An Analysis of Product Dimensions Out of Specification as Quality Claim Improvement Activity: Application of 8D Method in the Injection Plastic Industry

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Abstract

Every company tries to find ways to maintain its market position in an increasingly competitive business environment. In order to be successful, companies need to achieve their objectives and goals to make their vision a reality while adhering to their mission. Company claims report in the few years still haven’t solved yet. Such complaints are significant because customer satisfaction can only be improved if the root causes of problem is clearly identified. In the plastic industry that produces parts for the automotive industry, a systematic method named 8D is used to analyze product conformity to specifications. The 8D method consists of nine disciplines problem solving. The original purpose of 8D method was to eliminate the defect causing the problem, thus restoring customer satisfaction and level up the quality level of company. This research established the suitability of the 8D for complaint settlement. 8D involves team work to solve the problem and using a 9-step structural approach. This case study resulted that the 8D is effective. The total customer claims at the end of last year until this year in Dec 2020 totaled zero (0) and process rejection for incorrect dimensions was reduced from 0.07% to 0.01%.

Keywords: 8D; Customer Claim; Improvement; Problem Solving

Kata kunci: 8D; Klaim Pelanggan; Perbaikan; Pemecahan Masalah
1. **INTRODUCTION**

The industrial revolution, and into the 20th century, a structured approach to the understanding a problem become a topic of great cognitive interest, especially in the field of psychology. Many theories has been developed in Europe and in the US on problem solving, focusing the studies in the field of business, engineering, mathematics, social, personal, design, etc. Each with its own unique approach and method, but of course there will be some common areas.

In the late 80’s onwards, such structured approach slowly become more accepted in our daily work process. It also becomes a topic of study in school curriculum, especially business, social, and engineering studies. The structured approach such as 8D method is commonly used in automotive industries (naturally), manufacturing, healthcare and software. The approach such as 8D method with cross-functional teams is very important. Some of important points are making the awareness of the team members, gaining a deeper understanding and having eye-opening revelations. The 8D framework often provides a detailed awareness about problems and long-lasting solutions (Ehie and Sawhney, 2006) [1]. “Whereas Six Sigma focuses on data and process variables, the 8D-TOPS uses cross-functional teams, looks for root causes, and implements and test permanent corrections or improvements.” [1] [10].

The approaches of 8D’s are to define a problem, identify its true root causes, and make a long term corrective action preventing the problem from recurring. One of the steps is to make sure the customer is protected by containing all suspected material within your reach. Align your corrective actions with Poka Yoke solutions as far as possible.

1.1 Definition of 8D

The 8D consists of 8 disciplines steps for solving problems. It is a highly disciplined approach for resolving chronic and recurring problems. This approach uses cross-functional teams to synergize with each other and provides excellent guidelines to identify the root cause of problem, containment actions implementation, develop corrective actions and preventive actions then carry out these actions in order to make the problem permanently eliminated [2]. The 8D are: isolating from underlying causes which caused the unexpected condition, identifying the contributing factors causing the problem, eliminating systemic factors that cause the problems, keeping teams from jumping straightly to the final conclusions too early, and preventing problem recurrence [5].

The 8D method can be used for solving critical problems, major problems, chronic and recurring problems. The 8D method usually used when the problem that are very complex and unable to be resolved by a single most experienced person; communication must go across company levels, other departments and/or to customers during and after problem resolution; and usually used when the customer or management requests 8-D implementation.

However, the 8D is ineffective if being used for non-recurring problems or problems which can quickly be solved by individual effort, problems with known root causes, making a decision between different alternatives solutions, and problems where the simplest and most obvious solution is likely to be the best or adequate solution [9].

Why not apply the 8D to all problems? The 8D problem solving approach will take several weeks to several months in order to solve a problem. It takes people from cross-functional teams at least from 4 different organizational areas to effectively apply the 8D team problem solving approach (production section, quality, product engineering, marketing, manufacturing section, supplier, etc.), and requires management side to support for allocated time, related resources that may be required, and the authority to make the appropriate and required changes.

1.2 8D Disciplines Steps

Pre 8D: Recognized the problem that will be solved, a discussion with management and all related leaders is needed to decide and prioritize existing problem to be solved. The 8-disciplines consists of: [2] [5] [6] [7] [8]

Prepare and Plan for the 8D: Generated plan for solving the problem and determine the prerequisites.
D1 - Establishment of Team:
Establish a team of members with experienced in project development and understand the product/process knowledge very well. Appoint a team leader and a cross-functional team of people with problem-solving skills from different divisions or departments representing the possible origin of cause.

