TREATMENT OF NON-CONFORMITIES OF A PRODUCT CARRIED OUT IN AN AUTOMATIC MANUFACTURING SYSTEM

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Rezumat. *Ţinând cont de competiţia globală la care sunt supuse companiile în ziua de astăzi acestea sunt obligate să introducă, pe piaţă, produse conforme cu specificaţiile tehnice. Inevitabil că la clienţi vor ajunge şi produse neconforme, dar este de dorit ca numărul acestor produse neconforme să se reducă continuu. Scopul acestui articol este de a prezenta utilitatea unor tipuri de analiză care să conducă la depistarea cauzelor rădăcină care au făcut posibilă producerea unor produse neconforme. Aceste analize se realizează atât în cazurile în care produsul neconform a fost depistat înainte de a ajunge la client cât şi în cazul în care acesta a ajuns în posesia clientului. Într-o piaţă concurenţială, ţinerea sub control a neconformităţilor unui produs realizat într-un sistem automatizat de fabricaţie contribuie semnificativ la creşterea cifrei de afaceri a companiei care reuşeşte acest lucru. De aceea, companiile sunt preocupate să reducă semnificativ numărul produselor neconforme care ajung la clienţi.*

Abstract. *Taking into account the global competition to which today's companies are subject, they are required to place products on the market in accordance with certain technical specifications. Inevitably, non-compliant products will arrive to customers, but it is desirable that the number of these non-compliant products should continually be reduced. The purpose of this article is to present the usefulness of some types of analysis that lead to the root causes that made it possible to produce non-conforming products. These analyses are carried out in cases where the non-compliant product has been detected before reaching the customer, and also if it has come in the customer's possession. In a competitive market, controlling the nonconformities of a product made in an automated manufacturing system contributes significantly to the growth of the company's turnover. That is why companies are concerned to significantly reduce the number of non-conforming products that reach customers.*

Keywords: nonconformity, defect, poka-yoke, 5 What, QC Story.

1. Introduction

Over the last few years, we have witnessed an increase in product quality, but there are still non-compliant products. When a non-compliant product is detected,

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certain corrective measures that are determined by complex analyses, designed to eliminate the root cause of the nonconformity, are immediately made. In parallel, to prevent non-conformities or to detect non-compliant products in order to isolate them, it is necessary to take preventive measures so that they do not reach the customer. These preventive measures apply in particular to areas at risk of non-conformities. It is desirable to prevent so that non-compliant products do not reach customers, rather than dealing with situations where non-compliant products have been detected by customers. Thus, our customers will trust our products, which they can recommend to other potential customers.

This paper aims to establish responsibilities and describe the process of identifying, documenting, evaluating and treating the product that does not comply with defined requirements to prevent its unintentional marketing and notification of the functions involved. Also, some types of analysis triggered by the non-compliant product are presented.

2. Product Non-conformity

The distinction between the concepts of "defect" and "non-compliance" is important because it has legal connotations, especially those associated with the issues of product liability. Consequently, the term of "defect" should be used with great caution.

If the term of "quality" is used exclusively for technical evaluations, in most cases it is necessary to associate it with an adjective, such as the quality measure or the relative quality. From conception to execution, delivery and consumption, the stages of making products are determinant for their quality. Satisfaction of expressed and implied consumer requirements is underlined by the notion of "nonconformity" and "defect". And because defect is understood to be the failure of a prescribed use condition, the distinction between nonconformity and failure lies in the nature of the features to which it refers. Thus, by failure is meant the cessation of a product's ability to perform required functions or interrupting its operation.

However, the ISO dictionary comes with the explanation of some terms used along the productive chain or after the fault is identified, namely the product / service nonconformity: - Recurrence = action on a non-compliant product to prevent intentional initial use; - Reclassation = modifying the class of a nonconforming product to make it conform to requirements different from the original; - Repair = action on a non-compliant product to make it acceptable for intentional use; - Recrefaction = action on a non-compliant product to make it conform to the requirements.

Thus, non-compliance means, according to ISO, the non-compliance with the specified requirements, while the defect is the non-fulfilment of the requirements for the intended use. The first term refers to the strict compliance with the provisions of the contract and the other strictly to the use of the product.

