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Examination of manufacturing procedures in TestBed 4.0

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Abstract: This article delves into the systematic examination of production processes within the context of TestBed 4.0. The study bifurcates these processes into distinct categories, namely pre-production procedures and core production processes, encompassing essential sub-steps crucial for ensuring the seamless execution of customer orders. The analysis sheds light on how TestBed 4.0, with its integration of Industry 4.0 elements, contributes to heightened efficiency and innovation in manufacturing. By exploring the interconnectedness of production equipment and digital models, the study highlights the potential for creating intelligent and automated industrial enterprises. The findings underscore the role of TestBed 4.0 in responding to market dynamics and fostering competitiveness for industrial enterprises, particularly within the European market.

1 Introduction

In the industrial sector, there is a growing focus on exploring ways to enhance production processes. This necessitates the examination of individual components constituting the production process, utilizing workplaces and laboratories equipped with integrated elements from Industry 4.0. The analysis of these processes not only reduces the time it takes for products to reach the market but also enhances the company's offering diversification [1-3].

TestBed 4.0 adapts to market changes and demands, providing the capability to establish intelligent industrial enterprises that are fully automated and consistently optimized through the integration of production equipment with digital models. The opportunities presented by TestBed 4.0 for implementing innovative designs play a vital role in ensuring the competitiveness of Slovak industrial enterprises in the European market [4-6].

2 Division of processes

In industrial enterprises, a large number of processes are carried out, which are necessary for the correct course of production and ensuring the delivery of the ordered product to the customer on the specified dates. Such processes take place gradually, with a certain continuity. Therefore, in order to achieve high performance of the company, it is necessary to organize and control these processes effectively in order to ensure high production efficiency in the company at the lowest possible costs [7].

We divide these processes into two main parts:

Pre-production processes, which include processes such as:

- Communication with customers.
- Creating an offer for the customer.
- Order acceptance.
- Construction processing.
- Processing of production technology.
- Purchase of necessary material for production.

The production processes include:

- Planning of production.
- Production management.
- Shipping of the finished product.

2.1 Communication with the customer about a potential order

This process consists of the request of the customer who asks for the preparation of an offer, which includes the price, the delivery date, and the conditions under which the industrial enterprise can deliver the goods. The customer also specifies the number of necessary manufactured

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pieces. An industrial company tries to develop an offer so that it is profitable and at the same time the price must not discourage the customer, because the customer sends the request to several companies. The data about the shipment will be taken over by the business center (Fig. 1) of the company, which will record and store it. Based on these documents, he instructs the preparation of an offer for the customer.

Figure 1 Workplace for product data management

2.2 Creating an offer for the customer

The offer for the customer includes the price, terms of delivery of the products, and the date of delivery of the goods. The offer must be processed in such a way that the company receives more funds from the order than the costs associated with the material, the price of labor, the operation of machines, energy, the use of company premises, and other production costs. He has to design the offer in such a way that it is profitable and he has to take care of the delivery of the goods on time and to the agreed place specified by the customer. This whole process must be prepared in advance and correctly, which can sometimes be difficult. The use of PLM software and their databases make this process easier for us because they allow us to compare a new order with a previous order of a similar kind and, based on this information, determine the time required for production.

The price offer is prepared by the business center of the company, which collects data from:

• Construction departments
- sells his statement on the construction of the product and its complexity.

• Technology departments
- sells his estimates for the price of material consumption, work, or cooperation.

• In stock
- sells price estimates for materials and cooperation.

After incorporating all the data, the business center adds a corporate margin and sends the prepared offer to the customer.

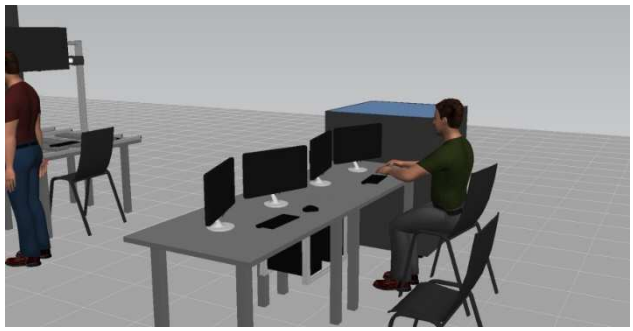

Figure 2 Price offer processing workplace

2.3 Order acceptance

The customer receives price offers and considers the most suitable one, prepares an order, and sends it to the chosen company. The customer will reject other offers. Based on the received order, and ordering contract, the company issues an instruction to start the preparatory processes of production.