D2 - Problem Description:
Clearly specify the problem by identifying in terms what, who, where, when, why, how and how many (5W2H). Make sure that all team members understand the problem.

D3 - Development of Interim Corrective Actions to Prevent Damage:
Protect the customer from further defect products by blocking and marking the inventory and what is being produced. Also, identify what is in transit and report to the customer. To continue delivery, sort/ rework may be needed. Any rework has to be submitted to and verified by the customer.

D4 - Definition and Analysis of Root Causes:
Identify all potential root causes in all possible working area related to machine, man, method, material, measurement and environment that could explain why the problem occurred and why the problem has not been noticed at the time. Brainstorm to identify possible root causes and reasons why the problem occurred and was not detected before shipping to the customer. Verify TRUE root cause(s) based on facts.

D5 - Determination of Permanent Corrective Actions:
Confirm that the selected corrective actions make the problem permanently eliminated and no-recurring, so customer will be safe.

D6 - Implementation and Validation of Permanent Corrective Actions:
Define and implement the most effective corrective actions, and permanent corrective action. Check if the intended corrective actions solved the problem. Implementing and removing the corrective actions should work as a flip switch for turning on and off the problem.

D7 - Preventing the Recurrence of Problem:
The management and operation systems need to modify, review practices and procedures to prevent recurrence of this and similar problems. Review and improve the processes which prevent the recurring issues. Use Lessons Learned concept (Yokoten).

D8 - Congratulate and Recognize the Team:
After the team task is completed and project results meet all customer requirement, the team needs to be formally recognized for all collective efforts and thank them formally.

Need to summarize team’s experience and knowledge and complete documented information for 8D report [3] [4].

1.3 Supporting tools for analysis
a) 5W2H FORM
5W2H is used to define and understand the extent of the problem by asking 7 questions:
• WHAT happened?
• WHY is it a problem?
• WHEN did it happen?
• WHO detected it?
• WHERE was it detected?
• HOW was it detected?
• HOW MANY?

b) ISHIKAWA (FISH BONE GRAPH)
The way to gather all possible causes to a problem we are used this structure:
c) 5WHY FORM
This question-asking technique is used to find sequential causes for the failure and identify the failure path.

| Why | 1 | 2 | 3 | 4 | 5 |
|-----|---|---|---|---|---|
| Occurrence | Why did the problem occur? | Why? | Why? | Why? | Why? |
| Nozzle suction failed to pick up drum core | Suction dirty from foreign material | Some of adhesive suck by suction when drum core missing | • Machine cannot stop when drum core missing | No sensor for detect drum core missing | |
| | | drum core not enter at slider | drum core dimension at high limit | Material issue | NA |
| Leak out | Why wasn't the problem detected? | Why? | Why? | Why? | Why? |
| Taping operator failed to detect stamping wrong direction | Sequence checking is not standard | Sequence checking does not include in process control items | Sequence checking is not clearly highlighted into operation instruction | Sequence checking does not include in FMEA study | |
2. METHOD OF RESEARCH

A series of phases that are used in this research is 8D with supporting tools for analysis:

Table 2.1 Customer Claim Report

| No. | Claim          | 2018 | 2018 | 2020 |
|-----|----------------|------|------|------|
| 1   | Dimension Out  | 1    | 2    | 2    |
| 2   | Silver Mark    | 1    | 0    | 0    |

Table 2.2 In-proses dimension out defect (Jul - Sept 2020)

| No. | Type of Defect | Jul   | Aug   | Sept  |
|-----|----------------|-------|-------|-------|
| 1   | Dimension Out  | 0.02% | 0.09% | 0.07% |

Figure 2.1 8D Procedure

3. RESULTS AND DISCUSSION

This research tries to explore various reasons & find solution of repeating dimension product out of spec customer claim in automotive injection plastic supplier. For the conduct of research, detailed steps were applying the 8D Method which each stage are:

Step D0: Prepare and Plan for the 8D

First step for analysis purpose, we collected in the past three months rejection data for dimension product out of specification. Dimensional variation product (dimension product out of specification) is a defect produced by the molded which part dimension varying from batch to batch or from shot to shot while the machine settings and molded remain the same. To identify process defect, Pareto analysis has been carried out. The purpose of this step was to focus on the major issue. The following table shows the procedure for collecting necessary data:
Figure 3.1 Defective breakdown by machine and defect type (Jul-Sept' 20)

Step D1: Establishment of Team
Cross functional team was formed to solve the major issue. Team leader appointed from whom the ones with problem-solving skills from different divisions or departments representing the possible origin of cause. Selected members have adequate knowledge about the process and product. They know about where the problem occurred, why the problem happened, and they have experience to solve the problem by technical disciplines skill and improve these condition by implementing several alternative solutions.

