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# The analysis of the toys production process quality

# Analiza jakości procesu produkcji zabawek

**Kamila Dębska[1], Piotr Sygut [2]**

[1] Student, Politechnika Częstochowska, Polska, e-mail: kdebska@o2.pl

[2] Dr inż., Politechnika Częstochowska, Polska, e-mail: piotr.sygut.wz@gmail.com

**Abstract:** The paper presents the results of research carried out in a company producing children's toys and products for the automotive industry. Was made an quality analysis in the manufacturing process for the children's toys - fire brigade. The study used quality management tools: Pareto-Lorenz and Ishikawa diagrams. Based on the survey identified production areas that require attention and eliminate the source of the incompatibilities.

**Streszczenie:** W pracy przedstawiono wyniki badań zrealizowanych w przedsiębiorstwie produkującym zabawki dziecięce oraz wyroby dla przemysłu samochodowego. Wykonano analizę jakości w procesie produkcyjnym dla zabawki dziecięcej - straż pożarna. Do badań wykorzystano narzędzia zarządzania jakością: diagram Pareto-Lorenza i diagram Ishikawy. Na podstawie przeprowadzonych badań określono obszary produkcji które wymagają uwagi i eliminacji źródeł powstawania niezgodności.

**Key words:** toys production, production quality, Pareto-Lorenz diagram, Ishikawa diagram

**Słowa kluczowe:** produkcja zabawek, jakość produkcji, diagram Pareto-Lorenza, diagram Ishikawy

## 1. Characteristics of the test object

Examined company is a manufacturer of toys for children, but not only. The company is a dynamically developing company, which employs almost 200 employees. The company works with qualified engineers in managerial positions with long experience and relevant expertise in the production of tools and design. The total area of the production hall and warehouse is about 4,000 $m^2$.

There are three branches of the development of the company. First st of them is the production of children's toys made of plastics, such as cars, sets of sand or kits. The next direction is the production of parts for the automotive industry, such as discs, brake drums, hubs and rollers and the manufacture of metal. The last direction of business activity is the production of tools such as injection molding.

Production department alone produces molds that are used to produce toys, because it is an independent company. The company also has its design department, where skilled workers carry out projects of toys. This department is equipped with a position where the projects are carried out, which are based on the CAD / CAM - Pro / ENGINEER WILDFIRE in version 3.0. The company is also equipped with central utilities, which are manufactured molds and other tools that are used in the production of toys, which reduces the cost of buying a ready-made parts needed for the production of toys and gives you the ability to quickly put the finished product on the market. High quality toys provides a use for the production of injection molds of modern CNC machines. The range is aimed at consumers, educational institutions and wholesale customers. Toys are produced on the Polish market and abroad (Russia, the United States or Canada). The company has implemented System The Governance Quality based on the PN - EN ISO 9001: 2008 in the field of production and sale of brake drums and discs, and other metal products on the basis of the documentation the customer and the design, manufacture and sale of toys and other plastic products, as evidenced this is the obtained certificate. With the introduction of the Quality Management System it straightened out business activities, management processes within the company structure, which helped to improve processes, obtained accuracy in characterizing sites and the real causes of errors (incompatibilities), which is associated with a reduction in the number of defects, repairs and complaints. Systematized documentation was improved and the company's internal communications, what unmistakable improving the flow of information.

The discussed product on which it is focused at work is a toy - fire brigade (Fig. 1).

*Fig.1. Fire brigade*

Fire brigade toy is designed for children aged 2 years. The product is safe, has no sharp edges. It is characterized by high quality thanks to innovative production solutions. The toy is polypropylene with the addition of a suitable pigment. During the production of toys for all the parts of this product they are made on the forms that were created by skilled workers on modern hydrau-

lic injection molding companies Arburg and Krauss Mafeii. The process of assembling the finished pieces of this toy is quite long and requires a lot of concentration. The product consists of 33 parts, which clearly must be properly prepared to assemble and put them together. During the production of parts for the assembly of the product and finished parts are performed a plurality of inspection by a qualified person. The product is easy to use so every child who plays with the toy will not have a problem with a tweak or sliding ladder. The toy is 50 centimeters in length so it is a big toy. Guard moves forward and backward on the wheels, which are fixed by means of screws. It has a ladder, which can be spread apart and pushed together. It also has four peasant women. The finished product is packaged in a cardboard box, which is also designed accordingly.

