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8D REPORT AS THE PRODUCT IMPROVEMENT TOOL

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ABSTRACT

Nowadays, all companies look for ways to ensure that the products they manufacture are of the highest quality and that they meet all expectations of customers, thus increasing their satisfaction. It should be noticed however that the business environment, customer expectations, and the products of competitors are changing. Furthermore, production technologies and machines are becoming obsolete. It is therefore necessary to seek new solutions to improve what is done. To achieve this goal, various types of quality management or improvement tools can be used, such as the 8D Report. This paper aimed to analyze the production problems occurring during the production of window slides using the 8D Report in a company producing stamped metal parts for the automotive and home appliance industries. This analysis was carried out based on complaints submitted by the main business partner. Once the root cause of the problem was identified, permanent corrective actions were planned and implemented according to the 8D Report, which also helped to reduce the likelihood of recurrence of this and other similar problems. The case studied has demonstrated that with the combination of knowledge and experience of the team, the application of modern quality tools offers concrete and measurable effects and allows solving problems, which before the preparation of the Ishikawa diagram, the Pareto chart, and the 8D Report were considered impossible to solve by the employees of the enterprise studied.

KEYWORDS: Production engineering; quality management; improvement; 8D Report.

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1. INTRODUCTION

Enterprises operate in a dynamically changing environment. Customer requirements concerning the products or services offered are changing, as are the materials, technologies, laws, and regulations available. Resources are also transformed. Therefore, it is important to keep track of the changes and to continuously improve in order to meet these changing conditions (Krynke et al., 2014; Klimecka-Tatar and Ingaldi, 2020).

It should be emphasized that ordinary employees who directly manufacture products, perform quality analysis, or prepare production resources often know the processes that take place in the enterprise. Managers can use their knowledge to solve problems and improve the company. They should be provided with a simple tool that does not require too much training and that can be used by employees to solve the problems they encounter in the enterprise (Ulewicz et al., 2019; Knop, 2019; Pacana and Czerwińska, 2020).

With the changing environment, in addition to the need for change and improvement, every enterprise, regardless of the sector, size, or experience, must solve various problems. They are an indispensable part of the business operation and are often impossible to predict. Some problems are easy and quick to solve; however, there are also problems whose solution represents a substantial challenge for the enterprise. Many of them occur repeatedly and unexpectedly, and the problem is not solved but only temporarily hidden. Observation of the production process provides an opportunity to respond immediately to any deviations. However, it should be noticed that the emergence of problems can also be treated as an opportunity for improvement.

The 8D Report is one of the methodologies used to solve RCA (root cause analysis) problems in a standard and systematic way. It allows for a systematic approach to solving problems and stimulates the process of continuous improvement in the enterprise. It is a multi-stage procedure that uses other tools and methodologies of the quality management system to effectively handle internal and external problems (complaints). The analysis is based on standardized eight stages. The stages provide an opportunity to identify the causes of the problem and to specify the corrective actions required. Following the guidelines of the 8D Report will save time and ensure a comprehensive approach to the problem (Rambaud, 2006; Šolc et al., 2017; Cao and Guo, 2015). The 8D Report should be prepared with due diligence and the root cause of the problem should be identified. The analysis should avoid focusing on human error. Rather, the causes of the problem should be sought in the system that failed to prevent an employee from making mistakes.

The aim of the paper was to analyze production problems occurring during the production of window slides using the 8D Report methodology. This analysis was carried out based on complaints submitted by the main business partner. The 8D Report revealed the root causes of the problem and helped develop corrective actions that would prevent the problem from recurring in the future.

LITERATURE REVIEW

The 8D Report allows identifying, improving, and eliminating external (customer complaints) and internal (problems reported by employees or identified using the standard quality control procedure) errors. The problems reported are important in terms of quality costs (Jujka et al., 2015; Realyvásquez-Vargas et al., 2020).