Table 3.1 D1 Team members

| Department            | Name      | Title                |
|-----------------------|-----------|----------------------|
| Quality               | Ely R     | Quality Inspector    |
| Quality               | Sri Anik  | Quality Supervisor   |
| Production            | Arifin    | Production Manager   |
| Maintenance           | Imam S    | Maintenance Supervisor|
| Production Engineer   | Aditya S  | Product Engineer     |
| Production            | Sukardi K | Production Supervisor|
| Purchasing/Warehouse  | Irawati S | Purchasing Supervisor|

Step D2: Problem Description
This step is one of the most important steps and it is crucial for solving the problem. Problem in details and clearly identified will be solved using this step, and this problem is specified in detail by quantifiable parameters. We are usage 5W2H tools analysis, which the form is given in table 5 below.
Table 3.2 D2 Problem Definition

| Customer Name | PT XYZ Tbk |
|---------------|------------|
| Containment Action | NG (scrap or reject) |
| Customer Location | Gresik, Indonesia |
| Lot No. | LQ4012-10-A2020 |
| Customer Contact | Yoshima Kaneguchi |
| Claim Status | Recurrent |
| Supplier Part No | SLO 0350041365 |
| Part Name | SLCR 30 |
| Failure Rate or Quantity | 400 pcs |
| Defect Category | Major |
| Manufacturing Date | 26.10.2020 |
| Problem Description | Diameter product out spec: STD: 310 ± 2 ACT: 307.52 - 307.58 mm |

Step D3: Development of Interim Corrective Actions to Prevent Damage

The ultimate aim of this step is controlling the process in order to non-compliance product is not sent to the customer. This step is only as immediate protective action and often has no connection with the causes of the problem.

Table 3.3 D3 Development of Interim Corrective Actions to Prevent Damage

| SPECIFIC CONTAINMENT ACTION (describe): | Quality Alert was posted at production floor in order to let all section in-charges understand and know the customer quality issue. |
|----------------------------------------|--------------------------------------------------------------------------------------------------|
| Temporary actions to contain the problem and "fix" until permanent corrective action is in place (validate that the actions taken work) | |
| Quality Alert in Place | Yes | No |
| Material In Process (Qty) | Good | NA | Bad | 0 pcs |
| Material In Warehouse (Qty) | Good | NA | Bad | 0 pcs |
| In Transit (Qty) | Good | NA | Bad | 0 pcs |
| Customer Warehouse (Qty) | Good | NA | Bad | 0 pcs |
| Certification Marks On Parts/Boxes | Yes | x | No | 0 pcs |
| Conforming Material Expected Date | 11 | 5 | 2020 |
| mm | dd | yyy |
| Marking Method | Red Marking Passed |
Step D4: Definition and Analysis of Root Causes

1. Technical root cause analysis

Analyze all the potential root causes of the issue carried out by engineering team and QC team. Root causes analysis is defined by one or more of the following tools 5Why, Brainstorming or fish bone diagram as below:

![Fishbone Diagram](image)

**Figure 3.2 Dimension out fishbone graph**

2. Leak out 5Why root cause analysis

Failure mode was identified. Mold was found as a root cause to produce variation of dimension product because its design was the problem due to cavity design problem. Dimension out of specification were detected after production process.

| Leak out | Why wasn't the problem detected? | Why? | Why? | Why? | Why? |
|----------|----------------------------------|------|------|------|------|
| Dimension out of specification passed from inspection process | Product shrinkage after checked | Checking was performed during shrinkage period | Timing checking did not include in standard checking method | PFMEA was developed without considered for timing control |

Table 3.4 Leak Out 5Why Root Cause Analysis

Step D5: Determination of Permanent Corrective Actions

Corrective actions clearly linked to all individual root causes analysis for both failure occurrence and failure of leak out. The purpose of fifth discipline of the 8D is to choose the best permanent corrective action to eliminate the root cause of problem and the best permanent corrective action for the location of leakage.
Table 3.5 D5 Determination of Permanent Corrective Actions

| PIC    | Due Date  | Status |
|--------|-----------|--------|
| In order to minimize dimension product out specification, our team determine improvement items as below : |
| Corrective Action for Occurrence Root Cause |
| Perform daily injection parameter checking in order to confirm machine performance. | Imam | 20-Nov-20 | Ongoing |
| Modify all mold cavity on the center limit of dimension product | Imam | 20-Nov-20 | Ongoing |
| Corrective Action for Leak Out Root Cause |
| In order to validate effectiveness of implemented corrective actions, the next new production lot orders will be 100% inspected. | Arifin | 11/10/2020 | Ongoing |
| Review SOP dimension product inspection method to add: |
| - Cooling time product before check | Srianik | 11/10/2020 | Ongoing |
| - Product laying position checking method |

