UNIVERSITY OF PITESTI SCIENTIFIC BULLETIN
Faculty of Mechanics and Technology AUTOMOTIVE series, year XXVIII, no. 32

Study on improving the sewing process by applying the QRCI method in the automotive industry

Gina Mihaela SICOE
University of Pitești , Romania

*Corresponding author e-mail: gina.sicoe@upit.ro

Article history
Received 8.09.2022
Accepted 12.10.2022

DOI https://doi.org/10.26825/bup.ar.2022.006

Abstract. The aim of this paper is to analyze and resolve the non-conformities identified by the internal quality control for the studied product, "Insert the front door side panel". The paper presents the way to identify the causes of non-conformities in the manufacturing flow, by analyzing the way of carrying out the activities and the reference documents within the workstations where the non-compliant products were manufactured. Because the problem was identified in time, nonconforming parts were not delivered to the customer, thus avoiding a complaint from him. An internal QRCI was opened to solve the problem. If the nonconforming parts were delivered to the customer and the customer filed a complaint with the supplier, a thorough 8D analysis was required.

Keywords: Quality, QRCI, Process Improvement, Problem Solving Method

INTRODUCTION

The current concept of quality in economics has a broad meaning. According to this theory, the image of a product is represented by its features. The feature is an attribute of the product that differentiates it from others and that confers the value of using the product, so the property of the product to satisfy a social need [1].

Continuous improvement is an essential activity for all companies in the automotive field. Effective hazard analysis in project, process and product areas is important to stabilize the actions taken by the company [5]. These prudent practices can reduce product or process incompatibilities. This approach is consistent with the idea of continuous improvement. In addition, the impact of these actions on the natural environment must be considered in the pursuit of sustainable development and production. This is due to the prevailing and necessary actions that are taken to improve products and processes so that they comply with the principles of sustainable production, for example the case of manufacturing companies.

Quality is a concept with a very broad meaning, which makes it extremely difficult to define it from a scientific point of view. Quality is one of the main elements that make an organization competitive in the market, to build a certain reputation. The term "quality" comes from the Latin word "qualis", which can be translated as "way of being".

Organizations depend on their customers and therefore should understand the current and future needs of their customers, should meet the requirements of the customer and should be concerned with meeting customer expectations as best they can.

The main mission of the organization is to satisfy the needs and desires of its customers. Organizations need to be aware that medium and long-term survival is only possible by tailoring their

service to customer needs. Quality is what the customer wants and not what the institution decides is best for him.

Identifying and satisfying customer requirements is the starting point of quality management for all activities in the enterprise.

METHODOLOGY

The QRCI (Continuous Improvement Rapid Response) is a tool for solving quality problems. Within the QRCI we find several levels of approach. It starts with the production line QRCI, it goes from the department QRCI (production) to the factory QRCI. [2], [3]. The application form contains several methods for solving problems. In case of a complaint to the factory from the customer, the 8D method is applied, [4] otherwise, when the non-conformity is identified internally, the QRCI is completed, without the 8D method, the"5 Why method ?", the analysis of the defect in the tree structure etc.

The purpose of the QRCI is to focus on:

- Customer protection;
- Finding the root cause of the problem and defining the corrective actions;
- Avoid the recurrence of the error.

The QRCI opens when a problem arises by applying the rules of the reaction mode. A team of engineers, line managers and operators is working together to solve this problem and prevent the recurrence of others.

The QRCI comprises 8 stages:

- D1- Defining the problem;
- D2 - Similar risks;
- D3- Immediate actions to protect the client;
- D4- Cause of non-detection;
- D5- Cause of occurrence;
- D6- Corrective actions;
- D7- Effective follow-up;
- D8- Lessons learned.

ANALYZED PRODUCT

" Insert the front door side panel " is the subject of the study. It consists of a plastic part, which is ordered from a supplier and four inserts made of natural leather or PVC, depending on the customer's preferences, inserts made on the manufacturing flow.

In appearance it has several functional seams and a decorative seam positioned in the middle.

