# Methodology of the quality management in the productive process

**Article** *in* Journal of Achievements of Materials and Manufacturing Engineering · September 2008

Source: DOAJ



Marek Tadeusz Roszak
Silesian University of Technology

Journal of Achievements in Materials and Manufacturing Engineering
VOLUME 30
ISSUE 1
September
2008

# Methodology of the quality management in the productive process

**D. Szewieczek [a], M.T. Roszak [a,*], D. Helizanowicz [b]**
[a] Division of Materials Processing Technology, Management and Computer Techniques in Materials Science, Institute of Engineering Materials and Biomaterials, Silesian University of Technology, ul. Konarskiego 18a, 44-100 Gliwice, Poland
[b] Fiat Auto Poland, Dyrekcja Handlowa, ul. Grażyńskiego 141, 43-300 Bielsko Biała, Poland
* Corresponding author: E-mail address: marek.roszak@polsl.pl

Received 08.05.2008; published in revised form 01.09.2008

**Industrial management and organisation**

## ABSTRACT

**Purpose:** The quality management in the productive processes is essential in formation of the quality of the final product. It is particularly important in the motor industry. The paper presents characteristics of the management methods and application of the processing point analysis in the chosen productive process.
**Design/methodology/approach:** To solve the problem presented in the paper the authors used the method of the processing point analysis applied in the enterprises adapting the quality management model of the World Class Production.
**Findings:** In the paper there were presented the results of the analyses for the productive process of the back door assembly with usage of the processing point analysis.
**Research limitations/implications:** Presented in the paper methodology and the way of running the processing point analysis being an example of the quality management in the process may serve as the guide for realization of similar tasks.
**Originality/value:** Original application at the example of the methodology of the processing point analysis.
**Keywords:** Quality management; Quality control; Process; Management system

## 1. Introduction

The car is a necessary part of our life. For the years of development of technology and economic transformations it stopped to be a luxury. Nowadays there is an era of inexpensive and reliable cars, available for people with average salaries. The customer, through continuous evaluation of the product during its exploitation, eliminates producers of cars whose quality of the final product is too low matched his expectations, quality, functionality and prices. To maintain loyalty of the purchasers for the make, the producers tend to assure maximal satisfaction and guarantee of the security through continuous development of the productive systems using suitable manager instruments.

There were presented establishments of the basic model of the quality management World Class Manufacturing (WCM) for the system of production in the motor industry. There were also presented results concerning usage of Processing Point Analysis (PPA) in the process of improvement of the quality for assembly of cars in purpose to provide repeatability of the chosen process in the Fiat Auto Poland in Tychy.

The management is the main function of task realization tending to achieve the aims. The quality of realization of management depends on many factors which may influence its level – difficult to define. The quality management presents the main instrument necessary not only to achieve the aims by organizations but also to perfection the objects – productive / creative systems – and subjects of management – groups of employees and work positions.

The productive system constitutes a number of elements and relations between them and relations of transformations of inputs into outputs from the system. There is purposefully projected and organized material, energetic and informative system exploited by a man, serving to produce determined products in aim to satisfied the customers [1, 3].

The purposes of each productive system:

- increase in quality and modernity of products,
- increase in productivity ,
- decrease of own costs of production.

The productive system constitutes the collection of positions or productive modules associated with each other by relations resulting from the productive process which may have different character [2, 5]:

- configurative; resulting from distribution of positions or productive modules,
- technological; resulting from phases of the productive process and operations,
- administrative; resulting from the administrative service and the management of production,
- functional; resulting from the steering of the productive process.

The quality of the product created in the productive process is understood dependently from the form of the product. Nowadays the customer of the motor industry assumes that the bought product meets the requirements associated with all the measures of the quality such as functionality, reliability, durability etc. The strategy of the factory must be directed at fulfilment of the needs defined by the customer but also development of those features of products or services which should precede or even stimulate new needs of the potential customers [7].

One of described in this range methodologies – Kano – postulates that the quality of the product should be seen at three levels of requirements [7] :

- determining the basic features; for instance for the passenger car there is minimum of features which must be fulfilled by the vehicle to be registered as passenger car;
- determining the performance; for instance the car at the given class must not exceed the limit of loud over 65 dB, must develop velocity to 160 km per hour, etc.;
- deciding about attractiveness, for instance the products which possess characteristics not used by other similar products and which the customer takes as unexpective.

