

## Chapter 10

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### **OPERATION OF PRODUCTION SYSTEM IN FOOD INDUSTRY IN ACCORDANCE WITH THE REQUIREMENTS OF 3<sup>RD</sup> TOYOTA'S MANAGEMENT PRINCIPLES**

**Abstract:** Improvement is a very important part in the organization. Reducing cycle time allows fast response to customer orders. This chapter presents the results of research carried out in the company producing vegetable and fruit preserves. Research was carried out according to the BOST method designed at the Institute of Production Engineering, Czestochowa University of Technology. The obtained results allow obtaining the opinion of employees on the functioning of the production system.

**Key words:** BOST, Characteristics of respondents, Toyota's management principles, correlation analysis, Muda.

#### **10.1. Characteristics of a research facility**

The company specializes in the manufacture of food products. The main products are: canned vegetables, concentrates, vinegar, spices, additives, dinners, sauces, juices, syrups and fruit preserves.

The company was established in 1994 by two brothers. Originally involved in the production: bait fish and the production of vinegar. In 1998, transformed into the Department of Production and Foodland started to deal with the processing of vegetable and fruit.

The years 2001-2002 were important in the history of the company. At that time, bought modern production lines and completed installation

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of its own Vinegar, with a target production capacity of 20million liters ofvinegarper year.Vinegaris one of themost modernin the region.The company obtainedthe quality certificateISO9001:2001and HACCP.

In 2003 the company was transformed into a company general partnership. The company sells its products in the domestic market and in North America, Europe and Asia. Today, the company employs more than250 employees.

## **10.2. Identification of the value added in the production of pickles**

The manufacturing processrelates to the productionof the product, or processing of materials into finished products. These activities are associated with the planning of operations, operatives cheduling, control ofquantity and quality of manufacturing (DURLIK I. 2007, BORKOWSKI S., ULEWICZ R. 2008).

Technological process is called the main part of the basic manufacturing process in which a change of shape, physicochemical properties, the external appearance of the processed material or permanent change of mutual position of the various parts included in the manufactured product, or assembly of components and products (DURLIK I. 2007, BORKOWSKI S., ULEWICZ R. 2008).

In terms of technology can be distinguished: the phase, processes and operations carried outthroughout themanufacturingplant ora cell (BORKOWSKI S., ULEWICZ R. 2008).

The production process of the pickles is presented in the Figure 12.1.In parentheses are shown the time of each operation.

The operations specified in this process are following:

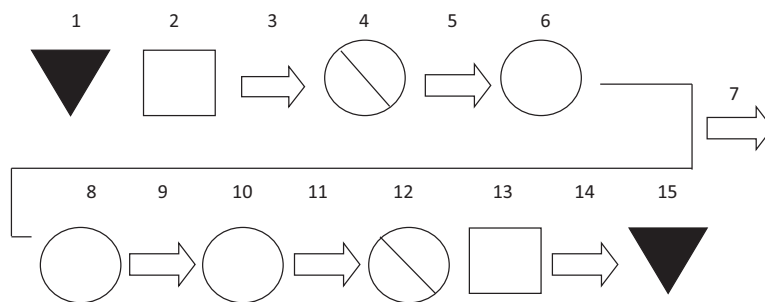
1. Storage of raw materials (65 s.)
2. Control of raw materials (65 s.)
3. Transportation from the warehouse to the production line (20 s.)
4. Portioning ingredients depending on the size of the jar (40 s.)
5. Transportation to the position of adding spices (5 s.)

6. Adding spices (35 s.)
7. Transporting flooding (10 s.)
8. Flooding jar (15 s.)
9. Transportation to the pasteurizer (15 s.)
10. Preserving (1500 s.)
11. Transportation to the position of labeling (50 s.)
12. Labeling jar (2 s.)
13. Visual inspection and leak (30 s.)
14. Transport the finished product to the main warehouse (900 s.)
15. Finished foods warehouse (8500 s.)

