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Use of Quick Response Quality Control (QRQC) Method in Process of Problem-solving – Case Study

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Abstract. This article presents an assessment of the use of the QRQC problem-solving method in the production-line area of a selected enterprise. This method was used to comprehensively solve the problems that could be observed in various areas of the company's operation, including quality, safety, and logistics. Based on literature research, the literature was analyzed and criticized, the researched method was characterized, and the principles on which it was based and the levels of its application were presented. The stages of the implementation of the QRQC method as well as the participants and their roles in the problem-solving process were presented. Then, a survey questionnaire was developed using the diagnostic survey method, and research was conducted among a representative group of operators who worked on the production line in a company that had been using the QRQC method to solve production problems for many years. The research made it possible to assess the functioning of this method in the studied enterprise, determine its advantages and disadvantages, assess the employees' understanding of the rules, the ease-of-use of the method, and the support that was received from the management during the entire QRQC process. The research results will allow the company to make mature decisions regarding the use and improvement of the functioning of the QRQC method. The conclusions from the study can be used by other companies that use this method or want to use it in their problem-solving practices in an effective and efficient manner.

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1. INTRODUCTION

Nowadays, company are facing various challenges such as higher product and service quality, shorter lead times, and increased competition (Antony et al., 2023; Skalli et al., 2023). In such a complex and changing environment, merely focusing on efficiency and costs is not enough – striving for perfection is becoming more and more important. The occurrence of problems on many levels seems obvious, so an important element of an enterprise's activities is continuous improvement and focusing on the process of solving problems that may occur (both inside and outside the enterprise).

Over the years, companies have developed many tools and methods for solving problems. The most popular tools that have been used in this area include the Five Whys method and the Ishikawa diagram. These are used in many comprehensive approaches for solving problems; the most popular of these include lean manufacturing (and the A3 Report that is related to this approach (Liker, 2004)) as well as Ford's Global 8D method (*8D – Problem Solving in 8 Disciplines. Method. Process. Report*, 2018; Soliński, 2019).

Although it is not as popular as those that are mentioned above, another method that is used to solve problems is the Quick Response Quality Control (QRQC) method.

This method was created and implemented in 2002 at Valeo – one of the leading suppliers of parts in the automotive industry. Its comprehensive characteristics can be found in (Aoudia, 2012; Aoudia & Testa, 2012). The QRQC method is a method for solving problems that arise in various areas and at various levels of an organization, such as a production-line area, a department, or the entire plant. Its name is an acronym that was created from the first letters of the phrase – Quick Response Quality Control, which can be translated as quick response – quality control. The main goal of this method is to solve the problems that can be observed in a given area of a company's operation, including quality, safety, and logistics. It focuses on a quick identification, analysis, and solution of the problem.

It integrates certain elements of methods such as Seven Questions (5W2H), Five Whys, PDCA, or Global 8D (Deming, 2000; Imai, 2012; *Six Sigma Blog: Sigmology*, 2022) and supplements them with process integration and cascading mechanisms for solving problems at several levels of the company and practice that allows for a significant minimization of its problem-solving time.

2. CHARACTERISTICS OF QRQC METHOD

The QRQC method is based on several theoretical foundations, such as the zero defects principle, the Jidoka system, and the Japanese philosophy of San Gen Shugi (which is often called the philosophy of three realities or three dimensions: San – three; Gen – real, current; Shugi – philosophy, dimension).

The first two are widely described in the literature on the subject (Liker, 2004; Womack et al., 1990). The zero defects principle was formulated by Crosby (1988) and consists of striving to eliminate all errors through the appropriate staff motivation, communication, and cooperation among the employees. The Jidoka system (Liker, 2004; Ohno, 1988) involves designing the process as well as the machines and people that/who are involved in it in such a way as to prevent errors by quickly detecting errors and immediately stopping a process.

The third of these (San Gen Shugi) includes the following:

- The actual location (GEN-BA) where a problem occurred. Performing an analysis at the location of the defect allows for the proper assessment of a situation.
- Actual parts (GEN-BUTSU). This statement means how to handle any affected parts. The good and bad parts are reliably compared to an established standard.
- Actual data (GEN-JITSU). The analysis that is undertaken should be based on objective data and not on opinions or assumptions.

