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Application of 8d methodology - an effective problem solving tool in automotive industry

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Abstract: Quality plays an important role in an organization from automotive industry to become more efficient and effective in the global market. In this sector there are many requirements to problem solving process using standardized methodologies, according to international standards. 8D methodology has become very popular among manufacturers because it is effective to use. The aim of this paper 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 company from automotive industry. The results can be used by the management in continuous improvement as additional motivation for more effective use.

Keywords: 8D, QRQC methodologies, problem solving, quality improvement

1. Introduction

The automotive industry is one of the most important sectors of the global economy. Improvement in quality of product and process is necessary for any company from this sector in order to survive and to grow in competitive market. For this, problem solving techniques are required by the quality management in the automotive industry. Regarding quality management, problem solving is fostered by the Measurement Systems Analysis work group [1], [2] and the standard IATF 16949:2016 of International Automotive Task Force [3], [4], [5] for automotive industry. The goal of this QMS standard is the development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain. According this standard, the organization shall have a documented process for problem solving including: root cause analysis, methodology used, analysis and results. One of the methods used is 8D methodology based on Quick Response Quality Control (QRQC) tool. The 8D method (also called G8D, Global 8D, TOPS 8D) is one of the most widely used problem-solving tools related to nonconformities reoccurrence prevention in the manufacturing process, commonly used for complaints management in automotive industry. It consist of 8-steps to be followed by quality improvement team for problem solving as well as for product and process improvement [6]. QRQC is described as a quick and comprehensive problem-solving process for the industrial and services sectors that ensures problems

do not reoccur while at the same time establishing dynamics of continuous improvement and modifying management culture. This paper presents the 8D methodology through case study for improving of quality in the automotive industry for powder painting processes.

2. 8d methodology

The 8D methodology is effective in developing proper actions in order to eliminate root causes and in implementing the permanent corrective actions to eliminate them. It also contributes to explore the system of control that allowed the escape of the problem [7], [8], [9]. The 8D methodology involves teams working together in order to solve quality problems, using a structured 8 phases, table 1 [9].
QRQC is a quality tool support of the 8D methodology. The basis of QRQC is the quick answer to a quality / manufacturing issue no matter if it's an external / internal customer or a supplier.

Table 1. Phases of 8D Methodology

No.	Phase of the 8D methodology	Description
1	Problem description	To identify the problem, the 8D team tries to acquire more information as possible from the customer, which constitutes the first analysis performed in the problem-solving process. The location and nature of problem must be given along its effects. Another important information is whether the problem included is intermittent or whether it could happen on similar products or processes. While depicting the problem, the 5W (Who, What, Where, When, Why) And 2h (How, How Many/Much) method should be used, where the accompanying inquiries must be addressed completely and efficiently and WHY for each question. The responses to these inquiries help us clarify the background and connections.
2	Reference to similar products	This phase is done with the purpose to detect other products with the same nonconformity risk. The subsequent aspects must be taken into consideration: the list of the detected problems, the place of their detection, the technological process in question, what other parts are realised in the same process, whether here is also a nonconformity risk in what they are concerned, where these parts are used.
3	The first analysis	In this step identification of genuine cause and determination of restorative measures aimed to solve the problem permanently. To obtain root cause, all the causes which are found wrong are wiped out. Both the manufacturing process and the control process are taken into account. The point where the problem has escaped the control system (escape point) must be sought for and detected, as well as the moment when it could have been detected.
4	Immediate action plans	Measurements are carried by two means, it is carried out by • means of control devices (digital data and outputs are associated to computers) • means is carried out by using statistical methods: statistical Process Control, Process Capability (cp), Process Capability index (Cpk), histograms, and Pareto diagrams.
5	Final analysis	This phase is carried out with the purpose of obtaining a real and complete of the situation in order to find the root causes and to decide the optimum actions required for the treatment of the causes. This phase aims at finding the causes, not the solutions. Final analysis implies a detailed analysis of the data. For this purpose, multidisciplinary team work is used; such teams go on the respective site in order to understand the problem. It must be noted that most of the complex problems usually have more than one root cause that interact with each other. The validity of these causes should be verified because it is essential to treat the real causes.
6	Final action plans	Establishing an implementation plan for permanent corrective actions. Permanent actions are analysed and applied in order to prevent the recurrence of the problem permanently. The final elimination action must be focused on the real main root causes (phase 5) and on the escape point (phase 3). Thus the aim is to solve both the root causes of the problem, as well as the root causes of the failure to detect the problem. In order to prevent the recurrence of the problem, a number of actions are applied: updating procedures, training the personnel.
7	Confirmation of the action plans	Phase 7 of the 8D method is very important due to the fact that it allows for the closing of the action plans. The effectiveness of the final action plans is checked. It is a key stage meant to avoid the recurrence of the quality problem. The Supplier Quality Service will require evidence of the effectiveness of the action plans and, in order to be able to validate the 8D, may also perform an audit if it finds that the effectiveness of such actions is not trustworthy. So long as the effectiveness of the actions is not proven, the supplier should make sure that it supplies 100% good parts by carrying out checks. The Supplier Quality Service will be notified in what the results of such checks are concerned.
8	Preventing a recurrence of the problem	In this step the 8D team analyse whether the corrective action executed would avoid or enhance the quality of similar products and processes.

