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Implementation of the QRQC Method as a Quick Response to Reduce the Number of Non-conforming Pieces in an Industrial Enterprise

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Abstract

This paper deals with the implementation of the QRQC method in a selected industrial enterprise, the subject of activity of which is the production of seats and their mechanisms, emission control technologies, and interior and exterior components for automotive. It is a quick response in quality management and its application is based on the Global 8D method. QRQC is also an effective and detailed problem-solving tool designed to prevent problems from recurring by introducing continuous improvement and changing the organization's management approach. An analysis of NSF's assembly division, where they deal with the assembly of dashboards, found that the scrap rate is €390 per day. Elimination of the non-conforming pieces took place on the assembly line where the painted parts are assembled into the dashboard. The role of the QRQC is not to find out why paint defects occur at an in-house paint shop supplier, but to find out why operators do not identify paint defects before the painted part is assembled and welded with other parts. The company has been tracking the development of non-conforming parts based on the Stop Scrap project, which implemented the QRQC method, and the scrappiest part turned out to be the left-side dashboard welded to the painted pad, with paint defects on the painted pads being the most common defect. As a final step, the effectiveness was evaluated after the implementation of the measures proposed in the QRQC. The importance of the study is that the current economic situation is critical for many industrial organizations and cost reduction is key to long-term sustainability The consequence of using the QRQC method is a reduction in the number of non-conforming parts by almost 50% after almost 6 months.

Keywords: *Quick response quality control method, Global 8D, Improvement, Cost reducing, Dashboard, Non-conforming parts, Scrap*

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1. Introduction

Currently, non-compliance can be categorized as a significant factor that needs to be addressed immediately, as neglecting it will lead to serious problems. Serious problems can lead to an increase in complaints and make the company appear as an unreliable supplier in the eyes of the customer. This is why it is necessary to catch a problem while it is still in the company. STN EN ISO 9000:2016 Quality management systems. Fundamentals and vocabulary define quality as a degree to which a set of inherent characteristics of an object fulfills requirements [14].

QRQC respectively Quick Response Quality Control comes from the association of the term Quality Control – which is the control of quality – and the term Quick Response – which means a quick response [8]. It is an effective and detailed problem-solving tool designed to prevent problems from recurring by introducing continuous improvement and changing the management approach of the organization. For the resolution of internal complaints and non-conformities, the most commonly used methods such as QRQC are important concerning the assurance of the production process. This method is directly based on the G8D method. The primary objective of the 8D methodology is to implement and consolidate corrective actions concerning the quality management system [8]. This is a methodology aimed at identifying and eliminating root causes of failure, and then implementing permanent corrective actions to prevent recurrence [5]. Once simplified and certain rules are followed, QRQC will become an effective problem-solving tool, not only in the automotive industry. The name of the QRQC method speaks, about a rapid response for quality management, which can be used in various fields, not only in the quality field. The QRQC method is versatile because it can be applied in a wide range of processes. It is most commonly used in influencing product quality, production processes, logistics, internal and external complaint handling, occupational safety and health hazards, and efficiency measurement.

The G8D method is primarily used in practice to resolve external complaints from customers. Based on the binding requirements entered into by the company with the customer during the design phase, the supplier is obliged to develop and implement corrective measures into the process. The G8D method can be used to solve internal problems in the production process. The QRQC method is based on the sequential steps of G8D. From an organizational point of view, it is necessary to define a QRQC team and it is not necessary to implement all the steps in the G8D method. The QRQC method becomes more efficient and transparent in solving internal problems [3].

Within the NSF division in the surveyed organization, the following problems occurred at individual sites:

Gaps	Months, €				Total, €
	1	2	3	4	
IP	9055	6290	4330	4750	24425
Flock	1965	1700	60	110	3835
GB	695	1340	320	510	2865
DP	630	775	700	1190	3295
BMW	260	110	75	285	730

Where:
IP - installation of dashboards
Flock - parts covered with black matt materiál
GB - installation of lockers intended as storage space
DP - installation of door panels for VW UP

BMW - installation of clips on painted parts for BMW vehicle

In line with this, the study was conducted to identify the main problem in an industrial enterprise to reduce non-compliance and reduce the costs associated with it.

2. Literature review

The QRQC method will be used to solve the identified problem, which was the painted parts on the dashboard, using the G8D method. Comparison of the sequence of steps of the QRQC and G8D methods:

1. Establishing a QRQC team.
2. Description of the problem.
3. Definition and implementation of corrective actions.
4. Finding and defining the root cause.
5. Eliminating the root cause.
6. Verifying the appropriateness of the measures put in place.
7. Closure of the QRQC in question [4].

