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Modeling Business Processes in Manufacturing Companies

Modelado de Procesos de Negocio en Empresas de Manufactura

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## Resumen

El artículo considera la optimización de los procesos de negocio en las empresas manufactureras. Los autores consideran el concepto de procesos de negocios, distinguen sus tipos y describen sus funciones. Se presta mucha atención al orden de las medidas tomadas por las empresas manufactureras para optimizar los procesos comerciales presentados en forma de gestión algorítmica. Los principales métodos utilizados a lo largo de la investigación incluyen la cognición, el análisis retrospectivo y documental, así como la síntesis, la generalización y la sistematización. La optimización de los procesos de negocio en cualquier empresa manufacturera es una tarea compleja que requiere el modelado de los procesos de negocio, destacando sus aspectos desafiantes, la reingeniería y el control posterior. Los autores determinan las principales etapas y aspectos teóricos de los procesos de negocios en empresas manufactureras, identifican posibles alternativas a una elección estratégica, definen indicadores de desempeño de proyectos de inversión y proponen modelos de procesos de negocios para las actividades de una empresa.

**Palabras clave:** Empresa; Modelo; Inversiones; Reingeniería; Gestión de Riesgos.

## Abstract

The article considers the optimization of business processes in manufacturing companies. The authors consider the concept of business processes, distinguish their types, and describe their functions. Much attention is paid to the order of measures taken by manufacturing companies in order to optimize business processes presented in the form of algorithmic management. The main methods used throughout the research include cognition, retrospective and documentary analysis, as well as synthesis, generalization, and systematization. The optimization of business processes in any manufacturing company is a complex task that requires modeling business processes, highlighting their challenging aspects, reengineering, and subsequent control. The authors determine the main stages and theoretical aspects of business processes in manufacturing companies, identify possible alternatives to a strategic choice, define investment project performance indicators, and propose business process models for a company's activities.

**Keywords:** Company; Model; Investments; Reengineering; Risk Management.

## Introduction

The world experience of leading companies shows that the development of any company and the growing efficiency of its activities are impossible without a proper strategy as a set of measures aimed at achieving a goal. This article is relevant since the activity of any enterprise is associated with risks. In this regard, it is necessary to form and apply an investment strategy within the competence of various departments. Modern business is conducted in a highly competitive environment, and making adequate decisions requires a deep assessment of the situation and a reliable forecast of future events (Kravchenko, Dragunova, Kirillov, 2020).

Thus, it is impossible to model the activities of a company without modeling its business processes, which are an important part of managing manufacturing companies. The latter are characterized by the increased complexity of business processes due to the technical and technological specifics of production. However, other activities of manufacturing companies (financial, marketing, etc.), as a rule, are large-scale and based on many different business processes.

The optimization of business processes in a manufacturing company is a complex process that requires a company to comprehend and improve such business processes. Manufacturing companies need to optimize business processes due to the following factors (Maslevich, 2021). Manufacturing companies strive for cost reduction, whose identification becomes easier if production activities are modeled in the form of business processes. Manufacturing companies have business processes associated with both people (employees) and machines, mechanisms, and equipment, which increases their variability and complexity and requires great attention from management personnel.

## Literature review

### *Theoretical aspects of business processes in a manufacturing company*

Before considering the features of modeling various activities in manufacturing companies, it is necessary to characterize the essence of business processes.

The relevant literature offers the following definitions of a business process as a scientific category:

- "A business process is a set of functions organized in a certain sequence that ultimately benefit an internal or external customer" (Kirchmer, 2017, p. 12);
- "A business process is a series of actions within a company that leads to the achievement of a specific goal" (Drucker, 2017, p. 9);
- "A business process is a formal representation of a series of related actions that are performed in a certain order to achieve a clear goal" (Kumar, 2018, p. 24).

The activity of any manufacturing company can be represented as a set of business processes. Thus, the activities of a manufacturing company can be managed according to the process-based approach, in which business processes will be the object of management.

The process-based approach to business management in manufacturing companies is more appropriate than the functional approach since it allows one to optimize operational activities, identify strategic development priorities, and divide areas of responsibility for production results at each stage of the life cycle of created products. The use of the process-based approach strengthens horizontal links between various divisions of a manufacturing company, while its employees are responsible for business processes.

An important feature of business processes as an object of optimization is their typology. The relevant scientific literature often provides the following classification of business processes (Figure 1).