It should be emphasized that the 8D Report is based on the multi-stage work of the entire team, which in turn uses effective methods and tools for quality management or improvement. Therefore, it cannot be treated as a method, but as an orderly process that consists in using specific procedures when solving a problem (Kowalczyk, 2012; Rambaud, 2006; Šolc et al., 2017).

An 8D Report is a tool for team-based problem solving. It was developed by engineers of Ford Motor Company to improve the quality of products and processes at Ford. The engineers worked based on the military standard “Corrective action and disposition system for nonconforming material” of 1972. Based on this standard, they developed training materials in 1987, named “Team-based problem solving”. The materials outline clearly defined procedures, consisting of eight stages and were thus called 8Ds (eight disciplines). The 8D methodology can be used by anyone. It is used to solve various problems, not only those arising in the production line. Ford Motor Company has popularized the method to such an extent that it has become well known in the automotive industry and is the most widely used method in automotive companies (Ćwiklicki and Obora, 2009; Rambaud, 2006; Xu et al., 2018; Kaplík et al., 2013; Cyganiuk et al., 2019; Klimecka-Tatar, 2020).

The procedures based on the 8D methodology are typical for handling external complaints and building customer-supplier relationships. However, this approach should not be viewed only as the 8D Report, since the methodology can have many different applications. It is used not only to handle customer complaints but also to solve many problems that arise during the entire production cycle. It consists in properly finding the root cause of the occurring problem, eliminating it, and introducing measures to prevent its recurrence. The method is typically used within the organization and its results can be presented to the customer as requested (Alexa and Kiss, 2016; Behrens et al., 2007; Wahjoedi, 2020; Łuczak and Maćkiewicz, 2006; Kumar et al., 2017; Grecu et al., 2015).

The primary objective of the methodology is to implement and consolidate corrective actions in relation to the quality management system. It comprises eight stages, which set out a procedure to follow an established pattern. Each of them must be recorded in a document called 8D Report.

At the very beginning, a meeting is organized to appoint (based on the principle of interdisciplinarity) a team that will employ the 8D methodology. The roles of individual team members are established. The team members familiarize themselves with the principles of work and make suggestions for modification of the group composition (Łuczak and Maćkiewicz, 2006; Chlpeková et al., 2014).

Next, a detailed description of the problem is prepared. The description is often made by placing comparative photos of the complete product and faulty product in the 8D report. Such a comparison guarantees a precise depiction of the non-conforming part. During the second stage, the group members identify the problem by asking themselves the following questions (Łuczak and Maćkiewicz, 2006):

- What happened?
- What's the problem?
- When did this happen?
- Who found it (operator's name)?
- How was the defect found?
- How many defective products were found in total?

The third step is to eliminate the problem immediately. The actions performed during this step are temporary. They are designed to prevent the recurrence of defects in subsequent deliveries of products to customers until effective corrective actions are taken.

During the fourth stage, the team analyses the root causes of defects. Each member of the appointed group defines potential causes of the defects which, in his or her opinion, were not defined during the process design phase. Since the root causes of problems most often lie in the organization management, the team members identify the causes using the quality management tools they know and use in their company. The most common tools are the Ishikawa diagram, Pareto chart, histogram, scatter plot, and control charts (Magar and Shinde, 2014; Tague, 2005). The following questions should be answered to move on to the next step: Is the potential cause the origin of the problem? If not, one must look for another cause.

The fifth stage is designed to reduce the possibility of a problem arising in the future. The members of the team suggest corrective actions which they believe will effectively and permanently eliminate the recurrence of the same problem. It is often claimed that effective production requires the use of popular methods supporting quality management, such as FMEA, QFD, or SPC (Popa, 2011; Sher, 2006; Khorshidi and Gunawan, 2013; Zhao, 2011).

The sixth stage involves the implementation of the corrective measures identified during the previous stage. The effectiveness of these actions is also verified by controlling the quality of products and providing a percentage of the number of products in accordance with the standard. In the case of a negative assessment, the team returns to the fifth (or fourth) stage until the corrective actions are considered effective (Łuczak, 2015; Thompson and Taylor, 2008).