Taking into consideration relatively big complexity of products of motor industry it is necessary to use suitable mechanisms which eliminate possibility of occurrence of faults or reduce results of those faults done in the phase of development of the product and in each successive phase. Taking into minimum the costs of the production can be reached by application of different methods which purpose is not to detect the faults but to prevent their occurrence. Such an approach is deeply connected with the quality management. Such methods as Statistical Process Control SPC, analyses of measurement systems, FMEA methods, evaluation of the quality system including auditing are numbered among them [5, 8, 14].

The evaluation of the quality of the product or the process should be preceded by establishment of features according to them this evaluation is done. Such features can be divided into (according to possibilities of measurement of them) [7]:

- measurable; which can be measured and expressed by different units of measure,
- immeasurable; which can be described only with words.

Because of practical and easy usage of application of quality evaluation and its realization the measurable features are better than immeasurable features.

One of the management methods is the quality control in the productive processes. It is especially meaningful in the motor industry because the quality of the product is dependent on a lot of elementary features among which the biggest group there are geometrical features of component elements of the produced products defined as tolerability's and relations among them [12].

At the end of the forties the commonly used measure of the quality level was defectiveness expressed by percentage. Accepted quality level allowed 1-2% of incorrectness of the products. At the beginning of the eighties the commonly used method describing the quality of the product was statistical evaluation (with determined probability) of percent contents of population in the limits of tolerability. In the next years the percent evaluation of defectiveness was replaced by numeral indexes of ability [16]. This solution is used in the most productive processes as the effective instrument of the quality control.

The conditions of the work constitutes one of the elements forming the quality of the product and process. The formation of work conditions in the assembly only partially depends on the technologist because the basic technical solutions, it means equipment in the productive hall and general work conditions (material parameters of work environment) result often from the activity of other organizational units in the factory [9].

## 2. Application of the method

The car is one of the most advanced technologically products for common usage. It consists of over five thousands parts and each of them has its own projective, investigative, technological and productive process. The purpose of the realization of those processes is to achieve products of the highest quality.

The quality of the work determinates the quality of cars and is the consequence of determined conditions of the work

The system World Class Manufacturing is based on the consequent eliminating of losses in all the fields of the factory through rigorous applying and improvement of work standards – operative cards. The purpose of WCM is to develop operations of the organizing system in the factory, just to achieve the world class level of competitiveness.

The Japanese WCM comprising Total Quality Control (TQC), Total Productive Maintenance (TPM), Total Industrial Engineering (TIE) and Just In Time (JIT) is practically the means to provide great advantages and profits – Figure 1 [4].

| World Class Manufacturing | | | |
|---|---|---|---|
| **Fluctuations of needs**<br>No reserve (short time with possibility of quick arrangement) | **Problems of quality**<br>No defects (introduced during the process of quality) | **Damage of machines**<br>No damages (great availability) | **Production**<br>Minimal cost (motivation to greater productiveness at low work absence) |
| **JIT** | **TQC** | **TPM** | **TIE** |
| Process Excellence | | | |

Fig. 1. The model of the quality management WCM [4]

The project was realized according to 7 steps presented at the Figure 2 [4].

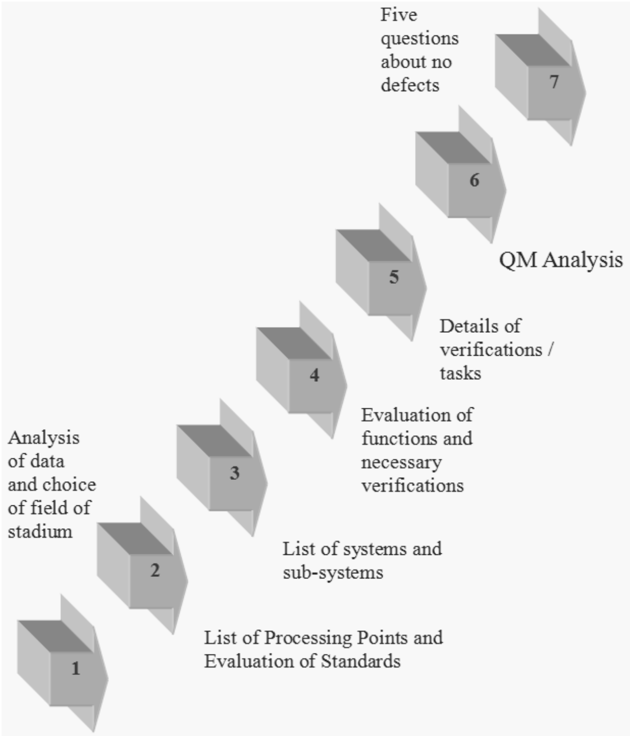



Fig. 2. Seven steps of Processing Point Analysis [4]

**1. First "step" – the analysis of data and choice of the field of stadium:**

- Preparing the description of the phenomenon,
- Preparing the purposes of SMART.

