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EVALUATION OF INNOVATIVE POSSIBILITIES OF PRODUCTION PROCESS IN THE ROLLING MILL

3.1 INTRODUCTION

Each company, even if achieves success in the market, with time has to think about making changes or introducing innovations. They are essential in a competitiveness in the market.

The word innovation in Latin "Innovare" means creating something new. Therefore, innovation can be defined as the process of transforming the existing possibilities in new ideas and introducing them into practical use [1].

Innovation can be seen as scientific or technical fact, which aims to develop innovative capacity. Because innovation is needed for the company growth. Made invention is an innovation as long as in the practice new, previously non-existent solution is used in this field [2].

An important type of innovation is the innovation of the process. These are all changes involving improvements to new or significantly improved production methods, including how to arrive with the product to customers.

It is important that the introduced innovation has brought tangible results, so it should be well planned and carefully implemented. Therefore, authors decided to conduct a research connected with the possible effects of innovations in the selected company.

3.2 RESEARCH METHOD

The aim of the research is to evaluate the factors influencing the development of the concept of the production process in the selected company on the basis of the employee opinion. The authors of the study decided to use one of questions from the BOST methods.

The BOST method, that is Toyota's management principles in the questions, is an innovative surveyed method which investigates intangible resources of the company. It was created in Institute of Production Engineering, Faculty of Management, Czestochowa University of Technology by Multi Professor Eng. Stanislaw Borkowski. It is the result of years of research. This method was described in papers [3, 4, 5].

The BOST method has a form of a survey. This survey occurs in two versions: for the employees and for their superiors.

With the answers it is possible to evaluate importance in areas such as enterprise mission, quality, standardization, visual control, manufacturing process, etc. So it is very comprehensive research tool [6].

In the article 1st Toyota's management principle, which is "Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals" [7], was chosen. The employees were supposed to answer the question: What factors decide on development concept of your company ?, thinking about the company in which they work for. They had to evaluate the individual factors of innovation introduction on a scale 1-7 (where 1 – the least important, 7 – the most important factor). The factors listed in the question are following [8]:

- Customer's interest (DK),
- Innovativeness of a product (IP),
- Cooperation with partners (WK),
- Confidence in relations with employees (ZP),
- Independence and responsibility of employees (SP),
- Development of technology (RT),
- Preservation of culture in the enterprise (PR).

The survey was conducted among the employees of one of the Polish rolling mills. The research included 30 production workers of that rolling mill.

3.3 CHARACTERISTIC OF THE RESEARCH COMPANY

The research steelwork is a modern company with a stable production process, organizational system, friendly for the surrounding environment. The mission of the company is to strengthen the company's position in Poland and abroad as the most efficient producer of long steel products with high quality.

The rolling mill of the research company is a continuous average type of rolling mill. It was launched in 1999. At the beginning its assortment included rounds flat steel bars, round steel bars and reinforced bars.

The research rolling mill is equipped with a devices from the company Danieli Morgardshammar. It is one of the most modern rolling mills in Europe, and the most modern in Central and Eastern Europe. In this rolling mill it is possible to implement the stringent requirements of designers connected with engineers or technical parameters and quality of ribbed bars, for both domestic and foreign market. This rolling mill is still modernized in order to meet the requirements of the customers [9].

3.4 CHARACTERISTIC OF RESPONDENTS

The survey was conducted among 30 production workers of the rolling mill in one of the Polish steelworks. In table 3.1 it is shown the general characteristics of the respondents (demographics of the survey). However, in table 3.2 the characteristics of surveyed employees were presented. The research characteristics of the respondents are following:

- gender (MK),
- education (WE),
- age (WI),
- job seniority (SC) – that is experience,
- mobility (MR) – that is which place of work,
- mode of the employment (TR).