The penultimate stage consists in the development of preventive actions taken in the fifth stage. The aim of the seventh phase is to prevent the recurrence of similar problems in the future, not necessarily linked to those identified (Łuczak and Maćkiewicz, 2006; Nováková et al., 2017).

Eventually, the report is submitted to the manager who appointed the team responsible for the project. The contribution of the entire team and the individual participation of the group members is also discussed. Each activity carried out in accordance with the stages described above must be documented. The results of the analysis are documented in the form of a report (Łuczak, 2015; Biondi et al., 2013).

The 8D report is prepared in the form of a specially designed sheet. This can be done once the root cause of the problem has been properly identified. Following the instructions contained in the methodology ensures that the defect will not occur again in the future.

2. METHODS

The study was conducted in an enterprise that uses metal stamping technologies to manufacture products for the automotive and home appliance industries. Quality requirements are particularly stringent in the automotive sector. This is due to the serious consequences in terms of both costs and consumer safety. Even a small product defect can have disastrous consequences.

Despite an effective control process that prevented the enterprise studied from receiving complaints about the window guides for a long time, the first complaint was re-

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ported in January 2018, after two years of cooperation with the main partner in this area. It concerned the exceeding of length tolerance for the guide section from one hole to another (43+/- 0.02). In February, the complaint was repeated. The company solved the problem by providing the customer with good products and scrapping the incorrect ones. No cause of error was found. The problem was solved for some time, but after a month, the enterprise studied received another complaint with the same content.

The company could not find the cause. After a long analysis and observation of the production of window guides, the team failed to find the causes of continuous problems with the same dimension (43 +/- 0.02), which made it impossible to install the guide in the car window. The problem was difficult to detect because it occurred randomly. The standard production inspections every hour often failed to reveal any deviations, but there were faulty products between the individual inspections which could only be detected using 100% quality control.

The managers asked the authors for help in improving the quality of manufactured products. The authors were to choose a research method, but also participated in the analysis as members of a six-person research team.

The 8D report was used to analyze the problem, which allowed identifying an important cause of the defect and helped eliminate it. This analysis was preceded by defining a problem using two important quality management tools, i.e., Ishikawa diagram (Suarez-Barraza et al., 2019; Jalal et al., 2019; da Silva et al., 2019) and Pareto chart (Zdrazil and Applova, 2016; Hajizadeh et al., 2015).

3. RESULTS AND DISCUSSION

The Ishikawa diagram was used to identify the main causes of defects related to dimension 43 +/-0.02 being out of tolerance, which made it impossible to assemble the window guides. The analysis started with a brainstorming session in order to collect all possible causes that were responsible for the problems with the installation of the window guides. Further analysis allowed for the division of the causes into six categories (method, man, machine, material, management, and environment). The prepared Ishikawa diagram is presented in Figure 1.

Figure 1 shows the cause-and-effect diagram for the occurring error and identifies the likely causes of the defect. The two most influential factors in the figure are men and their surroundings. The origins of the problem should be sought within these categories.

In the following stage, the team prepared the Pareto chart. The analysis revealed the most common causes of the production problem. Each expert assessed the causes on a scale of 1 (least significant) to 6 (most significant) on the Ishikawa diagram. They had to evaluate six selected causes of problems and, importantly, each person was allowed to use each assessment only once. The diagram identified the most important causes that most contributed to the error. Chart 1 contains the data necessary to draw the Pareto chart, while Figure 2 shows its graphical interpretation.

