

AN IDENTIFICATION OF AREAS REQUIRING IMPROVEMENT IN THE COMPANY PRODUCING THE ILLUMINATION – CASE STUDY

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Abstract: The article presents a case study of the practical use of BOST surveys to identify the most important areas that require improvement actions. It was made the identification and of areas requiring improvement from the fourteenth Toyota's management principle point of view. According to this principle it is crucial to determine the causes of problem by solving technical issues. The research object is company from illumination branch. Some production workers of the company with the help of BOST questionnaire survey showed, which factors can bring the best effect after being improved. In frames of the work it was made characteristics of the research object - producer of illumination, the presentation of research methodology and content fourteenth Toyota's management principle. Based on the survey results of carried out on the population of production workers, a series of importance areas for improvement was formulated. The aim of the analysis is to present which factors are the most important by building the significance sequences of obtained results. In the article were presented results of analysis with using circular charts, box-and-whisker plots and some statistical tools. The results obtained for the type of small and medium-sized enterprises overlap with the results of tests verified in other enterprises.

Keywords: BOST method, improvement, importance hierarchy, Toyota's management principle, statistical analysis

1. INTRODUCTION

Survey and research method determined as BOST (Borkowski, S., 2016) was formed as a result of author's fascination in Toyota Motor Company (Gao and Low, 2015), in its management and production system, enhanced after reading a book by Jeffrey Liker "The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer" (Amasaka, 2012; Liker and Franz 2011; Kleszcz et al., 2013). BOST studies known also as Toyota's management principles in questions, were drawn up in order to assess in practice the approach to management principles amongst many manufacturing companies and service in Poland (Borkowski et al., 2014). Toyota's management

principles in BOST method are described with some characteristic where set of factors was called "areas" (Borkowski et al., 2013). Some principles are divided into two or even three areas. This method describes Toyota's management principles with its characteristic factors (Knop and Mielczarek, 2018). The presented questionnaire has a ranking scale. Respondents may assess the significance of a given factor by placing one of the numbers within the range of scale in an appropriate box. After the description of the main part of this method its further elements will be outlined briefly. The BOST method allows assessing the significance of factors describing the 14 Toyota management principles (Liker, 2005).

2. CHARACTERISTICS OF THE RESEARCH SUBJECT

Enterprise on the base was conducted research is a producer of of illumination. At the beginning, the company conducted its activity only on the Polish market, and main recipients were stores and building market. Thanks to individual customers could in the more luxurious way make choice and the purchase of the interested model. The company specializes in the production of lamps and chandeliers for internal applying: ceiling chandeliers, desktop, floor lamps and wall lamps. The offer of lamps is divided thematically on: modern lamps and classical, plafond from bent glass, lamps to the kitchen, the lamp to the children's room, the lamp to lighting the outside elevation of the house. Now the company is employing more than 70 people on different positions which are able to fulfill requirements of the customers. An advantage of the enterprise above the competition is the fact that every year the company releases on the market the bulk of new collections of lamps assigned to light insides. Company is competitive with foreign countries - exporting its products to many countries. Moreover the company is aspiring to attaining the position of the leader in the production of lighting, appreciated and bought by customers in entire Europe. An organizational structure of the company can determine as linear, flat. There are not a large number of managerial ranks what quicken the flow of information and the procedure of making a decision. In every department there is one manager who has the smaller or larger group of workers under itself. Production managers are responsible for the course of an entire production process and for creating and correct implementing of new ideas or the technology. New workers before working on full-time must have an internal examination in the company. Thanks to this procedure the enterprise has the guarantee that a new worker will be performed tasks competently. The workers' staff is selected well both in terms of the qualification as well as the ability of individual workers for the work in the team. Advantages of the company is professionalism realized by many years some projects connected with designing and accustoming to the production lighting let the company collect experience that constitute strong capital for the future. The quality control is present at every stage of the production, having conceived from careful selection of sub-suppliers, through the control of materials delivered by them and sub-assemblies, the control of half-finished products processing in every phase, and on final goods finishing. It is supposed to assure that the product is safe and is characterized by good quality. The company has a linear organizational structure. In the linear structure, two subgroups are outlined in which we distinguish between managerial and workers. The department manager may have supervision over a certain number of employees. The department employee has a strictly defined supervisor. It allows you to group

employees according to the categories of their duties and the implementation of agreed activities