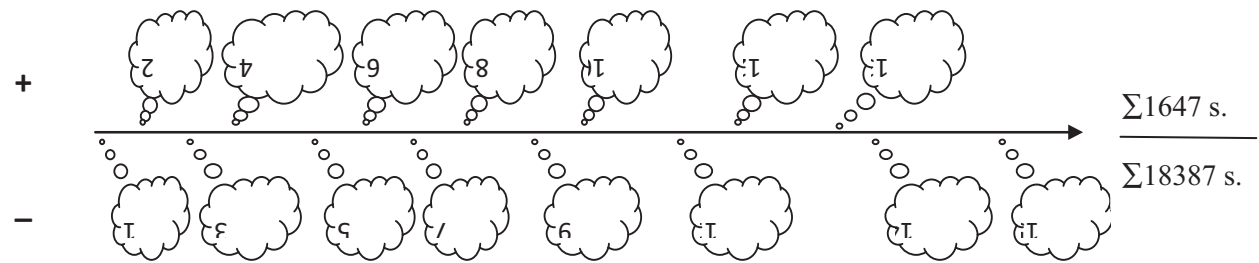
The manufacturing process pickles consist of 15 operations. From the point of view of the customer operations included in the production process are divided into steps:

- **Bringing added value** - all activities generating value from the point of view of the customer (TAPPING D., SHUKER 2010).
- **Do not bring added value (MUDA)** - all actions that will increase the cost or time, do not bring any contribution (TAPPING D., SHUKER T. 2010, BORKOWSKI S., ULEWICZR. 2008, KORNICKI L., KUBIK S. (ed.) 2008).

In Figure 10.1 shows the cycle time divided into the total cycle time and waiting time.



**Fig. 10.1. The pickles production process in a technological aspect.**  
 Source: own study



**TOTAL CYCLE TIME** (added value) 1647 s. + **TOTAL WAITING TIME (MUDA)** 18387 s. =  
**TOTAL EXECUTION TIME 20 074 s.**

-114-

*Fig. 10.2. The production process of pickles divided into value-added operations (above the line) and not adding value (below the line).*

Source: own study

### 10.3. Experiments

In order to assess the situation at the company carried out BOST survey.

The method BOST (the name comes from the first two letters of the author's names, is legally protected (BORKOWSKI S. 2012a). Toyota's management principles are described characteristic factors. Their number depends on the scope of the rule, ranging from 4 to 10. A set of factors is called area.

Some of the rules are divided into two or three areas. Toyota's management principles are divided into four sections. While the survey BOST has two versions: version for employees and supervisors version.

Version for employees contains set factors that describe of the rules: 1, 2, 3, 4, 6, 7, 14 and the roof of the house of Toyota parts (quality, cost, execution time, safety, morale) (BORKOWSKI S. 2012b, BORKOWSKI S. 2012c).

Employees were asked to assess the factors of area "E4". A question describes the third Toyota's management principle.

The 3<sup>rd</sup> Toyota's management principle is as follows (BORKOWSKI S. 2012b):

***Principle 3. Use "pull" systems to avoid overproduction.***

The 3<sup>rd</sup> Toyota's management principle is described in the BOST survey by question E4:

***The organization of the production system provides:***

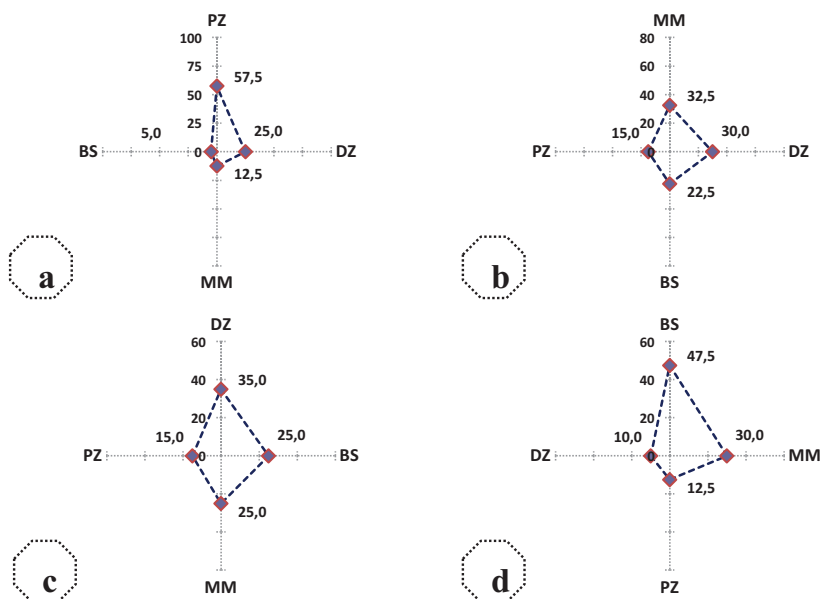
In the box type 1, 2, 3, 4 (4 factor the most important).

