

## APPLICATION OF THE PRINCIPLES FOR LOGISTICS PRODUCTION COMPANY EFFECTIVITY

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**Keywords:** testing, system, simulation, automation, modernization

**Abstract:** The thesis focuses on the effectiveness of product testing. A system analysis is used in diploma thesis in the detailed analysis of the individual subsystems and their characteristics, which later improve the project proposal and emphasize the efficiency and the demands or requirements of the company for the final solution of the problem. The solution utilizes Tecnomatix 13 simulation of individual product testing, and its results are later taken into account in the economic evaluation of the proposed testing system. At the same time, the current situation is compared with the proposed project.

### 1 Introduction

The thesis is focused on the effectiveness of product testing. The problem is related to the constant search for back-logs and more efficient business activities to ensure competitiveness on the market. The main goal of the thesis is to design an efficient system testing in a particular company, so as to manage with the quantity of assembled products. The system analysis is used in diploma thesis to solve current problem. It is also used the simulation in software Tecnomatix 13, which is used in the current state of product testing as well as the new, suggested system of testing products. The results of the simulations are aimed primarily at occupancy of machines and amounts of tested products. These results are then reflected in the economic evaluation and comparison of the quantities of the products tested, the cost of the test product, staff costs in the current state of the with new system for product testing. An important part of the thesis is the pricing of the suggested

new system of testing and payback period of the new system.

#### 1.1 Analysis of current situation

The project is carried out in a company engaged in the manufacture of low-voltage devices. In the usage of system analysis, specific department was analysed, as department of assembly of products, where deficiencies were identified as outputs of analysis and they needed to be solved [1].

Product assembly department consists of seven parts:

- 1) Part for the assemblage of the necessary components - in this section necessary components are folded into one, which is important for the actual assemblage of the products. This work is performed by human personal on special devices. Example of the components shown in Figure 1 - on the left are the necessary components, and on the right is a composite component.

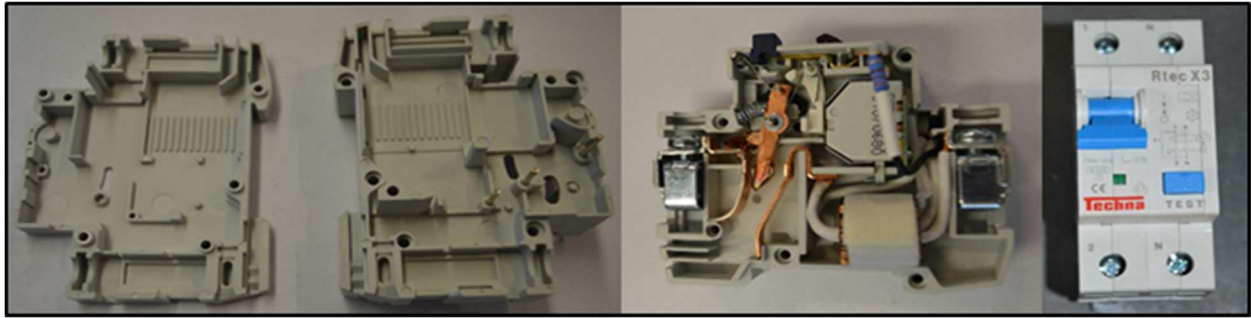


Figure 1 Components necessary for the product assembly

- 2) Part of the storage components- in this section the necessary components are stored, which are made directly in our company or bought from external suppliers. Also in this section are also stored parts, which were used in previous operation. Mentioned parts are very important for product assemblage. They are stored in plastic containers. The warehouse system is the type of market.
- 3) Mounting part – There are 2 parts folded in this section, and it is PFI\_I and PF\_II. Components from the market are stored into plastic case, which will be closed, stored and used for next part of testing (Figure 2).

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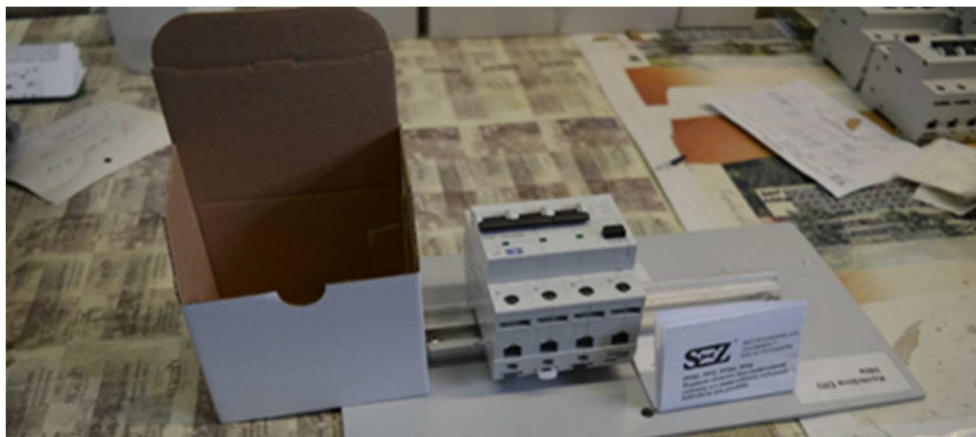
*Figure 2 Components necessary for the product PFI\_I assembly*

