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IMPROVING THE EFFECTIVENESS OF PROCEEDINGS WITH DISAGREEMENTS IN A PRODUCTION PROCESS WITH APPLYING OF REPORT 8D

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Abstract: The aim of the study is to use the 8D methodology to solve the production problem, which was the incorrect installation of the rings in the piston designed for excavators. The idea of the method used is to correctly identify the causes of the problem and implement corrective actions to prevent recurrence of the problem. In order to detect as many potential causes of non-compliance as possible, the working team conducted brainstorming sessions and then developed the Ishikawa diagram. Team members found that the most common source of the problem was human error. In order to eliminate it, it was decided to carry out a series of training courses and to additionally equip assembly stations. The presented methodology of solving quality problems can be implied in every production company.

Keywords: 8D report, kpis, production process, quality management

1. INTRODUCTION

The production process, in its essence, has always been exposed to the occurrence of incompatibilities and problems, which are usually caused by unforeseen events. However, errors that may occur or exist in the process can be identified by means of quality management methods and tools that enable the process to be monitored at each stage of product manufacture (Anette von Ahsen, 2008; Antosz, et al., 2013; Ebenzer et al., 2011). These instruments, when properly applied, allow for effective quality management and thus for making effective decisions on continuous improvement of production (Pacana et.al, 2018a, b; Ulewicz, 2018, Wolniak, 2011). Constant monitoring of the production process enables a quick reaction to any deviations that may occur between the implementation plan and the actual execution of a particular product. Emerging non-compliances determine changes in production activities in order to improve production efficiency, increase the level of process quality (minimising the occurrence of non-compliance) and avoid additional production costs (Iwasiewicz, 1999; Pacana et al., 2016). The quality control present in the production process also provides an opportunity to check whether there are any significant problems during the production process. However, errors and inconsistencies can be prevented before they

occur (before the process is started) or when the process has already started. Occurrence of problems in the production process determines the need to solve them in a current and effective way, such a solution helps to prevent the company from incurring much higher production costs than they were foreseen, in addition, the implementation of rapid corrective actions usually does not affect the increase in working hours (Łasiński, 2007; Łuczak et al., 2007).
In order to ensure a systematic and orderly way of solving emerging problems and incompatibilities as well as their transparent documentation, the 8D method is recommended (Łuczak et al., 2007; Pacana et al., 2017). This method combines a number of tools to support quality management, thus enabling a thorough analysis of the causes of possible and actual non-compliance (Golińska, 2018; Kapliık et al., 2013.).

2. METHODOLOGY

Commonly, the 8D analysis is associated with a form in which 8 steps are analyzed and filled in systematically by the quality department employees in case of customer complaints (Atigre, et al., 2017; Korenko, et al., 2013). Due to the lack of an internal procedure, adapted to the context of the organisation, for dealing with non-compliant products and due to a lack of understanding of the essence of the 8D analysis, in many organisations the form is developed by one person and, after it has been developed, it is immediately sent back to the customer (Golińska, 2018; Krajnc, 2012; Marksberry, et al., 2011).
In the case of research, the preparation of the 8D report included the stages and activities presented in Table 1.

Table 1
Stages of the 8D analysis

Stage of method 8D	Activities carried out under the different stages
0D - preparation for process 8D	Preparation for the 8D process In this step: • a complaint form has been prepared.
1D – establishment of the 8D work team	Proper selection of team members, bearing in mind that this is a prerequisite for success. In this step: • a list of the members of the working party is defined, • the function of each member of the working party is defined.
2D – problem definition	Based on collected data (measurable and reliable) and facts. In this step: • Historical data relating to the analyzed problem has been analysed, • Risks associated with the occurrence of non-compliance have been identified, • Problem to be analysed.
3D – implementation and verification of these temporary deterrent measures	Customer protection. In this step: • Temporary, deterrent actions have been identified which have contributed to minimise the damage to internal and external customers and ensure continuity of action, • The feasibility of the specific deterrent actions has been assessed,

	• A timetable for the deterrent actions has been drawn up and implemented immediately, The supervision of the deterrent measures was systematically carried out.
4D – identification and verification of root causes	Identify the source of the problem. In this step: • Potential causes of the problem have been identified, • Based on the list of potential causes of the problem, a list of actual causes has been developed, including an estimate of the contribution of the specific cause to the occurrence of the non-compliance.
5D – selection and verification of corrective actions	Action selection. In this step: • The effectiveness of the implemented immediate actions (step 0D) and temporary, restraining actions (step 3D) was assessed, • Alternative corrective actions were identified, • Targets were identified, those responsible for specific targets, deadlines for implementation, ways of evaluating and monitoring their effectiveness.
6D – implementation of corrective measures	Choice of actions. In this step: • The established timetable for the implementation of corrective actions has been established and consistently implemented, • The implementation has been monitored and the effectiveness of the implemented actions has been assessed.
7D – preventing reoccurrence	Indication of preventive measures. In this step: • An assessment of the situation after the implementation of corrective actions has been made, • A list of all actions aimed at eliminating the possible causes of the undesirable situation analysed has been drawn up, • The most effective preventive actions that reduce the risk of the same or similar problem have been identified, • A process of improvement and implementation of preventive actions has been defined.
8D – closure report	Completing the report. In this step: • recognition was shown to the working team for their effort and work in solving the problem; • archiving of records relating to the implemented activities.