Distinction cannot be avoided; it should be done because defective products can no longer be used in certain situations. In other situations, however, when certain requirements are not strictly imposed on the product, it is possible to use it, taking into account certain non-conformities and changing product specifications.

The term "defect", as opposed to that of "user-friendliness", is closer to the consumer's vision. The European Community Directive on the legal liability of the supplier is enforceable in this respect. This reinforces the idea that a product can also take other uses in relation to the intended one, depending on the presentation or the method of reprocessing adopted.

Regardless of adoptions, adaptations and restructuring, product quality is structured and high on the ISOfoundation: - quality = the extent to which an assembly of intrinsic characteristics meets the requirements; - receance = need or expectation that is declared, generally implied or mandatory; - class = category or rank assigned to different quality requirements for products, processes or systems having the same functional use; - customer satisfaction = customer perception of the extent to which the requirements have been met; -capability = the ability of an organization, system or process to achieve a product that will meet the requirements imposed on it [4].

3. Treatment of Product Non-conformity at Dacia Mechanical Use

Dacia Mechanical Plant and Chassis covers a wide range of activities: manufacture of aluminium parts, assembly and assembly of motors and gearboxes, machining of parts and assembly of front and rear semi-axles, pressing and welding of GMP axles and frames - propeller) for Dacia, Renault and Nissan vehicles all over the world. More than 65% of the plant's output is for export to Renault and Nissan Group plants. Mechanical Plant and Chassis Dacia is organized in four manufacturing departments with 122 production lines: Aluminium, Engines, Gearboxes and Chassis.

The Engines Department's mission is to manufacture and manufacture engine components and engine assembly, K7J (1.4L) and K7M (1.6L), which equips Logan and Sandero and H4Bt (0.9L) available on the new Logan, Sandero, Sandero Stepway and Clio 4 models [2].

3.1 Factory Line Cylinder head K7

This line of manufacture is an integral part of the Engines Department. The cylinder head is the engine component that is mounted above the cylinder in order to create a closed space between the top of the piston and the inner walls of the cylinder. It is made by alloy casting or aluminium alloy casting. A cylinder head may be individual, on each cylinder, common to all cylinders or grouped for several cylinders. The cylinder head appears as a cylinder cap having a cavity at the bottom, a cavity which, together with the piston at the dead end, and the walls of the cylinder form the combustion chamber. The shape of the cylinder head differs depending on the type of engine.

The K7 cylinder head is a complex and automatic line, the cast-iron cylinder made of an aluminium alloy, goes through several machining operations until it reaches a finished product (see Figure 1). Among the operations performed on this manufacturing line we can mention the following: milling, drilling, boring, threading, brushing, washing, etc.

3.1.1 Procedure for handling non-conforming and / or potentially non-compliant K7 cylinder head

Identification of non-conforming K7 is made by manufacturing and / or quality by applying the NECONFORM PRODUCT ID (see Figure 2) on each product.

Fig. 1: K7 Cylinder head [1]

Fig. 2: Non-conform product label [1]

Under the heading “Remarks” - PARTS / PRODUCTS IN ANALYSIS. Isolation of the non-compliant or potentially non-conforming K7 cylinder head is done in specially designed areas - the yellow / red delimited area in the labelled container by the factory. Analysis of the non-compliant or potentially non-compliant cylinder K7 is carried out by an analysis group made up of: - representative manufacturing (as applicable - detector and rebutter generator); - representative

department of manufacturing quality; - representative logistics (when needed); - representative engineering process (when needed); - representative study office (when needed).

The analysis allows for the isolation of non-compliant products and the determination of the type of action: - the use or delivery of compliant products; - Choice of treatment actions.

At this stage, we draw up the Analysis Report form - Rebuttal note. The report should contain all the types of rebuttal of the analyzed period, marked according to the classification index. Recording Report Report - Rebuttal note is made in a special register at UEL level. After analyzing the non-compliant product (on each exchange), the representative of the area where the non-compliant product has been identified completes the Analysis Report - Rebuttal Note, and can generate corrective actions. If the analysis group is not able to meet the exchange group II and III, the Analysis Report - Rebuttal Note is completed at the end of the exchange, the validation is done the next day: in the "manufacturing point" - where all the representatives of the group participate Of analysis.