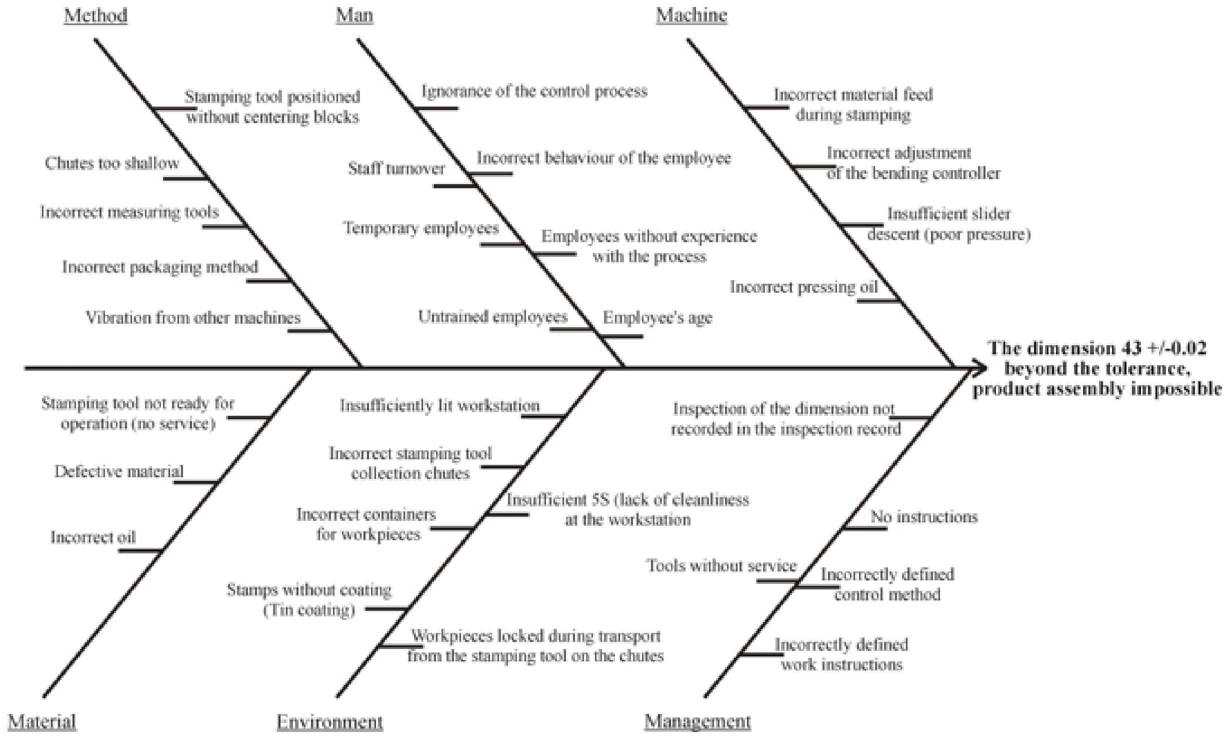
Chart 1. Data of the Pareto chart for the defect studied

No.	Type of defect	Total number of assessments of individual defects	Relative number (%)	Relative cumulative number (%)
1	Workpieces locked during transport from the stamping tool on the chutes	34	27.42	27.42
2	Untrained employees	21	16.94	44.36
3	Inspection of the dimension not recorded in the inspection record	16	12.90	57.26
4	Incorrect stamping tool collection chutes	13	10.48	67.74
5	Incorrect containers for workpieces	13	10.48	78.22
6	Incorrect packaging method	12	9.68	87.9
7	Chutes too shallow	5	4.03	91.93
8	Incorrect material feed during stamping	5	4.03	95.96
9	Tool without service	4	3.23	99.19
10	Incorrect pressing oil	1	0.81	100
	Total	124		

Source: own study

Figure 2 shows that five different defects determine 80% of problems occurring during the window guide production: workpieces locked during transport from the stamping tool on the chutes, untrained employees, inspection of the dimension not recorded in the inspection record, and incorrect containers for workpieces. However, it was impossible to identify the cause that particularly often led to defects. It was only observed that one of the dimensions in the inspection record was beyond tolerance (43 +/- 0.2).