**2. Second „step" – list of processing points and evaluation of standards:**

- Preparing the description of the phenomenon,
- Preparing the description of the rule of this phenomenon,
- Preparing the description of operative standards.

**3. Third „step" – list of systems and sub-systems:**

- Identification of sub-systems which participate in production,
- Preparing the list of determined systems and sub-systems.

**4. Fourth "step" – evaluation of functions and necessary verifications:**

- The analysis of possible reasons of deviations in systems or sub-systems.

**5. Fifth "step" – details of verifications / tasks:**

- The analysis of the phenomenon,
- Determination of the methods of verifications and criteria of evaluation,
- Description of the found verification of the phenomenon,
- Description of reparative tasks when abnormalities were found,
- The analysis "know-why' is performed when the response for the criterion to check is NO and the solution is not obvious,
- Determination of consequence for not done reparative activities.

**6. Sixth "step" – QM analysis. Elaboration of QM Matrixes for verification of critical compounds through following conditions to provide homogeneity:**

- Parameter – what will be verify,
- Standard value – measurement and tolerability,
- Measurement instrument – how it is measured,
- Frequency – how often, when,
- Responsibility – who is doing this task.

**7. Seventh "step" - five questions for no defects. We check if this technique caused achievement of purposes established in the first step. If NO, the process should be repeated once again.**

WCM could be introduced only through development of competitions and organization able to [4,10]:

- fight with prodigality and losses,
- engagement of all the persons who work at every, organizational level,
- rigorist usage of methodology and instruments,
- prevalence and standardization of achieved results .

The producers of cars are interested in continuous perfectioning of all the actions which influence on quality of the product. Effective perfectioning of products and processes needs to apply suitable methods and techniques of quality management [9].

The methods are complex means of actions during solving different problems. On the other hand, instruments and techniques are procedures of actions based on practical experiences, serving to reach concrete operative purposes. The instruments and techniques are used in models of management individually or may be a fragment of applied methods [4]. The techniques and instruments can be used in all the stages of life of the product, but the methods are rather directed into concrete phases of product creation and are purposefully adapted to them.

The methods of guarantee of quality are used in successive stages of process of quality improvement [6]. To them belong:

- methods which identify and precise the problem (e.g. the chart of flows, brain-storming, control sheets, Pareto's graph, table data analysis, table diagram),
- methods which qualitatively and quantitatively precise the stages of processes and phenomena, analyse reasons of problems (e.g. histogram, graphs of correlation, reason-result diagram, FMEA, control cards, stratification, experiments' planning, Pareto's graphs),
- evaluation of capability of machines, processes, measure-control means,
- methods of artificial intelligence (e.g. neuronal nets),
- methods supporting making a choice, planning, introducing and evaluation of solution (e.g. Gant's graph, critical way, PERT nets – diagram, diagram of planning of process of undertaking decisions.

The quality control is one of the methodologies which plays the key role in repeatability of assembly.

The purpose of quality control application is associated with:

- assurance the customers the product of high quality reducing the costs,
- determining the productive conditions so that it should be possible to avoid inconsistencies,
- maintenance of determined conditions in purpose to guarantee consistencies in time,
- increasing the competitions of employees .

To the instruments and techniques - which purpose is effective achievement of foundations of quality control methodology in the model of quality control WCM in Fiat Auto Poland – belong [4, 8, 10, 13]:

- 5S – an instrument determining the duties of all the employees ,
- 4M – an instrument allowing to type and group factors (reasons) causing a determined result.

5W1H – it is an instrument of logistic analysis used in the new techniques of quality improvement which purpose is to guarantee a complete vision to the analysis of the product or the subject of discussion in all the basic aspects:

*what? – when? – where? – who? – which? – how?*

Five questions serve to the deeper problem.

