

Mechanism of Ensuring Competitiveness and Sustainability of Industrial Enterprises

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Abstract. *The direction of development of the economy of the country and the region in modern conditions sets modernization. The purpose of this development is to form a new quality of life and a positive image of the territory in terms of its attractiveness for labor and capital investment. Industrial activity continues to be the main “driver” in the socio-economic development of many countries. Moreover, in the conditions of the digital economy, the leading countries are focused on the use of advanced production technologies. These technologies contribute to the implementation of qualitative changes in the development of production and society, and also are aimed at the active development of advanced industries and the modernization of basic industries. In addition, the criteria for economic growth are the indicators of production dynamics. It is known that production with a high proportion of added value and a significant intellectual component, in which elements of new technological structures are already present, form the core of modernization. Large-scale use of digital technologies and their active embedding in a business model of the industrial enterprises is the objective requirement that provides not only and not just a competitive advantage, how many survival, being operational need. Existence in the modern world of global problems demanding coherence of actions both within the industries, and within the companies, dictates the need of search and improvement of mechanisms of ensuring competitiveness at all levels of managing. Thus, the aim of the work is to propose a mechanism to ensure the competitiveness of industrial enterprises. Expand the goal is expected through the solution of such tasks as 1. To reveal the principles and factors of competitiveness of industrial enterprises in the context of digital transformation and convergence of technologies 2. Describe the management system ensuring the competitiveness of industrial enterprises. 3. To estimate system effectiveness of management of competitiveness of the industrial enterprises. The subject of analysis is the process of ensuring competitiveness and its management in industrial enterprises. The study applied a combination of qualitative and quantitative methods. As a qualitative method, a desk study was used to identify the studied parameters and collect data on them. The method of theoretical analysis and modeling in the formation of a management system ensuring the competitiveness of industrial enterprises. Methods of statistical analysis allowed processing the data. Because of the study, the following results were obtained: major factors of competitiveness in the conditions of digital transformation and convergence of technologies are the setization, cognition, creativity. A model of a management system to ensure the competitiveness of industrial enterprises has been built. Elements of this model are the target subsystem, the operating subsystem, a functional subsystem, the providing subsystem and the operated object. On the basis of this model assessment of system effectiveness of management of ensuring the competitiveness of the industrial enterprise is made. It is proved that the introduction of elements of digital technologies to the activity of the industrial enterprises positively affects the level of their competitiveness and stability. The results obtained are the basis for further research in order to develop strategies and improve the mechanisms for ensuring the competitiveness of industrial enterprises.*

Keywords: industrial enterprise; mechanism; competitiveness; stability.

Introduction

The specificity of the modern stage of socio-economic development is such that competitiveness and sustainability are determined not only by the quality of the product offered but also by the speed at which innovative products are brought to the market, as well as by their ability to meet needs. All this is achieved by breakthrough technologies. Their source is the production of knowledge and high technology. These same factors form the basis of real growth in the economies of developed countries.

The production of knowledge and technology is impossible without enterprises and a developed economy without some of their critical mass. We understand the set of mutually agreed and interdependent elements, subsystems and mechanisms as manufacturing enterprises. They are responsible for processes of self-development, the organization, production and function according to the general laws of business, providing a possibility of innovative development. Since manufacturing enterprises are key suppliers of new goods, their development is considered a central factor in the diversification and massification of demand (UNIDO, 2018).

The present stage of development imposes the following requirements to manufacturing enterprises:

- Focusing on consumer experience;
- Development of operational flexibility;
- Gaining the trust of stakeholders;
- The widespread use of technology in order to optimize costs, increase productivity, and satisfy consumers who are increasingly using digital technologies more and more.