The QRQC method was designed to ensure quality in the production area. It can be characterized as a method of quick and comprehensive problem-solving that ensures finding the root cause, and the actions that are taken within it should guarantee that the problems will not reoccur in the future (Banica & Belu, 2019). QRQC is a tool for quick responses to problems (mainly of a qualitative nature) that occur in an enterprise (Teczke & Obora, 2018). According to its creators, it is defined as a philosophy of action that is closer to total quality management (TQM) than it is to other problem-solving tools that are used in the automotive industry (Global 8D method, Report A3) (Aoudia & Testa, 2012). QRQC was first used by Valeo in 2002.

This is based on six basic principles that organize and rearrange the process of its use (Aoudia & Testa, 2012):

1) *Quick response* – the method assumes identifying the problem as quickly as possible and solving it equally quickly.
2) *Specific people* – problems should be solved by people with appropriate knowledge and skills in solving them and conducting analyses.
3) *Concrete Object* – This refers to one of the three principles of reality in San Gen Shugi. The analysis should be performed on a specific tool or part.
4) *Specific area* – solving a problem should take place where it occurs.
5) *Specific data* – reliable verified documentation should be used during the problem-solving process.
6) *Logical thinking* – solving problems should be based on the logical reasoning of the problems and combining facts and cause-and-effect events.

The principles that are listed above are nothing new in quality-management systems and methods; together, however, they create a comprehensive approach that is characterized by effectiveness and efficiency and allows for quick results and significant benefits.

3. LEVELS OF PROBLEM-SOLVING ACCORDING TO QRQC METHOD

The main goal of the QRQC method at each level of a company is to detect a problem or defect, protect the customer, respond quickly, collect data, verify compliance with standards, keep a history of events, solve the problem, and (if necessary) explain the problem. The end result is solving the problem and drawing conclusions for the future as well as possible changes in the methods of conduct that allow for the continuous development of the organization. The problem-solving takes place at three levels; these are presented in Table 1.

Table 1. *QRQC levels – source: own study based on Aoudia and Testa (2012)*

QRQC levels	Level characteristics
Line QRQC	Its scope includes the smallest production unit in an enterprise, which is called the autonomous production zone (APZ). The people who are involved in this process are the operators and the leader. They take action to immediately correct a problem that has been detected in their area of work. The time that is allocated for the entire QRQC process (i.e., from its detection to the rectification of the problem) is a maximum of 24 hours.
Department QRQC	Its scope covers the problems of many autonomous production units (APZ). These problems are more global in nature, affecting a larger group of production units as well as internal and external stakeholders (these concern warranty returns that are reported by customers and the failure to achieve the planned organizational goals, among others). The team that is responsible for solving the problem consists of specialists from various areas of the company's operation (e.g., quality, production, and logistics). As in the case of Linear QRQC, this diverse interdisciplinary group of people theoretically has 24 hours to complete the process; however, this goal is often not achieved due to the complexity of the problem.
Company QRQC	Its scope covers problems from various areas of the plant that affect the functioning of the entire production company. Teams are created and involve managers and other people who are responsible for individual departments of the company.

If a team that is working on a production line is unable to solve the problem at their own level, the problem may escalate. Passing the problem higher up in the company hierarchy can be done at two levels: the first of these is departmental QRQC; if the problem has not been solved at this level, the next stage is to transfer it to the next level (which is company QRQC).

4. QRQC AT PRODUCTION-LINE LEVEL

The described methodology is implemented at various levels in a production company, such as areas of the production line, department, or the entire plant. The entire process is carried out based on forms that are adapted to individual areas. The QRQC application process includes key activities such as the following:

- problem detection,
- standardization of reaction rule,
- internal communications and escalations,
- troubleshooting,
- inspections of completed activities.

Due to the research that is being carried out at the production line level, the procedure at this level when solving problems using the QRQC method is described below. The linear QRQC scheme is based on four stages (Fig. 1):

1) detection,
2) communication,
3) analysis,
4) verification.