The problem-solving procedure using the QRQC method is oriented directly to the focal point of the problem. Based on the sequence of steps of the QRQC method, it is necessary to orient to the actual place where the problem appeared and where it needs to be solved. It is important to isolate the faulty 30 parts. The worker then subjects the parts to a more thorough analysis. At this stage, all non-conforming parts must be isolated from the rest. The reason for this precaution is to ensure that parts are not inadvertently put back into production. We prevent this by using part marking with a label such as defective part or blocked part. For smaller parts, it is advisable to apply color coding to differentiate the boxes. In practice, the color red is most often used for non-failures. For better identification, understanding, and error elimination, the damaged part is used as a model. For more effective problem-solving, it is necessary to have a record that provides realistic and sufficient information about the parts produced, such as the date of production, the quantity of non-conforming parts, data on input materials, and the condition and setup of production machines. Defining the problem is a separate solution of the QRQC method. It starts with a description and definition of the problem encountered. Immediate corrective actions are applied after the problem has been identified and identified. Immediate measures allow the production process to continue without risking quality. These actions shall be recorded on a QRQC form describing the problem, with the responsible person and a deadline for each action. After ensuring a quick response, we follow up by successfully ensuring the production process is running while protecting the customer [1].

Determine the causes of a potential problem, there are a large number of methods that are used to analyze the problem and find the root cause. In practice, the "Five Whys?" method is very often used for simplicity. This method is not suitable for solving more complex problems, as it can become cluttered with a larger number of causes. For this reason, the Ishikawa cause and effect diagram is appropriate for the industry. QRQC is a team-based method and is therefore useful in completing the Ishikawa diagram and applying the brainstorming method. It allows a large number of potential causes to be obtained. In practice, so-called QRQC centers are used to solve QRQCs, which neatly collect all QRQCs from a given department, unless they are already closed. To define and clarify the problem, use the 5W and 2H method, which consists of asking 7 basic questions:

1. W (What) – What is the problem?
2. W (Who) – Who discovered the problem?
3. W (When) – When was the problem discovered?
4. W (Where) – Where did the problem occur?
5. W (Why) – Why did the problem occur?
6. H (How) – How was the problem identified?
7. H (How many) – How many non-conforming products have occurred [2]?

By answering these questions we can work out the next steps. These steps consist of verifying all the causes that were suggested in the previous step. They are inserted into the cause-and-effect diagram to verify their effects. It is most convenient to make a complete list of all theoretical causes. For each cause, a responsible person will be chosen along with a deadline for completion. When submitting results, it is a great advantage to have some evidence, for example in the form of a photograph, data from a database, results from measurements, etc. This will help other members to clarify the seriousness of the cause and allow the impacts to be identified in detail. The design and application of long-term corrective actions will be determined in the penultimate phase of the QRQC. It focuses only on certain root causes and the main objective is to identify and apply long-term measures. Long-term action to address and eliminate root causes, ensuring that the problem is not addressed by a similar mistake. The measures put in place will be evaluated and closure will be provided to the QRQC. Effectiveness and impact need to be verified for long-term measures to be put in place. Measurable process outcomes are used for this step. It is a comparison of the original values that were found before the long-term measures were introduced. If the measures are effective, their effect on the process will lead to the elimination of the problem, so the QRQC is closed. The main idea is to react quickly to a problem that has arisen and protect the customer and the internal process from remaining in an undesirable situation, with an emphasis on a team approach. The principle is the same with the G8D method, but G8D is most often used as a tool for communicating with the customer in case of complaints. In contrast, the QRQC method has become an important component of the internal culture of companies not only in the automotive industry. The quick response methodology has been introduced in companies in the automotive industry. By using it, various important influences triggering problem situations can be recorded in a structured approach. The goal is continuous improvement. It is about continuous improvement and development without waiting for the best solution. QRQC is a management method where managers train workers on the job [2].

3. Results and discussions

At the Vib2 site, it was found that 70% of the defects were paint defects. The most scraped part is the left-hand dashboard welded to the painted pad, with paint defects on the painted pads being the most common defect [9], as can be seen in [Figure 1].