At the same time, it improved the supervision over production and employees, because the manager deals with the designated department. Significant decisions are made by the owners who take into account the beliefs and suggestions of the crew during the consideration.

3. RESEARCH METHODOLOGY

The fourteenth principle teaches us reflection and continuous improvement. The purpose of choosing this principle is to determine causes of a problem by solving technical problems. Continuous improvement of the production is very significant for a company, which has been functioning on the market. It should be emphasized that the proposed issue is a valuable instrument in the analysis of processes requiring improvement Respondents were asked to provide answers to the following question: "Which area can bring the best effects after being improved?". Decide with use of the scale 1÷10 (10 is the most important factor). The set of factors was selected for description of the fourteenth Toyota's management principle (Mielczarek and Knop, 2015)

ZT		Employment of workers
SM		Incentive system
PT		Portfolio of technology
JK		Quality
UM		Machine maintenance
RE		Employee – superior relationship
DA		Documentation
PN		Flow of information
WS		Cooperation with customers
WD		Cooperation with suppliers, partners

The questionnaire survey was carried out in the researched enterprise producing illumination amongst 45% production workers. i.e. more than half of workers. Such a large research group of directly production workers will allow to precise identification of areas requiring improvement in the surveyed enterprise.

4. STRUCTURE OF RATES DESCRIBING THE FOURTEENTH TOYOTA MANAGEMENT PRINCIPLE

The results of the study were detailed in the analysis. For development a series of important factors the structure of individual assessments is presented. At the beginning was made an analysis of the structure of granted assessments to individual factors. The percentage structure of assessments was presented in Fig. 1.