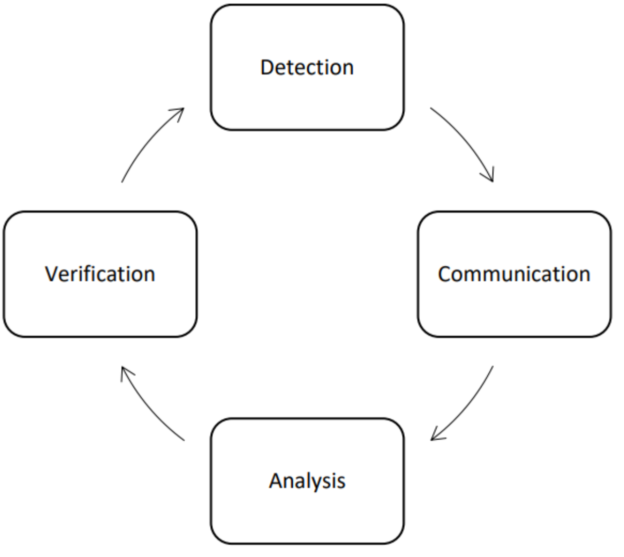

Fig. 1. *Operational diagram according to Line QRQC method*

Stage 1: Detection involves identifying a problem and determining the actual situation. The problem is categorized into one of the following categories: safety, quality, failure, logistics, or process efficiency. In order to standardize the descriptions of the problems, the seven-question method (5W2H) is often used, which allows for an objective presentation of the problem.

Stage 2: Communication assumes the provision of information about the problem to all interested parties. Additionally, immediate actions should be taken to protect internal and external customers at this stage. An example of such an action may be sorting pieces into those that meet the specification (OK) and those that do not meet the specification (NOK).

Stage 3: Analysis includes an analysis of the source of the problem and the formulation of the corrective actions. Using the Five Whys tool, it is possible to find the root cause of the problem. As a result, the proposed corrective actions concern a specifically defined cause of the problem. The person who is responsible and the estimated time for implementing a given corrective action are both defined.

Stage 4: Verification is focused on verifying the completed activities. The responsible person checks whether the proposed and implemented actions have had the intended effects. At this stage, it is also marked whether the problem has been escalated to a higher level and that the analysis is closed.

As described above, the QRQC method at the line level allows one to comprehensively address a problem in four steps – from its occurrence to its elimination.

5. CHARACTERISTICS OF CONDUCTED STUDY

The research was conducted in August 2022. The data was collected using a direct survey questionnaire among the employees in one of the automotive industry enterprises where the QRQC method has been used for many years. The survey was anonymous, and the questions concerned the operators' opinions on the QRQC method. The use of a survey questionnaire as a research method allowed for a direct measurement of the examined characteristics and behaviors.

A representative research group was randomly selected from the operators, which constituted part of the employees who held the position of production operator. The study group consisted of 20 people. Due to the fact that a similar number of men and women worked on the line, it was decided to conduct a study with a 50%/50% structure – selecting 10 women and 10 men for the study.

Among the respondents, most of the people were aged 26–35 (a total of eight) – 40%, followed by people aged 36–45 (seven) – 35%. The third largest group in terms of size was people aged 18–25 (four) – 20%, and one person was from the 46–55 age group – accounting for 5%. The study did not include any representative of the 56–65 age group. The educational structure of the employees was almost uniform, as 19 people had secondary educations; this constituted 95% of all of the respondents (one person had only a primary education).

Analyzing the period of employment in the enterprise of the respondents, the largest groups were those with 1–2 years and 3–10 years of work experience; in both cases, there were seven people – constituting 35% of the entire survey group. The next positions were taken by four people with less than one year of work experience (a share that was equal to 20%), and two people had more than ten years of experience in the company in question (a share that was equal to 10%).

The randomly chosen and representative group of respondents includes a full cross-section of people of various ages and experiences. These people were trained in the QRQC methodology and participated in the QRQC process numerous times.

It can also be assumed that, due to their lack of higher education, the surveyed people did not have the opportunity to become familiar with quality assurance tools and methods during their school educations; their knowledge was acquired only during their training and work in the surveyed enterprise.

In the survey, a questionnaire was prepared that included 25 questions (20 of which were formulated in the form of theses), and a five-point Likert scale was used to evaluate them.

The Likert scale was described as follows:

1 I strongly disagree.
2 I tend to disagree.
3 I have no opinion.
4 I tend to agree.
5 I definitely agree.

To assess the reliability of the questionnaire for collecting the survey data, the Cronbach's alpha coefficient was used. This is one of the coefficients that is most often used in psychology. The reliability that was measured in this case concerned the internal consistency of the tool (survey questionnaire) and whether it did it well and presentably. The calculated Cronbach's alpha parameter for the survey was 0.77, which defined the test as "good". The higher the internal consistency of a test, the higher the Cronbach's alpha value. It is assumed that the minimum values of this statistic should be greater than 0.70.