- 5 x why? – the basic and easy method of problem solution through looking for primal reason and planning of provisory actions removing the result, and definite actions removing the primal reason,
- 5G – method of problem solutions thanks to which one tends to the effect of value "zero" such as "zero of accidents", "zero of defects", ""zero of failures" in all the productive system through organization of management,
- Poka-yoke – "Poka"- avoid , "Yoke"- casual faults. The purpose of this technique is to eliminate the defects resulting from removing repetitive tasks or actions which depend on memory and consciousness/attention,
- Kaizen- "Kai"- change, "Zen"- think over the change. The instrument serves to gradual and continuous change, decreasing the costs through perfectioning,
- One Point Lesson OPL – a specific technique useful in transferring of important information in fast time.

Five conditions for "zero of defaults" – this method defines rules of quality assurance through equipment of work position (instruments, machines) [5, 11, 14]:

- Six Sigma – it is a methodology of quality management elaborated at the world level in factories of different size and range. It allows to manage in an effective way of processes in a factory enabling controlling of logics "reason-result" based on their functioning: it means that it supplies possibilities to identify, qualify and eliminate of activities which not bring advantages for defining of new work standards,
- Failure Mode and Effect Analysis FMEA – is one of the most important methods used during planning quality and in the process of continuous perfectioning,
- Processing Point Analysis PPA - it is an instrument for the productive system managed according to the model WCM. Its main purpose is to achieve the vision "zero defects" through eliminating of defaults with established weight.

The technique of problem solving with usage of PPA is characterized by following advantages:

- advanced reparative instrument which searches for conditions of restoration to the previous state within complex systems,
- a good instrument in case of chronic losses influencing the performance and efficiency,
- it can be used in the other fields,
- it is particularly useful where the losses have multiple, internally associated reasons,
- it should be considered if this action is full-time or part-time,
- the groups can be smaller,
- the level of details is much bigger and the process is becoming much demanding,
- the work is registered on the tables of opinions and a separate table may be necessary for each "step",
- an experienced Team Leader is necessary for maintenance of internal discipline in all the "steps",
- technical knowledge should be available.

The instrument PPA was applied in the process of improvement of the quality in operations of assembly of cars in productive unit in the Fiat Auto Poland Tychy – welding room – one of the most modern departments in the factory. Complex car body, similar to distribution board, power pack etc., is particularly and strictly measured to provide guaranteed quality.

Elaborated during realization of this work PPA project for the process of assembly of the boot door was made in purpose to: reduction at 50% one of currently present faults weight 10 from 0.85 points/car to 0.425 points/car in FIAT (one of the cars), position 18 – posterior door – difficult opening/closing, chosen from list of defects in February 2007.

Reasons for necessity of usage of additional method of measurement of minimal velocity needed for closing the posterior door of the boot in Fiat (one of the cars) in the productive unit Fiat Auto Poland Tychy – Welding Room.

The elimination of the defect concerning improper assembly of the posterior door of the boot is associated with reducing costs of production, because every repairing interference in case of difficult opening/closing of the posterior boot door needs additional controls and regulations which must be done by educated staff.

Methodologies, instruments and techniques of WCM come into being from the experience of the employees, from an effort used in creation a product [10].

The result of introduction of above presented instruments and techniques is an effective achievement of foundations of quality management model WCM thanks to the cultural change which – according to Yamashina – "helps in perception of situation in a new light and thinking as do people of action, as thinkers" [10].

The presented model of methodology of quality management in the productive process is associated with application of operative instrument such as Processing Point Analysis PPA used in the quality management model World Class Manufacturing WCM for the chosen process in the productive system realized in Fiat Auto Poland Tychy.

The methodology of a modern instrument of problem solving as PPA used in this elaboration has to provide repeatability of the realized process. The methodology of a modern instrument of problem solving as PPA used in this elaboration has to provide repeatability of the realized process.

In the paper the processing point was analysed – the assembly of complex posterior door of the boot to the car body. The analysed defect resulting from ICP data is caused by unfitting of complex posterior door to the niche of the trunk.

There is 11 systems for the operation of the assembly of complex posterior door (complete car body, connecting elements, lock of the door, bolt of the door, joint, gas springs and hinges, external margin, internal margin, external profile, moment of tightening of screws) which influence on difficult opening/closing the door. The key systems can consist from the sub-systems (their compound elements), for instance in case of the complete car body: external roofing, frame and door niche.