Source: Own elaboration based on (Łuczak et al., 2006; Chen and Cheng, 2010; Purzycka, 2020)

The application of the presented methodology makes it easier to identify the causes of a qualitative problem, and allows to indicate how to solve it verification of the actions taken (Łasiński, 2007; Rambaud, 2006).

3. PURPOSE AND SCOPE OF THE RESEARCH

The aim of the study is to analyse the quality problem identified in the batch of products - incorrect assembly of sealing rings in the piston (Figure 1) - and to determine the reasons for the occurrence of non-compliant castings and to propose remedial actions, the target aim of which is to reduce the number of non-compliant castings or to eliminate them completely.

Fig. 1. Piston with incorrectly installed sealing rings
Source: Own elaboration based on (Federal Mogul Gorzyce, 2019)

The conducted research concerned batches of products made in the 3rd quarter of 2019 in one of the production companies located in the southern part of Poland.

4. DISCUSSION OF RESULTS

In order to analyse the problem after the implementation of each of the steps indicated in the second point, the 8D report was successively developed. The finished report is presented in Table 2.

Table 2
The characterizing criteria the alternatives (types of machines)

8D report form			
General characteristics of the problem	Name of the part	Part number	Start date
Incorrect installation of sealing rings in the piston	Piston designed for excavators	(-)	(-)
1. 0D - Preparation for the process 8D Development of a complaint form by a technology and quality specialist regarding the event under consideration immediately after it has compared the product delivered to the customer with the product template and documentation		6. 5D Taking corrective action Obligation to provide training for assembly workers. The scope of training should improve professional qualifications and the level of knowledge of the employees who carry out all activities that affect the quality of the finished product. In addition, employees were obliged to participate in training courses on Kaizen topics.	
2. 1D - Appointment of the 8D team Members of the 8D work team: - Leader Production manager, - Technology and quality specialist, - Production worker.		7. 6D Measurement of the effectiveness of corrective measures For a period of one month, a thorough monitoring of the work of assembly workers during the quality control of installed sealing rings. After the assembly of the rings was verified, the product was again inspected by a technology and quality specialist. Improper installation of the sealing rings did not occur even once during the test period.	

3. 2D - Problem description The resulting quality problem was detected by the customer during the unloading of the delivered order. The customer has reported the observed irregularity to the manufacturer. After reporting an oral complaint, the technology and quality specialist was delegated to the customer to inspect the goods delivered by the manufacturer. It turned out that the products produced and then delivered to the customer actually have defects. The supplied piston batches are not properly fitted with sealing rings.	8. 7D - Measures to prevent reoccurrence of non-compliance It has been found that every newly hired assembler has to undergo mandatory training in quality control at assembly stations. In addition, it was decided to permanently install an appropriately shaped, illuminated and equipped table with stands for sealing rings to quickly distinguish the type of ring. It was also decided to place a reference piston with mounted rings on the workstation.
4. 3D - Taking temporary corrective action Product non-conformity was presented to the company management. The team performed "gemba walking"; to diagnose the situation on the assembly line. After obtaining the necessary information related to incorrect assembly of the rings in the pistons, the Production Manager decided to provide technical documentation and place a pattern of correct assembly of the rings on each of the assembly stations. A colour division has also been introduced for containers with different types of sealing rings. As part of the corrective measures, a 100% visual inspection of the mounted rings at the control station and at each subsequent stage of the production process was introduced.	9. 8D - Completion of activities The process of analysis of this qualitative problem took 9 days. The members of the working team have seen each other several times during this time, performing the task assigned to them. For one month, it was checked whether the changes made to the process bring the expected results and whether the assembly workers perform their duties carefully. The employees were interviewed about the implemented changes. Congratulations and thanks to each member of the working team for solving the quality problem.
5. 4D - Determining the most important causes of the problem In order to detect as many potential causes of non-compliance as possible, the working team conducted brainstorming sessions and then performed additional analysis of the problem using the Ishikawa diagram. Team members found that the most common source of the problem was human error. The participants concluded that the assembly check carried out by the production worker was inadequate	The 8D report form was accompanied by all the forms and documents developed during the solution of a recurring problem with incorrect installation of sealing rings.
Closeing date: (-)	Signature of the person preparing the 8D report (-)

Source: Own elaboration based on (Federal Mogul Gorzyce, 2019)

The implications of the changes in the assembly process of the sealing rings presented in the 8D report have benefited both the employees and the employer. Due to the introduction of training, employees have gained favourable conditions for the development of their competences and qualifications (creation of a clear training plan, linked to the knowledge and skills necessary for a specific job). An important benefit is also the implementation of development activities during the performance of their duties at the place of employment using various development techniques and methods. The employer, in turn, has gained a clear structure of the training plan as part of the development of employees'; competences and skills. However, the most important benefit should be the achievement of the qualitative objective of eliminating the human factor as the reason for the occurrence of nonconformity of products and at the same

time an increase in the quality level of the offered products. Achievement of the main goal of the 8D report is confirmed by the key quality indicators (included in the group of key performance indicators) used in the company. Figure 2 shows the level of identified nonconformities - incorrectly installed sealing rings in the offered products measured by the QR (QR) index. The quality ratio and QBR (Quality Buy Rate) are the most important factors in the development of the quality of the products. Quality Buy Rate before and after implementation of corrective and preventive actions is presented in Figure 2.