Table 3.1 Features of respondents. Characteristic

Symbol	Features' marking and their characteristic					
	MK	WE	WI	SC	MR	TR
1	Men	High school	< 30	< 5	1	Regular
2	Women	Professional	31 - 40	6 do 10	2	Transfer
3		Secondary	41 - 50	11 do 15	3	Finance
4		Higher	51 - 55	15 do 20	4	
5			56 - 60	21 do 25	5	
6			61 - 65	26 do 30	6	
7			> 66	31 do 35		
8				> 36		

Source: own study

Table 3.2 Features of respondents. Percentage characteristic

Symbol	Features' marking and their rate characteristic					
	MK	WE	WI	SC	MR	TR
1	90	7	17	23	43	63
2	10	17	23	10	33	20
3		47	33	20	0	17
4		30	10	23	10	
5			10	7	7	
6			7	7	7	
7			0	10		
8				0		

Source: own study

Like in every company, also in the research rolling mill it was noted high diversity of the surveyed employees. Among the surveyed production employees 90% are men. It is important to remember that the rolling mill, where the working conditions are very difficult, is the research company. Almost 50% of employees have secondary education, 30% higher education. Over 30% are people who are 41-40, with 11-15 or 15-20 job seniority (experience). In the company over 66 year-old people do not work (pension age). For most of the employees the research rolling mill is 1st or 2nd place of work, what means that the managers of the rolling mill steelwork think about experienced staff, and they know how much the employees training costs the company. Over 60% of people got their work in the research rolling mill in regular mode of the employment.

3.5 RESULTS OF THE RESEARCH

The results obtained by the various factors listed in the question are presented in figure 3.1 in a form of a circular graphs.

Analising figure 3.1 it was seen that:

- Factor customer's interest (DK) by 23.3% of respondents were evaluated at 7, and only 1.6% gave an evaluation 1 (fig. 3.1a).
- Factor innovativeness of a product (IP) received 20% of the evaluation 7, and only 3.3% of 1 and 6.7% of 2 (fig. 3.1b).

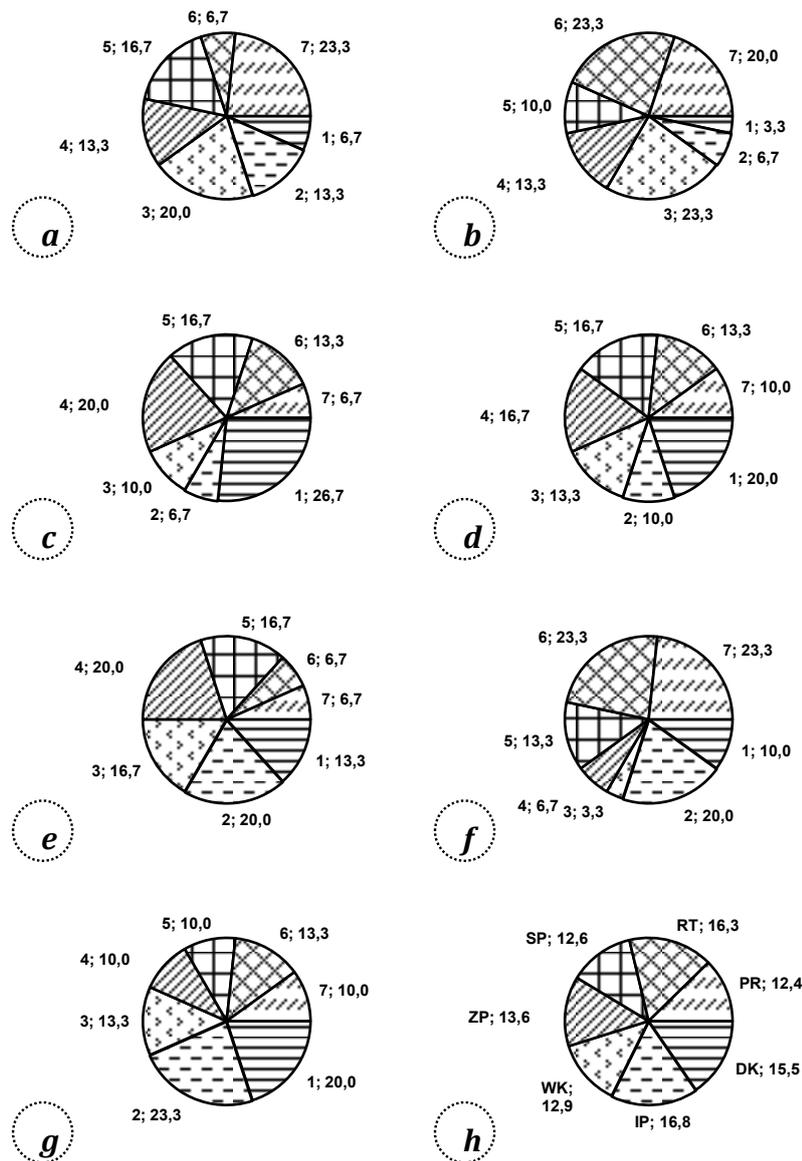


Fig. 3.1 Principle 1. Circular graphs - evaluation structure of the factors' importance for E2 area:

