Chapter 9

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IMPORTANCE OF THE PRODUCTION PROCESS DURING MANUFACTURING OF ELECTRIC SOCKET

Abstract: In the chapter basic concepts of production management: production system and process and manufacturing process were presented. Production process of the chosen product depicted technologically and in an object depiction were also presented. In the research part BOST survey – Toyota management principles in questions was used, a detailed analysis of the E3 area referring to the 2nd principle of Toyota management was conducted. Analysis of the research results was presented in the form of tables, histograms, pie charts and radar chart.

Key words: production process, electric socket, production process depicted technologically and in an object depiction, survey BOST, area E3

9.1. The concept of the production system and the production process

Defining the model of the manufacturing system in a free market economy Ireneusz Durlik stated that "a manufacturing system constitutes a purposefully designed and organized material, energetic and informational structure exploited by the man and serving the purpose of producing definite goods (products or services in order to satisfy different needs of consumers)" (DURLIK I. 1993).

Analyzing possibility of the processes in a manufacturing company it should be remember all the processes occurring in the enterprise, not only

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those processes that are directly related to the production. While thinking about the introduction of the improvement actions people must also focus on supporting processes or those less important for the company, because they have to keep in mind that the company will be as strong as its weakest link, hence the emphasis on the development of every, even the seemingly less important process, because it is a part of the whole operation of the company (DZIUBA S.T., SZOŁTYSEK K., KOZYRA C. 2011).

The process can be described as "changes that occur consecutively in the cycle, resulting from their actions" (PAJĄK E.2006).

Manufacturing process, according to Ireneusz Durlik it is “process of transformation, or change of the input vector X into the output vector Y” (DURLIK. I 1993).

The production process consists of successive steps in a process, namely:

- research and development,
- manufacturing process,
- distribution and maintenance.

9.2. Production process of the chosen product depicted technologically

The electric socket type E, called also French socket is the object of the research. Currently In Poland the electric socket-contact is one of the most popular electric sockets. This socket is used in Europe with the exception of countries such as the UK, Ireland, Cyprus and Malta.

Production process of the research electric socket depicted technologically is presented in Figure 9.1.

Characteristics of the route points (BORKOWSKI S., ULEWICZ R. 2008, DURLIK I.1993, BURCHART-KOROL D., FURMAN J. 2007): 1. Storage of elements (socket contact, gasket, nut, cover, bush, earth terminal, pins, screws, rubber bund, plate, packaging). 2. Inter-department transport of the elements from the storage to the production hall.

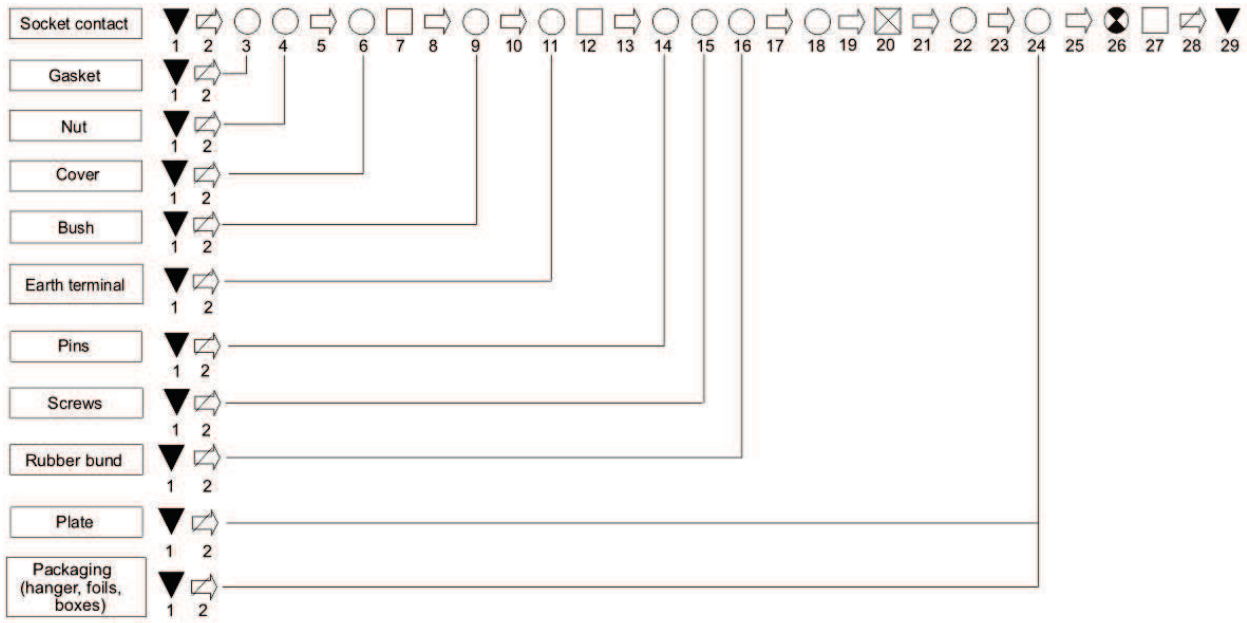

Fig. 9.1. Production process of the electric socket type E depicted technologically.