## 2. The process of children's toys production

Production of fire brigade begins to produce all the parts needed for the emergence of such toys, which have previously been designed by designers. The finished project goes to employees who are involved in creating molds. Then the magazine is downloaded material, which by means of a forklift truck is taken to the right place. Mixture of raw materials is appropriately designed and depending on what is to be the color of the colorant portion is added. Then the material goes into the dryer until dry. After drying hopper to an injection molding machine is fed the dried material, and the material is heated in a cylinder injection until the obtained liquid state. After this follows the injection of it to the appropriate forms and the process of curing. The whole process is supervised by a person who ensures the proper conduct of this process and in case of any faults quickly responding. Finished semi-finished products are packed in boxes by individuals who supervise the work of the machine, and then are exported to the warehouse where they are stored until installation. When all the parts required to ensure that the fire brigade was created following installation of all toys. The whole installation process is controlled by a person who is appointed to this task. Its task is to pay attention to the smallest details and is therefore a good chance of catching faults during installation, and not when the product goes to the customer. At the beginning of semi-finished products are imported from the warehouse to the work place. The person who performs the installation of the toy must be focused, not to miss any part and be accurate in carrying out the installation. The first step when installing fire brigade is the deburring wheels, or deprivation of sharp edges and removing films using a small, sharp knife. When the wheels are ready, worker poking fun at them axles. Then deburring are the cab and chassis. At the cabin lights are studded. Another activity is the longest and deburring ladders, which are composed of two parts. It should also be careful of that one and the other part was in the same color, then composed them. The next stage of the installation, it is studded cabins on the chassis, and then ladder. Of course, all the time the process is monitored and if a problem occurs is quickly solved. After these actions by a screwdriver axes of the wheels are screwed to the chassis and to this operation uses three screws, one to one axle. This operation is performed during the last assembly. After the assembly takes the final inspection and only after that product is packaged depending on the order in boxes or mesh. Packaged product is laid on a pallet and transported by truck is a warehouse waiting for transport to the customer.

## 3. The analysis of obtained results

In order to identify incompatibilities and sources of their causes, the study used two tools of quality management. Quality tools used to collect information and then processing as well as to oversee the process of quality management, and thus to detect abnormalities, defects and errors in the services or products, and also runs processes. Therefore, these tools allow for the visualization of data and the monitoring and diagnosis of specific processes. They make it possible to verify the effectiveness of actions taken, and also are instruments through which carried out monitoring activities (ie processes) throughout the product life cycle [1-4].

For the evaluation of the measurement results was used the first tool that is Pareto - Lorenz diagram, quality management shows what and where we need to take corrective action in order to get the maximum effect. Finding and eliminating incompatibilities will allow the company to improve its performance in sales, reduce the number of complaints which also reduces the cost of which shall be borne by the company due to the improving of what the client is watched after purchasing the product. This method can also be used in other industries, it is also widely used in general management. Using this method focuses on performing corrective action against the key 20% causes incompatibilities that occur during the manufacturing process. Table 1 shows the incompatibilities observed for the test period. Each non-compliance is marked "N".

***Table 1. Symbols and names of non-compliance and their frequency of occurrence***

| Incompatibilities symbol | Incompatibilities name | Frequency of occurrence |
|---|---|---|
| **N1** | Discolorations on plastic | 9 |
| **N2** | Injection error | 9 |
| **N3** | Plastic damage | 13 |
| **N4** | Material dents | 6 |
| **N5** | Inadequate length axis | 5 |
| **N6** | Incorrect body shape | 10 |
| **N7** | Ladder jams | 11 |
| **N8** | No mark CE mark | 10 |
| **N9** | Badly tightened wheels | 28 |
| **N10** | Error in painting | 10 |
| **N11** | Inadequate color ladders | 8 |
| **N12** | Abnormal shape of wheel | 5 |
| **N13** | Cracks on plastic | 8 |
| **N14** | Abnormal shape of cabin | 8 |
| **N15** | Lack of one of the car components | 12 |

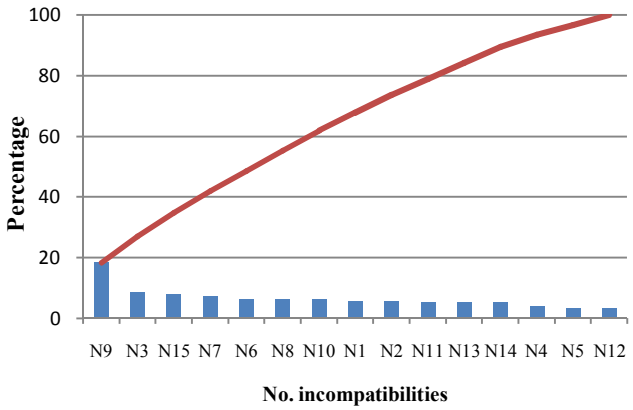


***Fig.2. Pareto - Lorenz diagram***

On the basis of the data contained in Table 1 was created chart Pareto-Lorenz diagram for the period under study (Fig.2).