Before elaboration of PPA project of defect elimination one should describe the defect using the analysis of inconsistencies Quality Assurance Matrix QA MATRIX.

The methodology of the quality control of the assembly of posterior trunk door is based on measurement of margins, profiles and moments of tightening of posterior trunk door in the given model of car.

During 8 hours of work the car bodies from Fiat are three times measured by 112 types of measurements. There are examined: external margins, internal margins, external profiles of elements of car body and moments of tightening of screws. There are also verified the posterior door in purpose to achieve their consistency (repeatability) with nominal values.

During one shift there are measured three car bodies. The measurements are conducted in particular places of car body according to the plan using the device Magam Data Made and digital slide caliper. The device Data Made is applied dependently from the used measurement instrument, among other things it is necessary for measurement of eight internal margins and eight moments of tightening of screws in the posterior door of the boot (Fig. 3).

Fig. 3. The distance plate of the posterior boot door for the measurements of margins and external profiles

For the needs of this work there were examined the elements of the posterior trunk door.

To make this measurement possible the base point should be determined which will be the reference for the measures. In case of the posterior door of the boot it is mounted in place of the bolt in the niche of the boot.

The course of the examinations is performed according to the instruction – control plan. In the instruction there is an exact description of measurement points including terminology, nominal values with their tolerability's and figures presenting their localization in the car body. The results of the measurements are sent and analysed by usage of computer program Quantum.

Thanks to this program it is possible to follow the course of the examinations.

The results of the measurements are collected in the internal memory of the computer and sent through Internet to the diagnostic centre.

The posterior door of the boot of one of the cars Fiat were twice examined during 8 hours of work, after leaving one of two assembly line (66 measurements for one examination). The points and characteristic apertures of the described element of car body were examined. The measurement is realized in purpose to verify consistency (repeatability) with nominal values. The measurements are done in locations of the door according to those determined in the control plan using Bravo nt device.

The results of the measurements constitutes points which are characterized matched to X, Y, Z axis. For the need of the work only elements of measured characteristics of the posterior boot door were analysed. The difficult opening and closing of the door is associated with three points of characteristic (in case of external roofing), ten points of key characteristics and four points of indirect characteristics (in case of the frame).

The card of control plan of internal margins of the posterior door contains example points for measurements with their characteristics – there are presented in the graphic form. This card is used at the measurement position in purpose to acquaint the staff with requirements of measurement.

The methodologies of calculations $C_p$ - index of quality control and $C_{pk}$ - index of quality ability presented on the example of 30 results of measurement systems of internal margin of the chosen point LGI370D.

In the project of processing point analysis PPA the values of quality indexes $C_p$, $C_{pk}$ are analysed. Below there is presented methodology of calculations of described indexes.

Data for the point LGI370D:

GLT= 14.5 mm; DLT= 11.5 mm; n= 30 measurements; $x_i$= result of the successive measurement. Searching values: $C_p$, $C_{pk}$ = ?

Results of 30 measurements of system of internal margin of the point LGI370D in the posterior door in the car Fiat made on 03.2007.

The results of the successive measurements presented in the table are written on cards SPC. After 30 measurements statistical analysis is done to determine percent of results lying behind limits of tolerability.

Table 1.
The results of 30 measurements of the system of the internal point in the posterior door LGI370D

| No. of measurement | $x_i$ [mm] | No. of measurement | $x_i$ [mm] |
|---|---|---|---|
| 1 | 13.86 | 16 | 13.45 |
| 2 | 13.74 | 17 | 13.27 |
| 3 | 13.85 | 18 | 13.57 |
| 4 | 13.44 | 19 | 13.38 |
| 5 | 13.65 | 20 | 13.17 |
| 6 | 13.69 | 21 | 13.49 |
| 7 | 13.49 | 22 | 13.55 |
| 8 | 13.57 | 23 | 13.75 |
| 9 | 13.63 | 24 | 13.93 |
| 10 | 13.62 | 25 | 13.69 |
| 11 | 13.70 | 26 | 13.47 |
| 12 | 13.41 | 27 | 13.63 |
| 13 | 13.49 | 28 | 13.78 |
| 14 | 13.57 | 29 | 13.51 |
| 15 | 13.61 | 30 | 13.66 |

To determine values $C_p$ i $C_{pk}$ (3, 4) standard deviation $\hat{\sigma}$ (2) and variation $S^2$ (1) associated with it should be calculated:

$$S_*^2(x) = \frac{1}{n}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2 \tag{1}$$

where:

$x_i$ - considered variable,

$x$ - arithmetical mean value,

$n$ - no. of elements.