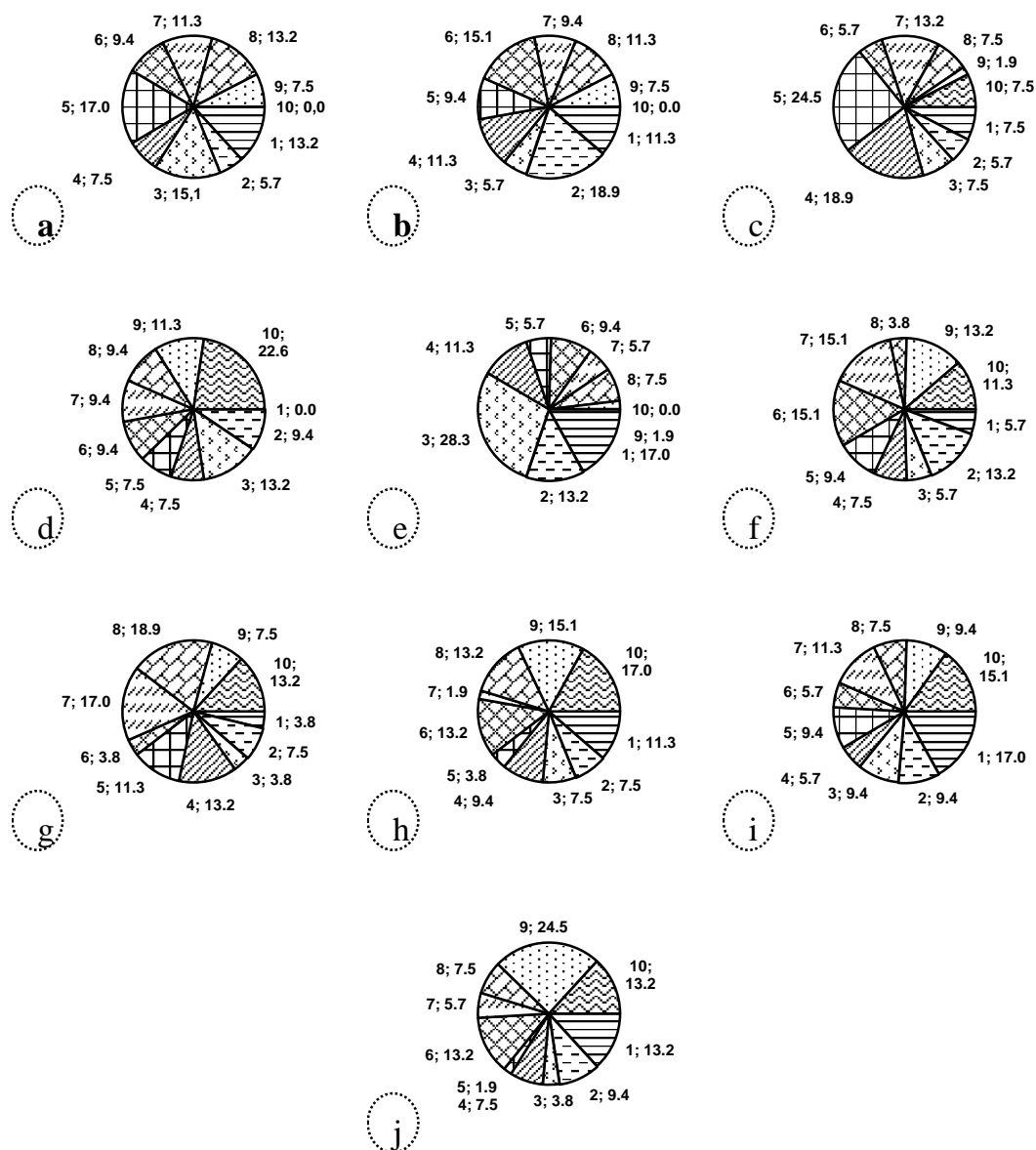


Fig. 1. Circular charts - structure of evaluation of the importance for individual factors:
 a) Employment of workers, b) Incentive system, c) Portfolio of technology, d) Quality,
 e) Machine maintenance, f) Employee – superior relationship, g) Documentation, h) Flow of
 information, i) Cooperation with customers, j) Cooperation with suppliers, partners

Basing on circular charts a table showing numbers of the factors importance was built in the purpose of locating each of them in frames of next assessments. It can be concluded from the above mentioned charts that employees of enterprise recognize *quality* (JK) as the most important factor. This cell was filled up with the black color in the tablet which is showing the place of factor *quality* (JK) of significance sequences for every evaluations.

Table 1.
Places of the factor in importance series for individual evaluations

Assessment	Place of factors in the number of the importance									
	1	2	3	4	5	6	7	8	9	10
1	DA	PN	UM	WD	PT	ZT	RE	SM	JK	WS
2	UM	ZT	DA	PN	PT	WD	JK	SM	RE	WS
3	ZT	DA	RE	UM	WD	PN	PT	SM	WS	JK
4	DA	SM	RE	UM	WD	WS	ZT	JK	PT	PN
5	WS	RE	SM	PT	PN	DA	UM	WD	JK	ZT
6	WS	SM	WD	JK	PN	DA	ZT	PT	RE	UM
7	RE	UM	JK	PN	SM	ZT	PT	WD	WS	DA
8	JK	PN	SM	WD	WS	PT	ZT	DA	UM	RE
9	JK	PT	SM	PN	UM	WS	DA	RE	ZT	WD
10	PT	JK	WS	PN	WD	RE	SM	DA	UM	ZT

As results from data included in table 1 in the case of factor *quality* (JK) assessment “8” and “9” is the most important, also assessment „10” turned out to be the crucial factor. In the case of least important assessments, i.e. from “1” to “5” this factor was on the distant place in the importance series. To the purpose of determining ultimate number of the importance series for factors in enterprise was used average. Fig. 2 is presented average values of assessments for each factor.