The order is processed by the business center of the company, which registers it and instructs individual departments to prepare complete documentation for production planning.

2.4 Construction department

He is responsible for the correct construction of the product and the verification of the correct functionality (Fig. 3), the development of technological documentation and the creation of the parts list for the given product.

Figure 3 Workplace for structural design verification

2.5 Technological department

He is in charge of developing the technological process of production for the given product - estimation of material consumption, or proposes cooperations.

2.6 Warehouse

The role of the warehouse is to ensure continuous and smooth operation in terms of material security, it is responsible for ordering missing material and ordering cooperation.

After all the details have been worked out, the documentation is sold to the production planning department.

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2.7 Planning of production

This process has the task of designing an optimal production plan (Fig. 4) so that all orders are produced at the agreed time, at the same time it ensures that production is not too complicated and everything is produced as quickly as possible, with the highest utilization of people and machines in the company.

The production planning section is responsible for creating the plan, which takes care of the effective implementation of technological processes into the current production plan and takes into account across the entire company:

- Material stock.
- Cooperation with other companies.
- Priority orders.
- Order delivery date.
- Production capacities.

The production plan is subsequently taken over by the production management department.

Figure 4 Workplace optimization of production procedures

2.8 Production management

The production management section is responsible for adapting the production plan to the current state of production. Production plans are made ahead of time. When creating a production plan, production planners cannot foresee situations that may arise in production, for example, machine failure, lack of material, or absence of a production employee. Production management must respond adequately to these deficiencies and adjust the production plan in cooperation with the production planner in order to ensure the smoothness of production processes and information flow (Fig. 5) throughout the company. The production manager has the task of correctly assigning work to individual sections in production, at the same time he is also responsible for issuing the material necessary for production and solving the most common problems occurring in production.

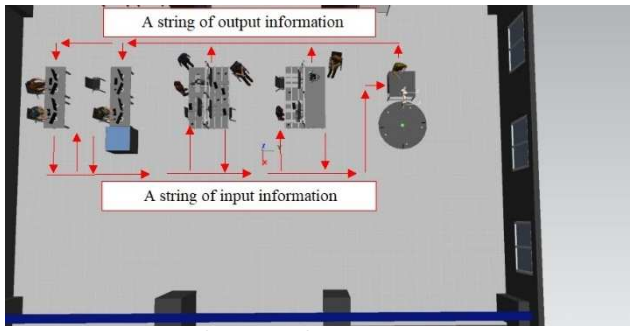

Figure 5 Information flows within workstations

2.9 Shipping of the finished product

The shipment of goods is handled by a warehouse employee who, on the basis of the shipping document, which determines what and when needs to be sent, prepares the finished products and gives instructions for the preparation of the necessary shipping materials, for example:

- Billing sheet.
- Delivery document.
- CRM confirmation.

This process ends with the final shipment of the product to the customer according to the agreed terms.

3 Conclusion

The production management section is responsible for adapting the production plan to the current state of production. Production plans are made ahead of time. When creating a production plan, production planners cannot foresee situations that may arise in production, for example, machine failure, lack of material, or absence of a production employee. Production management must respond adequately to these deficiencies and adjust the production plan in cooperation with the production planner to ensure the smoothness of production processes and information flow throughout the company (refer to Fig. 5).

The production manager has the task of correctly assigning work to individual sections in production while also overseeing the dynamic nature of the production environment. This involves effective communication and collaboration with various departments to address unforeseen challenges and maintain optimal workflow. The coordination between production management and planners is crucial for agile responses to disruptions, ultimately contributing to the overall efficiency and reliability of the production processes [8].

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