Source: own study

3. Placing gasket and socket contact in the form. 4. Screwing nuts to the socket contact. 5. Transport to the next stand. 6. Placing subassembly of the socket contact in subassembly of the cover. 7. Inter-operational control. 8. Transport to the next stand. 9. Screwing the bush to the body. 10. Transport to the next stand. 11.Screwing earth terminal to subassembly of the cover. 12. Operator control. 13. Transport to the next stand. 14. Placing pins in subassembly of the cover. 15. Screwing pins to the subassembly of the cover. 16. Placing rubber bund. 17. Transport to the next stand. 18. Screwing pins. 19. Transport. 20. Testing of the product efficiency. 21. Transport to the next stand. 22. Marking the body. 23. Transport. 24. Removing the plate from a plastic bag. 25. Transport. 26. Placing the plate. 27. Control. 28. Transport. 29. Storage of the final product.

9.3. Methodology of the research - survey BOST

In the research company survey BOST - Toyota management principles in questions was conducted (BORKOWSKI S. 2012a, BORKOWSKI S. 2012b, BORKOWSKI S. 2012c). This research was carried out among 40 employees.

For the entire survey area E3, which was a base of the detailed analysis of the company producing electrical outlets, was separated. This area is connected with the 2nd Toyota management principles (Assessment of production processes functioning in case of goods of high quality requirements). Respondents were asked to answer the following question: Which factor is the most important in the production process? They could choose from the following factors::

- Continuous system of problem detection (CP),
- Stopping production after discovering a quality problem (PE),
- Standard tasks, processes, documents (SZ),
- Providing authorizations to subordinates (EU),
- Application of only reliable technology (ST),
- Application of visual control (SN).

The respondents in answers to this question were asked to evaluate each factor in order of importance by giving marks from 1 to 6, where the least important factor is evaluated as 1, and the most important factor is evaluated as 6.

In addition, in the chapter the characteristics of respondents indicated in the BOST survey as E12 area was also presented.

9.4. Results analysis

In Table 9.1 the numerical characteristic of the respondents features is shown, while in Figure 9.2 the percentage characteristics of the respondents of the company producing electrical sockets (area E12 of the BOST survey) was presented, due to:

- gender (MK) - 1- man, 2- woman,
- education (WE) - 1- high school, 2- professional, 3- secondary, 4- higher,
- age (WI) - 1- below 30 years, 2- 31÷40 years, 3- 41÷50 years, 4- 51÷55 years, 5- 56÷60 years, 6- 61÷65 years, 7- over 66 years,
- job seniority (SC) - 1- do 5 years, 2- 6÷10 years, 3- 11÷15 years, 4- 16÷20 years, 5- 21÷25 years, 6- 26÷30 years, 7- 31÷35 years, 8- 36 years and more,
- mobility (MZ) - current employment is a place of work: 1- first, 2- second, 3- third, 4- fourth, 5- fifth, 6- sixth,
- mode of employment (TR) - 1- regular, 2- transfer, 3- finance.

From Table 9.1 and Figure 9.2a it results that among the surveyed employees women dominated - among respondents there are 25 women (this is 63% of the respondents).

Table 9.1. Features of respondents. Numeral characteristic. It concerns company producing electric socket

Symbol	Features' marking and their rate characteristic					
	MK	WE	WI	SC	MR	TR
1	15	1	4	3	10	25
2	25	13	10	6	17	5
3		22	12	5	4	10
4		4	9	6	3	
5			2	8	6	
6			3	7	0	
7			0	3		
8				2		

