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ANALYSIS OF THE POSSIBILITY OF USING THE D3 DISCIPLINE OF THE G8D METHOD IN SOLVING QUALITY MANAGEMENT PROBLEMS FOR NOK PRODUCTS

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Abstract: In the paper the D3 discipline of the G8D method has been presented. In the presented procedure all decisions are made regarding the introduction of interim corrective actions - ICA. The algorithm of conduct for the discipline and the quality management tools that the discipline uses have been also presented. It has been also discusses how to proceed for the D3 discipline in determining temporary corrective actions for the NOK detail with the preceding actions in the D2 discipline.
Keywords: G8D method, D3 discipline, temporary corrective actions, quality management, production process, complaint

1. INTRODUCTION

The G8D method is an effective method of quality management and problem solving at the producer's and at the customer's. It allows for solving problems related to the customer's complaint in relation to defective NOK (NOT OK) products received from their manufacturer (Grecu at al, 2015). This method applies only to those complaints that were caused by the fault of the product manufacturer. A NOK product is a product that has manufacturing errors, classifying it as a deficiency (defective product / semi-finished product) or it does not comply with the specification specified in the documentation delivered to the manufacturer.

The G8D method consists of eight basic steps (Ramachandran et all, 2013; Cyganiuk at al, 2019), which allow, among others on: determining what is the cause of the complaint, how the product defect is manifested, what can be done to protect the customer (before the problem of producing defective products is solved), and it also concerns the introduction of corrective actions during the production process so that defects do not arise. The G8D method, in addition to all activities aimed at preventing

production and delivering defects to the customer, also requires the completion of a report in which the activities performed are recorded step by step. Such a report is very often especially useful during the implementation of the G8D, e.g. for structurally similar NOK products.

When analysing the NOK product and the place of its formation in the production process using the G8D method, a number of quality management tools are used, such as the Ishikawa diagram, Pareto diagram, control cards (Ramachandran et all, 2013; Celmerowski, 2007), FMEA method. It is also used, among others reports from other G8Ds, inspection reports, deficiency reports, interviews with leaders responsible for a given production process, process flow diagram, Poka-Yoke or brainstorming. All these activities are aimed at finding the cause of the existing shortage production of NOK products and accelerate the solution of problems and finding their source in the production process. It is obvious that there is also the possibility of using other methods to solve the problem, such as 5 Why (Celmerowski, 2007).

The D3 discipline of the G8D method allows the definition and implementation of so-called Interim Containment Actions (ICA), the task of which is to isolate the effects of the problem from the customer's production process (Global 8D solving workbook, 2018). The temporary corrective actions defined in the D3 discipline allow the development of so-called permanent corrective actions. This means that the D3 discipline gives the supplier of the NOK shortage time to solve the problem in their production process, and thus at the same time to carry out the remaining G8D steps (other disciplines).

2. THE ALGORITHM OF CONDUCT IN THE D3 DISCIPLINE OF G8D METHODS

Having the correct description of the problem provided by the D2 Discipline (described in (Global 8 D solving workbook, 2018; Cyganiuk, 2019)) and knowing why the detail sent to the client turned out to be NOK (what is the cause of the detail defect), then the discipline should be used D3 of the G8D method. On the basis of the items in the G8D report (in relation to the D3 discipline), it is possible to establish and implement Interim Corrective Actions, the purpose of which is to remove the problem (symptom) arising at the customer.

Interim corrective actions are carried out until it is possible to introduce permanent corrective actions in the company producing the defective detail (Kaplik at al, 2013). Of course, permanent actions must be validated. Interim corrective actions give the company the time it takes to move through the next G8D disciplines.

Actions taken in the D3 discipline as part of interim corrective actions must not only be verified but also validated.

The procedure algorithm for the D3 discipline used in the G8D method is presented in Fig. 1.

Activities in the D3 discipline must therefore provide the customer with a minimal impact of the problem (symptom) on the production process and give the G8D team time to develop and introduce permanent corrective actions that will undergo the validation process and completely isolate the problem from their own production process, ensuring defect-free production. Of course, when introducing interim corrective actions, the company's financial capabilities and the use of the owned stock of machines should be taken into account.