Step D6: Implementation and Validation of Permanent Corrective Actions
The aim of sixth discipline of 8D is validating effectiveness after implementing corrective action and ensuring there are no negative consequences. Important thing is effectiveness of each corrective action was properly evaluated. Ensure there is evidence that the failure mode/defect has not reoccurred. It is detected by 100% confidence and quality of process manufacturing system were updated as a result.

Table 3.6 D6 Implementation and Validation of Permanent Corrective Actions

| Permanent Corrective Actions                                                                 | PIC    | Due Date  |
|---------------------------------------------------------------------------------------------|--------|-----------|
| In order to validate effectiveness of implemented corrective actions, the next new production lot orders will be 100% inspected | Arifin | 10-Nov-20 |
| Perform daily injection parameter checking in order to confirm machine performance.       | Imam   | 10-Nov-20 |
| Review SOP dimension product inspection method to add:                                        | Srianik | 12-Nov-20 |
| - Cooling time product before check                                                          |        |           |
| - Product laying position checking method                                                     |        |           |
| Information regarding maintenance routine will keep into internal maintenance record        | Imam   | 9-Nov-20  |

Step D7: Preventing the Recurrence of Problem
In this step we established preventive actions to avoid occurrence comparable problems in the other production processes and products. Also,
we updated the necessary system including policies, practices and work procedure to prevent problem and similar ones (eg. control plan, work instruction, standard operation procedure, and inspection sheets) reoccurrence of this.

Table 3.6 D7 Preventing the Recurrence of Problem

| Preventing the Recurrence of Problem                                      | PIC    | Due date   | Status |
|--------------------------------------------------------------------------|--------|------------|--------|
| • Training to all related section with direct interaction will be conducted | Maulida | 2-Nov-20   | Done   |
| • Implementation of corrective actions to similar process                | Srianik| 12-Dec-20  | Ongoing|
| • Patrol check by QC leader by 2 hourly                                  | Ely    | 10-Dec-20  | Ongoing|

Review All affected document/systems

| Document                                      | PIC   | Completion date | Doc .No. |
|-----------------------------------------------|-------|-----------------|----------|
| Corrective action validation                  | Sri anik | 15-Dec-20       |          |
| Maintenance Routine                           | Imam  | 10-Oct-20       |          |
| Maintenance Routine                           | Imam  | 10-Oct-20       |          |
| Training                                      | Ely   | 17-Oct-20       |          |
| Update PFMEA                                  | Ely   | 13-Nov-20       |          |
| Update Control Plan                           | Ely   | 19-Oct-20       |          |
| Update SOP and WI                             | Ely   | 28-Nov-20       |          |
| Others (Define)                               |       |                 |          |

Step D8: Congratulate and Recognize the Team

We conducted final meeting with the 8D team to review and evaluation of steps D0 thru D7. Conclusion of the problem solving with agreement of the involved persons and also customer. 8D activities related to this problem finally concluded and no open or "in-progress” action items. Recognize each team member and their contributions and also obtain customer approval to formally closed the 8D’s.

Table 3.7 D8 Congratulate and Recognize the Team

| Lessons Learned                                                                 | PIC                | Due date | Status |
|---------------------------------------------------------------------------------|--------------------|----------|--------|
| • Dimension out of specification will be improved                               | All section related | 15-Dec-20 | Ongoing|
| • Set up meeting to review the implementation of each corrective action, and then close the 8D's report | Arifin             | 16-Dec-20 | Ongoing|

Management review and approval

| Yes/No  | Title       | Name     | Date    |
|---------|-------------|----------|---------|
| Yes     | Quality Manager | Suyitno  | 20-Dec-20 |
| Yes     | Plant manager     | Hendra S  | 20-Dec-20 |

4. CONCLUSIONS

After implementing permanent corrective and preventive actions and closing the 8D activity were observed in next 5 days production lots for the issue of dimension out of specification, the total rejection reduces from 0.07 % to 0.01 %. In terms of customer
complaints need to be monitoring continuously until the improvements that have been made prove effective.

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