6. DISCUSSION OF SURVEY RESULTS

The results of the answers to 20 questions are presented in the forms of box plots in Figure 2. Analyzing the median value of the answers to all of the questions was 4 (the mean was 3.5), which may suggest that the respondents generally tended to agree with the theses that were ut forward during the study. The median for the men and women was 4 (the mean for the men was 3.56, and for the women – 3.48).

After analyzing the results, it could be seen that the respondents were trained in the use of the QRQC method and that it was understandable to them (Questions Q14 and Q13). They approached their analyses with due care (Q20), and completing the QRQC was not a negative obligation for them (Q18)[1]. This was a good signal for the entire organization and proved the conscious use of the method among the operators on the production line.

The respondents pointed out the advantages of the QRQC method in most cases, agreeing with the following theses:

- QRQC makes it easier to solve encountered problems (Q6),
- QRQC form is easy to complete (Q7),
- form is correctly prepared and contains all necessary fields for analysis (Q21).

Most of the respondents indicated further advantages of the QRQC method, but some of them did not agree with these theses:

- QRQC method allows one to detect cause of problem (Q9),
- QRQC metod allows one to better and easier understand what is happening on production line (Q10),
- QRQC form is necessary document (Q11),
- QRQC form standardizes reporting of existing problems (Q19),
- QRQC metod allows one to increase awareness of product quality (Q23).

[1] Here, the thesis was that completing the QRQC was only a negative obligation for me.