- 4) Testing part of products – The testing is carried out on 5 testing devices, and the output can be with positive result or negative result. The products are inserted into test machines by using handmade. In this section is used high percentage of human work, which is not optimal. The simulation of testing products was created in the simulation software Tecnomatix 13 (student version), and the results were focused on number of tested parts and on the percentage of occupancy of machines.
- 5) Part of products setting - After testing the products, products with a positive result moving in the melting department, where the parameters of products were set.
- 6) Part for logo etching – The logo of company, or for company that is product made, is etched (Figure 3).



*Figure 3 Sample of designation logo on the product*

- 7) Part of the logo etching, packaging and shipping- Thanks to laser, the required descriptions are etched on the case of products (Figure 4). Later, the products are packaged and shipped [2].



*Figure 4 Product ready for packaging with the necessary manual paper*

### 1.2 Identified deficiencies

Identified deficiencies mainly point on the system of current product testing, where happen the situations, that products made in the current date is not tested, because of the time, and need to be tested during overtime shifts. Mentioned deficiencies are mostly connected with testing machines, which belong to old ones, what means that it requires more time to test one part.

The solution of this problem may be solved by simulation, which was used during analysis and was suitable for the synthesis purposes. Possibility to eliminate the mentioned deficiencies is to do more variants of testing, but mainly the solution depends on automatization and robotization of testing system. The role of simulation is to experiment and to suggest more efficient system of testing, which eliminate the mentioned deficiencies and after that, the company will obtain the reserves, which will have important role to secure competitiveness on the market [3].

## 2 The project of testing department of the new production line

For the long time, company thinks about change in process testing, because current way of product testing is not efficient. It is necessary to design new system of testing, which is going to be fully modernized, automatized and robotized.

This new system, may be mainly used to increase the number of tested products and reduced the number of operations, which are performed by operators [4].

All operations in the current situation will be included in a new project with new parameters.

### 2.1 The requirements of the company

The company got some idea, how testing line should looks like, requires and what should it performs. After the consultation about issues with my consultant for diploma thesis, the requirements were collected as required by company management, by the automatized line, and these are:

- distribution of products by type into two separate testing processes,
- that the product is shipped to the necessary equipment without the need for relocation of staff,
- increase the number of assembled products in one shift,
- that the product contains identifying information about the production, about the results of testing,
- to test line separated the products tested according to the test results (positive, negative).

### 2.2 Machines and equipment needed for a new testing line

Now, new testing machines have better performance. The most important is time in which they can test the product without the passing the same test twice because of negative result of the test.

New machines have a few seconds shorter testing time but as mentioned, these machines will test the product only once without the need for repetition. Modernization of machine (purchased new ones) indicates the different times of testing and riveting, which are listed in table 1, together with a comparison of current machines and new machines. New machines are offering new functions, and this fact is very important for greater efficiency of product testing compared to the current testing process [5].

Table 1 Comparison of new machines with the current

Machine / equipment	Time operation of the new machine	The original time operation
Tester No. 1, reading the data by RFID chip	24 seconds	27 seconds
Tester No. 2, reading the data by RFID chip	21 seconds	27 seconds
Tester No. 3, reading the data by RFID chip	17 seconds	25 seconds
Tester No. 4, reading the data by RFID chip	23 seconds	23 seconds
Tester No. 5, reading the data by RFID chip	15 seconds	22 seconds
Machine for the definitive closure of the product	5 seconds	7 seconds

The new test line must require the mentioned requirements of the company management and therefore it is necessary to design and to use devices that require these requirements and ensure greater efficiency of product testing. These machines are also designed to incorporate into an automatized testing process. Times necessary to testing line are bellowed in the Table 2.

### 2.3 Simulation of the new testing line in the simulation software Tecnomatix 13

After the finding of necessary data, parameters and management requirements on the new testing line, which

are shown in Table 1, Table 2 and the above mentioned requirements of the company, were suggested several options for system of product testing. However, the efficient is the simulation model, bellowed in Figure 5 [6,7].

