

# AN EVALUATION OF REALIZATION OF THE PRODUCTION PROCESS IN THE CEMENT MILL

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## Resume

In this chapter there were presented the characteristics of the research object (cement mill) and the description of the enterprise products. There was introduced an analysis of the results obtained on the basis of the BOST questionnaire survey and there was made a statistical analysis concerning principle 4 of the Toyota. The structure of evaluation was determined and importance series were built.

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## 1. History and quality policy in the cement mill

The main raw material for the production of cement is limestone. The location surroundings of the workshop have rich deposits of limestone. For that reason in 1959 the authorities of the state made a decision about building a cement mill in this area. The fact of the beneficial location was an additional factor helping a new investment on the coal trunk-line Silesia – the Baltic Sea Coast. In the seventies of the 20th century the cement mill was built by the Conglomerate concentrating a few production plants with similar businesses in one organizational structure, i.e.: two units producing cement, two units dealing with the production of calcium and one producing agricultural limestone.

The eighties of the last century is a period of crisis for the cement mill and of political transformations on a national scale. New owners invested in the modernization of two rotary furnaces. The modernization depended on replacing the so-called wet method with the dry method in the production of clinker. It resulted in productivity growth of the clinker with simultaneous lowering of energy consumption and

technological fuel. Fig. 1 shows a modernised technological line for the production of clinker.



Fig. 1. Modernised lines for the production of clinker

According to the declared policy on quality the cement mill is a producer of cement for the Polish market as well as foreign ones. The applied systems of quality management are still being developed and a possibility to improve them in the future is being sought. It is realized by effective managing of basic processes which, thanks to investments, are supplied in more efficient technologies and modern devices. The quality control of products in the cement mill is based on the Integrated System of Management in accordance with norms PN-EN ISO 9001:2001, PN-EN ISO 14001:2005, PN-N 18001:2004, AQAP 2120: 2003. In December

2009 the Company Laboratory received accreditation of the Polish Accreditation Centre in accordance with norms PN-EN ISO/IEC 17025:2005.

## 2. The preliminary presentation of results

### 2.1. Combination of results

A valuable supplement of carried out examinations is the interpretation of BOST questionnaire results (BORKOWSKI S. 2012a). It allows a better look at the enterprise through the eyes of workers. In order to form an opinion it is essential to know the opinion of workers of different ranks in the enterprise. In the analysis there was used a question from E5 area (BORKOWSKI S. 2012b). The question that was analysed read: "What elements are the most important in the realization of a production process?". The person who fills in a questionnaire is to judge the following factors (BORKOWSKI S. 2012c):

- *Short series of products* (KW).
- *Steady duty of machines* (RM).
- *Steady duty of workers* (RO).
- *Rhythmicality of supply* (RD).

This question in the BOST questionnaire is in accordance with the 4th principle of the Toyota (BORKOWSKI S., ROSAK-SZYROCKA J. 2011). In table 1 numerical combination of evaluations has been presented.

Table 1. Principle 4. Numerical combination of the factors importance evaluation for E5 area

Evaluation	Indicating the factors			
	RO	RM	KW	RD
1	1	0	32	2
2	20	2	2	11
3	6	20	1	8
4	8	13	0	14

Source: own study

### 2.2. Statistical analysis of the results from the BOST questionnaire

Making statistical analysis of the studied area six statistical tools were used: arithmetic average, variance, standard deviation, the coefficient of variation, skewness and excess coefficient (Fig. 2)

The average level of the measurable feature was presented with the help of the average

(KONSTANCIAK M., BORKOWSKI S., JAGUSIAK M. 4/2011). While analysing Fig. 2a concerning the result of the average it was taken into account that the majority of respondents judged the response concerning *steady duty of machines* (RM) on the level 3.31.