a) DK, b) IP, c) WK, d) ZP, e) SP, f) RT, g) PR, h) average

Source: own study

- Factor cooperation with partners (WK) mostly was evaluated by the respondents (26.6%) at 1, and the least often (6.7%) as 7 (fig. 3.1c). This factor was not too important for the employees.
- Factor confidence in relations with employees (ZP) the most often received the evaluation 1 (20% of responses). It is a factor with a great diversity of responses (fig. 3.1d).
- Factor independence and responsibility of employees (SP) mostly was evaluated at 2 and 4 (20% of responses), and the least often at 6 and 7 (6.7% of responses) (fig. 3.1e).
- Factor development of technology (RT) was usually evaluated at 6 and 2 (respectively 23.3 and 20% of responses). That is wide variation in the responses, and probably a large asymmetry of the distribution (fig. 3.1f).

- Factor preservation of culture in the enterprise (PR) received 23.3% of the evaluation 2 and 20% of 1. 7 was granted to this factor only in 10% (fig. 3.1g).
- On average, the highest score was given to factor innovativeness of a product (IP) – 16.8% and development of technology (RT) – 16.3%. It means that these factors affect, according to the employees, the concept of the development of the research rolling mill (fig. 3.1h).

To provide distribution of quartiles a box-and-whisker plot was used. Schematic version of box-and-whisker plot is presented in figure 3.2.

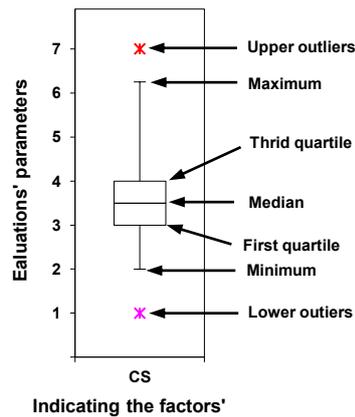


Fig. 3.2 Box-and-whisker plot – characteristic

Source: own study

A box-and-whisker plot provides a wealth of information on the empirical distribution. The location of the box in relation to the numerical axis is the location of the distribution, the vertical line separating them into two sets is a central tendency. On the other hand, the length of the box representing the difference between the first and third quartile, shows the diversity of characteristics for 50% of the central unit.

A vertical line representing the median divides the whole box into two parts, covering 25% of the observations. Depending on the location of the median in the box it indicates skewness in the central part of the distribution.

Complementary part of the plot are "whiskers" located outside of the box. When the whiskers are of equal length, they prove about the symmetry of the distribution. Longer right whisker than the left one shows the positive skewness (asymmetry). Longer left whisker than the right one shows the presence of a negative asymmetry across the distribution.

Correct image of the skewness on the basis of the box-and-whisker plot may be disturbed when some observations "stand out" from the rest, they are denoted with x^* (x of "star").

In figure 3.3 the box-and-whiskers plot for all factors of the research area is presented.

Analysing the box-and-whisker plot (figure 3.3a for individual factors of 1st principle it is possible to see lack of symmetry of quartiles in all cases, apart from the factor independence and responsibility of employees (SP). In this case, both the box that is divided into two equal parts (fig. 3.3b and 3.3c), and both whiskers, which have the equal length (fig. 3.3d), have an impact on the symmetry of the distribution of quartiles.