3. Case study

In our paper, we have focused on the use of 8D methodology to solve the various problems encountered in the production of automotive components. In our case it was a problem that occurred during powder painting processes, Figure 1. The problem was identified in the Quality Wall by an operator. Powder painting is the application of solid powder to create industrial coatings.
The powder is applied by an electrostatic process to a substrate, usually metal, and acquires excellent properties when the particles are heated and polymerise on the substrate. This method is widely used to protect surfaces and ensure a pristine finish that cannot be achieved with regular paints.

Date: 30.09.2019
Part name : Bar HJD PH3 ROOF BAR
Part number : 112240
Impurities and cavities on the surface of the bars
Quantity: 229 parts

Nonconforming part	**Conforming part**
	

Figure 1. Nonconforming painted parts

This problem was solved by using 8D and QRQC methods. The stages of the methodologies are shown below in the table 2 - 9.

Table 2. Problem description

Reference Number: 112240	**Issued by:**	**Validated by :**
Parts name: Bar HJD PH3 ROOF BAR	**Function**	**Function**
	Date 30.09.2019	**Date: 30.09.2019**
1. Details of the problem	**Date:**	
Report N°: 6102-3339	**Affected quantity: 229**	
Description: *Impurities and cavities on the surface of the bars* Why is it a problem? Visual problem. Who detected the problem? Customer Who generated the problem? Supplier How was the problem detected? Customer production line visual control When did the problem occur? 30.09.19 When the part has been produced? 18.09.19 How many? 128 Nonconforming bars and 229 Nonconforming painted bars		

	Yes	**No**
Recurrence		√

Table 3. Reference to similar products

2. Other concerned similar products?			
Can this defect appear on other similar parts?			
	Yes	**No**	**Comments / Results**
Other pieces	√		
Products same family	√		
Left / Right	√		
Symmetric product		√	
Front / Back		√	
Others		√	

Table 4. The first analysis

3. First analysis

At this step we used QRQC methodology, a tool for quick resolution no repletion the problems. It uses tools as Ishikawa diagram and 5 Why.

5W1H method allows the problem to be broken down and determine a root cause.

Description of the problem	**Results**
What is the problem?	Impurities and cavities on the surface of the bars
Who detected the problem?	Operator
Where was the problem detected?	Quality Wall
When was the problem created?	30.09.2019
How many?	229 parts
Why is it a problem?	The client's requirements are not respected

The cause of this problem will be further investigated using the Ishikawa diagram, figure 2 (which is also named Fishbone). That constitutes a significant point in the topic of methods for problem solution is actuating as a key tool to solve assembly and maintenance troubles in the automotive and transport sectors. It is used to identify possible causes of a specific problem.