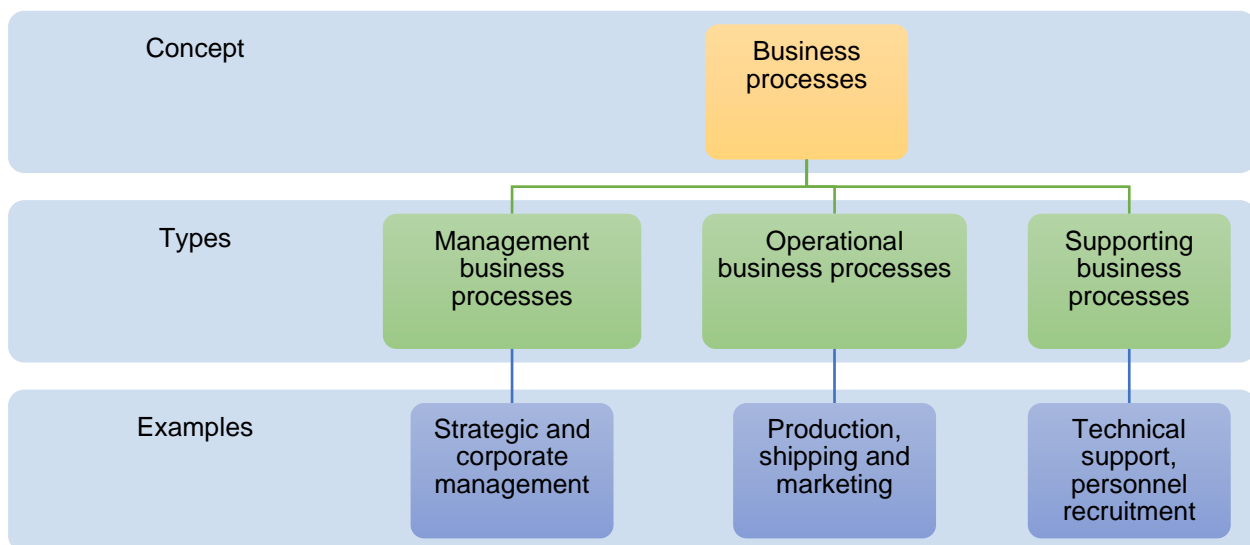


Figure 1: The classification of business processes (Pobegailo, 2017, p. 38)

Most business processes of enterprises can be divided into management, operational, and supporting. All functional subsystems of the company are controlled through management business processes at the level of corporate and strategic management.

Operational business processes are related to the main activity of an economic entity. In the case of a manufacturing company, these are production processes and the manufacture of products. Such business processes are the most complex and control demanding since the quality of products and customer satisfaction depend on their state.

Supporting business processes accompany operational ones and solve those tasks that are not directly related to production activities. For example, they cover accounting, marketing, and human resource management.

There is another classification of business processes according to source attributes. Accordingly, business processes are divided into interorganizational, cross-functional, and interpersonal. The first type includes those business processes that occur in cooperation between different companies that somehow interact in the market and form partnerships. The second type is business processes within a manufacturing company that cover several functional divisions. The third type of business processes symbolizes the personal tasks of groups or individual employees as part of a particular division of a manufacturing company (Volkov, 2018, p. 56).

Business processes of manufacturing companies are also characterized by the following functional features:

- Complexity (all business processes of a manufacturing company are interconnected and form a set);
- Cyclicity (business processes are repeated in the activities of an enterprise according to formalized rules);
- Systemic completeness (business processes cover all vertical activities, from the purchase of raw materials to the sale of finished products of a manufacturing company);
- Purposefulness (business processes have specific goals and solve certain tasks);
- Cross-functionality (business processes reflect certain functions that are divided into actions and procedures);

- Measurability (a company can monitor business processes through indicators that allow measuring the state, quality, and dynamics of business processes);
- Boundaries (business processes have inputs and outputs that indicate their boundaries);
- Adjustability (business processes can act as objects of management and be subject to management influence) (Golovkova et al., 2019, p. 113).

## **Materials and Methods**

The methods of cognition, retrospective and documentary analysis, synthesis, generalization, and systematization were selected as the main scientific methods. We used various sources of information to formulate and solve the research topic: strategic plans, regulatory legal acts, statistics posted on government websites, and monographs and articles, including those published in journals indexed by Scopus and Web of Science.

## **Result and discussion**

### *Modeling business processes of a manufacturing company*

The optimization of the business processes in a manufacturing company is a complex process that requires comprehensive research and consequent improvement (Mason, Spring, 2011; Morrow et al., 2007). Manufacturing companies need to optimize business processes due to the following factors:

- Manufacturing companies strive for cost reduction, whose identification becomes easier if production activities are modeled in the form of business processes;
- Manufacturing companies have business processes associated with both people (employees) and machines, mechanisms, equipment, which increases their variability, complexity and requires great attention from management personnel;
- Manufacturing companies are large business entities and, like the others, they face difficulties in identifying management processes if there is a multi-level organizational structure, a large number of departments, etc. Thus, the concept of business processes can become an effective tool for improving the financial and economic activities of manufacturing companies.