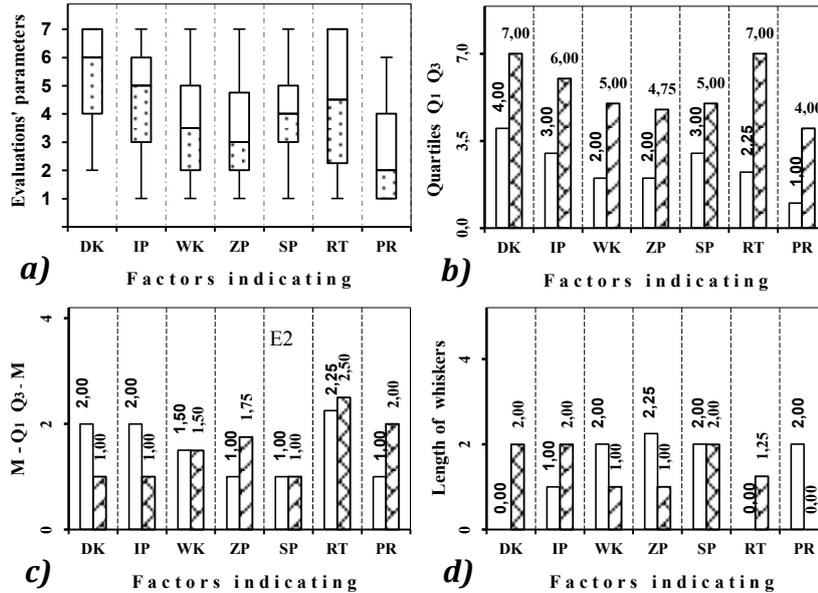


Fig. 3.3 Improvement power. Box-and-whisker plots and its elements:
a) basic graphs, b) Q1 Q2 quartiles, c) M - Q1, Q2 - M suitably, d) length of whiskers:
upper (without filling), lower (with filling) for factors in E2 area

Source: own study

In case of the factors cooperation with partners (WK), confidence in relations with employees (ZP), preservation of culture in the enterprise (PR) positive asymmetry was noticed. These factors were evaluated as less important by employees.

While in case of the factors customer's interest (DK), innovativeness of a product (IP) and development of technology (RT) negative asymmetry was found. These factors received higher evaluations given by the surveyed employees.

An analysis of the correlation between the characteristics of respondents and the evaluations given to individual factors was conducted. The results of the analysis are presented in the form of a bubble chart (figure 3.4). Three different levels of significance were taken into consideration ($\alpha = 0.2$, $\alpha = 0.1$ and $\alpha = 0.05$). In figure 3.4 1 indicates a positive correlation, while 2 means negative correlation.

Analysing figure 3.4a it is possible to see that there is correlation between gender (MK) and customer's interest (DK) with significance level $\alpha = 0.2$, also between gender (MK) and confidence in relations with employees (ZP) with $\alpha = 0.2$ and $\alpha = 0.1$, gender (MK) and independence and responsibility of employees (SP) with $\alpha = 0.2$, $\alpha = 0.1$ and $\alpha = 0.05$. In case of the correlation between gender (MK) and confidence in relations with employees (ZP), negative relation was observed, what means that for women this factor was less important.

In case of education (WE) (fig. 3.4b) there was observed negative correlation with development of technology (RT) with significance level $\alpha = 0.2$. For the person with higher education level this factor was less important.

Observing the age (WI) of employees (fig. 3.4c) it was noted negative correlation with innovativeness of a product (IP) and cooperation with partners (WK) with significance level $\alpha = 0.2$. For older employees these factors were less important.

From figure 4d it results that there is negative correlation between job seniority (SC) and innovativeness of a product (IP) with significance level $\alpha = 0.2$.

In case of mobility (MR) (fig. 3.4e) there is negative relation with innovativeness of a product (IP) with significance level $\alpha = 0.2$ and positive correlation with development of technology (RT) with $\alpha = 0.1$ i $\alpha = 0.05$. People who change their place of work more often evaluated development of technology (RT) higher. Maybe it is connected with their experience which they took from other place of work.

From figure 3.4f it results that there is negative correlation between mode of the employment (TR) and independence and responsibility of employees (SP) with $\alpha = 0.2$ and also positive correlation of this characteristic with preservation of culture in the enterprise (PR) with all significance levels.

In other cases, the correlation was not significant, which means that there was no link between the characteristics of respondents and the evaluation of those factors.