Sorting. Following the analysis of the previous step, the chillers can be sorted and / or retouched. They are identified with the NECONFORM PRODUCT ID label and marked as TRIAT and / OR RETURN as appropriate.

The Cylinder head are sorted according to the Sorting Guide. Products considered to be conforming after sorting are identified by the green label - PRODUCT CONFORM (see Figure 3) signed by the person who performed the operation (manufacturing / quality) and affixed to the packaging label.

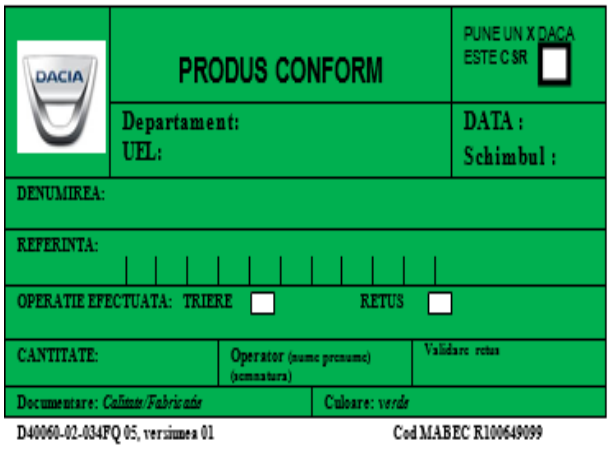

Fig. 3: Conform product label [1]

Retouching. K7 Cylinders head requiring retouching are handled according to rehearsal / retouching / retouching / rehearsing plan / ranges / FOPs. For retouching and / or CSR features, retouching ranges / documents must be validated by the involved RRSH.

Validate retouching. After completion of the retouching, the conforming cylinders are identified with the green label "PRODUCT CONFORM", signed under the heading "Validation" by the UEL Manufacturing / Quality Chief (according to the repairs / retouching plans / gauge / FOPs), affixed to the packaging label to the operator who performed the retouching.

Derogation. The chiclets proposed by the analysis group for the derogation are identified with the PRODUCT NECONFORM identification label, the DEROGATED item is ticked and treated according to the quality procedure - Derogation of the non-compliant product. The form of compliance must be signed by the analysis group (as appropriate: quality, manufacturing, DIVD, etc.).

Validation derogation. The request for derogation is endorsed by the stakeholders, according to a Dacia internal procedure.

Use or product delivery. The chats for which the retouched or the waiver has been validated, including the trials, are promoted in the flow or delivered to the customer by the Logistics / Manufacturing function.

Reboot. Cylinders considered by the analyst group to be rebutted are identified with the NECONFORM PRODUCT label, ticked under the heading REPLACEMENT. The rebute is declared in the PSFP computer system (then automatically transmitted to the GPI) at the end of each exchange by the UEL Manufacturing / Logistics Chief. Containers with rebuttal cylinders are secured (locked) or located in areas away from the manufacturing stream. A mapping of these areas must be at the department level. Rebuff chaussures are mutilated (they become unusable for the purpose for which they were made) by the representative of the manufacturing / logistics. The pieces so mutilated are discharged (based on the Report of Analysis - Rebuttal Note) from the department by the logistic representative within 24 hours. Upon receiving / removing the counterfeit, the PSFP / SIPE Records of Analysis Reports - Rebuttal Notes are verified by the UEL Logistics Chief, UEL Manufacturing Manager (if applicable GPI Screen Copied). GPI information on Rebut is transferred to VALO STOC and ALCOR for the purpose of revaluing and recording rebate [1].

3.1.2 Types of analysis triggered at the detection of non-conforming K7 cylinder heads

Often, what just seems to be "a problem" is, in fact, a symptom of a more serious problem. Managers who want to find solutions to problems need to carry out a root-cause analysis to ensure they have identified the real causes.

A problem is a difference between what it is and what it must be or can be. This definition leads us to consider two main situations: - the problem is caused by a malfunction, in the sense that one thing (or more) does not conform to the specification. This is the case for a deregulating part or production system. In this case, solving the problem is a return to normality; - the problem is determined by the desire to improve the existing, in the sense that there is an opportunity for progress or a new goal is drawn. In this case, solving the problem is progressing to the goal level.