Other functions and parameters of machines already mentioned in the tables, can be seen in simulation model, were suggested, so that the testing process was efficient and worked without any operator intervention (person) [8].

Table 2 Other new equipment needed to test the line

Machine	Feature	Time / single action
RFID data recorder	It is used for recording basic information about the product.	3 seconds
Robot	Its functions are to pick up, set up, unload and lay the product.	2 seconds
RFID reader with divider according to the following operations	It is necessary to read the RFID chip and to divide the products according to selected categories.	4 seconds
RFID reader	It is necessary to read the data according to it pushes out the stopper for concrete worker of the department during the product assemblage.	2 seconds

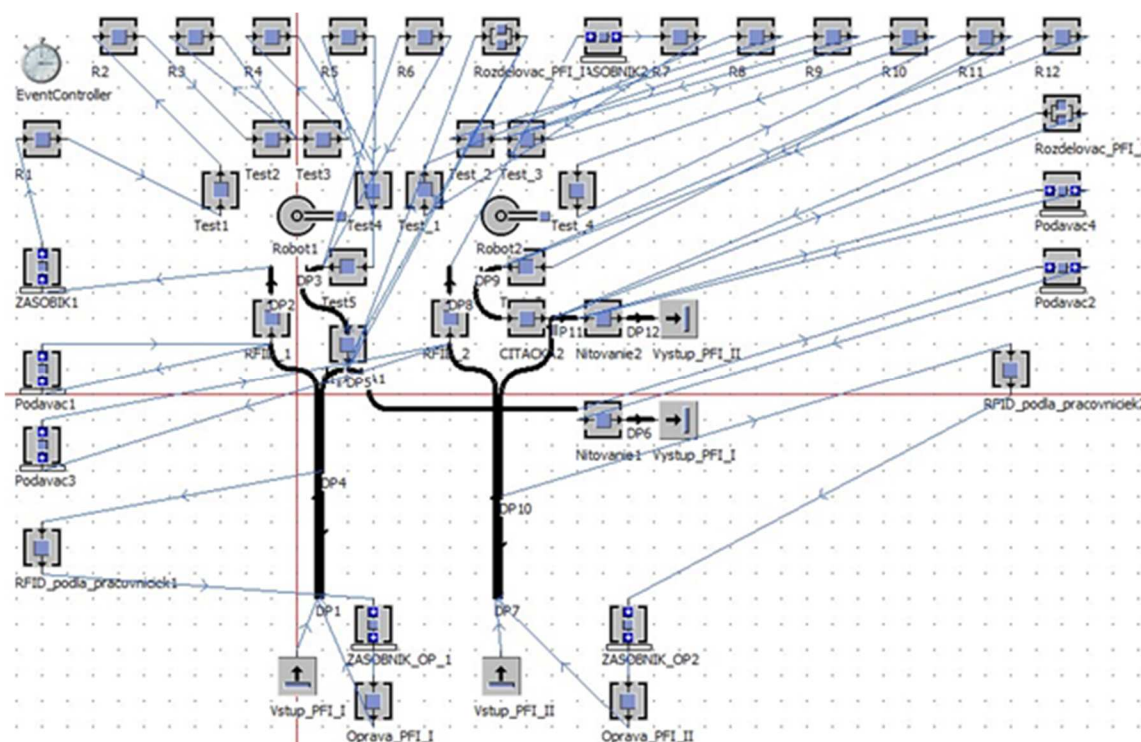


Figure 5 The simulation model of the new testing line in software Tecnomatix 13P

### 2.3.1 Simulation time

Simulation time was determined only at the inputs, since the workers have a working time 7 hours 20 minutes (8 hour shift - 30 minute lunch break - 10 minutes break for a snack). The whole simulation end up, until the all product entered the testing line, are not finished in tests.

### 2.3.2 Conveyor needed for the automatized testing line

For the product transportation, from A point to B point should be used conveyor that require the requirements for automatized testing regarding to the transport of products to the necessary places. Example of a conveyor together with the parameters:

- length - 11.1 m,
- width - 0.1 m,

- height - 1 m,
- conveyor speed - 0.5 m/sec,
- automatic stop (when the conveyor does not contain any product) [9].

### 2.3.3 Identification data on the product during the testing process

In order to product contains the identification data is used technology of RFID chip to read datas about product itself, but also about the whole production process and about the results of the testing process. RFID is glued on the product to save data needed for correct management of process of new testing line [10].