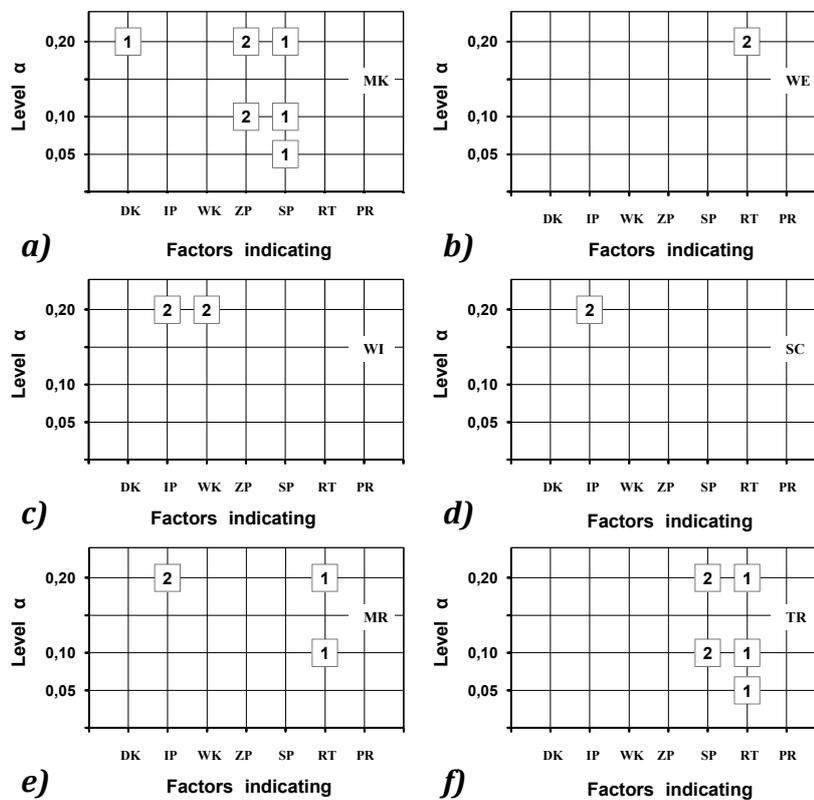


Fig. 3.4 Principle 1. An identification of statistically significant influence of respondents features:

**a) gender, b) education, c) age, d) job seniority, e) mobility, f) mode of the employment and significance level of importance evaluation factors for E2 area.
1 – positive correlation, 2 – negative correlation**

Source: own study

SUMMARY

The dominant feature of the companies operating in countries with a market economy is a constant search for new solutions, appreciating the human potential, his work and activity,

sustained commitment to improving the organization. Consistent implementation of the company management is a guarantee of the success.

The starting point to make changes in the company is the evaluation of the existing state. Such states are the best known by the employees of the company. The aim of this study was to draw the conclusions about the evaluations of factors decide on development concept of the production process in the chosen company.

30 production workers of the rolling mill in the Polish steelworks were asked to answer the questions in the survey. The BOST method was used as the research method. The results can be used by making-decision department.

Average the highest score was given to two factors determining the development concept in the company, i.e. innovativeness of a product (IP) – 16.8% and development of technology (RT) – 16.3%. This means that these factors are the best evaluated by employees. According to them this factors are the most important in the development concept in the rolling mill where they work.

They claim that the company should develop its technology or invest in new one to meet the rigorous requirements of the market. It is also important the product innovation, which determines the competitiveness of the company among others companies available on the market.

It should be noted, however, that all factors of 1st Toyota's management principle form one unit (in proportion) and it is not allowed to skip any of them in own activities.

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Abstract: *The dominant feature of the companies operating in countries with a market economy is a constant search for new solutions, appreciating the human potential, his work and activity, sustained commitment to improving the organization. Consistent implementation of the company management is a guarantee of the success. The aim of the research is to evaluate the factors influencing the development of the concept of the production process in the selected company on the basis of the employee opinion. The authors of the study decided to use one of questions from the BOST methods. The results can be used by the management of the research company to make innovative decision.*

Key words: *The production process, the method of BOST, Toyota's management principle*

OCENA MOŻLIWOŚCI INNOWACYJNYCH PROCESU PRODUKCYJNEGO WALCOWNI

Streszczenie: *Dominującą cechą przedsiębiorstw działających w krajach z gospodarką rynkową jest ciągle poszukiwanie nowych rozwiązań, docenianie potencjału ludzkiego, jego twórczości i aktywności, trwale zaangażowanie w proces doskonalenia organizacji. Konsekwentne realizowanie przedsiębiorczości w zarządzaniu stanowi gwarancje sukcesu. Celem badań jest dokonanie oceny czynników decydujących o koncepcji rozwoju procesu produkcyjnego wybranego przedsiębiorstwa na podstawie opinii pracowników. Autorzy do badań postanowili wykorzystać metodę BOST, czy zasady zarządzania Toyoty w pytaniach. Wyniki badań mogą być wykorzystane przez kierownictwo badanego przedsiębiorstwa w podejmowaniu decyzji innowacyjnych.*

Słowa kluczowe: *proces produkcyjny, metoda BOST, zasada zarządzania Toyoty*

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