Modern industrial enterprises should integrate technologies such as digital modeling, digital logistics, cross-sectoral cooperation, a convergence of the functionality of the executive mechanism of the new product and the digital control system, additive manufacturing, lean technologies, quantum technologies, and the enterprise information system (Tolstykh, Gamidullayeva, & Shkarupeta, 2018). Thus, we observe and become participants in the process of “new industrialization” carried out on a modern technological platform.

The formation of a new technological core is based on the convergence of technologies, resulting in the blurring of the boundaries between industries: Nanoelectronics, bioinformatics, bioeconomics, etc. (Sheppard, Gillespie, Hirsch, & Begley, 2011). The peculiarity of this moment is the rejection of the disciplinary binding of technology. Thus, nanotechnologies, based on discoveries in the field of the micro world, are used in information technology, in the creation of new materials, in biotechnology, in medicine. Top technologies are used in all key technology groups that are important for solving global world problems. There are 16 such technology clusters, or applications (applications), as noted, for example, in analytical and prognostic reports of the RAND Corporation (Silbergliitt, Antón, Howell, Wong, & Gassman, 2002). These top technology applications are a response to the needs and requirements of world social development and the challenges of the time.

The use of these technologies will allow industrial enterprises to not only take leading positions but also require them to change business models and build modern management systems on their basis. It is noteworthy that of the companies that were members of the 500 largest corporations in the world in 2000, currently, more than half do not exist (Fortune Global 500, 2019). On the basis of the research of 400 large companies from different fields of activity of MIT Sloan School of Management and Capgemini Consulting proved that the use of new technologies and techniques of management causes a change of financial performance. Got profits of the company 26% more, then their competitors who actively used technologies and new methods of management. 17% more profitable than competitors the organizations, which actively invest in digital technologies, work, but give attention to management a little. Those companies, which did not apply new technologies and techniques of management in comparison with other subjects of the market, reduced profit by 24% (Westerman, Tannou, Bonnet, Ferraris, & McAfee, 2012).

Today, in essence, any company is a technology company. And technologies are becoming the most important competitive advantage of industrial enterprises and the basis of their sustainability. According to Boston Consulting Group, the leader among the innovative companies within already several years is the Apple

company. Distinguish the companies Google, Tesla, Microsoft, Samsung, Amazon from the most technological companies. Mitsubishi Electric in Japan, Siemens in Germany, SpaceX, Boeing, Lockheed Martin in America are carried to a number of the modern enterprises at which all processes are automated and joint among themselves with the help of the industrial Internet the AMRC Factory 2050 transforming plant in Great Britain (The Boston Consulting Group).

Practically all processes and production phases – from the design of a product before delivery to the consumer – happen in these companies in one digital system. As a result, the growth of efficiency of the enterprises and the formation of key competitive advantages is observed, and it causes an increase in their competitiveness and stability.

Literature review

The issues of ensuring the competitiveness and sustainability of industrial enterprises have been actively raised in the scientific community for a long time. They acquire a special significance in the context of digital transformation. Thus, El Hilali & El Manouar (2018) reveal the relationship between digital transformation and sustainable development of organizations and show how companies through digital transformation can increase profitability and social impact while reducing their environmental impact. Constantinescu and Panagoret (2017) proved that the widespread use of digital technology affects the competitiveness of an enterprise. At the same time, there are studies showing that digital transformation entails a change in business operations and strategic plans of companies for their effective management (Grab, Olaru, & Gavril, 2019; Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). At the same time, digital change also needs to be managed. An important element then is the development of digital transformation strategies (Matt, Hess, & Benlian, 2015; Schallmo, Williams, & Lohse, 2019; Tolstykh, Shkarupeta, & Shishkin, 2017). The implementation of these strategies and massive digitalization are forcing companies to make changes to their business models (Hanelt et al., 2015; Schallmo & Williams, 2018). Search for such business models that allow achieving high levels of productivity in a technological environment (Aversa, Haefliger, & Reza, 2017), growth of efficiency, stability, competitiveness (Westerman & Bonnet, 2015; Davenport & Westerman, 2018) and they all contain enormous growth potential.