**2.4 Location for the new testing line into Test department**

Conveyor must be located, so that the simulation results were not distorted, because conveyor length has important role in transporting products from A point to B point. This length is mainly associated with the indicator of transit time. Location of the new suggested testing line can be

seen in Figure 6 and Figure 7. The new testing line requires the demands of company in terms of its dimensions because the current machines are predominantly small in comparison to places they are located. When the whole line was designed, it was mostly taken regard on conveyor, which has important role according to location in the designed hall.

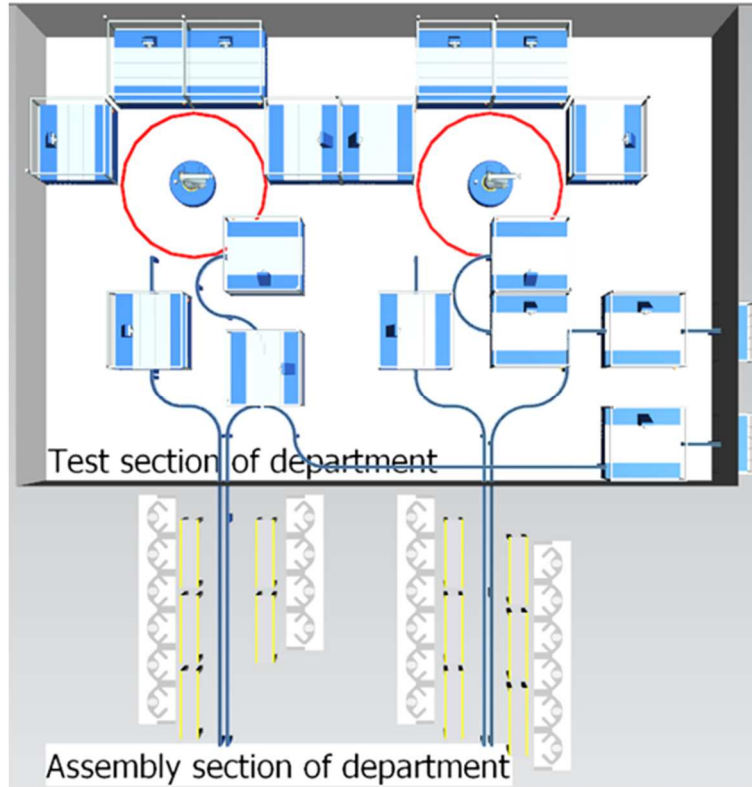


Figure 6 Location of new testing line into Testing department (top view)

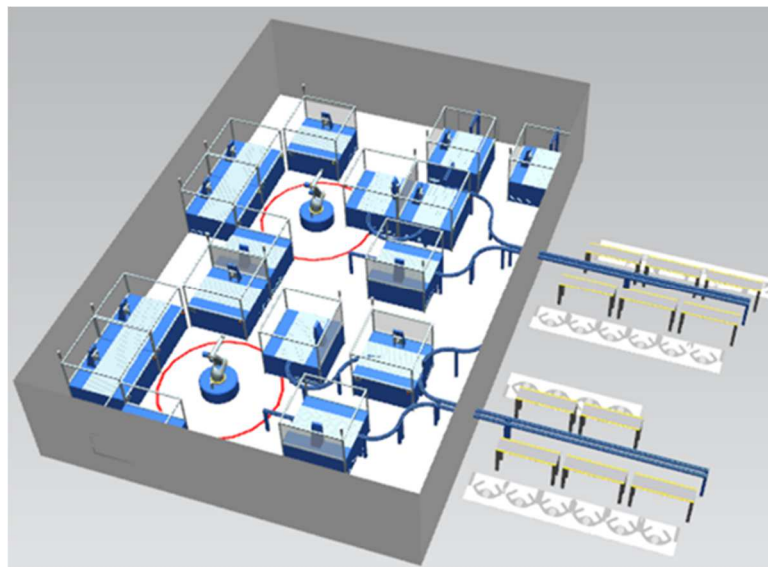


Figure 7 Location of the new testing line into Testing department (3D view)