Figure 1. Analyzed product

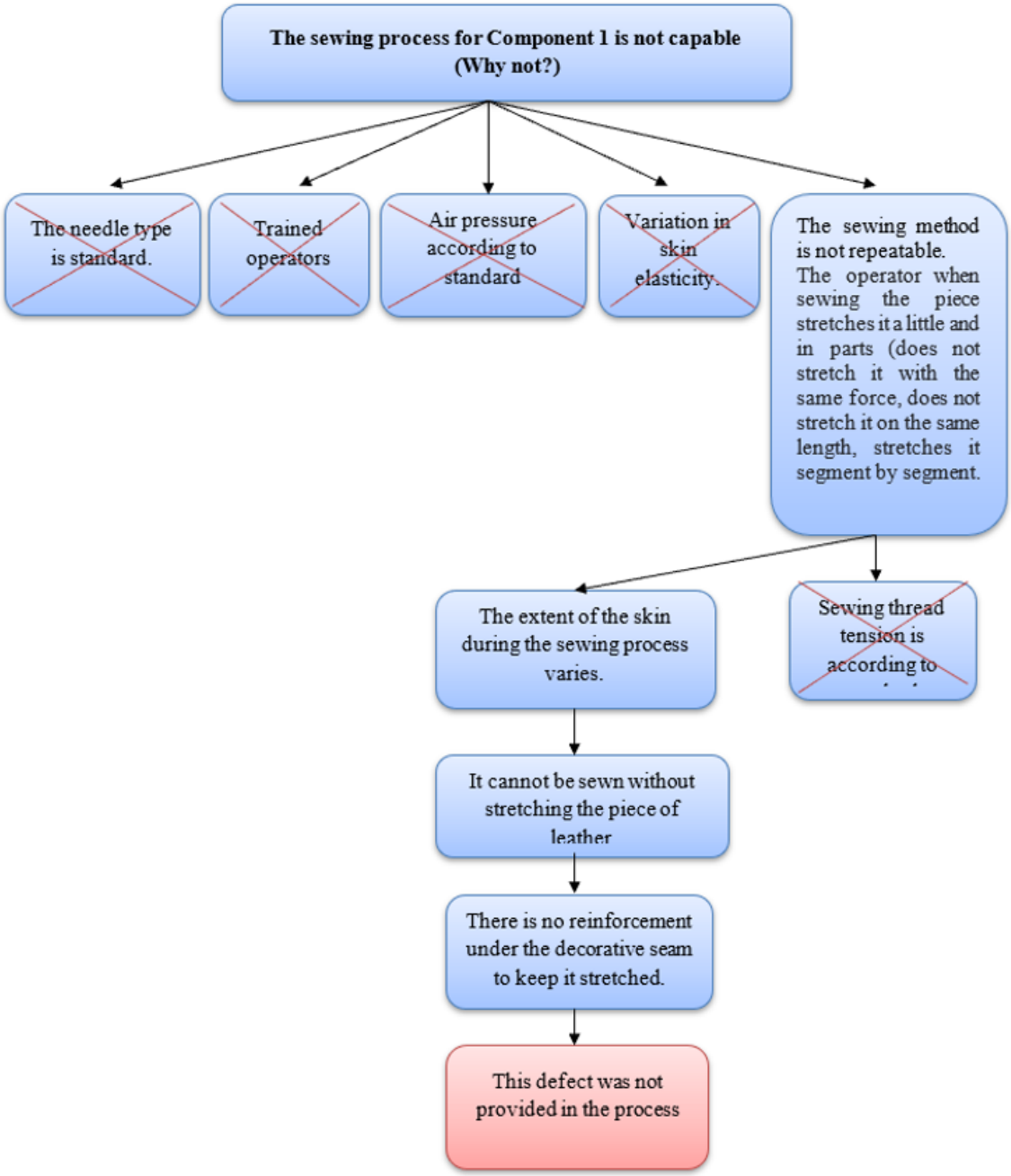
THE EXPERIMENTAL METHOD (QRCI ANALYSIS)

D1- Defining the problem

In March 2022 the manufacturer of the product faced a big problem: decorative seam in waves (this means a non-conforming seam). The quality department found that, during the month, scrap parts worth 70,000 euros were registered, a huge value for the company.

The factory manager, the director of the quality department and all the members of the quality department started a detailed analysis of the problem found in the factory (they opened a QRCI), in order to clearly establish „the problem".

Also, in the first step of the QRCI, "D1- Defining the problem", the "Analysis 5 Why?" is performed. This method is used in order to identify the five main causes that led to the appearance of the decorative seam in „waves".



D2-SIMILAR RISKS

Two more similar components are being made on the same production line: Component 2 and Component 3.

For Component 3, there is no risk of the decorative seam appearing in waves, as this component has no decorative seam.

The "front door side panel insert" and Component 2 are similar in terms of the manufacturing process, as both have both a functional seam and a decorative seam.

Why doesn't the decorative wave seam appear on Component 2?

The 2 components were compared and it was found that Component 2 has a piece of reinforcement under the decorative seam called PREPO (reinforcing rubber insert), which has the role of keeping the decorative seam straight, figure 2.