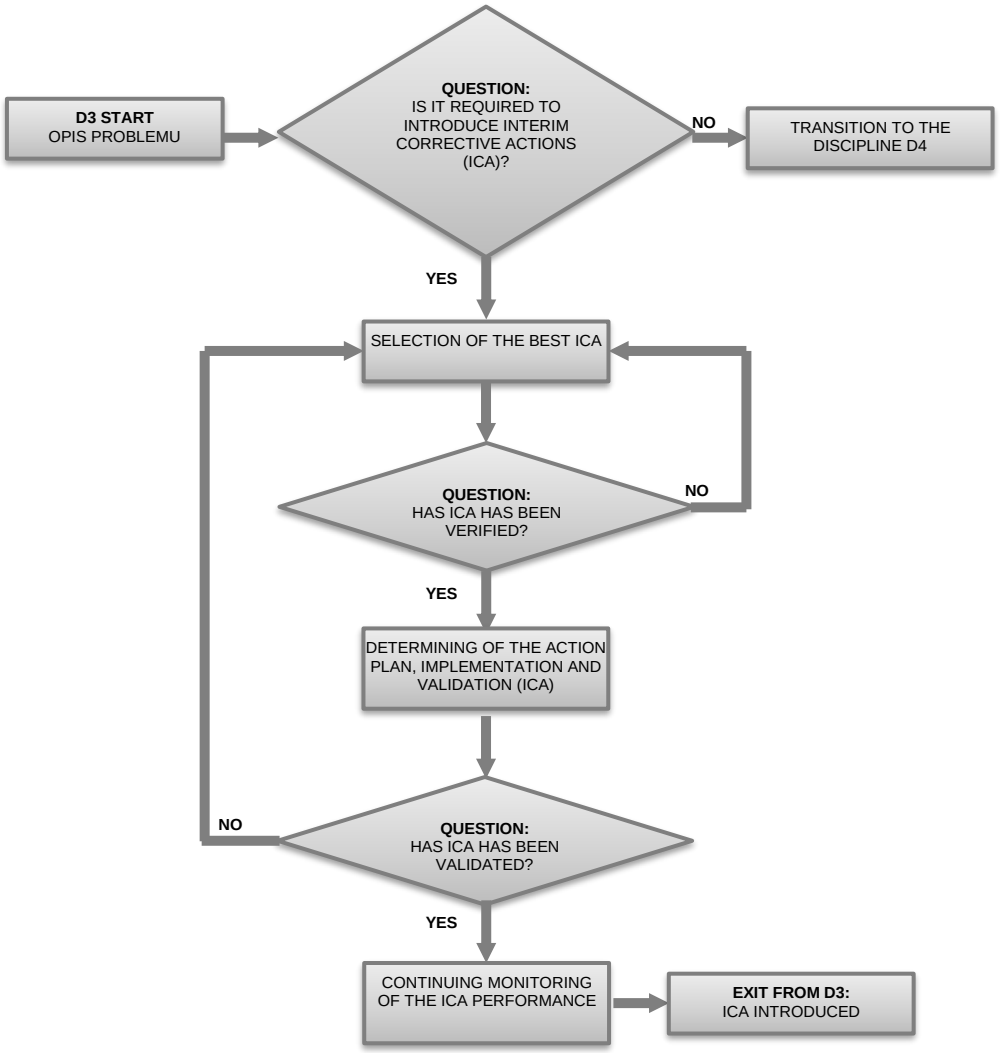


Fig. 1. Algorithm of conduct in the D3 discipline - flowchart (Global 8 D solving workbook, 2018)

It is absolutely necessary to consider that temporary corrective actions may be a costly move and may require the introduction of an additional process (Global 8 D solving workbook, 2018), therefore it is always necessary to analyse all criteria for introducing such actions, as well as all proposed and verified solutions, in order not to expose companies to excessive costs.

Examples of the interim temporary corrective actions are:

- action at the customer experiencing the symptom (e.g. repairing defective products, if possible),
- repair of the defective product in the company that produced the rejects,
- carrying out a 100% inspection of each product made as part of interim corrective actions, which has been verified and validated,
- introducing a replacement production process in the company as part of its own machine park or incurring additional costs of purchasing the necessary machines and devices.

Each of the exemplary methods entails additional costs for the company. At the same time, there is no certainty that these actions will provide full customer protection and

will fully eliminate the problem until permanent corrective actions are introduced (mainly the first batch of products is validated).
When completing the G8D report in the D3 discipline, the "% Effective" items are filled in, where the percentage value of the effectiveness of the temporary corrective actions that have been achieved is given.

3. APPLICATION OF D3 DISCIPLINE ALGORITHM FOR NOK DETAILS BASED ON D2 DISCIPLINE ASSUMPTIONS

The OK type detail (Fig. 2) produced by the company is a steel plate, with the bending angle 90°. Holes are made on both arms of the plate, where a nut is welded over one of the holes. The sheet metal is then painted.