Figure 1. Ishikawa diagram for the defect studied



Source: own study

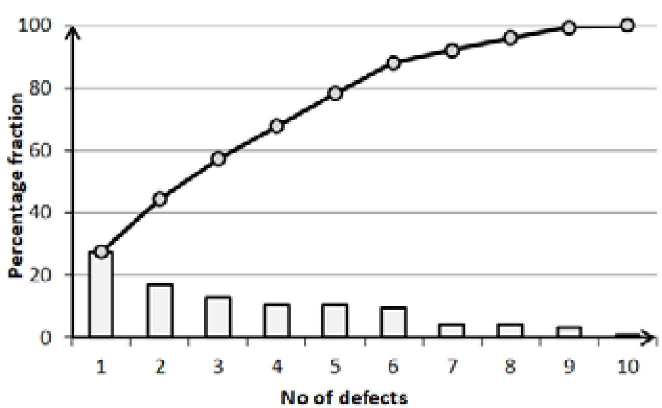


Figure 2. Pareto chart for the defect studied

Source: own study

However, after the analysis of the Ishikawa diagram and Pareto chart, it was found that the problem is caused by the workpieces locked in chutes. The chute is presented in Figure 3, and it is designed to move the workpieces during transport from the stamping tool to the container with the finished product.

Figure 3. The chute used in the enterprise studied

Source: own study

The 8D report was prepared after identifying the main cause of the problem. Chart 2 presents the 8D report, prepared after a comprehensive analysis, and taking corrective actions. Due to the requirement of confidentiality, some information was removed from the Report to prevent the identification of the examined object (including the names of persons responsible for individual actions, problem-solving team, and individual dates).

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Once the main cause of the problem was identified, permanent corrective actions were planned and implemented using the 8D Report, which helped reduce the likelihood of recurrence of this and similar problems. A detailed description of the problem was made by asking various questions related to the issue and adding photographs of the defect to the report. Quick actions were then implemented in the enterprise to eliminate the problem immediately.

The fourth section of the report identifies the cause of the problem. This stage required using the previously prepared Ishikawa diagram and Pareto chart, which detected the problem with the chutes. Using the 5-Why method, the following question was asked: Why are workpieces jammed when moving from the stamping tool through the chutes? This analysis helped identify a key problem, which was too deep a hole between the stamping tool and the chute, caused by too high a position of the chute, which caused random jamming of workpieces from time to time.

Once the main cause was found, corrective and preventive actions were specified to prevent the problem from recurrence in the future. The person responsible for each action was assigned and the dates of implementation were specified. Finally, the report was submitted to the Quality Manager.

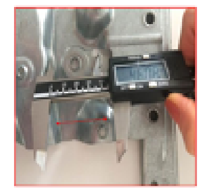
The analysis allowed for the development of the so-called quality alert, which is a warning message for machine operators. A quality alert is a kind of notification that contains the necessary information about the complaint such as the name of the part and the company for which it is produced, a description of the defect, and a definition of the effect that the defect may cause. The Production Director and the Quality Department organized a meeting to inform each employee about the problem. A quality alert was posted at every workstation where window guides were stamped.

4. CONCLUSION

The 8D report is used in virtually all manufacturing sectors. This method emphasizes both the indication of immediate solutions to the problem (interim containment actions) and the identification of root causes, followed by the determination of permanent corrective and preventive actions (systemic actions) enabling the definitive elimination of the problem. This method is based on the analysis of facts, i.e., the actual situation on the production line.

This study, based on the 8D methodology, demonstrated how a quality problem can be solved in a simple, logical, and standardized manner. However, this involves a lot of information acquired from various areas connected with the process that increase the likelihood of accurate identifi-