<b>DZ</b>		Delivery on "request" the customer
<b>MM</b>		Maximum use of machines, people
<b>PZ</b>		Formation of stocks
<b>BS</b>		Fast execution of the contract

A radar chart is used to assess the validity of the factors E4 area (Fig. 10.3).

Figure 10.3a, has been presented range of validity of factors for evaluate "1". Based on the data found that the most ratings of "1" received the factor: formation of stocks (PZ). Rating of "1" states 57.5% of total ratings for factor formation of stocks (PZ).

Figure 10.3b, has been presented range of validity of factors for evaluate "2". Based on the data found that the most ratings of "2" received the factor: maximum use of machines, people (MM). Rating of "2" states 32.5% of total ratings for factor maximum use of machines, people (MM).



**Fig. 10.3. E4. Principle 3. Radar charts of the factors' importance E4 area for evaluations: a) „1”, b) „2”, c) „3”, d) „4”.**

***It concerns to companies producing pickles.***

*Source: own study*

Figure 10.3c, has been presented range of validity of factors for evaluate "3". Based on the data found that the most ratings of "3" received the factor: delivery on "request" the customer (DZ). Rating of "3" states 35% of total ratings for factor delivery on "request" the customer (DZ).

Figure 10.3d, has been presented range of validity of factors for evaluate "4". Based on the data found that the most ratings of "4" received the factor: delivery on "request" the customer (DZ). Rating of "4" states 47.5% of total ratings for factor delivery on "request" the customer (DZ).

#### **10.4. Evaluation of the impact characteristics of respondents to the results of research**

An important element of the BOST survey is to analyze the influence of the characteristics of respondents in the results.

Correlation analysis is conditional on the existence of two sets of data. The data sets represent the explanatory variable and the dependent variable (PUŁASKA – TURYN B. 2008).

Explanatory variables are the characteristics of respondents are presented in the Table 10.1.

Below shows description of the symbols shown in the Table 10.1:

- **MK - Gender** („1” – Male, „2” – Female).
- **WE - Education** („1” – primary/vocational, „2” – secondary, „3” – BA, BSc, „4” – MA, MSc.)
- **WI - Age** („1” - < 30 years old, „2” - 30 – 40, „3” – 40 – 50, „4” – 50 – 55, „5” – 55 – 60, „6” – 60 – 65, „7” > 60).
- **SC - Job seniority** („1” - < 5 years, „2” - 5 – 10, „3” – 10 – 15, „4” – 15 – 20, „5” – 20 – 25).
- **MR - Number of previous places of employment** (given number defines a number of previous places of employment).
- **TR - Mode of employment** („1” – normal, „2” – transfer, „3” – better financial conditions).

*Table 10.1. Characteristics of the respondents*

Sym.	DESIGNATION OF CHARACTERISTICS AND THEIR DESCRIPTION					
	MK	WE	WI	SC	MR	TR
1	Male	Primary/Vocational	< 30	< 5	1	Normal
2	Female	Secondary	31 - 40	6 do 10	2	Transfer
3		BA/BSc	41 - 50	11 do 15	3	Finance
4		MA/MSc	51 - 55	16 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*

Figure 10.4 contains a summary of statistically significant correlation coefficients between evaluation of a factor and selected respondents characteristics: gender (MK), education (WE), age (WI), job seniority (SC), mobility (MR), mode of employment (TR) for three levels of  $\alpha = 0.05, 0.1, 0.2$ .