Also, a problem can be simple or complicated (complex). The simple issue is the issue for which information, data, figures can be gathered by collecting and observing the effect. In this case, bindings from causes to effects can be determined by analysis, and action on these causes the problem to disappear. These simple problems are determined by the principle that the same causes always produce the same effects. The complicated problem does not differ much from the simple one; it differs by the number of component elements. A complicated problem can be broken down into several simple problems that are treated separately using the same methods. Certain complex issues have the particularity of not having simple relationships between causes and effects, but the same causes do not always produce the same effects.

The "5 Why" Analysis was first used by Sakichi Toyoda, one of the founders of Toyota, in 1930, and then developed by Taiichi Ohno. It all started from the desire to understand a situation as objectively and quickly as possible, seeking to get explanations from those directly involved in the activities that led to the observed situation, repeatedly using the question "Why is it happening (or not) something specific?" or "Why did the observed symptom appear?" The principle applied in the "5 What?" method is similar to the funnel principle (see Figure 4) [3].

In simpler cases of emergence of non-conforming cylinders (problems first appeared), the technique of "5 Why?" is used in order to reach the essence of the problem.

The purpose of the technique is to explore the cause and effect of the work process, highlighting a particular problem. This method is applied repeatedly asking "Why" (five times, as a rule) until the root of the cause of nonconformity is reached. Although this technique is called "The Technique of the Five Why?", Depending on the nature of the nonconformity identified, the root cause can be

determined by asking the question a few or more times. For each answer given to why, we need to make sure that the set of facts is taken into account. Never is what is "natural" or "normal" as a cause or response to why.

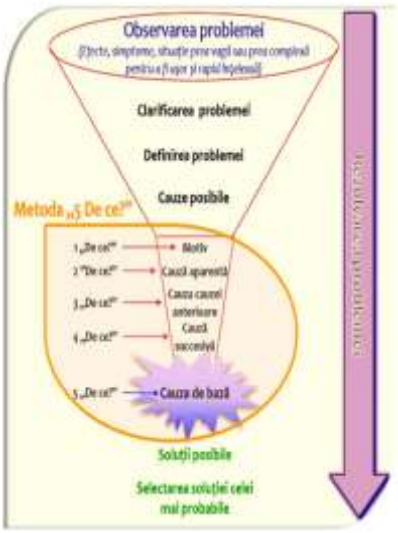

Fig. 4: K7 The funnel principle [3]

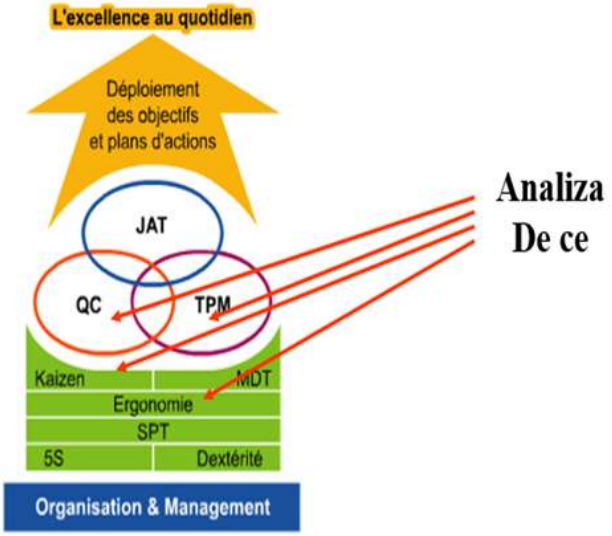

Fig.5: Analysis 5 Why in the SPR Rack [1]

At Dacia & Renault, the "5 Why" will be found, among others, in the following equipment (see Figure 5): -Arts of causes: case analysis according to 4M families (Material, Workbench, Methods, Means); - QC Story: Analysis of repetitive problems; - MBR: Long Stop Analysis or Major Incident (Cold).

In the beginning we describe the facts observed on the field, so they are indisputable. Use: What it does, C, U, C, C, Why (What does, Who, Where, When, How, Why). Make an installation scheme if necessary. When the true causes are not obvious, it is thought to seek out the explanation paths with the 4M: Workbench - Material - Methods - Means. It is important not to judge only on true facts; we must eradicate all possible causes that can lead to this problem. Because this takes a long time, it is necessary to prioritize actions, which implies an analysis of defect modes and their criticism.