For 30 measurements of internal margin the variation is as follows (Table 1):

$$S_*^2(x) = \frac{1}{30}\sum_{i=1}^{30}\left(x_i - 13.59\right)^2$$

$$S_*^2(x) = 0.028 \text{ mm}^2$$

standard deviation - $\hat{\sigma}$ :

$$S_*(x) = \sqrt{S_*^2(x)} = \hat{\sigma} \tag{2}$$

$$\hat{\sigma} = 0.017 \text{ mm}$$

Index of quality control - $C_p$ :

$$C_p = \frac{GLT - DLT}{6\sigma} = \frac{T}{6\sigma} \tag{3}$$

where:

$GLT$ - upper limit of tolerability,

$DLT$ - lower limit of tolerability,

$\sigma$ - standard deviation,

$T$ - field of tolerability

T= 14.5 – 11.5 = 3 mm

$$C_p = 2.94$$

Index of quality ability - $C_{pk}$ :

$$C_{pk} = \frac{GLT - \bar{x}}{3\sigma}, \text{ if } GLT - \bar{x} < \bar{x} - DLT, \tag{4}$$

$$C_{pk} = \frac{14.5 - 13.59}{3 \cdot 0.17} \quad \text{because } 0.91 < 2.09$$

$$C_{pk} = 1.79$$

Calculated $C_p = 2.94$ i $C_{pk} = 1.79$ for 30 of measurements of the system of internal margin of the point LGI370D of the posterior door in the car Fiat Panda done until 03.2007 are greater than 1.33. There was shown that number of parts lying behind limits of tolerability (number of deficits) is not greater than 0.006%.

Presented above methodologies of $C_p$ i $C_{pk}$ calculations are done using the computer program. The results of calculations are presented in the form of graphic cards SPC.

The example of measurement card of the lock of the posterior door was presented above. The examinations for one element are conducted by the supplier for Fiat Auto Poland in purpose of certification – to show consistency of the compound with the requirements – Figs. 4 and 5.

The example sheet (Figs. 4 and 5) constitute part of the done PPA project for the analyses process.

| **Analysis of Processing Point** | |
|---|---|
| **STEP 4: EVALUATION OF FUNCTIONS AND NECESSARY VERIFICATIONS** | |
| **Tabel 4.** | |
| **NAME** | **Externa margin of l posterior trunk door** |
| **Purpose / Function :** | Proper fixing of the door in the niche of car body. Proper external margins. |
| **Compounds:** | 1. Measurements |
| **Rule of operations : Rule of operations :** | Providing compliance of points of measurements of external margins of the posterior trunk door with nominal values |
| **Operative standards :** | 1. Keys: LGE350 S, LGE350 D, LGE360 S, LGE360 D, LGE370 S, LGE370 D |