In a nutshell, the process of optimizing the business processes in a manufacturing company can be described as follows (Figure 2).

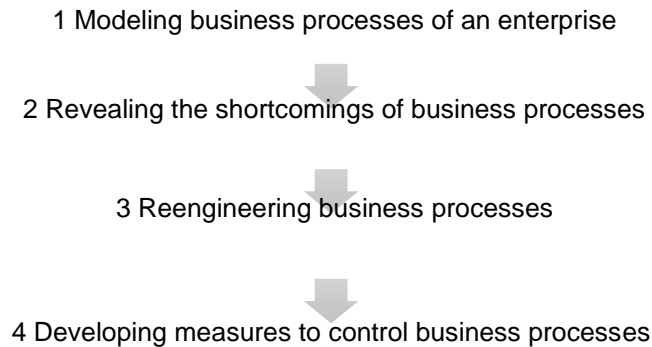


Figure 2: Stages of optimizing business processes in a manufacturing company

According to the above-mentioned scheme, business process modeling is the first stage. It helps the specialists involved in the optimization of business processes to get a clear idea of their structure, content, and function. For these purposes, enterprises use special methods of structural analysis and design which rely on different languages and modeling notations of business processes. In general, there are three approaches to modeling business processes: functional, process-based, and mental (Osterwalder, Pigneur, 2016; Prazdnichnykh, 2013; Stolbova, 2019).

The functional approach to business process modeling analyzes the inputs and outputs of business processes, where inputs are the resources that the company has and outputs are the desired results of such business processes.

According to the process-based approach, the emphasis is laid on the actions that will lead to the desired results rather than the results of business processes. Within the process-based approach, it is important to describe the sequence of business processes, decompose their internal structures and assess incoming resources.

The mental approach to business process modeling is the most accessible and does not require specialists who are familiar with complex notions for designing business processes. The mental description of business processes does not refer to functions and processes but to interrelated categories, i.e. the categories that describe business processes (Barmashov, Lyandau, 2019; Istomina, 2020; Loiko, 2018). These categories are displayed as mind maps. They reflect the main ideas, the direction of business

processes, and their relationship with each other. However, the simplicity of the mental approach does not reveal all the important details and characteristics of business processes. Therefore, this approach is applicable only to small- and medium-sized manufacturing companies. For large-scale industries, mental maps are not enough to optimize business processes (Smirnova, 2018; Gavrilova, Alsufyev, Yanson, 2014; Timmers, 1998).

Three approaches to business process modeling are compared in Table 1.

Table 1: The comparison of approaches to forming and describing business processes (Golovkova et al., 2019, p. 94)

Approach	Functional	Process-based	Mental
Basis	Function	Process	Concept
Total	Describing the desired outcomes of business processes	Describing the sequence of business processes	Describing the spheres of business processes
Complexity	High	High	Average
Automation	Possible	Possible	Difficult

The most developed notations for modeling business processes are as follows: IDEF0, IDEF3, DFD, EPC, BPMN, and UML. Their characteristics are presented in Table 2.

Table 2: The comparison of notations for modeling business processes (Golovkova et al., 2019, p. 98)

Description criteria (in notations)	IDEF0	IDEF3	DFD	EPC	BPMN	UML
Processes and operations						
Single input and output resources						
Input and output resource vectors						



Description criteria (in notations)	IDEF0	IDEF3	DFD	EPC	BPMN	UML
Process structure (decomposition)						
Process start conditions						
Process execution tools						
Branching and merging processes						
Asynchronous and synchronous processes						
Representation of environment elements						
Organizational structure element						
Event						
Scenario element						
Sequence of actions						
Resource flow						
Workflow element						
Dynamic simulation of script execution						
Object-oriented architecture description						

At the second stage, the optimization of business processes aims at determining their shortcomings, i.e. those aspects of business processes that impede their effective implementation. It is important that these shortcomings should repeat the structure of such processes. In addition, the problems of management, operational, and supporting business processes should be singled out. For production business processes, operational processes turn out to be the most challenging because of the increased complexity of production activities.

The problems of business processes can be described as qualitative or quantitative measurements, as well as risk profiles. The company should select an approach to describing business processes that is most relevant to the specifics of its production. One-time assessment of business processes cannot be used constantly as new issues arise regularly, and those identified during the analysis will be irrelevant in the future. Thus, manufacturing companies should conduct such analysis on a regular basis (Kiseleva, Simonovich, 2013, p. 55).