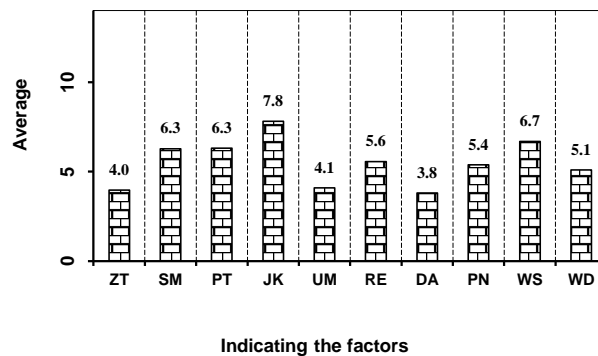


Fig. 2. Average values of importance evaluations for factors

The following significance sequences of factors have been obtained:

$$JK > WS > PT > SM > RE > PN > WD > UM > ZT \tag{1}$$

The most important factor which is supposed to bring the greatest effects after improvement according to the opinion of workers is a factor *quality* (JK). On a second place is factor *cooperation with customers* (WS), on third - factor *portfolio of technology* (PT). According to workers employing is least important factors *is employment of workers* (ZT), *machine maintenance* (UM) and *cooperation with suppliers, partners* (WD).

5. THE RESULTS CONCERNING THE STRUCTURE

Box-and-whisker plots is a convenient way of visually displaying the data distribution through their quartiles. It is useful when comparing distributions between many groups

or datasets. It is useful for indicating whether a distribution is skewed and whether there are potential unusual observations in the data set. Box-and-whisker plots are also very useful when large numbers of observations are involved and when two or more data sets are being compared. Calculation results of such positional statistical parameters as median, quartiles and range were presented using box-and-whisker plot with reference to all factors of the production process (Fig. 3) (Fouad and Mukattash, 2010). The aim of application of this statistical tool is to show distribution of evaluation for individual factors.

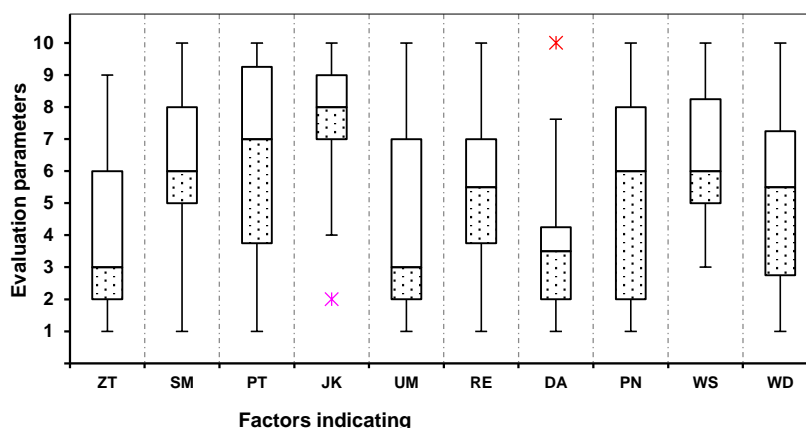


Fig. 3. Box-and-whisker plots and its elements for individual factors

Box-and-whisker plots provided a lot of valuable information about rating distribution to the examined factor (Knop, 2018). Analyzing Fig. 3a we notice that the strongest asymmetry of the disintegration refers to the factor *incentive system* (SM) *portfolio of technology* (PT) and *quality* (JK). A strong right-hand asymmetry of the disintegration is appearing for the factor (ZT), (UM), (DA), (PN) and (WS). Analyzing the disintegration of the factor *quality* (JK) we notice that sedimentation from average in on the level 2. Kurtosis is a measure of the concentration of results. It informs us about the extent to which our observations are concentrated around the average. This measure tells us how many of our results are close to the average. Fig. 4 is presented skewness and kurtosis for individual factors. Skewness is a measure of the asymmetry of the observed results. It informs us how the results for a given variable shape around the average. Are most of the observed results on the left side of the average, close to the average or to the right of the average.