Chart 2. 8D Report

8D Report			
Informações básicas	Título: Furo muito pequeno para uma roda de polia Nome do produto: Guia da janela de suporte do motor Quantidade rejeitada: 450 Quantidade verificada: 16.000		
1. Equipe de solução de problemas	XXXXX		
2. Descrição do problema	O que aconteceu?	Dimensão 43 +/- 0,3 fora de tolerância.	Uma imagem de um produto defeituoso: 
	Qual é o problema?	Trabalho incorreto na última etapa da produção.	
	Quando aconteceu?	Durante a estampagem progressiva.	
	Quem percebeu?	Operador da empresa Slovakian Door Company.	
	Qual foi o erro detectado?	Durante a montagem do produto acabado.	
3. Ação imediata	Ação		Data da tomada de medidas:
	Informações sobre o problema para os operadores de imprensa		XXX
	Inspeção de peças na empresa		XXX
	Inspeção no local do cliente (cliente que faz uma reclamação)		XXX
	Ações adicionais: Classificação ou reparo às custas do fornecedor (no prazo). Coleta de peças defeituosas às custas do fornecedor. Raspagem às custas do fornecedor.		
4. Causa do problema	A principal causa foi a localização de rampas na altura incorreta. Elas estavam muito altas em relação à ferramenta de estampagem, e as peças estampadas que eram transportadas através das rampas para dentro das caixas ficaram presas. O defeito não foi descoberto imediatamente por que as peças defeituosas apareceram de forma aleatória. Durante muito tempo, as rampas transportaram peças consideradas como não-defeituosas no Registro de Inspeção, seguidas por várias peças defeituosas; no entanto, o operador, ao inspecionar as peças duas vezes ao dia, não encontrou o momento em que as peças defeituosas estavam na rampa. O curso do problema: Peças trancadas durante o transporte a partir da ferramenta de estampagem na rampa. ↓ As peças aderiram umas às outras até formar uma pilha. ↓ A primeira peça não caiu e as seguintes emperraram. ↓ A primeira peça ficou emperrada contra o orifício da rampa. ↓ O furo para os sensores indutivos de queda das peças de trabalho fez com que ficassem presas. ↓ O orifício era muito profundo (as peças ficaram emperradas).		Ferramentas auxiliares: Diagrama de Ishikawa, Gráfico de Pareto
5. Plano de ações corretivas permanentes	Ação:		Data da tomada de medidas:
	Novas rampas para a coleta de peças da ferramenta de estampagem		XXX
	Um sensor ótico adicional para parar a prensa se uma peça não cair da ferramenta.		XXX
6. Implementação de medidas corretivas permanentes e sua avaliação	Ações implementadas:		Data da tomada de medidas:
	1. Inspeção aleatória das peças no armazém.		XXX
	2. Registros no relatório de inspeção quatro vezes ao dia.		XXX
	As medidas implementadas tiveram os efeitos esperados? 1. Sim Quantidade verificada [peças]: 1288 Número de peças sem defeito [%]: 100%		Data da tomada de medidas: XXX
7. Ações preventivas	Ação:		Data da tomada de medidas:
	Alteração do manual de instruções referente à descrição da remoção dos produtos das rampas (inspeção visual cuidadosa dos produtos antes da embalagem).		XXX
8. Conclusões	Data de fechamento: XXX		

Source: own study

cation of the root cause. The focus of corrective and preventive measures on root causes prevents the occurrence of the problem in the future.

The paper analyses a selected production problem. An 8D Report was prepared. Therefore, the question "Why is this happening?" was asked four times. It was found that the workpieces after stamping randomly jam in the chutes. The phenomenon was not detected during the daily process control and making records because operators found non-defective workpieces. From time to time, there was a build-up of workpieces between the outlet of the stamping tool and the chute, with part of them transported to the containers. When there were too many of them, they were pushed and deformed before packaging, and the entire process continued correctly until the workpieces jammed again between the chute and the press. Once the main cause of the problem was identified, permanent corrective actions were planned and implemented using the 8D Report, which helped reduce the likelihood of recurrence of this and similar problems.

The case studied demonstrated that, combined with the knowledge and experience of the team, the application of modern quality tools offers concrete and measurable effects and allows solving problems. This is because before the preparation of the Ishikawa diagram, the Pareto chart, and the 8D Report these problems were considered impossible to solve by the employees of the enterprise studied. However, overcoming consecutive individual difficulties through regular actions leads to continuous improvement and increases the effectiveness of the system. Eventually, this leads to a reduction in the costs that result from poor quality, improving the position of the enterprise in the market, and increasing customer trust concerning the products offered.

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