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Cause-and-effect analysis as a production efficiency management tool in the enterprise operating in a joinery industry

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Abstract: *Cause-and-effect analysis as a production efficiency management tool*. In the enterprise operating in a joinery industry, in an era of increasing competition more and more attention is being paid to operation excellence, which quantifies all measurements of efficiency. Increasingly, research is devoted to the methods and techniques that allows one to examine and diagnose the causes of the lack of efficient use of production factors. One of these methods, is the analysis of cause-and-effect which is referred to as a "fishbone diagram" developed by Ishikawa. This paper presents the practical application of this method and is based on the example of the wood industry companies.

Keywords: production factors, the efficiency of production factors, the analysis of cause-and-effect Ishikawa.

1. PRODUCTION SYSTEM EFFICIENCY

As E. Pająk claims "production system may be treated as a collection of workplaces in which a transformation occurs. The transformation is based on the change from the stream of material input into the products ready to be sold."[2] Basic elements of the production system input vector are determiners called factors of production and here we may include:

- Technical means of production, i.e. industrial premises, production area, production equipment and buildings,
- Work items, i.e. materials and semi-finished products.
- Energy factors: water, heat, electricity.
- Human factor- the company personnel;
- Information- the general data concerning the production process, product itself together with Staff experience and skills.
- Capital in the means of production (materials and semi-finished products) and money capital (in hand, in banks, receivables from the contractors). [3]

Optimal use of the above mentioned factors determines efficiency of the whole production process. Efficiency may be considered in a narrow and broad way. The first one „is focused on creating such processes and structures that effect in:

- More efficient use of machinery and devices, as a result- decrease in equipment failure, shorter time of retrofitting,
- Efficient processing of raw materials allowing waste minimization and reducing the amount of faulty components in total production effects,
- Effective use of human potential, visible in qualifications and skills of a personnel employed."[4]

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[2] E. Pająk.: *Zarządzanie produkcją. Produkt, technologia, organizacja,* Wydawnictwo Naukowe PWN, Warszawa 2011, p.11.

[3] I. Durlik.: *Inżynieria zarządzania. Strategia i projektowanie systemów produkcyjnych*. Część I. Agencja Wydawnicza Placet. Warszawa 2000, p.33-34.

[4] N. Baskiewicz.: *Współczesne koncepcje zarządzania a efektywność organizacji*. [w:] Cisek M., Marciniuk-Kluska A.: *Efektywność organizacji.* Wydawnictwo Studio Emka. Warszawa 2013, p. 24.

The most important factor in a narrow approach is a man. The second, broad approach refers to effective realization of the set strategic objectives.

2. ANALYSIS OF IRREGULARITIES IN A PRODUCTION SYSTEM OF GLUED SQUARE TIMBER WITH THE USE OF ISHIKAWA DIAGRAM

In a period of the last 2 years (2010-2012) in the analyzed carpentry and woodworking plant an increase in the Mount of faulty elements of the laminated timbers was observed. Irregularities were detected in a process of a control conducted while packaging of the products as well as clients' opinions and connected with them complaints. Defects were connected with :

- Thickness deviation in case of the timbers longer than 1500mm,
- Material surface defects in a form of big and soft wood knots,
- Discoloration at the junctions of separate elements, caused by the use of too thick layer of glue.

Increasing gradually amount of faulty timbers caused the need of changing the product standard into off-specification product and significant price reduction. Every single case of faulty product noticed by a client caused the loss of company reliability. It is necessary to analyze the reasons of such situation. In order to identify the effects, it is reasonable to make an Ishikawa diagram, based on looking for the reasons of the problem with the use of 5M method: [5]

- Manpower
- Methods
- Machinery
- Materials
- Management.

Their identification presented in a form of a table, gives possibility to analyze interrelations causing the certain problem. Information sequencing shows their hierarchy, and as a result allows to find new solutions helping to improve the faulty manufacturing process. Presentation of the reasons in a form of the table is a basis for the diagram construction.

Table 1. Reasons determining faulty manufacturing process of laminated pine and oak timbers.