When Analysis 5 From Logic, all phrases must logically link to "So", check back, then define action plans. If we were to make a summary of Analysis 5 From what we can say the following: - Before starting an analysis, check whether the issue has disappeared by applying an existing standard; - the problem is correct; - the question of why? (as long as it is necessary for the human cause); - dowise check

whether this cause implies the effect; - check if there are other causes; -to define the actions, then measure their effects.

Key Points for an Analysis 5 What to do to eliminate the problem are as follows:. - we judge only facts (check on the field, do not imagine); - make constructive and precise phrases (subject, verb, complement); - despite different skills if necessary; - Do not put what is normal as a cause in the analysis (e.g. the screw is unscrewed because the engine vibrates); - seeks to treat primary causes [1].

QC Story Analysis is a problem-solving method based on taking into account facts and data, without speculation, for a problem that is caused by several elements. Renault has decided to implement its own production system (SPR). This system is a set of values, principles, rules, standards and practices shared by all the actors of the four functions involved in manufacturing, namely: - product-process concept; -suppliers of parts, materials, components, manufacturing means; -logistics of parts and vehicle dispatching; - production.

Renault's Production System aims to achieve a global performance target that puts the Renault industrial system at the forefront of quality, cost, timing and management, as well as the proposed targets are all imposed because they are the industrial translation of Renault's strategic objectives: - the quality assurance required by internal and external customers; - reducing global cost; - the production of the required products at the requested moments; - responsibility and respect for people.

A successful QC Story approach depends on the following key points: - consider facts and data, not speculation; - consider variations (not only media); - Make the most of useful people - the process is as important as the result; - Make a planning using the PDCA cycle and keep it; - Stop the 9 steps and use the usual means; - Improvements are not useful if they are not sustainable (standardized); - not to be afraid of changes or mistakes; - nobody moves without motivation; - (and above all) practice, practice, practice …

Keeping this process is very important, leaving no milestone. This will make work easier, all the more if the activity lasts longer (a few weeks) or requires group work. In practice, it is sometimes necessary to add information in the previous steps after we have already advanced to QC Story.

Of all the aspects of QC Story, the following principles remain the most fundamental: - QC Story is a way of thinking about problems, not a method or a means; - QC Story is usable for all types of tasks where a problem is addressed or an existing one is improved; - QC Story must always be practiced and tested to prove its effectiveness; - This activity is endless, it is a continuous progress.

In more complex cases of non-conforming K7 cylinders, use this QC method Story. This type of analysis uses the Ishikawa diagram to identify the root cause that led to the noncompliance [1].

4. Conclusions

Some of the analyses triggered in detecting non-compliant K7 chillers had actions like installing Poka Yoke devices. Poka Yoke is a simple object (templates, warning devices, warning and information systems, etc.) that prevents staff from making mistakes. Poka Yoke is used to stop the machine or alert the operator that something is about to go wrong. There are 3 levels of Poka Yoke (alert, control).

As the practice of Poka Yoke usually comes from the occurrence of a problem, we can link PDCA QC Story to PDCA Poka Yoke (see Figure 6). As a result, if one of the interim solutions found in Step 6 of the QC Story is put into practice by a Poka Yoke, the creation and implementation of the Poka Yoke will be followed by a PDCA (see Figure 7).

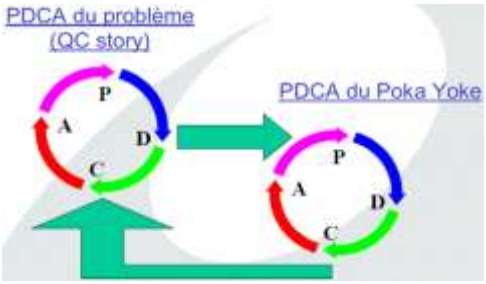

Fig. 6: Link between PDCA QC Story with PDCA Poka Yoke [1]

