WORKERS EVALUATIONS OF RIBBED WIRE COMPETITION AND ROLLING MILL TECHNOLOGICAL POSSIBILITIES

Stanislaw BORKOWSKI, Manuela INGALDI

Czestochowa University of Technology, Faculty of Management, al. Armii Krajowej 19b, p.309z, 42-200 Czestochowa, Poland; bork@zim.pcz.pl; manuela@gazeta.pl

Abstract

Machines and devices use a specific technology, giving the specific characteristics to the product. These features of the product may decide about its competition of the manufacturer on the market, what is responsible for existence of the manufacturer on the market. In the paper the relation between technological possibilities of the rolling mill and competition of its product (ribbed wire) according to workers evaluation was analyzed. This relation was used to show technological position of the research company.

Keywords: ribbed wire, rolling mill, technology, competition

1. INTRODUCTION

The technology can be defined as the overall knowledge of the particular method which concerns manufacturing of a good or achievement of a certain industrial or service effect. So it can be concluded that the company, in order to produce goods with sufficient quality, which find buyers in the market, must have adequate knowledge of their production [1].

Many products require the use of certain technology or can be manufactured with use of different technologies, and their choice depends on many factors: technical, economic, social or cultural, such as cost, time, legislation, safety, comfort, etc.

The own technologies, and at the same time the finished products will affect the position of the company in the market and hence the existence of this market. It means that the technology will also have an impact on the product competition.

The strategy position of the company then will depend on these two factors. It is easy to define this position with use of 3x3 matrix.

2. CHARACTERISTICS OF THE RESEARCH COMPANY

The research steelwork is the largest and most modern heavy plates producer and steel structures in Poland. In the company the Quality Management System according to ISO 9001: 2008 for the production of plates, slabs, precast and steel structures was introduced. It is one of the larger companies in the region that, in the same time, is the largest employer of the city.

Plates are manufactured in a reversing four-high mill from continuously casted slabs coming from own steel melted in an electric arc converter and subjected to secondary metallurgy treatment in a ladle furnace and vacuum degasser. The plate mill is the biggest department of the research steelwork, in which it is possible to produce plates according to individual customer requirements. The last modernization of the mill took place in 2008, after which production capacity can reach more than 1 million tons per year. The rolling mill has a 70% Polish market share and 5% European market share [2-4].
3. **RESEARCH METHOD**

The research which is presented in the article, is a part of the researches connected with BOST method conducted at Institute of Engineering Production, Faculty of Management, Czestochowa University of Technology [5-7]. This test method, based on the Toyota's production system can be successfully used both in production and service institutions. It was created by prof. Stanislaw Borkowski. It is a survey method which describes material and non-material resources such as: the most important areas of improvement, visual control of factors, elements of the manufacturing process, competitive products and manufacturing processes.

In the article it is presented one of the questions of the questionnaire. Respondents were asked for the assessment on a scale from 1 to 9 of the product competition (TK) and the technological possibilities of the manufacturing process (TW) (1 - low, 9 – high evaluation).

In the paper the 3x3 matrix, presented at first by Paul Lowe [8], with some its modifications of author presented already in papers [5-7], was used to evaluate both factors. In the original X-axis is represented by the technological possibilities and the Y-axis by the position in the market (changed for product competition by authors). The matrix shows that the adopted scale of assessment must be divided by 3. It was necessary to change locations of the borderlines to avoid problem with interpretation. Now they are placed between the possible answer. On the axes the letter symbols were introduced. Characteristics of the 3x3 matrix with the description of its parts is presented in Figure 1. For all companies part 1 is a main goal to achieve.

The research and its results presented in this paper are a continuation of previous studies using the BOST method connected with the described matrix.

4. **RESPONDENTS FEATURES**

During the development of BOST methods six key characteristics of the respondents were indentified. These are: gender (MK), education (WE), age (WI), job seniority (SC), mobility (MR), way of employment (TR). A detailed list of personal characteristics of the respondents is presented in Table 1.

![Fig. 1 Characteristics of 3x3 matrix and denotation of its parts.](image)

1. Focus on the revealed chance. 2. Improve the marketing.
3. Search for partners. 4. Discover the incidental market.
7. Buy the ready technology. 8. Develop your technological potential. 9. Search for occasions [own study]

### Tab. 1 Features of respondents. Characteristic [own study]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>MK</th>
<th>WE</th>
<th>WI</th>
<th>SC</th>
<th>MR</th>
<th>TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Men</td>
<td>High school</td>
<td>&lt; 30</td>
<td>&lt; 5</td>
<td>1</td>
<td>Regular</td>
</tr>
<tr>
<td>2</td>
<td>Women</td>
<td>Professional</td>
<td>31 - 50</td>
<td>6 to 10</td>
<td>2</td>
<td>Transfer</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Secondary</td>
<td>41 - 50</td>
<td>11 to 15</td>
<td>3</td>
<td>Finance</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Higher</td>
<td>51 - 55</td>
<td>16 to 20</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>56 - 60</td>
<td>21 to 25</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>61 - 65</td>
<td>26 to 30</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>&gt; 66</td>
<td>31 to 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>&gt; 36</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the conducted BOST research 35 employees (all workers) from the chosen plat mill took part. The detailed profile of the respondents is presented with use of radar graphs in **Figure 2**.