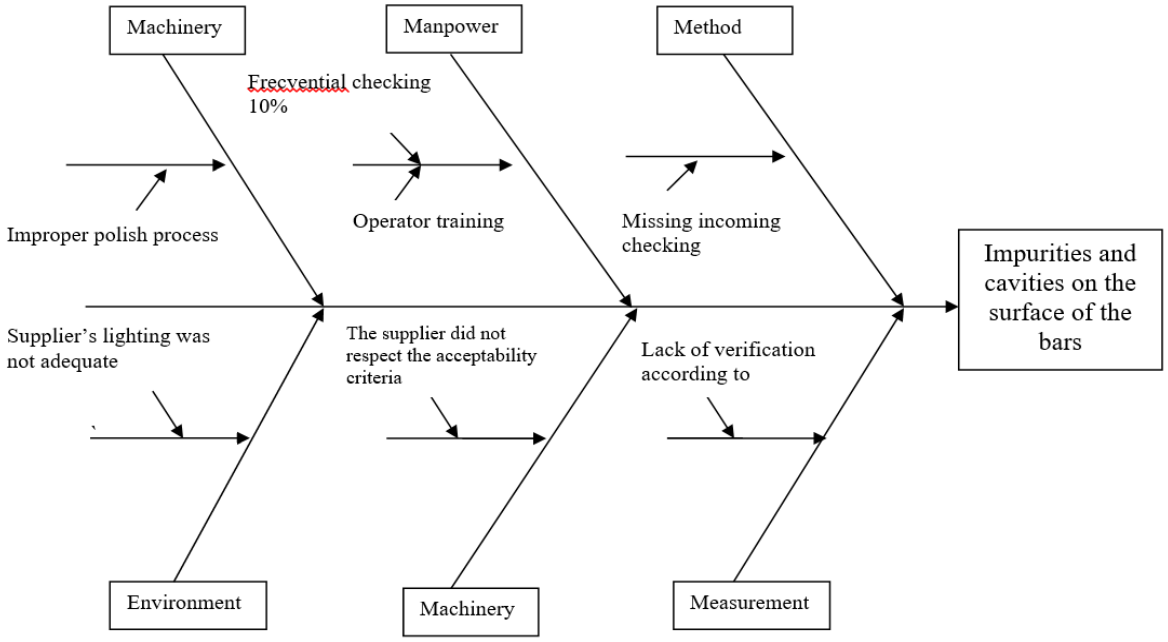

Figure 2. Fishbone for impurities and cavities on the bars surface

5 Why it is a simple approach to explore the causes until the root cause is reached.

Why?	Why?	Why?
Parts have small scratches, which can be seen after painting process.	The raw material had scratches, which stay even after the surface treatment processes. The parts with small surface failures were not detected.	Operators were not enough informed about the surface criteria.

The *non-detection actions* for the pallet support product in the table 2 are identified below.

Non-detection actions	Department
Elaboration of the pickling verification method	Methods
Instruction sheet for checking the bars support after pickling	Methods
Identification of the defect in critical board	Quality
Instruction sheet for checking rust on the bars support	Methods

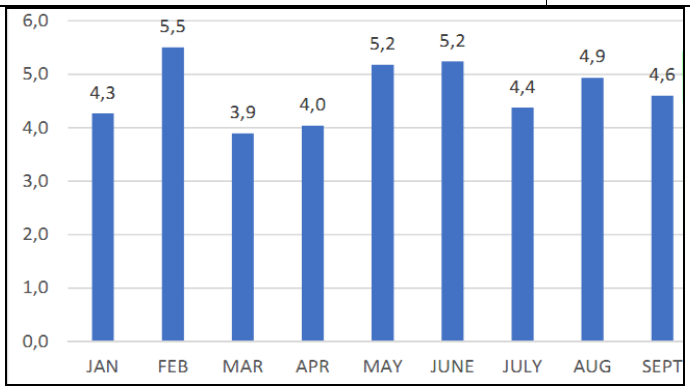

Figure 3. Failures evolution

Before the analysis, the average of the failures was 4.6, figure3, after the analysis the results obtained will be analyzed.