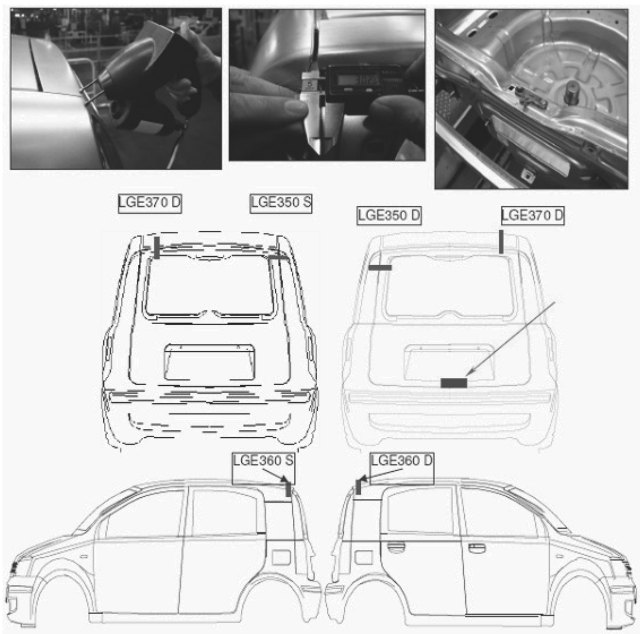



Fig. 4. Example of the sheet of factors for „step 4” PPA

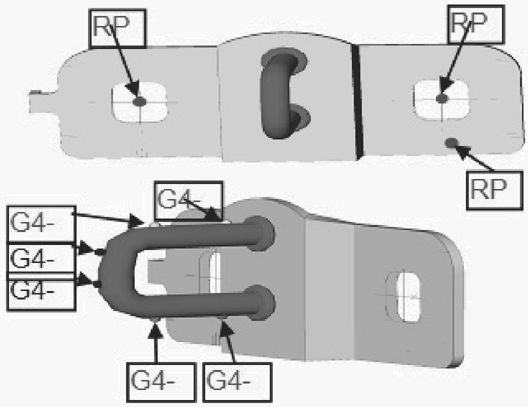
<table>
<tr><td colspan="5">Analysis of Processing Point</td></tr>
<tr><td colspan="5">STEP 5: DETAILS OF VERIFICATIONS / TASKS</td></tr>
<tr><td colspan="3">Table 9.</td><td colspan="2"></td></tr>
<tr><td>System</td><td colspan="2">Lock of the posterior trunk door</td><td colspan="2" rowspan="11">Fig.<br>
</td></tr>
<tr><td>Supplier:</td><td colspan="2">xxx</td></tr>
<tr><td>Parameters to check:</td><td colspan="2"></td></tr>
<tr><td>1. Base characteristics</td><td colspan="2"></td></tr>
<tr><td>Coordinates of openings:</td><td colspan="2">RPS 1 X: 3119.09 Y: 30.00 Z: 417.47</td></tr>
<tr><td></td><td colspan="2">RPS 2 X: 3117.85 Y: -30.00 Z: 419.04</td></tr>
<tr><td>Coordinates of point:</td><td colspan="2">RPS 3 X: 3107.14 Y: -30.97 Z: 410.58</td></tr>
<tr><td>2.. Key characteristics:</td><td colspan="2"></td></tr>
<tr><td>G4-CP0 X +X: 3121.80</td><td colspan="2">G4-CP3 Z -Z: 452.19</td></tr>
<tr><td>G4-CP1 X +X: 3113.54</td><td colspan="2">G4-CP4 X +X: 3094.65</td></tr>
<tr><td>G4-CP2 X -Z: 456.98</td><td colspan="2">G4-CP5 X -X: 3102.38</td></tr>
<tr><td>Requirements / means of check</td><td colspan="2">Result of measure</td><td>Reparative operation (for result N.OK.)</td><td>Consequences of not undertaking of reparative activities</td></tr>
<tr><td rowspan="7">Measurement machine METRO MESA</td><td colspan="2">Measurement card M 54 from .02.2007:</td><td rowspan="7">Application to supplier xxx of no efficiency mounting of the lock to posterior trunk door. Elimination of defective parts of the article</td><td rowspan="7">Improper position of the niche in the axis. Improper internal and external margin of the set of the posterior trunk door. Improper positioning of the posterior trunk door. Introducing of provisional technology based on 100% of control and eventual regulation of fitting of the lock with the trunk door during assembly. Non esthetic visually combination of the door in the.</td></tr>
<tr><td colspan="2">pkt. RPS 1: X: 0.03; Y: 0.11; Z: -0.20</td></tr>
<tr><td colspan="2">pkt. RPS 2: X: 0.03; Y: 0.11; Z: -0.21</td></tr>
<tr><td colspan="2">pkt. RPS 3: X: 0.03; Y: 0.11; Z: -0.22</td></tr>
<tr><td>pkt. G4-CP0: X: 3121.91</td><td>pkt. G4-CP3: Z: 450.79</td></tr>
<tr><td>pkt. G4-CP1: X: 3113.76</td><td>pkt. G4-CP4: X:3094.89</td></tr>
<tr><td>pkt. G4-CP2: Z: 455.60</td><td>pkt. G4-CP5: X: 102.36</td></tr>
</table>

Fig. 5. Example of the sheet of tests for “step 5” of PPA

## 3. Conclusions

The losses caused by defective production can come into being in all the operations of the productive system including operations of the process of the assembly. From economic point of view it is essential where the loss is located in the realized process. When the defective subsystem is detected at the end of the productive process, the additional costs arise, and it can be a reason of serious damage of other systems.