Materials and method

The study was carried out in accordance with the following steps:

1. To analyze the features of the development of industrial enterprises in the conditions of digital transformation and convergence of technologies;
2. Describe the management system of ensuring the competitiveness of industrial enterprises;
3. Assess the effectiveness of the management system to ensure the competitiveness of industrial enterprises.

The study used data from Russian industrial enterprises. These enterprises belong to the industry - mechanical engineering and are located in the Vladimir region. Performance evaluation was carried out for two years. The first year - 2014 is the base. Enterprises during this period did not use digital economy tools in their activities. The second-year is 2018. This year, enterprises are actively introducing the tools of the digital economy into their activities and are adapting and modernizing their business processes.

To obtain the results of the work we used the data contained in the statements of enterprises. Financial reports are publicly available. They are taken from the Interfax information disclosure system. Some of the information is the result of applying the method of expert estimates. The experts were the management of enterprises. Also, as a source of information, materials of scientific and practical and analytical publications, scientific reports were used. In the course of the study, scientific methods were applied: analysis and synthesis (to identify the characteristics of industrial enterprises in the context of digital transformation and convergence of technologies), theoretical search and abstract logical method (to describe the competitiveness management system of industrial enterprises), modeling (to build models of the competitiveness of industrial enterprises).

All qualitative indicators were evaluated using the following scale:

$$a_i = \begin{cases} 0, & \text{if the given attribute does not appear on the enterprise;} \\ 1, & \text{if there is very little or a minor sign of the symptom;} \\ 2, & \text{if a partial symptom is observed;} \\ 3, & \text{if the complete indication is observed} \end{cases}$$

All quantifiable indicators are summarized on the basis of the following scale.

$$a_i = \begin{cases} 0, & \text{if the indicator is 0;} \\ 1, & \text{if the indicator is within } (0,30] \\ 2, & \text{if the indicator is within } (30,70] \\ 3, & \text{if the indicator exceeds 70.} \end{cases}$$

All absolute indicators are reduced to relative, by assigning these values to the best indicators among enterprises in the industry.

The final assessment of indicators within the group is determined by the formula (1):

$$C = \frac{100}{a_{max} \cdot n} \cdot \sum_{i=1}^n a_i,$$

where a_{max} the maximum possible score in accordance with the scale;
n is the number of indicators to be evaluated;

The integral assessment of the level of efficiency is made according to the formula (2)

$$F = \frac{100}{a_{max} \cdot m} \cdot \sum_{i=1}^m a_i,$$

where m is the number of private performance indicators.

Results of the study

Most of the leaders of companies from various sectors of the economy are convinced that the use of innovative technologies is a matter of survival. Therefore, innovative technologies are an indispensable tool designed to help manufacturers achieve development in the framework of transformations caused by digital transformation.

These innovative technologies today include tools for the digitization of the production activities of enterprises, which are presented in Figure 1.