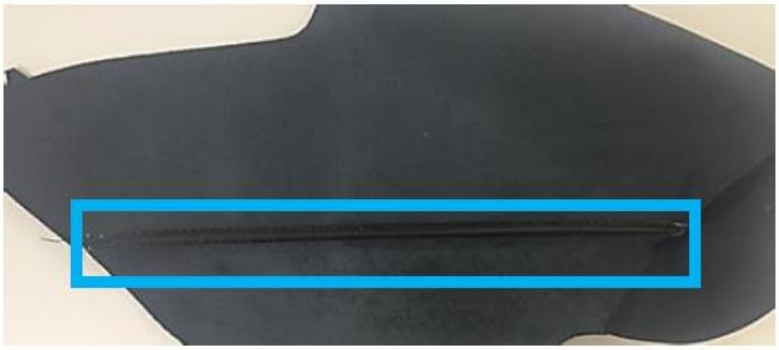


Figure 2. Component 2 with sealing rubber

D3-IMMEDIATE ACTIONS TO PROTECT THE CUSTOMER

The third step of the QRCI "Immediate actions to protect the client" includes "C2-Restriction". Table 1 shows the restrictions taken by the manufacturer.

Table 1. Restrictions taken by the manufacturer

Action	Date	Effect Yes/No	New risks detected Yes/No	Cooments
The parts must be checked in real time (after being sewn) in relation to the parts signed by the customer	23.02.2023	Yes	No	After checking the parts in real time, 5 out of line parts were found per day
The operator at the final control of the fixing line must also check the parts in relation to the new limits signed by the customer	23.02.2023	Yes	No	No scrap was found

D4-CAUSE OF NON-DETECTION OF THE DEFECT

The main reason why the "Decorative Wave Stitch" defect was not detected in time was that this defect is only visible if you stretch the piece of skin along its entire length.

The measures that were taken were to visually check, in real time, the seam of the pieces in terms of appearance.

Both the quality standard and the inspection instructions provided for only two possible defects of the decorative seam (skipped step and free step), which caused major confusion. From the point of view of the quality standard, the operator of the final inspection post of the sewing line checks the parts correctly, checking only if the two defects in the instruction are present. At the same time, however,

it was impossible to declare the piece with a decorative seam in the wave, because this defect was not included in the work instructions.

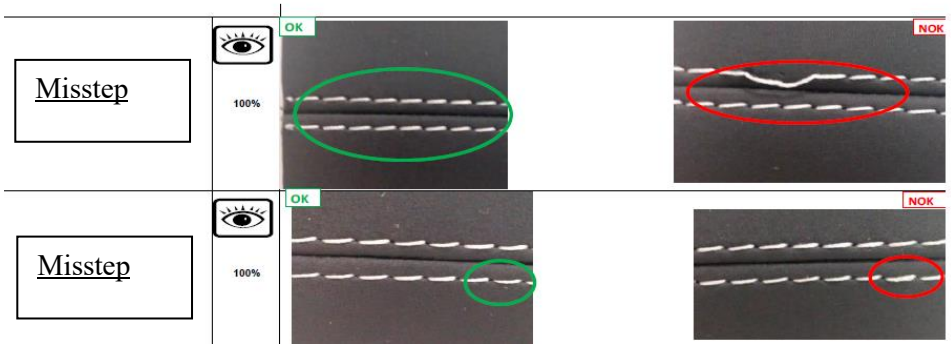


Figure 3. Defects included in the operating instructions

The following analysis was performed below:

1. The way the leather pieces are sewn has been investigated. Because the pieces of leather have a length of about 1m, the operator fails to make a continuous seam, the operation being performed in portions, segments, figure 4.

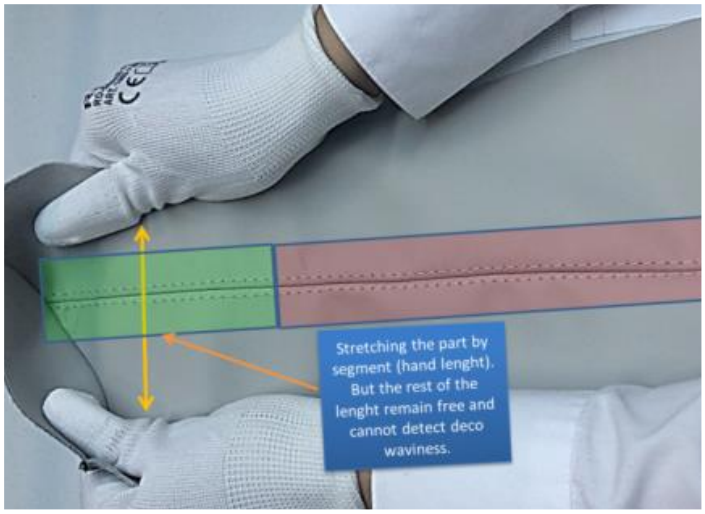


Figure 4. Stretching the part

2. It was also investigated how the sewing operator could detect the decorative seam in waves to stop the scrap pieces in the sewing line.

This second investigation has resulted in the operator sewing the parts for the " front door side panel insert " not being able to do two different things at the same time, namely: stretching the skin so that it can be sewn and checking in real time. if the right decorative seam comes out.