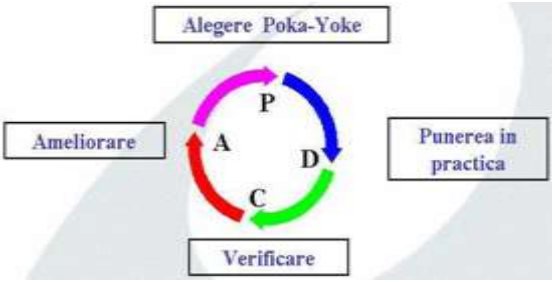

Fig. 7: PDCA Poka Yoke [1]

Thanks to the installation of PokaYoke devices, the K7 cylinder head has greatly improved the quality of the products. Thus, the non-compliant parts are found at the workstation without reaching the customer. Among the advantages that have emerged as a result of the active involvement of all human resources that have attributions to improve the quality of manufactured products, we can recall the following: - diminishing repatriation / retouch costs; - increasing the skills of operators; - dimensioning the number of nonconforming parts; - increasing customer satisfaction; - Positive recommendations offered by current customers to potential customers in the field.

Figure 8 shows the mapping of all poka yoke devices in the K7 cylinder head.

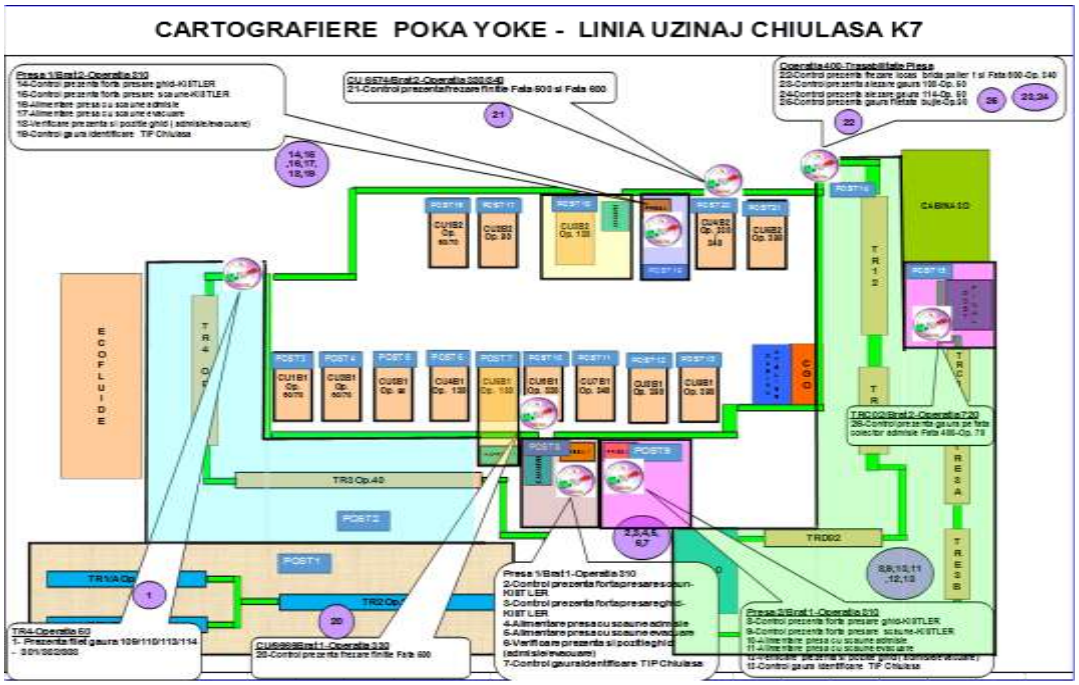

Fig. 8: Cartography Poka Yoke Factory Line Cylinder head K7[1].

Abbreviations

The following symbols are used in the paper:

ALCOR = Long-term IT application for Dacia & Renault accounting;
CSR = Regulatory Security Feature;
DIVD = Direction of Decentralized Vehicle Engineering;
FOP = Process Operation Sheet;
GPI = Integrated Production Management;
P (S) DCA = Plan (Standardize) -Do-Check-Act;
PSFP = Pilotage and Tracking of Parts Flow;
RRSH = Responsable Réglementation Sécurité Homologation;
SPR – Production system Dacia & Renault
SIPE = Système d'Information aux Presses et l'Embouttissage;
SPR = Renault Production System;
UEL = Elementary Unit of Work;
VALO STOC = Stock Valuation, Dacia & Renault IT Application.

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