Accepted in the productive factory system of inspection of the assembly process of the posterior door should provide demanded quality of the process. Application of PPA is associated with possibility of earlier detecting of reasons of deficits and undertaking suitable corrective activities.

The supervision of the assembly process of the posterior door plays an important role in achievement of applied quality level of the product – car, and the means of its realization significantly influences level of effectiveness and repeatability of production.

With usage of statistical methods, PPA looks like regulative system of maintaining assembly process in the established interval of variability. In case of detection of deviation from the established requirements, the corrective activities which steer of the system are undertaken. The repetitive necessity of correctiontestifies that the assembly process is incapable or uncontrollable, or the “regulator” incorrectly works, the diagnostic of reasons and modification of model of the assembly process or PPA project are needed.

Performing of measurements and analyses concerning the assembly process of the posterior door during the realization of PPA project allows to conclude:

Solving the problems of the repeatability of processes with usage of Processing Point Analysis (PPA) needs correct and particular recognizing the field of stadium and its analysis. The presence of deviation in the processing point is determined by condition of every system and subsystems, which take part in the function of the given processing point. It lies in detecting of defective subsystem during the production but not at the end.

Processing Point Analysis PPA constitutes the instrument providing valuable information about Statistical Process Control made in the process of production, results of examinations performed at suppliers of parts for FIAT. All this makes it easier to undertake suitable corrective activities. The most important application of PPA should be usage of this method to analysis of processing points in the process of production/assembly of products.

Performed in the work PPA of the assembly of the posterior door presents an influence of the quality of the assembly and the quality of the product on the planned repeatability of the process. For the analysed processing point the reparative actions were determined which purpose was to reduce by 50% the occurrence of the described defect in the car Fiat.

Performed in the work PPA project confirms necessity of application of additional measurement method of minimal velocity necessary to close the posterior door of the boot in the car.

## References


[1] D. Buchart-Karol, P. Musiał, The basics of management for engineers, Silesian Technical University Publishing House, Gliwice, 2006.

[2] M. Brzeziński, Organization and management of production, Publishing Agency Placet, Warsaw, 2002.

[3] I. Durlik, The engineering of management – Strategy and projecting of the productive systems, Publishing Agency Placet, Warsaw, 1996.

[4] Fiat Auto Poland, The basic methodologies and instruments for the productive system, Tychy, 2006.

[5] S. Tkaczyk, M. Dudek, Methodology research of quality in industry, Proceedings of the 7th Scientific International Conference "Achievements in Mechanical and Materials Engineering" AMME'1998, Gliwice−Zakopane, 1998, 513-516.

[6] H. Gitlow, S. Gitlow, A. Oppenheim, R. Oppenheim, Tools and methods for the Improvement of Quality. Homewood, Boston, 1989.

[7] A. Hamrol, The quality management with examples, PWN, Warsaw, 2005.

[8] A. Jednoróg, T. Koch, R. Zadrożny, Methods and techniques of quality assurement with particular meaning for the motor industry, The Problems of Quality 32/1 (2000) 17-26.

[9] A. Kawecka-Endler, The influence of organizational and technical factors on the quality of the assembly, The Problems of Quality 30/12 (1998) 16-19.

[10] A. Kucharczyk, The economics and the basics of management in the industrial factory, The Scientific and Didactic Publishing House AGH, Cracow, 1999.

[11] M. Dudek-Burlikowska, Quality estimation of process with usage control charts type X-R and quality capability of process Cp, Cpk, Journal of Materials Processing Technology 162-163 (2005) 736-743.

[12] K. Kujan, The techniques and management of the quality control in the construction of machines, The Publishing House of the Technical University in Lublin, Lublin, 2002.

[13] A. Meller, The methods of analyses and consequences of the deficits (FMEA), The Organizational Review 2 (1994).

[14] S. Tkaczyk, M. Dudek, Quality continuous improvement of production process in aspect of usage quality researches and estimation methods, Proceedings of the 11th Scientific International Conference "Achievements in Mechanical and Materials Engineering" AMME'2002, Gliwice−Zakopane, 2002, 567-570.

[15] K. Pasternak, The outline of the management of production, The Polish Economic Publishing House, Warsaw, 2005.

[16] S. Płaska, The introduction to the statistical management of the technological processes, The Publishing House of the Technical University in Lublin, Lublin, 2000.