Fig. 2. Detail OK - a steel sheet with all holes visible

The NOK type detail (Fig. 3) was detected by the end customer, who was delivered 3200 copies of the finished product, of which as many as 1250 incorrectly made details were recorded. The NOK detail was reported to the manufacturer as a complaint.

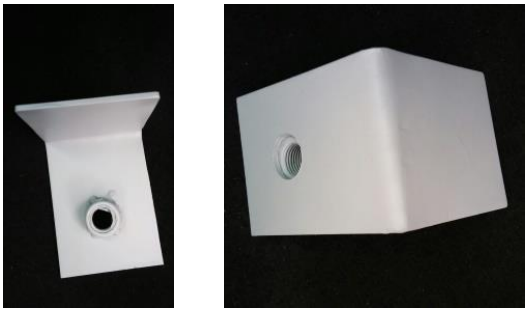


Fig. 3. Detail NOK – visible missing one hole

The on-site inspection showed that the complaint was justified, because the detail did not have one of the holes, which was inconsistent with the requirements set out in the construction drawing provided to the company by the customer - the recipient of the detail. The lack of an additional hole was found by the customer during the assembly process of the element in the final product. In addition, in the company of the producer an inspection of the finished parts intended for shipment was carried out, and errors in its execution were also shown.
An Ishikawa diagram was drawn up for the hole drilling process to discover the cause of the symptom (problem) at the customer. As previously mentioned, based on the

inspection of the NOK detail, the symptom was described as "no hole ϕ 16" and also as "no possibility to install the detail in the finished product".

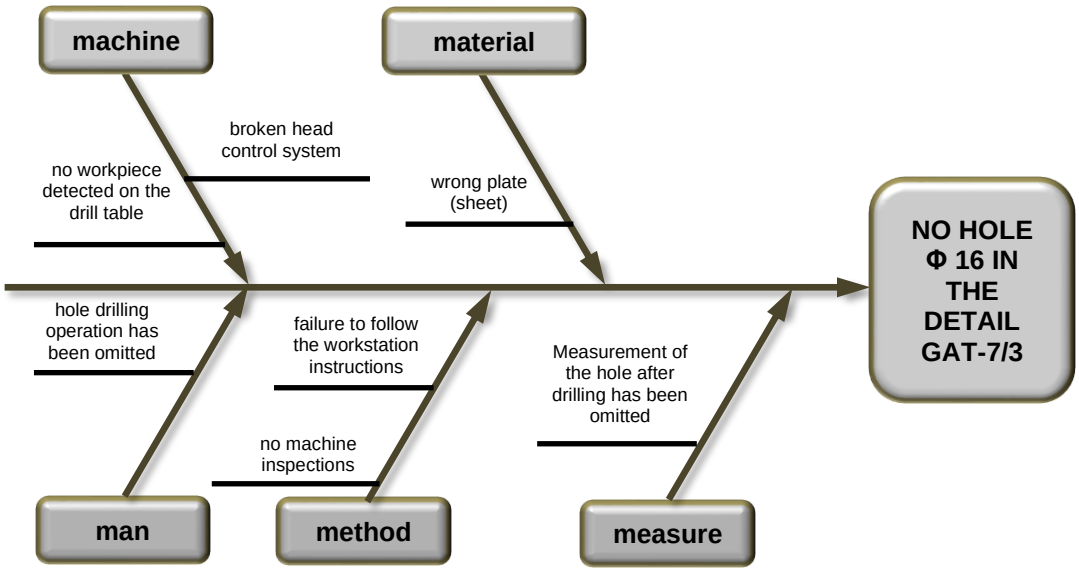


Fig. 4. Ishikawa diagram for the description of the problem of the lack of a hole - discipline D2

The G8D team, with the NOK details, confronted each of the possible potential problems that were classified (Fig. 4):

- the hole drilling operation was omitted,
- no workpiece was detected on the drill table,
- damaged head control system,
- failure to follow the position instructions,
- lack of machine inspections,
- wrong plate (sheet),
- hole measurement after drilling was omitted.

The analysis of the sensor operation in the device (drill) showed the correctness of its operation, as well as the assessment of the state of the head control system. In addition, the employee did not report any problems related to the operation of the device, and the inspections were performed on a regular basis, so these three reasons were rejected. The reason "wrong plate (sheet)" was also rejected as the employee did not report the delivery of another material to be processed, which he could have mistakenly dumped into the container of drilled products, instead of the container of non-conforming products. The analysis of orders in a given period also did not indicate a change in the production assortment. The observation of the employee did not show the reason for "non-compliance with the work instructions", but showed that the employee periodically skips the drilling process of the second hole, and also performs the measurement on only one hole due to the same size of both holes. The analysis performed in the D2 discipline preceding the D3 discipline allowed to obtain a description of the problem experienced by the client and which was the reason for the delivery of the NOK detail. The description of the problem is: "16 hole drilling operation was omitted."