Source: own study

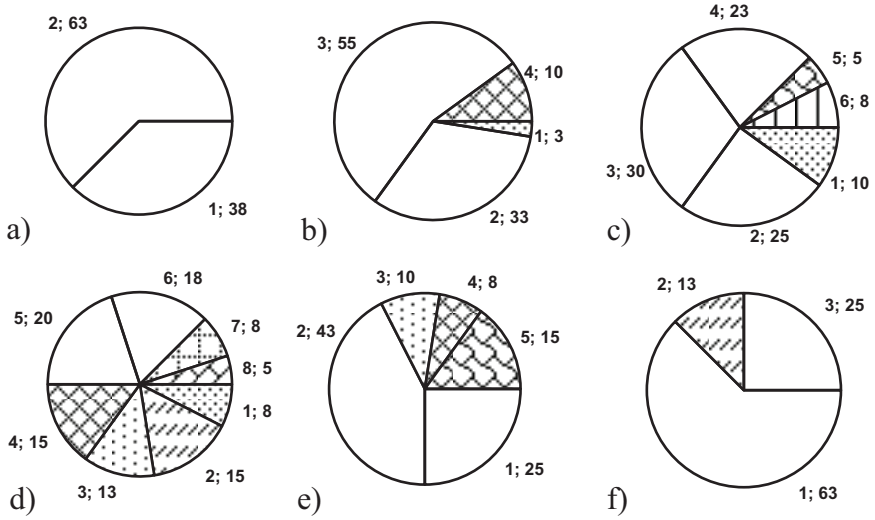

Fig. 9.3. Pie chart. Respondents characteristic with consideration of: a) gender, b) education, c) age, d) job seniority, e) mobility, f) way of employment. It concerns company producing electric socket.

Source: own study

Thinking about a further feature of the respondents, which is education (Table 9.1, Fig. 9.2b), among the respondents, the biggest group, i.e. 22 people, has a secondary education (which constitutes 55% of the total), 13 respondents are employees with professional education (this is 33% of all respondents), only one respondent has high school education (3%), while there were 4 people with higher education among the respondents (representing 10% of the total).In Table 9.1 and Figure 9.2c numeral and percentages characteristics regarding the age of the respondents are presented. They show that the largest group among the respondents turned out to be workers in the age group 41 ÷ 50 (12 people), which represents 30% of all respondents. Few less, because 10 respondents (25% of respondents), are workers between the ages of 31 ÷ 40 years and 9 respondents (23% of respondents) are workers between the ages of 51 ÷ 55 years. Among the respondents there was no employee who were above 65 years of age.

Another analyzed feature of the respondents was the job seniority. From Table 9.1 and Figure 9.2d it can be concluded that most respondents, 8 (i.e., 20% of respondents) have 21 to 25 years of job experience. Among the respondents the smallest group turned out to be 2 people with more than 36 years of job experience (representing 5% of all respondents).

The mobility was the next analyzed feature (Table 9.1 and Figure 9.2e). The elected employees during the survey determined which place of work is in the research company. The Figure and Table shows that most of the respondents, it means 43% (i.e. 17 people), is in a group for which the research company is second place of work. It also turns out that for none of the respondents the research company is 6^{th} or more workplace.

The mode of employment is the last analyzed feature of the respondents (Table 9.1 and Figure 9.2f). In the research company 63% of the respondents (i.e. 25 people) are employed in the regular way, 10 respondents (i.e. 25%) of employment due to financial conditions, while five respondents (13%) work in the company by transfer.

In Figure 9.3 the numerical distribution of evaluation of factors from area E3 are shown, while in Figure 9.4 percentage distribution of evaluation for each factor from 2nd Toyota management principle is shown.

Analysing Figures 9.3 and 9.4 it can be noticed that factor *continuous system of problem detection* (CP) received the highest number of evaluations "6" and "5" (each evaluation from 14 respondents). These evaluations represent 56% of all votes. Furthermore evaluation "4" represents 26% of all votes, and analyzed factor has not received the lowest evaluations "1" and "2".

Factor *stopping production after discovering a quality problem* (PE) by the most of respondents received the evaluation "4", "5" and "6". These evaluations represent 74% of all votes.

The next analyzed factor if the factor *standard tasks, processes, documents* (SZ). The figure indicates that this factor was 22 evaluated as "2" (which accounts for 44% of all votes), 16% of the votes are the evaluations "1" and the lowest number of votes received evaluations "5" and "6".

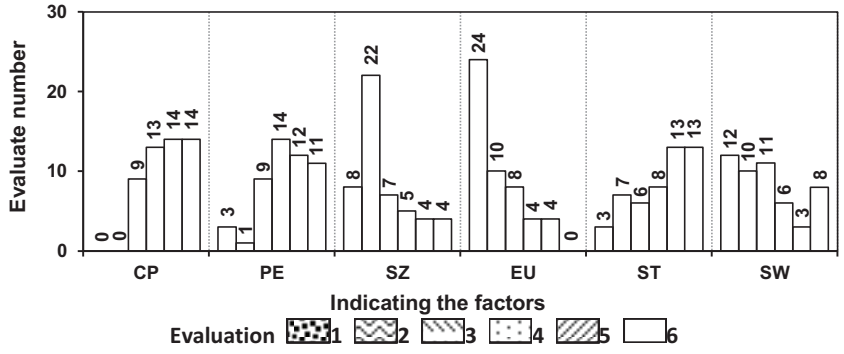

Fig. 9.3. 2nd principle. Analysis of distribution of the evaluation of the factors from E3 area. It concerns company producing electric socket.