Following the two investigations, it was concluded that this "Decorative wave stitch" defect could not be detected in the sewing line.

D5-CAUSE OF OCCURRENCE

This defect occurred because the sewing process is a manual one, performed by operators not by special devices / machines, which confirms that any repetitive operation performed by man can not be identical to the previous one and allows mistakes to occur.

However, the very high impact caused by the occurrence of this defect was due to the fact that it (the defect) was not anticipated in the design phase and thus was not introduced in the control instruction along with two other possible defects (jump step and free step), which led to the inability to detect its occurrence in time.

It was also stated that the factory standard stated that: "All parts of all existing designs with a decorative seam must have a rubber reinforcement to keep the decorative seam straight."

The actual situation does not meet the standard because the leather products for the "front door side panel insert" were sewn without that hardening rubber, because the plastic part was not provided from the design with the rubber insertion slot. This situation generates a non-compliance with the standard. However, in the design phase and in the PFMA stage (Analysis of failure modes and their effects) it was decided to carry out the sewing process of Component 1 without that reinforcing rubber, so the applied process was in accordance with the project.

D6-CORRECTIVE ACTIONS

Following these analyzes, the manufacturer also developed corrective actions:

1. It was decided to purchase new sewing machines with special devices for inserting and sewing the rubber band.
2. A safety stock has been made to replace the old sewing machines with the new ones, equipped with the special device.
3. Replacing old sewing machines with new ones.
4. Perform an adhesion test to see if the rubber band sticks to the sponge to avoid delamination.
5. The PFMA is updated (Analysis of failure modes and their effects). The use of rubber bands for such parts is mandatory in the action plan and also in the quality standard.

D7-EFFECTIVE TRACKING

In April, a detailed analysis of each working day and each shift was performed.

Throughout the month, work was done in a continuous flow, both on public holidays and on a few days on Saturdays and Sundays, in order to fix the problem as soon as possible.

On May 11, the last modification of the process was made, namely the old sewing machines were replaced with new ones with a special device through which the reinforcement is inserted and sewn. Since then, the number of occurrences of the "Decorative seam in the wave" defect has decreased to zero.

This drastic reduction in the number of defects is a huge gain and an important development for the manufacturer.

D8- LESSONS LEARNED

In the last stage of the QRCI entitled "Lessons learned" the lessons learned were completed:

For all components that are designed in all existing projects in the factory, which contain decorative seams to use reinforcement, rubber under the decorative seam to avoid the occurrence of the defect "Decorative seam in waves".

To analyze from the project phase all the actions that can be taken to prevent both the occurrence of this defect and the occurrence of other defects.

DISCUTIONS AND CONCLUSIONS

Following the analysis carried out in this case study, it turned out that the main elements that led to the appearance of the decorative stitch defect in the waves were:

1. The "decorative wave stitch" defect was not provided for in the Inspection Instruction and thus the final control operator on the sewing line could not detect it and issue an alert in time;
2. The sewing method is not identical: the operator when sewing the piece stretches it a little in parts and not with the same force;
3. The method of making the decorative seam for the piece " Insert side panel front door was not provided with a reinforcement under the seam;
4. The addition of this reinforcement was not possible in the series phase, because the plastic support did not have the channel for introducing the reinforcement as in other projects.

All these elements led to the appearance of this defect and at the same time to the huge financial losses.

Starting from the need to improve the sewing operation of the part " Insert the front door side panel, reduce the risk of producing non-compliant parts and reduce the effort of the operators during the sewing operation, a first step was to introduce in the Control Instruction this defective to be detected by the operator at the final checkpoint in the sewing line.

References

[1] Application of 8D methodology: An approach to reduce failures in automotive industry, SevilayUslu Divanoğlu, 2021.

[2] Impact of Total Quality Management on Innovation in Service Organizations: Literature Review and New Conceptual Framework. Procedia Engineering, Bon, A. T., MUSTAFA, E. M. A., vol. 53, p. 516-529, 2013

[3] Application of a quality management tool (8D) for solving industrial problems, Evandro Eduardo Broday, INDEPENDENT JOURNAL OF MANAGEMENT & PRODUCTION (IJM&P), 2013

[4] Application of "8D Methodology" for the Root Cause Analysis and Reduction of Valve Spring Rejection in a Valve Spring Manufacturing Company: A Case Study, T. S. M. Kumar* and B. Adaveesh, Indian Journal of Science and Technology, Vol 10 (11), DOI: 10.17485/ijst/2017/v10i11/106137, March 2017

[5] Method of Fuzzy Analysis of Qualitative-Environmental Threat in Improving Products and Processes (Fuzzy QE-FMEA), Pacana, Andrzej, and Dominika Siwiec, Materials 16, no. 4: 1651. https://doi.org/10.3390/ma16041651, 2023