Having the basis for the transition to the D3 discipline - that is, having a description of the problem, it was necessary to modify the tampering measures introduced at the beginning, protecting the customer against the lack of assortment to continue production and before the delivery of subsequent NOK details (withdrawal of a batch of defective products - drilling - return to the customer / inspection in the warehouse of products for shipment). The presence of the ϕ16 hole was checked using a visual inspection and a special gauge designed to control the manufactured elements (compliance with the dimensional and assortment requirements). An inspection was carried out for 500 units made in the company (in stock awaiting shipment to the customer) and after a partial inspection for 200 units, it was found that 50 units did not have a hole, and 23 had a hole but it was inconsistent with the current production range (current customer order). That means that 73 elements were included NOK details, of which, in the analyzed case, the total absence of a hole was recorded in almost 70% of the non-conforming details (68%), therefore the remaining control was performed only by visual method, qualifying the hole using the "is / not" method. A total of 105 non-compliant elements (no hole) were found from the tested population of 500. As can be seen, in this case, it was decided to introduce the 100% control. For holes not in accordance with the dimensions, additional G8D was opened. Further activities, i.e. activities carried out in the D3 discipline, concerned the implementation of detail control instructions at the production stand. The detail inspection instruction prepared in step D3, introduced as a solution for Interim Corrective Actions, is presented in Figure 5. This instruction requires the inspector to visually inspect the produced detail and qualify it to details OK (the employee puts the detail OK into a blue container) and to details NOK (the employee puts the NOK part into the red container).

The details from the blue container, before shipment to the customer, were checked once more time in order to verify if the initial selection was made according to the instructions shown in Figure 6.

Based on the activities carried out in the D3 discipline, the description was included in the G8D report in part D3.

The record indicates that it is still necessary to carry out activities according to the instructions in Figure 6 "continue 100% control with D0 according to the attached instructions - visual control for the presence of a hole". The client's protection against the delivery of NOK details was also confirmed. It should also be mentioned that in the D0 discipline the symptoms of the problem were determined and qualified for the opening of G8D.

The Deming's Plan-Do-Check-Act method was used to select the method ensuring the implementation of well-functioning interim Corrective Actions, and the most successful ICA was selected.

3. SUMMARY AND CONCLUSIONS

As can be seen, the key issue in resolving a customer complaint related to a NOK detail is to put in place effective methods for temporary corrective actions. This protects the customer against the delivery of another batch of defective products, and the manufacturer against financial loss, which may turn out to be significant (repair at

the customer's place / withdrawal from the customer and repair at the manufacturer's / scrapping of damaged items / financial penalties under the contract).
The 100% control introduced as part of the D3 discipline will allow us to deliver to the customer only correctly made details, while securing the further production at the customer company.
The operating instructions introduced under the ICA enforce the control of manufactured parts, reducing the probability of re-sending the NOK parts to the customer.

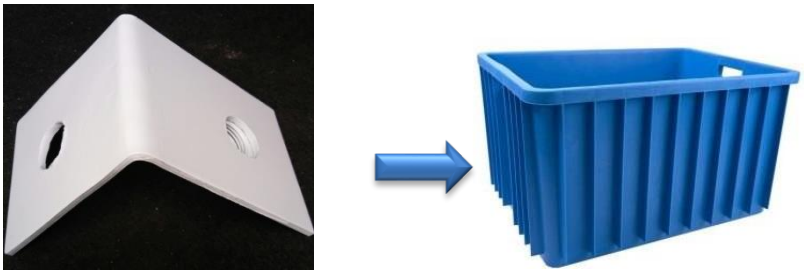
OPIS PROBLEMU
NO HOLE Φ 16 IN THE DETAIL GAT-7/3

Tools required: NO

Procedure: Check the presence of the ϕ16 holes
OK- there are two holes
NOK- at least one hole is missing

NOTE: Each controlled part is put into a container at the control stand with the division:

Blue container - detail OK



red container - detail NOK

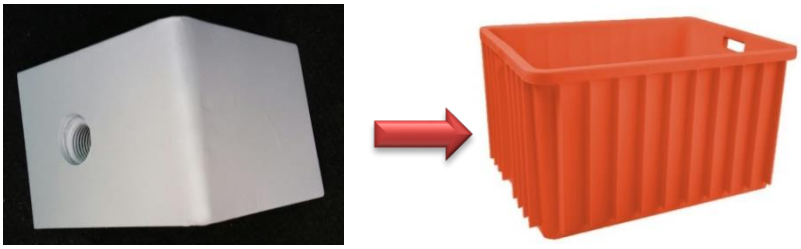


Fig. 5. Instructions for the 100% control of details for shipment - discipline D3

