reliability has been properly assessed. If the problem has extremely high reliability risk then the parts already in the field may need to be recalled.

Step 4: Identify the Root Causes (D4)

This step involves identification and investigation of the root causes of defect. For this purpose the tools like brainstorming technique, why-why analysis, fishbone diagrams can be used for deeper understanding of the probable causes for the occurrence of problem. All probable causes should be highlighted and mentioned in this step with the help of fish-bone diagram.

Step 5: Address the Corrective Actions (D5)

This step involves identification of all possible corrective actions to eliminate the root cause of the problem. The responsible person for the implementation of the corrective actions and the target dates of completion shall be enumerated in this step.

Step 6: Implementation of Corrective Actions (D6)

This step involves an actual implementation of the identified corrective actions, details of which must be documented. The date of completion and responsible person for the corrective actions must be mentioned in this step. Effectiveness of corrective actions must be presented through the rejection data or trend at periodic timeline.

Step 7: Prevent the Reoccurrence of the Problem (D7)

This step involves the implementation and documentation of actions which are required to prevent these defects or similar problem in the future. All preventive actions must be documented along with responsible person and target dates of completion.

Step 8: Congratulate the Team (D8)

This is the last step of the 8D methodology. After solving the problem there should be an acknowledgement or appreciation from the management for the good work done by 8D team. After completing these 8 steps it is required to submit the 8D report along with modified PPAP documents to the customer.

4. CASE STUDY

For the case study purpose, the coupling disc component was selected because the issue was live and occurred many times. There was maximum customer complaints about this part and there was demand of 8D for this part from the customer.

Figure 1: Coupling disc

4.1 Data Collection and Data Analysis

For preliminary analysis, past three months rejection data for coupling disc was collected. To identify the major defect, Pareto analysis has been carried out. The ultimate aim of this step was to focus on the major issue. The table shows the rejection data (defect-wise) of coupling disc.

Table 1: Rejection data for coupling disc

Name of Component	Coupling Disc	Total % Rejection
Total Parts Produced	137	37.95 %
Total Parts Rejected	52	

Table 2: Defect wise rejection data for coupling disc

Type of Defect	No. of Part Rejected
1 Dowel pin hole dia.13.2 undersize	43
2 Wrong pin fitting	6
3 Pin length undersize	3
Total Rejected Parts	52

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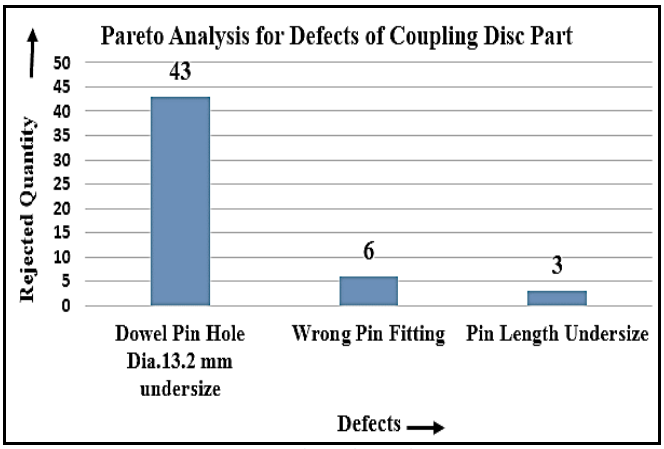

Figure 2: Pareto analysis for defects of coupling disc part

4.2 Applying 8D Methodology to Reduce the Rejection Level

After selecting the part and defect, 8D methodology is applied to solve the problem. The details of the activities are as follows.

Step 1: Forming the Cross-Functional Team (D1)

To solve the problem cross functional team was formed. From customer side one person from quality department and from supplier side four persons from machining and quality department participated in this activity.

Step 2: Description of the Problem (D2)

Table 3: Description of the problem

Statement of the defect as stated by customer	Dowel pin hole diameter 13.2 mm undersize
Where the defect is observed?	At customer end
How many parts have the defects?	43

Step 3: Containing the Problem (D3)

All the parts potentially affected by this problem were identified and their locations were pinpointed. All the parts at customer side as well as at supplier side were put on hold. Lots already on the line were called back to the stores.