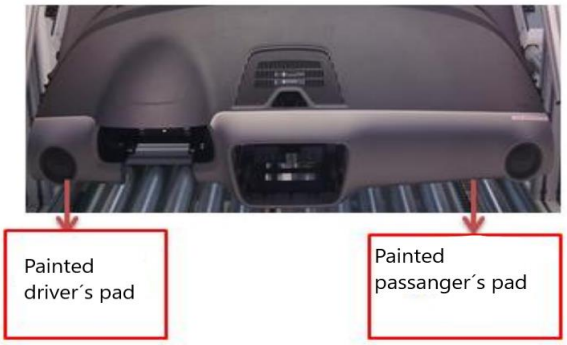

Fig. 1: Left-hand dashboard with painted pads [9]

The company decided to solve the resulting problem using the QRQC method together with the G8D method, with the first question, "What is the problem?" as the first step. The answer is: "Insufficient conditions for inspection of the painted part Welded IP LHD High vib2".

The position where the problem occurred is also listed and this position is vib2 (welder 2). As the brackets are sprayed in-house, the paint shop department needs to be notified via an internal complaint.

Another point is immediate action to protect customers. The condition of that measure is to propose immediate action within 24 hours. The immediate actions were aimed at detecting the damaged parts before they were mounted on the welded part of the dashboard and prevented an increase in non-failures as the painted pads are joined to the dashboard by welding. These actions include auditing the standardized work of gap leaders and operators on the assembly floor. Supervisors are responsible for this implementation. The time for the implementation of the action has also been determined and then it is necessary to answer whether the action was effective by marking Y (yes) or not by marking N (no). A new risk has been discovered, so the company indicates Y. Deficiencies were identified during the review of the standardized work. The first deficiency is that the part is picked up by the operator with two hands and hung on a hook that was not secured with protective tape, thus scratching the part. Supervisors watched the workflow of 5 operators manipulating the console at the start before welding it to the dashboard. A review of standardized work was conducted on the deck plate assembly. The review focuses on the work of the operators, i.e. it consists of points such as checking the respect of standardized work, respect of the sequence of work operations, respect of the work instruction, and the ability to achieve the standard cycle time. A special instruction was issued to inspect the console before it was assembled. The deputy manager was tasked with creating special instructions for the operators on the assembly line. It consisted in carrying out a 100% inspection of the painted brackets before inserting them into the Vib2 welder. If a paint defect is found, mark the spot with a red marker and call the gap leader. The termination process has been established and followed. The effectiveness of act of checking the pad before welding was effective and no new risk was discovered [9].

Immediate action was next, to be implemented within 24 hours. The cut-off time for the immediate measures has been set and the deadline for the implementation of the actions has also been set. Area D6 has a timeframe for verification of corrective actions and D8 consists of 60 working days from the implementation of the actions to create sufficient conditions for verification. Subsequently, possible reasons for scrapie were defined. In the case of painted pads, this could be due to poorly defined inspection conditions, part handling during assembly

of the part into the dashboard, damage due to a defective welder, or NOK pieces from the supplier. By analyzing the individual points, it was found that the operators handle the parts correctly during the audit of standardized work, even during random checks. Welding damage to the part was ruled out by testing 5 pieces. Damage from the supplier (paint shop) has been confirmed. To prevent the dashboard from going wrong, the increase in installation costs will be avoided. Based on operator responses pointing out inadequate conditions for inspection, this was defined as identifying a problem. Followed by questions 5W and 2H. During the use of this method most often the following questions are asked: What? Why? When? How? Where? Who? How much?, which relates to a given problem [7].

Findings:

- Why did the problem arise? The problem arose during the welding of the console and was found by the operator during the final inspection.
- When did the problem arise? It arose at 42 weeks.
- Who found the problem? The UAP manager found it.
- Where was the problem found? The problem was discovered on the Stop Scrap board during a meeting with the principal.
- How was the problem found? It was found by Pareto analysis.
- How much money did the problem cost? The problem cost 280 euros/day. The data is obtained from the company system [9].

The next step was immediate action. The immediate action is to train operators to detect paint defects before the pad is mounted on the dashboard. All members of the workplace are familiar with the problems encountered. The quality engineer has provided all participants with samples of paint defects that may occur on the parts. During the training, the NSF manager also pointed out the importance of following emergency instructions [9].

To identify corrective actions, the company prefers to use an is/is not analysis [Table 1].