Due to the longer time that may pass until the selection and implementation of Permanent Corrective Actions (disciplines D5 and D6 of the G8D method), the introduction of ICA becomes a key, though often labor-intensive method of securing the client that reports a symptom.
In the case of the problem analyzed in G8D, which was the lack of the ϕ16 hole in the part delivered to the customer, the introduced instruction significantly improved the situation in terms of preparing a batch of OK parts for the customer. The customer did not file a complaint as to the next batch of products delivered to him, for which a 100%

inspection was performed. Until the introduction of permanent corrective actions, the client did not report the delivery of incorrectly made details.

The G8D report indicates the effectiveness of the introduced ICAs at the level of 100%. The updated G8D report was of course made available to the customer. The key element of cooperation with the client during the implementation of G8D (including also for the D3 discipline) is, in addition to introducing ICA, also notifying the client about the progress in solving the problem, including sending the G8D report to the client after each update. Due to this, the client knows at what stage the problem solving process is and whether the manufacturer is able to ensure the delivery of details made correctly.

REFERENCES

Babica, M., Pająk, E., 2006. *Koncepcja metody eliminacji niezgodności w procesach produkcyjnych*. Zeszyty Naukowe Politechniki Poznańskiej, 3, 5-15.

Borcz, A., 2003. *Globalne wytyczne zarządzania jakością dla dostawców przemysłu motoryzacyjnego (ISO/TS 16949:2002) na tle sytuacji w branży*, Problemy Jakości, 3, 12-14.

Celmerowski, Z., 2007. *Metoda Global 8D*. Kraków: TQM soft.

Cyganiuk J., 2019. Idzikowski A., Kuryło P., Tomporowski A., Kruszelnicka W., *Application of algorithm of discipline D2 of G8D method in solving selected problems of quality control management*. System Safety: Human - Technical Facility - Environment, Vol. 1, no. 1, 599-606.

Cyganiuk J., Kuryło P., Idzikowski A, Frölich S. Niemira P., 2019. S*olving selected quality management problems with the use of the D4 discipline algorithm of the G8D method*. System safety: human - technical facility - environment: monograph, Warszawa: De Gruyter Poland - Sciendo, 996-1003.

Gl*obal 8D solving workbook, Results People developing people*, Essex
http://cdn2.hubspot.net/hub
/170850/file-18472412-pdf/docs/global_8d_workbook.pdf (access 2018).

Grecu, I., Belu, N., Misztal, A., 2015 *Increasing customer satisfaction through the application of the 8d methodology*. Management - the key driver for creating value Book Series: International Conference of Management and Industrial Engineering, 488-495.

Harmol, A., Mantura, W., 2002. *Zarządzanie jakością teoria i praktyka*, third ed. PWN Warszawa-Poznań, Poland.

Hamrol, A., *Zarządzanie jakością z przykładami*. 2012/ PWN, Warszawa, Poland.

Kaplík P., Prístavka M. Bujna M., Viderňan J., 2013. *Use of 8D Method to Solve Problems*, Advanced Materials Research 801:95-101.

Ramachandran, T., Prakash, R., Karthik, R., Valappa, Kumar S., 2013. *An application of g8D methodology as a problem solving tool in a manufacturing firm*. International Conference of Sustainable Manufacturing and Operations Management ISOM. Conference Materials, Gyandhara International, 331-335

Rambaud, L., 2006. *8D Structured Problem Solving: A Guide to Creating High Quality 8D Reports*. PHRED Solutions.

Skotnicka-Zasadzień B., 2018. *Use of the 8D method for the identification of quality problems in the production process*, Cross-border exchange of experience

production engineering using principles of mathematics : Modern mathematical methods in engineering 3mi, 223-229, Ostrava.

Tague, N., R., 2004. *Seven Basic Quality Tools*. American Society for Quality: Milwaukee, Wisconsin, USA.

Visser C. S.P, 2017. *8D Problem solving explained – Turning operational failures into knowledge to drive your strategic and competitive advantages*, CreateSpace Independent Publishing Platform.

Xu, Z.; Dang, Y.; Munro, P., 2018. *Knowledge-driven intelligent quality problemsolving system in the automotive industry*. Advanced Engineering Informatics, 38, 441-457.

Zarghami A., Benbow D., 2017, *Introduction to 8D Problem Solving: Including Practical Applications and Examples*, ASQ Quality Press.