The third stage seems to be the most ambitious. Within the framework of this stage, business processes are reengineered based on the problems identified in a manufacturing enterprise. Business process reengineering refers to the fundamental rethinking and radical redesign of business processes in order to significantly improve critical performance indicators, including cost, quality, service, and speed (Reshetnikova, 2019, p. 4).

Reengineering focuses on the clients of business processes, i.e. those individuals inside or outside the enterprise who obtain the results of their business processes (Kiseleva, Simonovich, 2016a, p. 42).

Depending on the revealed problems of business processes in a manufacturing company and their modeling results, there are different approaches to reengineering (Figure 3).

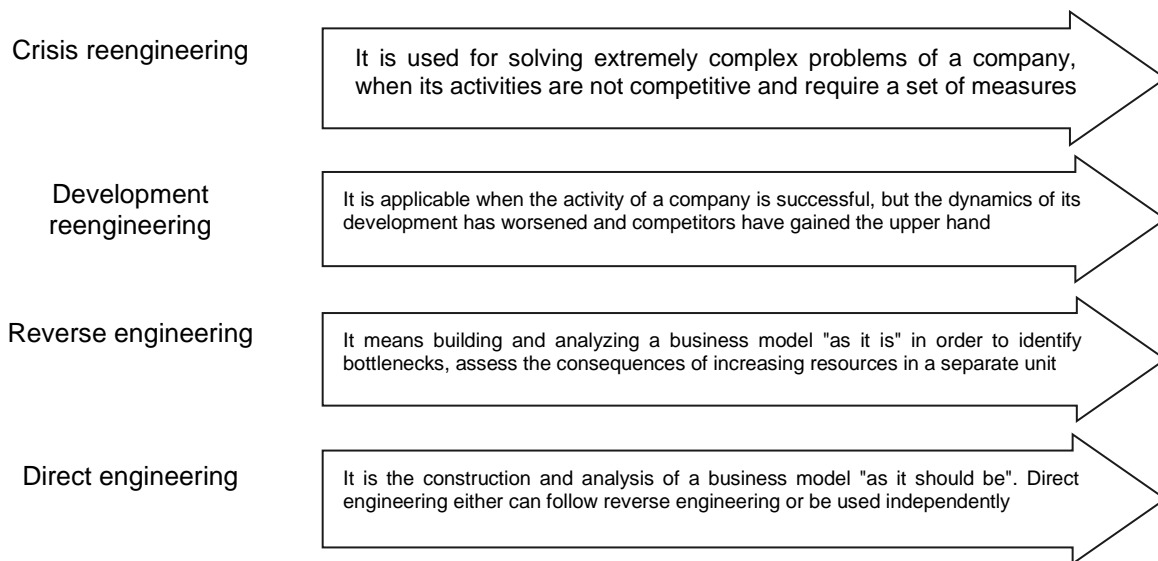


Figure 3: Approaches to reengineering manufacturing companies (Golovkova et al., 2019, p. 46)

At the fourth stage (after the reengineering of business processes), measures are developed for their further control and improvement:

- 1) To determine target values of business processes to be achieved in the short, medium and long term;
- 2) To define tools for controlling business processes and distinguish the persons responsible from the competent employees of a manufacturing company;
- 3) To form regulations for controlling business processes and specific deadlines for the implementation of control measures (possibly in the form of a graph).

Thus, the optimization of business processes in a manufacturing company requires the modeling of business processes, including their structure and content description. On this basis, the specialists of a manufacturing company can highlight the problems of business processes (Kiseleva, Simonovich, 2016b, p. 57). Accordingly, measures of business process reengineering are selected; optimization plans and projects are formed. After the implementation of measures to optimize business processes, they are being controlled in order to further improve business processes and prevent new problems (Porter, 2005; Khrustalev, Slavyanov, 2011).

## **Conclusion**

Modeling the activities of any company is impossible without modeling its business processes, which are an important part of managing manufacturing companies. The latter are characterized by the increased complexity of business processes due to the technical and technological specifics of production. However, other activities of manufacturing companies (financial, marketing, etc.), as a rule, are large-scale and based on many different business processes.

The optimization of business processes in a manufacturing company is a complex process that requires comprehensive research and consequent improvement. Manufacturing companies need to optimize business processes due to a number of factors.

Thus, the optimization of business processes in a manufacturing company requires the modeling of business processes, including their structure and content description. Based on this, the specialists of a manufacturing company can highlight the problems of

business processes. Accordingly, measures of business process reengineering are selected; optimization plans and projects are formed. After the implementation of measures to optimize business processes, they are being controlled in order to further improve business processes and prevent new problems.

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