### 2.5 Simulation results of the new testing line

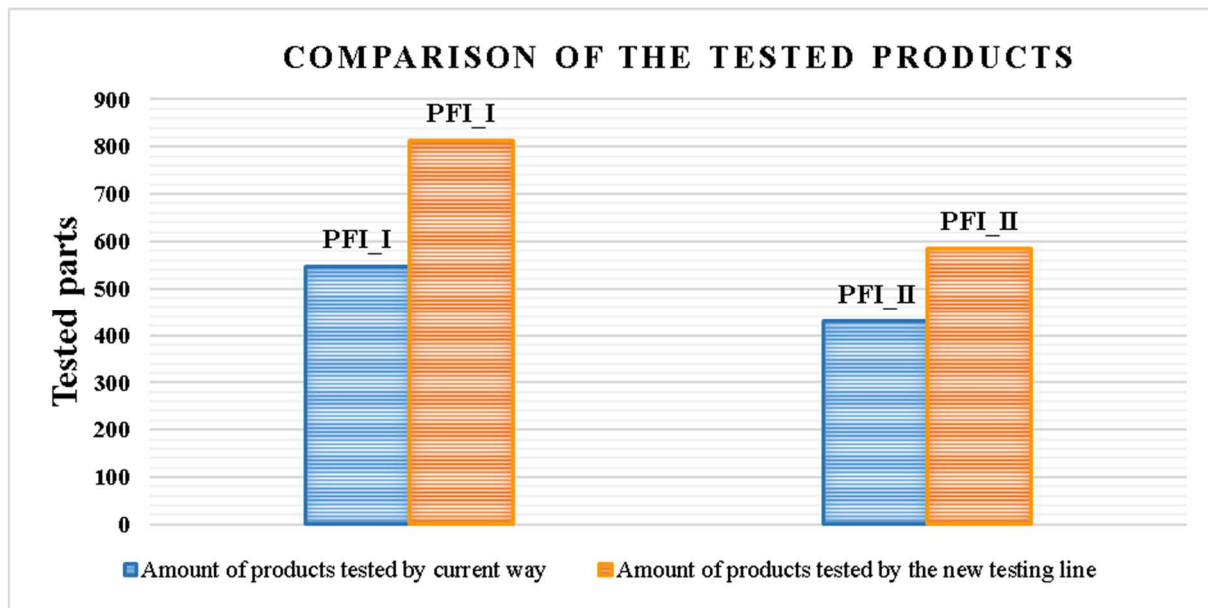
The results are mainly focused on capacity of the machines, the number of tested units, the number of repaired units and the time for a new production line is able to test all assembled products within one working shift.

These values are the most important from the perspective of the company.

The number of tested products in the testing line, can be seen in Figure 8 and percentage increase of tested products in Table 3.

*Table 3 The percentage increase in the products tested*

Type of product	The current number of tested products	Number of products tested on the new testing line	The increase in the product testing %
Number of products PFI_I	548	813	<b>32.60%</b>
Number of products PFI_II	430	586	<b>26.62%</b>



*Figure 8 Graphical representation of comparison tested products by current testing way and by the new testing line*

### 3 Results

The current method of product testing, requires more money, because it needs to be consider: wage costs, operating costs of testing, costs of protective equipment or clothing. The suggested testing line has lower costs, because in the new testing line, there isn't need of any human help, so the cost of wages and the cost of protective equipment are excluded. Operating costs are lower than the current cost of testing. In the new design has been added cost of RFID chips, but in such quantities tested RCDs price is acceptable, and it is valid that price is going to be lower, with greater quantity of products it is going to be bought. In the future the company plans to increase the production, so quantities of RFID chips are going to be higher.

After result evaluation, it got comparison of the current state with suggested new testing line with 0 staff costs, savings 19% for activity expenses and costs associated with one testing product with savings up to 87.5%. Investment return is assumed for 8.56 years. This investment return is going to decrease because of

increasing of production of products, so investment return should pay back sooner that it was expected.

### 4 Conclusion

The article topic is focused on efficient testing of products in a particular company and therefore in its analysis of the current state with the emphasis on the Assembly department, which is currently testing of the product performed. Application of systems analysis, whose task was to analyse and to find deficiencies and which are not effective for this system. The thesis points out the deficiencies and ways to eliminate them. As an ideal way of dealing with the deficiencies is simulation used in simulation software Tecnomatix 13. In this software it was experimented with multiple ways, how to deal with the requirements of the company management, function of new testing line, and also cost of the testing line. It was suggested fully automatized testing line, which allows company to keep capacities during increasing of amount of production assemblage. More important is fact that new

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testing line is going to be more efficient than the current system of product testing.

In this thesis are presented compared amounts of tested products in current and new testing method, an increase of 32.6% for the type of product PFI\_I and an increase of 26.62% for the type of product PFI\_II. In addition to increase of amount of tested products, costs indicators highlight the differences between those 2 systems. The cost are mainly focused on employees and costs associated with the operation but also important are overall costs on one tested product. These results were then compared and it was found that the new test line is less expensive and more beneficial for the company in the long term because the current way of testing is more expensive. The new test line is the pricing of an unnamed company, and the price was taken into consideration along with other costs in return for that investment. The investment return was calculated for 8.56years, what is acceptable period of the time. The results of this project are very positive, which can bring a lot of assets for the company.

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**Review process**

Single-blind peer review process.