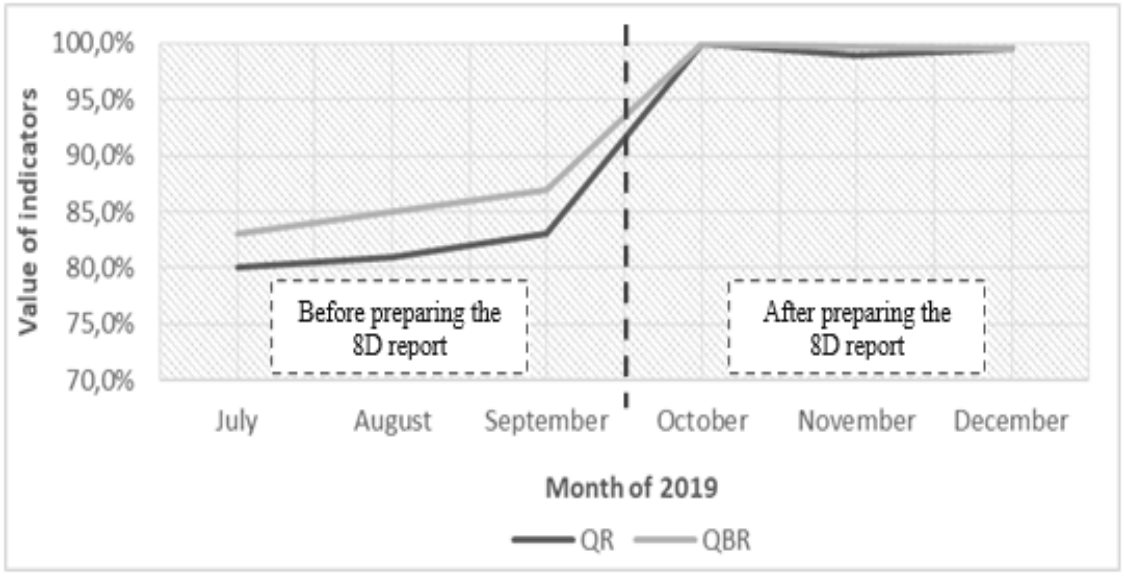

Fig. 2. QR and QBR indicator level in Q3 and Q4 2019
Source: Own elaboration based on (Federal Mogul Gorzyce, 2019)

The indicators used are calculated as:

- percentage of good quality products QR (ang. Quality Ratio), being the total percentage of good quality products produced, calculated according to the formula:

$$QR = \frac{GQ}{PQ} \quad (1)$$

where:

GQ (ang. Good Quantit), number of products meeting the quality requirements,
PQ – (ang. Processed Quantity), total number of products manufactured.

- the percentage of good quality marketable products QBR (ang. Quality Buy Rate) , i. e. the total percentage of good quality products including recycled elements, calculated according to the:

$$QBR = \frac{GQ+RQ}{PQ} \quad (2)$$

where:

GQ (ang. Good Quantit), number of products meeting the quality requirements,
RQ (ang. Rework Quantity), number of non-compliant but recyclable products,
PQ – (ang. Processed Quantity), total number of products manufactured.

On the basis of Figure 2, we can see a high increase in the quality of manufactured products in the fourth quarter compared to the third quarter of 2019. The average value of the QRR index in the third quarter was 81. 3%, while in the fourth quarter this value

increased to 99. 5%. In relation to the QBR index, there was also a 14. 8% increase in value in relation to the third quarter.

An important condition for ensuring the efficiency of manufacturing companies is to use and manage unique knowledge in a specific area. This kind of knowledge is called hidden knowledge. Transforming it into open and publicly available knowledge is an important organizational activity. Within the processes carried out in the company, it is possible to extract this knowledge using the 8d report in case, making it generally available.

4. SUMMARY

The tools and methods of quality management, which include the 8D method, contribute to the production of high quality products that meet customer requirements. A key link in the operation of any manufacturing company is the customer. Every buyer wants to buy a product of the highest quality, while every supplier or manufacturer should make every effort to achieve the best possible turnover. Without a doubt, the main factor influencing the purchase of a product is its quality, which should go hand in hand with an attractive price..

The 8D procedure, due to its time and cost-intensiveness, is only used to solve serious problems. While this is certainly reasonable, even for nonconformities of relatively low significance, problems may arise where the risk exceeds the level of risk acceptable to the organisation. This example of a qualitative problem was presented and analysed in the study. The non-compliance that was analysed was characterised by a relatively low level of significance - no loss of functionality and high detection rate - the non-compliance of the product was visible to the naked eye.

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