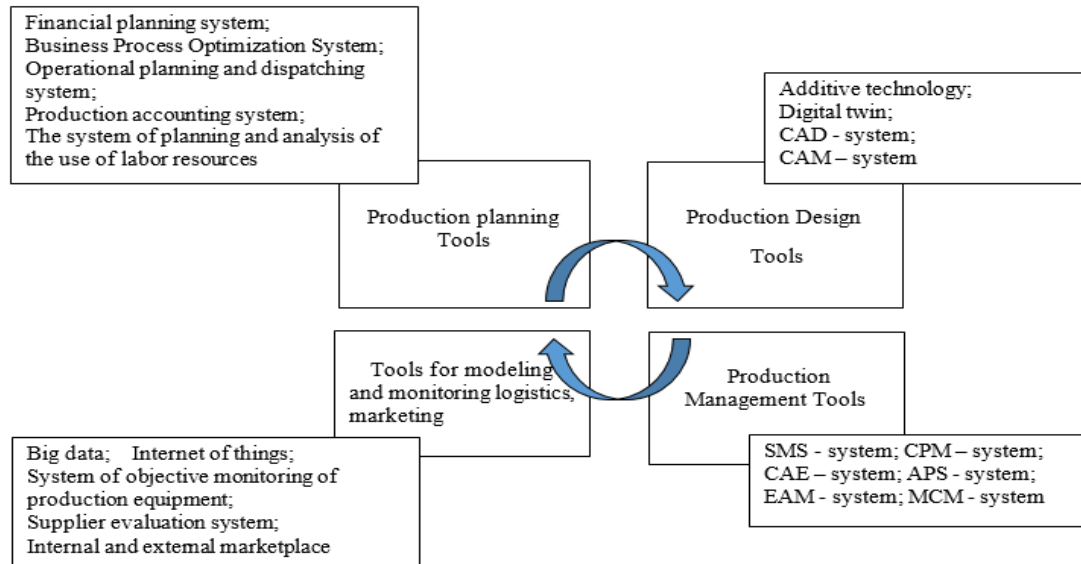


Figure 1. Digitalization tools of modern production
(Golubev & Shcherbakov, 2018; Kupriyanovsky et al., 2017)

The use of digital technology in industrial enterprises provides significant opportunities. The most significant are:

- monitoring of production processes in real-time;
- use the potential of cooperation with other manufacturing enterprises;
- search for suppliers that take into account the technical capabilities of the enterprise;
- search for specialists capable of solving technical problems;
- presentation of the technical capabilities of the enterprise for the production of products in order to attract potential consumers.

The main principles of sustainable development and ensuring the competitiveness of industrial enterprises include:

1. Accounting for the joint influence of the basic elements of the institutional environment (politics, society, economy, ecology, science, state) on the development of industrial enterprises.
2. Transformation of innovations into the main driving force for the development of industrial enterprises.
3. Concentration of resources in priority areas to achieve priority in research and in leading scientific and technical sectors of industry.
4. Creating value chains in order to organize the production of high readiness products (high value-added).
5. The implementation of the triple helix principle - the joint action of three sectors: science and education, business, and the authorities - as the basis of self-sustaining development.
6. Implementation of network interactions based on collaboration.
7. Creating a favorable environment for attracting investors.
8. Development of partnerships.
9. Development of international cooperation.

Under these conditions, the factors of competitiveness undergo significant changes, the systematization of which is shown in Figure 2.

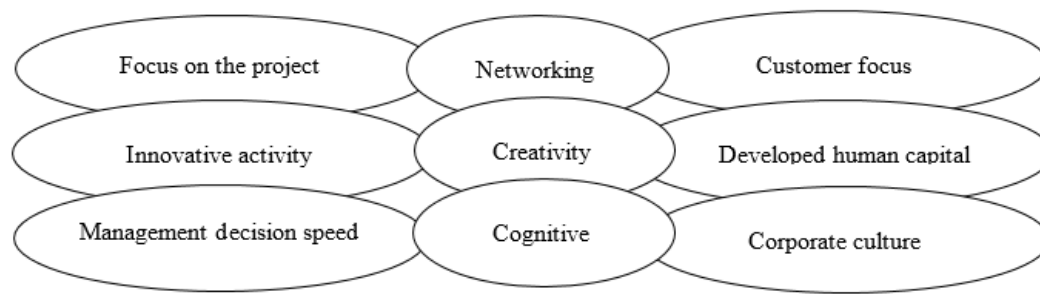


Figure 2. Factors of competitiveness in the modern economy
(Tolstykh, Shkarupeta, & Shishkin, 2017)

Moreover, the active use of innovation contributes to the reduction of the technological gap between Russian and leading global manufacturers, which is one of the conditions for achieving a competitive level. Thus, 91% of industrial enterprises invest in digital factories (Puha, 2018). Further growth of the industrial automation market is projected at 5–6% per year (Global Industrial Automation Control Market 2018-2022, 2018).