Table 5 Immediate action plans

4. Immediate action plan			
Which are the actions began to prevent the delivery of not corresponding products to customer?			
	Actions	**Quantity conform**	**Quantity Not conform**
During the manufacture process		0	0
Current stock		0	0
Stocking in Shop		0	0
Spare pieces		0	0
Others		0	0
How are OK products identified? Labeled: Checked 100%			
Expedition date / Remarks			

Table 6 Final analysis

5. Final analysis	**End date of analysis**	**20.10.2019**
Indicate the real causes on the whole Process: * Man, Material, Machine, Methods * Who, Where, When, Why, How * Changement de fabrication. Processus de Retouches * Maintenance		
Causes:	**Responsibility**	**Department**
Nonconforming self-control	D.G.	Production
New products, undisclosed by operators	P.R.	Production
The hanging of parts on the carriers is nonconforming	P.R.	Production
The available conditioning does not protect the parts against scratching due to contact between them	C.A.	Quality
The instruction sheet about the parts hanging is missing	P.R.	Production

Table 7 Final action plans

6. Definitive action plans	**W49**	
Actions	**Service / Responsibility**	**Date**
Realization of a Quality Alert	Quality	W48
Sorting in the customer plant	Production	W48
Sorting in the logistics platform	Production	W48
Sorting in lorries being loaded or on the road	Production	W48
Training of the operators about the failures and the company control criteria	Production	W48
Visual control and marking has been implemented after bending process to increase awareness on surface failures at polishing operation	Production	W46
Training of the operators concerning the parts hanging on the carriers	Production	W48
Visual control has been improved after painting process by adding additional visual control	Production	W48
Defining, with the customer, the conditionings to protect the parts during transportation	Quality	W49
100% Control and labeling of the first three deliveries	Production	W48

Table 8 Confirmation of the action plans

7. Action Plans Confirmation	**Validation date**	**20.10.2019**
The begun actions were confirmed like effectives?	**Yes**	**No**
	√	
Comment? *8D audit performed to demonstrate if the actions are sustainable and effective.*		

Table 9 Preventing a recurrence of the problem

Preventing a recurrence of the problem	**Closing Date:**		
After the update of the actions, the following subjects require one updated?			
	Yes	**Responsibility**	**Date**
All actions validated and put in place	√	Production	04.11.2019
Product FMEA and/or Process updated	√	Quality	04.11.2019
Control plan updated	√	Quality	04.11.2019
Update procedures	√	Production	04.11.2019
Instructions (control monitoring plans)	√	Production	04.11.2019
Specifications adapted (only in project)	√		n/a
Product / process design guide updated (only in project)	√		n/a
Lessons learned created and shared	√		04.11.2019
The audit performed by Quality and manufacturing at the naintenance operation level 1	√		
Each month, an information session on customer complaints and nternal complaints will be organized within the welding workshop	√		

The final stage of the 8D report aims to summarize all the experience and knowledge of the team, as well as the documentation used to prepare the 8D report. After taking the permanent corrective and preventive actions and closing the 8D activity through quality planning, the average of the failures reduces to 4.6 from 2.4.

4. Conclusions

The 8D methodology used in this paper is an excellent tool for solving the problem as well as for preventing defects from reoccurring. It is practical and simple sheet, which use isn´t allwasy easy. Appear as one of the basic problem solving methodology, 8D offers an essential solution from identifying the root cause until the implementation of preventive action. When solving a complaint, 8D reports are always demanded form suppliers. A future work can be suggested for other production

cases in which the 8D methodology to be used like a support for Failure Mode & Effect Analysis or Quality Assurance Matrix - tools for quality improvement in the automotive industry.

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