Step 4: Identification of the Root Causes (D4)

To identify the root causes of occurrence of defect and to get deeper understanding of probable causes for the occurrence of problem brainstorming technique and why-why analysis is used. The following causes were identified for the occurrence of problem

- In-process inspection was not followed by operator at defined frequency
- 13mm drill used instead of 13.2mm drill
- No use of GO, NO-GO gauge for checking hole
- Wrong sampling inspection(1 part checked in 1 lot)
- Less skill of the operator (Not maintaining proper drilling speed and wrong selection of tool)
- Rimmer tool having less sharpness
- Change in hardness of work-piece material

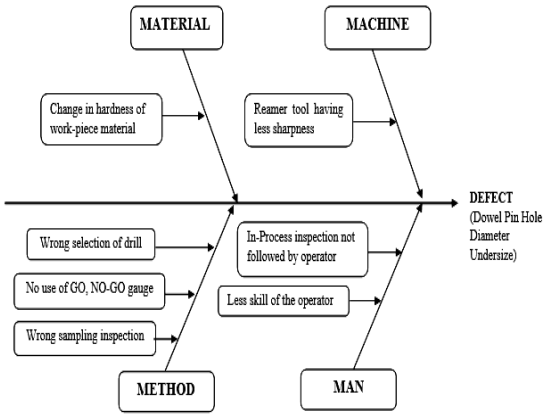

Figure 3: Fish bone diagram for the root causes of defect

Step 5: Addressing the Corrective Actions (D5)

Following corrective actions were recommended in order to avoid the occurrence of defects

- Use proper 13.2mm drill tool instead of 13mm drill tool for performing drilling operation.
- Use proper Go, No-Go gauge for checking hole size during the dispatch.
- Revise sampling inspection method (Instead of one sample, check 5 samples per lot)
- Maintain the tool history card

Step 6: Implementation of Corrective Actions (D6)

To avoid the defect from occurring, following corrective actions were implemented

Table 4: Description of corrective actions

Corrective Action Taken	Responsibility	Result of Corrective Actions
1 Used proper 13.2mm drill instead of 13mm drill for performing drilling operation. 2 Used proper Go, No-Go gauge for checking hole size during dispatch. 3 Sampling inspection method is revised (Instead of 1 sample, checked 5 samples per lot) 4 Tool history card maintained	Supervisors from Quality and Manufacturing Department	Defects at the time of reporting= 43 After completion of "Step 6" = 0

Step 7: Preventing the Re-Occurrence of Problem (D7)

Following preventive actions were recommended and implemented in order to avoid the reoccurrence of defects

Table 5: Description of preventive actions

Preventive Actions Taken	Responsibility
1 Dowel pin (Master Piece) is prepared for in-process inspection. 2 Tool box is prepared to place the drills separately according to their size in order to avoid human error.	Supervisors from Quality & Manufacturing Department

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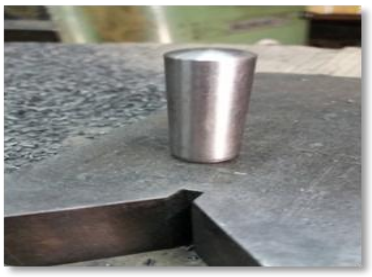

Figure 4: Dowel Pin Master Piece

Figure 5: Tool Box to place the drills

Step 8: Congratulating the Team (D8)

This was the last step of the process. After solving the problem the department head of the manufacturing and quality department acknowledges for good work done by 8D team for solving the issue. After completing these 8 steps, 8D report was prepared and submitted to Customer Company.

5. RESULTS

After taking the permanent corrective and preventive actions and closing the 8D activity through quality planning, zero defects were observed in next 3 consecutive lots for the issue of dowel pin hole diameter. So the total rejection reduces from 37.95 % to 6.57% and rejection level for the issue of dowel pin hole diameter reduces to zero percent.

6. CONCLUSIONS

The 8D methodology used in this paper is an excellent tool for solving the problem as well as for preventing defects from reoccurring. This conclusion is supported by means of the results of the case study. The results of the case study show that the methodology is effective and it provides systematic guidelines to the suppliers to reduce internal as well as external rejections. After implementing 8D methodology the rejection level for the issue of dowel pin hole diameter reduces to zero percent and total rejection percentage reduces to 6.57% from 37.95 %. After consistent monitoring the supply of coupling disc part for next 3 lots, no quality issues was observed for dowel pin hole diameter. So the company declares that the 8D activity is closed for the dowel pin hole diameter issue.

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