The possibilities determined by the achieved level of sustainability and the composition of competitive advantages are determined by the structure and potential of the mechanism for managing the competitiveness of an industrial enterprise.

Any mechanism has components, methodological components (Gorb, Yasnolob, & Protsiuk, 2016). The mechanism for ensuring the competitiveness of an industrial enterprise is a combination of organizational models, resources, factors and conditions, methods and structures for managing competitive advantages, which allow an enterprise to function effectively and develop steadily.

At the entrance of the mechanism is the goal. It consists of providing the necessary level of competitiveness of an industrial enterprise in the conditions of digital transformation and convergence of technologies. The goal determines the tasks, functions.

The results of the operation of the mechanism are its output, in which quality the level of competitiveness of an industrial enterprise and its sustainability are highlighted.

The functioning of the mechanism is based on principles. The main ones are:

- the principle of flexible management of the level of competitiveness of enterprises;
- the principle of fractal management of ensuring the competitiveness of enterprises,
- the principle of taking into account the dependence of sustainability of development and competitiveness on the rationality of combining a complex of factors of production;
- the principle of harmonization of short-and long-term goals of the enterprise with the obligatory account of the state of the technical and technological base of the enterprise and the dynamics of development processes;
- the principle of accounting for the occurrence of self-organization of elements of the control system when operating in conditions of uncertainty.

The work of the mechanism for ensuring the competitiveness of industrial enterprises is represented by three functions: transformation, strengthening and integration. The transformation function determines the targeted trajectory of the competitiveness of enterprises. The integration function is necessary to form the integrity of competitiveness and the mechanism to manage it. The gain function provides the use of the resource base of transformations.

The tools of the mechanism for ensuring the competitiveness of industrial enterprises in accordance with the allocated functions are divided into transformative ones, which are transferred from a state of noncompetitiveness / low level of competitiveness to a state of competitiveness; strengthening the basic characteristics of ensuring the competitiveness of the enterprise.

The competitiveness management system of industrial enterprises is a key element of this mechanism. It has a complex structure. Imagine it graphically in Figure 3.

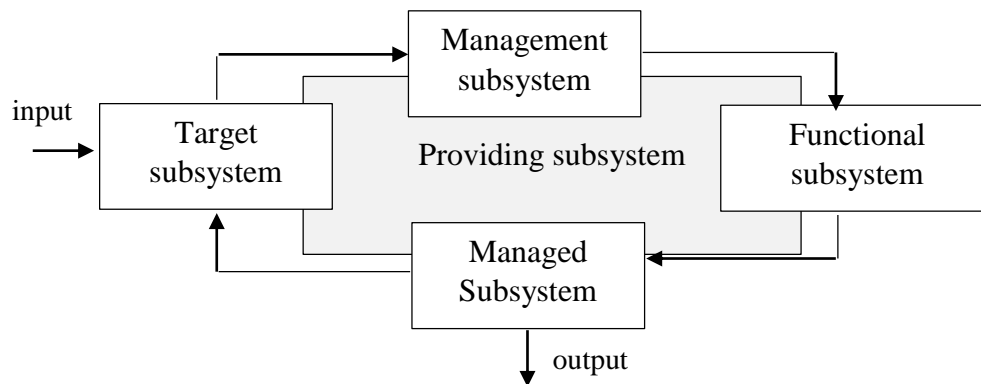


Figure 3. Industrial competitiveness management system
(own elaboration)

An extremely important task is to evaluate the effectiveness of the management system. In management theory, there are 6 approaches to conducting such an assessment: target, functional, compositional, multiple, behavioral, and resource.

Regardless of the approach used, the assessment is carried out through a set of indicators that evaluate each subsystem.