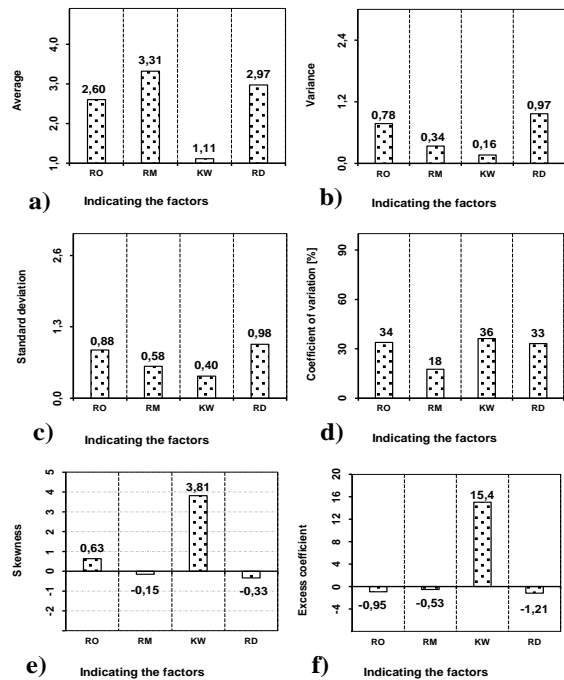


Fig. 2. Principle 4. Comparison: a) averages, b) standard deviation, c) variance, d) coefficient of variation for 5 area factors

The reply concerning *rhythmicality of supply* (RD) reached 2.97. The next statistical tool is a variance. From Fig. 2b it results that the maximum value of variance amounting to 0.97 concerns the reply on *rhythmicality of supply* (RD). The minimum value 0.16 received the answer *short series of products* (KW). Fig. 2c shows determined standard deviations. It results from them that *short series of products* (KW) has the smallest standard deviation. The fourth analysed statistical measure is coefficient of variation (Fig. 2d). The biggest diversity can be observed for *short series of products* (KW).

The reply concerning *steady duty of machines* (RM) was more explicitly judged by respondents. Skewness (Fig. 2e) is the simplest measure of the asymmetry for the factors in the researched area (BORKOWSKI S., MIELCZAREK K., BARTELEWSKA A. 2011). After analysing the results it was stated that the replies concerning *steady duty of machines* (RM) and *rhythmicality*

of supply (RD) have the disintegration left-side oblique, however for the reply *short series of products* (KW) and *steady duty of workers* (RO) the disintegration is positive which means that is on the right-hand side oblique. The last factor for analysis is kurtosis (Fig. 2f). It determines the measure of distribution and concentrating the results in the surroundings of the average (BORKOWSKI S., KNOP K., PLUTA M. 2011). The measures for *steady duty of workers* (RO), *steady duty of machines* (RM) and *rhythmicality of supply* (RD) show flattened distribution and the value for *short series of products* (KW) - slender distribution.

### 2.3. Importance series for factors describing the fourth principle of the Toyota

In order to analyze the structure of the answers for the purpose of getting the importance of features for the analysed area, they were assessed with taking into consideration the value assigned to determined factors (BORKOWSKI S., KNOP K., BARTCZAK M. 2011). On the basis of the received results there were presented importance series of factors for evaluation "1 ÷ 4". Formula 1 shows an importance series of factors for evaluation "1". On the basis of received results it was found that *short series of products* (KW) received mostly evaluation "1".

$$KW > RD > RO > RM \quad (1)$$

*Steady duty of workers* (RO) received mostly evaluation "2".

$$RO > RD > KW > RM \quad (2)$$

On the basis of received results it was found that *steady duty of machines* (RM) received mostly evaluation "3" (57.1%).

$$RM > RD > RO > KW \quad (3)$$

Similarly to evaluation "3", the factor *steady duty of machines* (RM) received evaluation "4" the most.

$$RM > RD > RO > KW \quad (4)$$

Formula 5 shows a series for the average.

$$RM > RD > RO > KW \quad (5)$$

The factor *steady duty of machines* (RM) is the area which was regarded as the most important one in the realization of the production process.

The last place was taken by the factor *short series of products* (KW).

### 3. Conclusions

The data obtained from BOST analysis allowed us to get to know the opinions of a representative group of workers in the topic of functioning of the enterprise in relation to a competent organization of the production process and its influence on the quality of produced goods. The respondents were with long professional experience and for the majority of them it was their first work place. The results from the analysis made it possible to state that according to the respondents the most important element in the realization of the production process was the factor *steady duty of machines* (RM).

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