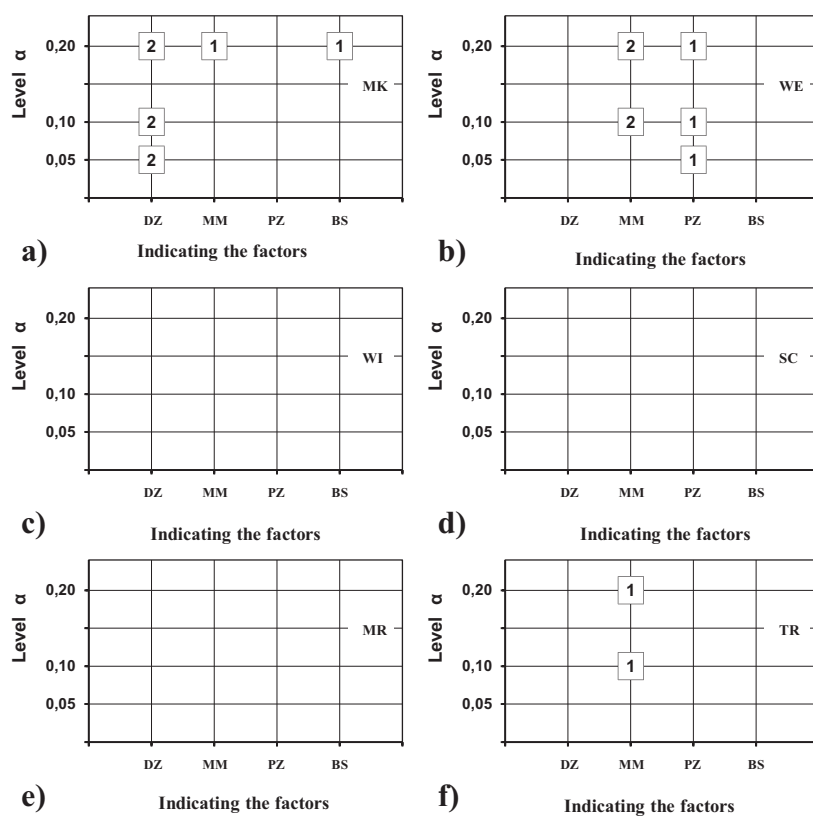
The correlation analysis, the impact of the characteristics of the respondents in the research results were used bubble charts:

- Gender (Fig. 10.4a). Determines the validity of the ratings of three factors: delivery on "request" the customer (DZ) - the negative correlation at the level of  $\alpha = 0.2, \alpha = 0.1, \alpha = 0.05$ . Maximum use of machines, people (MM) - the positive correlation at the level of  $\alpha = 0.2$  and fast execution of the contract (BS) - the positive correlation at the level of  $\alpha = 0.2$ .
- Education (Fig. 10.3b). Determines the validity of the ratings of two factors: maximum use of machines, people (MM) - the positive correlation at the level of  $\alpha = 0.2$  and  $\alpha = 0.1$  and formation of stocks (PZ) - the positive correlation at the level of  $\alpha = 0.2$  and  $\alpha = 0.1$ .



- Mode of the employment (Fig. 10.3f) Determinesthe validity oftheratingsof one factor: maximum use ofmachines, people (MM) - the positive correlationat the level of  $\alpha=0.2$  and  $\alpha = 0.1$

In the case, the three characteristics ofthe respondents: age, work experience, mobility, there is no statisticallysignificant effect onthe resultsof research (Fig. 10c, 10d, 10e).



**Fig. 10.4. Principle 3. Identification of statistically significant effect characteristics respondents: a) gender, b) education, c) age, d) work experience, e) mobility, f) mode of the employment and the level of significance to assess the validity of the factors E4 area.**

**1 – Positive correlation, 2 – Negative correlation.**

## 10.5. Summary

The company produces fruit and vegetable preserves, made an analysis of the production cycle time and was carried out BOST survey. It was found that the time value-added operations are eleven times less than the time not bringing added value. BOST survey is able to provide answers about the organization of the production system. Workers decided that the factor: fast execution of the contract (BS) is the strongest element in the enterprise. This information from workers can be used in improving the company.

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