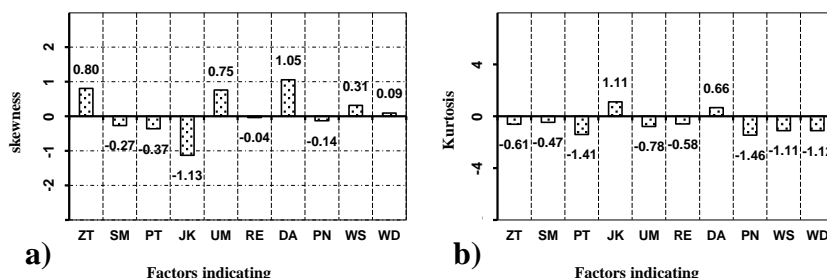


Fig. 4. Comparison skewness and kurtosis for individual factors

Skewness presented in Fig. 4a is a measure of the asymmetry of the disintegration. Five actors (SM, PT, JK, RE, PN) are characterized by a left-side asymmetry. The rest

of factors are demonstrating the right-hand asymmetry. The biggest power of asymmetry occurred for factors *documentation* (DA).

For the factor *quality* (JA) and *documentation* (DA) kurtosis (Fig. 4b), that is measure the concentration of the disintegration, is positive. It is attesting to the fact that the graph is quite stiff and slender. For remaining factors kurtosis is negative, i.e. flatter, and value of individual factors are less concentrated, than at the normal distribution. This statistical tool confirm that distribution of results is logical and can be helpful for evaluation actual state in enterprise.

6. CONCLUSION

Surveyed studies have shown the effectiveness of the selection of specific factors in the purpose of determining a series of validity. The use of this knowledge will enable effective use of the company's resources in improving the indicated areas. As a result of the research work, it was found that the most important area requiring improvement is quality. It is an important element of research for small and medium enterprises. The results of research are consistent with the research carried out in other such enterprises.

To the purpose of determining the rank of factors which can bring the best effect after being improved in the enterprise producing illuminations a BOST questionnaire survey was used. Research was carried out amongst production workers of the company. It allowed detailing factors which in the greatest degree can contribute for improvement processes in the company and the ones which have this smallest contribution. The carried out questionnaire showed that the enterprise had the great potential of filling the meaning position on the market. Functioning of the production system, although now is working perfectly, it is possible still to be improved. The quality of offered products can be improved through applying tools of the quality, or some elements of Kaizen philosophy. How results from the BOST questionnaire survey, the factor *quality* (JK) is the most important in the enterprise and often has been judged with the highest evaluation by respondents. The factor of the quality strongly influences on decisions of customers as for the purchase of final products. The market success of the company in the business of lighting products depends above all on, whether it will be in the state to deliver products about the appropriate quality. The quality level of lighting elements produced by the company is high, but constant improvement is needed.

Also important factor in guaranteeing the development of the company is *cooperation with customers* (WS). The company constantly is watching the market and is trying to meet needs for their customers, with richer offer of products, adapted for changing tastes of customers. Products of the examined brand are enjoying the unremitting interest on the market what is authenticating their prestige, the innovation and the functionality. The factor that is the least important, according to workers is *employment of workers* (ZT). They showed that the potential of workers whom the company administers present is enough for taking and the realization of challenges in the scope of improvement. In the company they are employed workers which are able to raise the productivity, develop some new products and to create the peculiar culture, a system of values and the organizational climate.

The practical use of BOST surveys gives the opportunity to benefit from the practical knowledge of employees at the company's production level. This may contribute to the identification of key areas for the functioning of the enterprise.

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