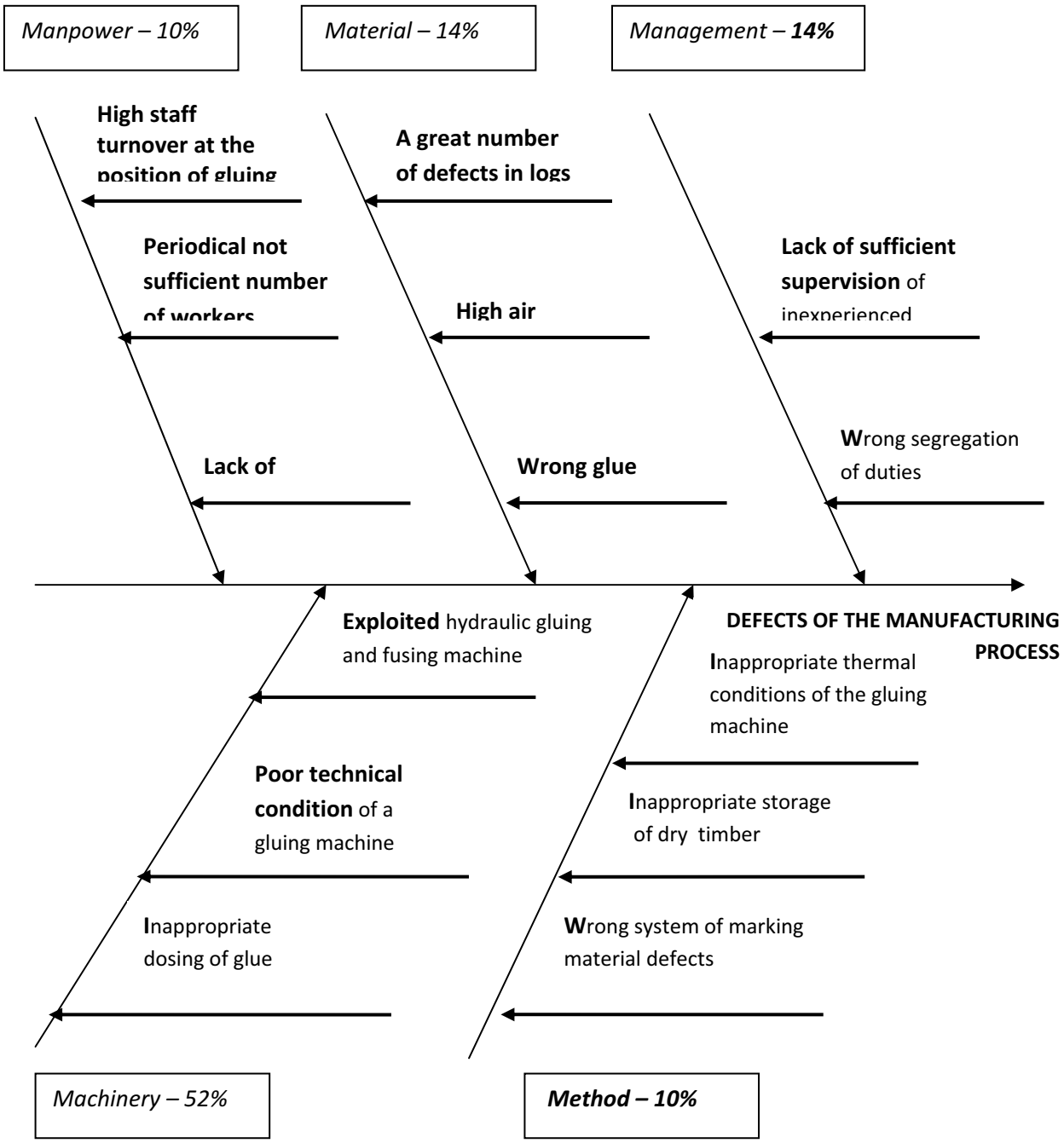
Identification of the factors determining 5M method and their percentage				
Manpower	Material	Management	Machinery	Method
1.High Staff turnover– 4%. 2.Cases of small number of employees – 2%. 3.Insufficient experience of New employees – 4%.	1.Logs with a great number of defects – 5%. 2.Too high wood moisture –5%. 3.unsuitable glue, e.g. expired, or frozen– 4%.	1.Lack of proper supervision over inexperienced workers– 8%. 2.incorrect segregation of duties –6%.	1.Poor technical parameters of the gluing machine – 20%. 2.Exploited hydraulic gluing and fusing machine – 25%. 3.Inappropriate dosing of glue - 7%.	1.Inappropriate thermal conditions in a gluing process – 5%. 2.Inappropriate storage conditions – 3%. 3.Marking of material defects with the use of special chalk, lack of laser cutting machine– 2%.
Total: 10%	*Total: 14%*	*Total: 14%*	*Total: 52%*	*Total: 10%*

Source: Own elaboration based on data provided.

[5]R. Batko: *Zarządzanie jakością w urzędach gminy.* Wydawnictwo Uniwersytetu Jagiellońskiego. Kraków 2009, p. 53.

Potential reasons, listed in a 5M table give possibility to create a fishbone diagram, called Ishikawa diagram.

Figure 1. Ishikawa diagram



Source: Own elaboration based on the materials available.

Basic reasons for the defects in the production of glued timber, ordered according to their importance, are:

a) Poor technical condition of the basic machinery and manufacturing devices: gluing machine and gluing-fusing machine,
b) Inappropriate thermal conditions of the gluing process and quality of glue.

Excessive number of material defects and too high moisture of wooden materials. Balanced reasons refer to a 3-year period of observation. Analysis conducted allows to formulate the conclusion, that in order to improve the faulty technological process the company should :

- Make major repairs in the gluing machine,
- Replace used hydraulic gluing-fusing machine by a more modern and efficient device for joining wooden elements.
- Eliminate purchase of low-quality materials and more attentively control the process of drying plank.
- Analyze the employees' qualifications, improve the interprocess control and final product control system.

CONCLUSION

The above presented analytical method allows for the identification of the causes of the lack of efficient use of production of factors and organization of the factors of production. It is the first step toward an increase in the efficiency of the production process and is the starting point for any improvement proposals.

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Streszczenie: *Analiza przyczynowo-skutkowa jako narzędzie zarządzania efektywnością systemu produkcyjnego w warunkach przedsiębiorstwa z branży stolarskiej.* W dobie rosnącej konkurencji coraz większą uwagę przywiązuje się do doskonałości operacyjnej, którą mierzy się wszelkimi miernikami efektywności. Coraz więcej prac poświęconych jest metodom i technikom pozwalającym na zbadanie oraz zdiagnozowanie przyczyn braku efektywnego wykorzystania czynników produkcji. jedną z niniejszych metod jest analiza przyczynowo-skutkowa określana mianem „diagramu rybiej ości" opracowanej przez Ishikawę. W niniejszym opracowaniu zaprezentowano praktyczne wykorzystanie niniejszej metody w oparciu o przykład przedsiębiorstwa branży drzewnej

Słowa kluczowe: czynniki produkcji, efektywność czynników produkcji, analiza przyczynowo-skutkowa Ishikawy

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