Table 1. Is/Is Not

Is (problem)	Is Not (problem)	Preserved measures
One-tube lighting	Lighting according to VDA 6.3	Lighting
Control time 11 seconds	Control time 30 seconds	Control time

Based on communication with the operators, it was found that the lighting at Vib2 was very poor (688 lux) compared to the final control (2000 lux). And the operators do not have enough time and space to check the parts at the final inspection. The final inspection is located 12 meters away from the Vib2 workstation. Another problem is that the operators have 11 seconds to inspect the painted part. An audit of standardized work to measure the duration of individual assembly operations found that operators were not adhering to the defined 90-second cycle time. It was found that on average, operators are left with an average of 30 seconds of the remaining time that they can use to inspect the painted parts more closely. The findings are defined in the document - Causes of non-compliance. These consist of the unification of the lighting according to VDA 6.3 between the repair (polish) and the welding of Vib2. Responsibility for the implementation lies with the method engineer. The second measure is to increase the fall check time from 11 seconds to 30 seconds. Supervisors are responsible.

The next step is aimed at eliminating the occurrence of errors. This step involves a complaint to an internal paint shop supplier, which resolves the issued complaint through the application of an action plan. This department must then implement corrective actions in the

action plan to reduce paint defects. The corrective actions in the action plan consist of tasks that are assigned to responsible persons. Deadlines for implementation are an important part of these. The corrective measures consist of increasing the luminance at Vib2 from 688 lux to 2000 lux. The second measure is to increase the control time from 11 seconds to 30 seconds. An audit of standardized work found that the operator has a work clock average of 62 seconds. In the work standard, the length of the working stroke is 90 seconds. The operator has 30 seconds to inspect the painted part before assembly.

In tracking efficiency, the organization focused on tracking the cost of non-failures over three months. It was found that the measures were effective as costs were reduced by a factor of 8.

The final step is lessons learned:

- Creating or updating standardized work - was implemented by updating the standardized work (work instruction). A thorough inspection of the painted part before welding was added and the work tact time was changed.
- Risk Assessment - lighting that did not meet the VDA standard could be considered a potential risk.
- Control Plan - had not been updated.
- Implementation of all measures - all measures were implemented within the timeframe[9].

The 8D report, which focuses on the synergy of interdisciplinary teams and a systematic eight-step approach, can be used to eliminate failures and non-conformities in many industrial sectors, including quality control. Focusing on corrective and preventive measures prevents the occurrence of problems in the future. This method means permanent corrective actions and, by identifying the root causes, prevents their reoccurrence in the future. The 8D method used in the organization and presented in this research is an excellent tool for preventing defects from recurring, as indicated by the PPM (parts per million) results but also by related costs[10].

This is confirmed by the main findings of Dziuba et al. [11]in their case study of a problem in an enterprise that uses metal stamping technologies to manufacture products for the automotive and home appliance industries. It concerned the exceeding length tolerance for the guide section from one hole to another (43 ± 0.02). The 8D report was used to analyze the problem, which identified an important cause of the defect and helped eliminate it. Another case study completed by Alexa and Kiss [12] shows the problems that are occurring with a customer. The customer received a delivery with delivery note 114643176, dated 06/27/2015 this delivery for delivering the customer complained, about the fact that the packaging finished goods did not comply with its specifications. Improvements implemented in this case study were implemented in the company. After the analysis in this case study on quality assurance in the logistics department of the factory, it ensures the production of sensors quality, preventing defects, if any of these defects are ways to improve to avoid recurrence. The third comprised case study has been prepared by Rathi et al., [13]. The main cause in the company is gearboxes in various segments, workers who complained to management about poor performance, and maintenance issues. The current work provides a motivating perspective on the application of 8D in other manufacturing organizations such as heavy industry, automobile, and so on. The presented study has reduced the assembly time and defect part numbers from 95 to 26, resulting in a 76.63% reduction in defects. This represents how defects and time management were reduced after implementing the 8Ds methodology

versus before implementing the 8Ds methodology, as well as a frequency comparison. In this case, the most common defect is a vibrating conveyor, which was reduced from 38 to 10, resulting in a 74 percent success rate.

4. Conclusion

In this paper, the QRQC method was presented and applied to the problem of painted pads on a dashboard, using the G8D and Is/No's methods. Remedial measures were proposed to address the problem and the implementation of all the measures has resulted in a reduction in non-compliance of almost 50% over six months.

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, easy, and fast way. The focus of corrective and preventive measures on root causes prevents the occurrence of the problem in the future.

The case study demonstrated that, combined with the knowledge and experience of the team, the application of modern quality tools offers concrete and measurable effects and allows for solving problems.

Resolving the quality issue, in this case, the painted dashboards need to be done immediately. The company under review is one of the 10 with the highest achieved costs compared to other sister companies in the world. Correct identification of the problem leads to the definition of immediate measures to remedy the problem and, consequently, preventive measures to prevent the problem from occurring in the future, thus ensuring cost reduction, customer satisfaction and improvement of the production processes them.

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