In as indicators of the target subsystem, allocate the degree of resource savings, labor productivity, the share of exports in the proceeds from the sale of products; share of value-added.

The control subsystem can be described using the share of new products in the volume of production; the proportion of intangible assets in the balance sheet; rhythm of work; quality management performance.

The functional subsystem is characterized by the functions performed by the competitiveness management system of an industrial enterprise: planning, organization, motivation, regulation, control. To assess the functional efficiency of the system, it is advisable to use the measure of the degree of performance of the function. The provisioning subsystem is assessed through the use of indicators of resource efficiency: capital productivity, material performance, the rate of renewal of the company's fixed capital, salary return, cost of consumption, the level of computerization of business processes. Managed object level of competitiveness and economic development of the enterprise. The results of the evaluation of the effectiveness of the competitiveness management system will be given in table 1.

Table 1. Evaluation of the effectiveness of the production system of enterprises

Efficiency	AO KEMZ		AO MSZ	
	2014	2018	2014	2018
Target subsystem	50	75	33,33	66,67
Management subsystem	50	66,67	66,67	50
Functional subsystem	60	80	53,33	60
Providing subsystem	61,11	83,33	55,55	55,55
Managed Subsystem	46,3	52,3	45,83	60,4
Total	66,67	86,67	66,67	66,67

Source: own elaboration

Based on the proposed assessment, the ways to improve competitiveness and sustainability are the development of a strategy for the sustainable development of an enterprise, the further introduction of new technology projects and the further digitization of production activities. In addition, it would be advisable to strengthen the marketing component by conducting a more active advertising campaign and developing a discount policy.

The mechanism for ensuring the competitiveness of industrial enterprises, introduced into practical activity, will allow solving a number of tasks, namely:

- 1) to ensure the competitiveness of individual functional areas within the overall development strategy of an industrial enterprise;
- 2) timely provide various types of resources for the process of developing competitiveness;
- 4) effectively organize the process of managing the competitiveness of an industrial enterprise;
- 5) to coordinate the work of all elements of the mechanism in order to ensure the necessary level of competitiveness and development;
- 6) conduct a simulation of ensuring the competitiveness of an industrial enterprise;
- 7) to form the economic, organizational and managerial prerequisites for ensuring the competitiveness of an industrial enterprise.

The mechanism for ensuring the competitiveness of an industrial enterprise can also be viewed as a process of activating unused reserves of competitiveness growth or the transformation of the potential of its increase into reality.

Discussion and conclusion

This study complements other studies in the field of industrial competitiveness.

The study was aimed at describing the management system of ensuring the competitiveness of industrial enterprises and identifying directions for improving the management of the competitiveness of industrial enterprises.

In a study using the methodology for assessing the effectiveness of the competitiveness management system for industrial enterprises, the level of efficiency was determined.

Based on the study, it can be concluded that the introduction of digitalization tools into the activities of modern industrial enterprises entails an increase in competitiveness and sustainability. Therefore, the obtained results characterize the effectiveness of the competitiveness management system of an industrial enterprise. There is an increase in efficiency levels.

Calculations show that the efficiency of the control subsystem is inferior in terms of the efficiency of other subsystems. The introduction of elements of digital technology in the activities of industrial enterprises has a positive effect on the level of their competitiveness and sustainability.

The use of digital technologies gives industrial enterprises a new impetus for development, starting the processes of changing the paradigm of production activity. Digital platforms, combining the tools of analysis and intellectual research of large data arrays, machine learning, the industrial Internet of things and much more, are a key factor in transforming the business model of industrial enterprises. Thus, the digitalization of production enterprises is not only the use of digital technologies in production activities but their integration into existing business processes and the transformation of the latter. Further areas of research may be related to answers to questions: How do you need to transform business models? What elements of a business model require transformation? How will the transformation of a business model affect the competitiveness and sustainability of an industrial company? What should be the pace of technological change to ensure competitiveness and sustainability in modern conditions?

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