In the analyzed period the main non-compliances that have occurred are badly tightened wheels and damage plastic. The main disagreement badly tightened wheels means that this problem

should be dealt with first because the mismatch is critical, which rules out its use and a potential threat to the customer. The least impact on the process is inadequate axis length. Another incompatibility affect the process of the damage plastic which could be due to the fact that employees during storage or transport did not keep proper precautions are not following procedures related to the storage and transport.

Way to secure the parts used in the assembly of the finished product does not provide adequate product protection. To not happened to such a situation foreman should pay attention to employees and more in control of the course of storage. Another tool that we use to evaluate the measurement results is Ishikawa diagram, which is a graphical representation of the chart cause - effect. Using this chart, you can determine the cause, which causes quality problems the company. The right side shows the result of non-compliance.

The main causes that have a direct impact on the occurrence of incompatibilities is noted using the arrow side, which are directed toward the main and the main causes are: man, method, material, machine, management.

To produce the graph in the enterprise is appointed a group of experts, the best representatives who have to deal with employees, method, material management and machine. The best way to create such a chart is brainstorming giving you many options to find the causes, and the further steps to eliminate them and to further improve the production process (Fig. 3).

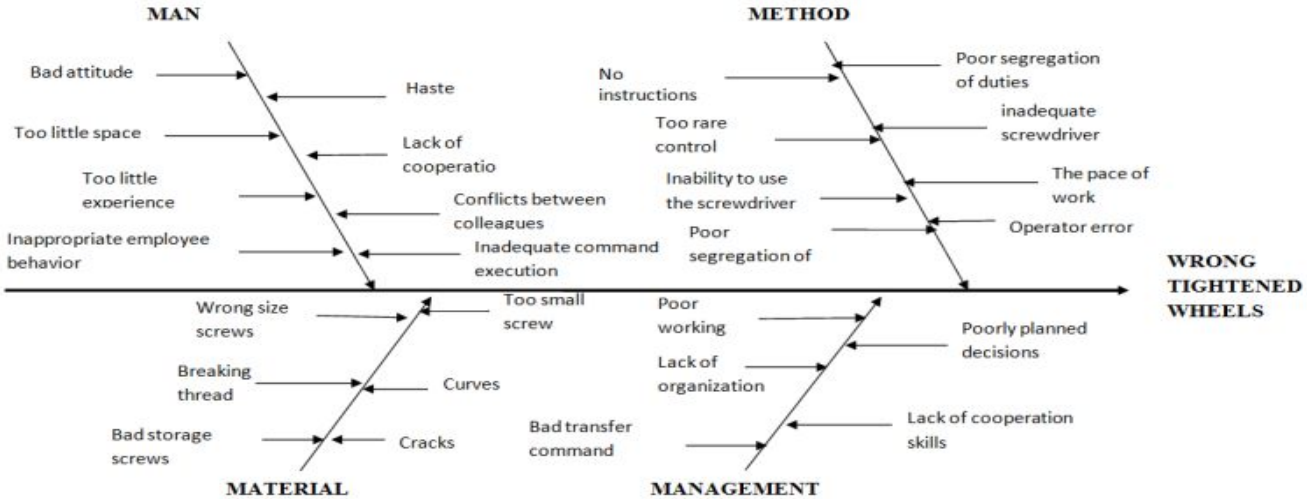


***Fig. 3. Ishikawa diagram***

Figure 3 shows in the form of Ishikawa diagram the factors affecting the formation of the main incompatibilities for the company. Among the factors that are relevant to the mismatch in the present article were identified: the man in this group was most important category - too little experience. The group method the most important factor is the pace of work, the next factor is the management, this group concluded that the cause arises, because it is a bad oversight. The last group and the material for the formation of the reasons lies in the lack description of the package. The company, in order to eliminate the factors resulting from non-compliance shall enter corrective and preventive actions, so that the process will be conducted without unnecessary complications. Rapid elimination of potential non-compliance makes it possible to reduce production costs. The company should continually improve their processes. As a result, decrease the number of complaints by customers, waste that occurs as a result of haste man, or as a result of the order screws to attach the wheels of poor quality. Managers should also focus on employee because too little experience or inability to use the screwdriver causes the command he got from the supervisor is not properly made. In order to improve employee should be trained to avoid future such situations.

## 4. Summary and conclusions

In order to identify incompatibilities and their causes to the study they were used two tools of quality management. Quality tools used to collect information and then processing as well as to oversee the process of quality management, and thus - for the detection of irregularities, inconsistencies and errors in the services or products, and also runs processes. Therefore, these tools allow for the visualization of data and the monitoring and diagnosis of specific processes. They make it possible to verify the effectiveness of actions taken, and also are instruments through which carried out monitoring activities (ie processes) throughout the product life cycle. Thanks to the analysis company learned what mistakes occurred during the production process and which now must pay particular attention to in the future to avoid committing these mistakes.

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