Source: own study

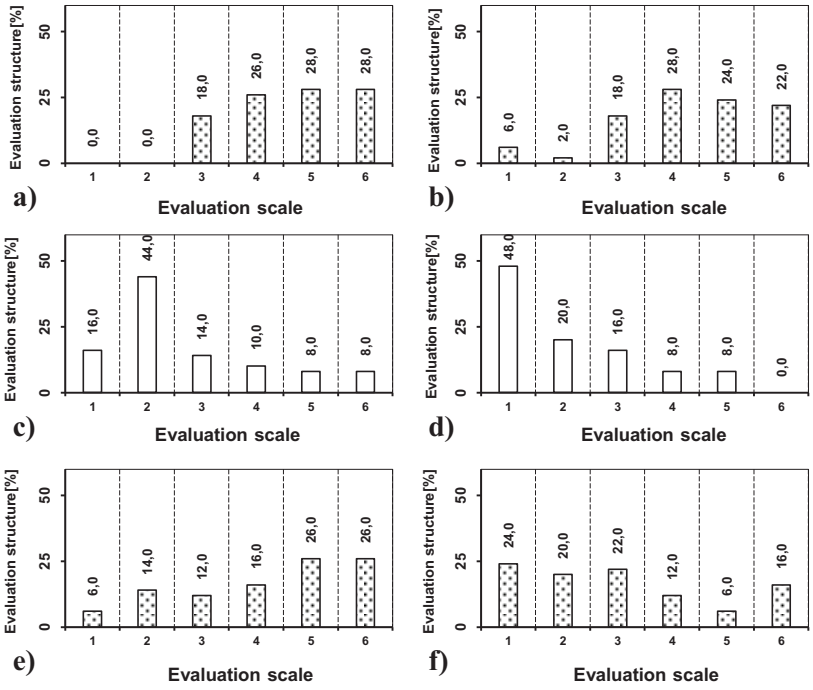

Fig. 9.4. 2nd principle. Histograms - the structure of the evaluation of the factors from E3 area: a) CP, b) PE, c) SZ, d) EU, e) ST, f) SW. It concerns company producing electric socket.

Source: own study

Analysis of distribution of the evaluations for the factor *providing authorizations to subordinates* (EU) shows that as 24 respondents gave to this factor the evaluation "1" (this represents 48% of all votes). From 10 employees (20% of all votes) this factor has got "2", and the evaluation "6" was not given by any of the respondents.

Another factor analyzed in terms of distribution of the evaluation is the factor *application of only reliable technology* (ST). 26 respondents (52% of all votes) rated this factor as "5" and "6".

Last factor analyzed in terms of distribution of evaluation is the factor *application of visual control* (SN). This factor has received from

the most of the employees the lowest evaluation “1”, “2” and “3” (for 33 employees, representing 66% of all votes).

9.5. Summary

In Figure 9.5 the average (numerical) importance evaluations of factors from E3 area is presented by the radar chart.

The least important factor in the production process according to respondents is the factor *providing authorizations to subordinates* (EU), whose average evaluation was 2.1. Another factor less important for the respondents turned out to be the factor *standard tasks, processes, documents* (SZ), whose average evaluation was 2.7.

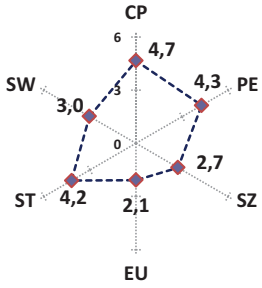

Fig. 9.5. Average (numerical) importance evaluations of factors from E3 area. It concerns company producing electric socket.

Source: own study

Next in the increasing order factor evaluated for its importance in the production process has been the factor *application of visual control* (SW) – 3.0. The last three factors have obtained a very high average according to the respondents, and the differences between them are small, and the factor *application of only reliable technology* (ST) received average 4.2; factor *stopping production after discovering a quality problem* (PE) average 4.3. The factor that according to the respondents turned out to be the most important in the production process was the factor *continuous system of problem detection* (CP), whose average evaluation was 4.7.

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