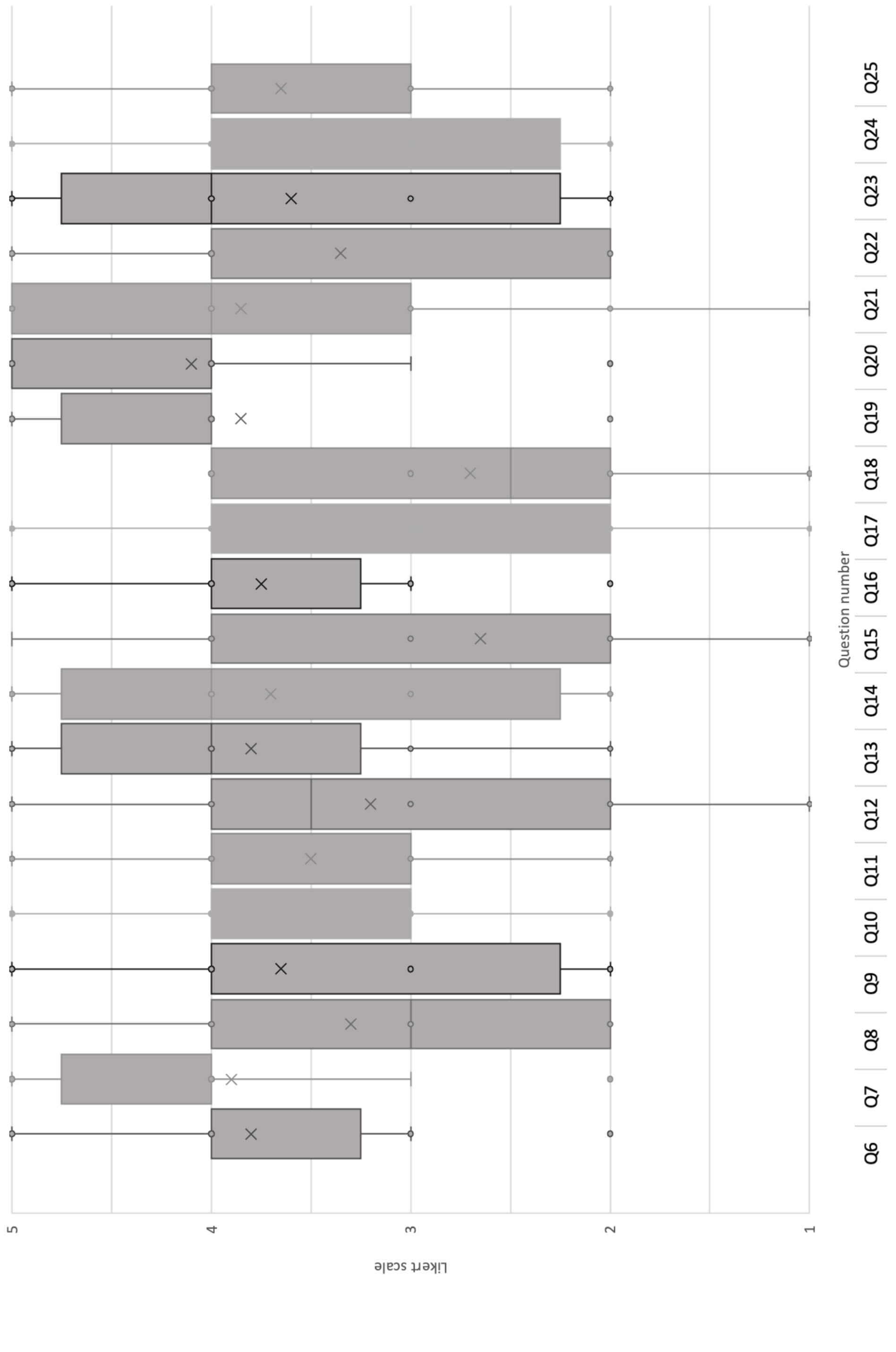

Fig. 2. *Boxplots for Q6–Q25 survey questions*

The majority of the respondents indicated that they had no opinion on the following statements:

- QRQC method allows for better communication between operator and leader (Q8),
- QRQC form does not require much time to complete (Q22).

The respondents indicated that the planned activities in QRQC are being implemented (Q24), although some had no opinion on this matter. Also, the effects of the implemented activities were positive (Q25), and the QRQC analyses were sources of knowledge for them regarding any possible problems that may be encountered in the future (Q16).

The respondents were quite critical of the leader's actions, and these questions received the lowest ratings. Pointing out that the leaders did not conscientiously check the QRQC analyses that were prepared by operators (Q17), they did not congratulate and celebrate reporting and conducting QRQC (Q15). Additionally, they indicated the lack of a task on the topic that QRQC allowed for better communication between the operator and the leader (Q8), which did not reflect well on the leaders' work.

Two control questions were formulated as part of the study. Their aim was to examine whether the surveyed people consciously answered the questions. These were worded as follows:

- QRQC form is a necessary document (Q6),
- QRQC form is unnecessary, and filling it out is tedious chore (Q13).

The answers to these theses were as follows: I rather agree (Q6), and I rather disagree (Q13); this can be interpreted as the operators consciously answering the questions.

The women were more critical – their answers contained the lowest and highest averages of the individual answers. The largest absolute differences between the average answers of the men and women could be seen in the following questions:

- Q24 (question answer value of 1.1) – the change in the work standard indicated in the form has been implemented (most women had no opinion here);
- Q20 (question answer value of 0.8) – I always fill out the form carefully (most women definitely agreed here).

7. CONCLUSIONS

The results of the research that was conducted on the evaluation and the use of the QRQC method allowed us to draw conclusions in several aspects, which were as follows:

1) The operators on the production line know and use the QRQC method in their company.
2) QRQC makes it easier for the operators to solve the problems that they encounter, and the QRQC form itself is prepared correctly.
3) The operators approach QRQC analyses with conscientiousness and care.

4) The vast majority of the operators see and confirm the basic advantages of the QRQC method.
5) The operators have indicated the positive effects of using QRQC in their enterprise.
6) The operators have evaluated the work of the leaders and their support negatively.

After analyzing the data from the survey, the authors of the article prepared the following recommendations based on their conclusions:

1) Employee skills should be continuously improved through training and involvement in QRQC analyses.
2) Management should constantly emphasize the importance of using the method and its positive effects (because the example comes from above).
3) Leaders should engage in the QRQC process.
4) After completing the QRQC procedure, the leaders should clearly communicate completions and acknowledge the contributions of their team.
5) Training should be organized for leaders in communication, providing feedback, motivating, and recognizing the needs of their employees – perhaps they are not aware of how their involvement and the feedback they give affect others.
6) A review of the scope of the leaders' responsibilities should be carried out – it is possible that the lack of an appropriate commitment is due to an excess of other responsibilities.
7) An idea to better motivate and support the activities of the leaders may be, for example, organizing a competition for the best leader of a zone where the voters would be the operators.

The study that is provided and described in this article is a case study that is specific to the given industry, location, and culture of the company. The results of the study may help the examined company make mature decisions regarding the application and improvement of the functioning of the QRQC method. The conclusions from the study can be used by other companies that use this method or want to use it in their problem-solving practices in an effective and efficient manner.

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