![Radar graphs](image)

**Fig. 2** Radar graph. Respondents characteristic with consideration of:

a) gender, b) education, c) age, d) job seniority, e) mobility, f) way of employment [own study]

In the research 35 people took part, of which 29 are males. It should be emphasized that this may be caused by the industry, to which the company belongs and therefore specific work. In the company mainly people with a professional education (14 people) are employed, but the number of workers with higher education (10 people) is also big. In the research people, who are over 60 years old, didn’t take part. Most of workers are between 31-40 and 56-60 years old, which means that the company focuses on an experience, but do not want to hire older people. The age of respondents is also connected with the experience of the employees. In the company it was observed that there was a group of experienced workers (26-30 years) which are the teachers for a large group of less experienced workers (6-10 years). This should result in the continuity of the staff. For most employees this is already 2nd-3rd job and they were employed in normal way.

5. **RESULTS**

The usual presentation of research results in the analysed case would not show fully the real situation of the company. The figures illustrate the results better than tables. A compilation of several figures together allows for better interpretation of the obtained results. So overall it was decided to present the results in the form of figures in a variety of forms, and these forms combine with each other (**Figure 3**). The map of evaluations and the map of sum of evaluations will let observe the distribution of votes between the different parts of the 3x3 matrix, and at the same time to determine the strategic position of the research plate mill. However, the radar graph shows the summary of the evaluations.
It should be noted that both research factors didn’t get the lowest evaluations (Figure 3a). However, it should be underline that no one of the interviewed employees evaluated at the same time the product competition (TK) and the technological possibilities of the manufacturing process (TW) as 9. It was not observed any dominant pair of evaluations or accumulation of the answers. This difference of evaluations may have been caused by highly diversified of the research workers structure (Figure 2). The most frequent evaluations were placed in parts 3 and 4 of the 3x3 matrix (Figure 3b and 3c). This means that the research plate mill should: 3. Search for partners. And 4. Discover the incidental market.

Box-and-whisker plot (Figure 4) provides a number of information on the empirical distribution [9]. The location of the box in relation to the axis determines the location of the distribution, the vertical line that divides it into two parts defines a central tendency. While the length of the box representing the difference between the first and third quartile, shows characteristics of variation of 50% of the central units. A vertical line representing the median divides the whole box into two parts, comprising 25% of the observations.

The “whiskers”, which are outside of the box, are complementary to graph. When the whiskers are of equal length, it indicates the symmetry of the distribution. Longer right whisker in relation to the left one shows positive skewness (asymmetry). While longer left whisker in relation to the right one shows negative skewness (asymmetry).

In Figure 5 the results of the research with use of the described plot were presented.

It was not observed any evaluation which did not suit to the rest. In case of the technological possibilities of the manufacturing process (TW) it can be seen the symmetry of the distribution. Both the box and whiskers...
are symmetrical. However, in case of the product competition (TK) it was observed the asymmetry of the box, while both whiskers have the same length. The median is located closer to the first quartile, which means positive asymmetry in the central part of the distribution.

Also a statistical analysis [9-10] of the two research factors was conducted (Figure 6). The asymmetry of the distribution was also taken into the consideration in order to confirm the results presented with the box-and-whisker plots.

Both factors the product competition (TK) and the technological possibilities of the manufacturing process (TW) received average evaluation from the employees more than 5 (Figure 6a). For the second factor the average was slightly higher. Taking into account only received averages and putting them in the 3x3 matrix the research company would be in the middle: 9. Search for partners. However, in fact, in this part of the matrix there were only 3 pairs of evaluations.

The product competition (TK) was characterised by higher variance and standard deviation (Figure 6b and 6c). It can also be noted that in the case of this factor greater variation of the evaluations received from employees was observed (higher coefficient of variation in Figure 6d). This factor was also characterised by stronger asymmetry of the distribution that the technological possibilities of the manufacturing process (TW) (Figure 6e). However, it should be underlined that also in this case was not too strong positive asymmetry, what confirmed the analysis with use of the box-and-whisker plot (Figure 5). Both factor had the distribution flatter than normal distribution (negative kurtosis in Figure 6f).

6. SUMMARY

At the end the authors decided to examine the impact of the respondents features on the evaluations of both factor. For this purpose correlation graphs were constructed (Figure 7).
There was the correlation between the age of the employees, declared place of work and the evaluation of both factors. In case of both respondents features there was positive correlation for the technological possibilities of the manufacturing process (TW) with $\alpha = 0.2$ and $0.1$, while for the product competition (TK) negative only with $\alpha = 0.2$. It means that the technological possibilities of the manufacturing process (TW) was higher evaluated by older people and people changing work more often. In case of the product competition (TK), opposite situation was observed.

It was also observed negative correlation between job seniority and the product competition (TK) with $\alpha = 0.2$. For the technological possibilities of the manufacturing process (TW) there was positive correlation with way of employment with the same level of significance.

In the other cases the correlation wasn’t significant, so there was no relation between respondents features and the evaluations given by asked workers.

LITERATURE


[5] BORKOWSKI, S. Documents containing coined the term (TOYOTARYZM) and containing the name and structure of the developed method (BOST). Confirmation of the date. „AAK” KANCELARIA PATENTOWA. Czestochowa 2012.


