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STAGING THE PROCESS OF ENHANCING OF COMPETITIVENESS OF MACHINE-BUILDING ENTERPRISES IN THE CONDITIONS OF INDUSTRY 4.0

ЕТАПІЗАЦІЯ ПРОЦЕСУ ПІДВИЩЕННЯ КОНКУРЕНТОСПРОМОЖНОСТІ МАШИНОБУДІВНИХ ПІДПРИЄМСТВ В УМОВАХ ІНДУСТРІ 4.0

The article is devoted to the issues of increasing the competitiveness of machine-building enterprises participating in the processes of the Fourth Industrial Revolution. The study aims to determine the features of the process of ensuring the ability of enterprises to compete in international high-tech products markets. The article identifies the main technologies of Industry 4.0, emphasizes the role of innovation in providing long-term competitive advantage, and highlights the main components of competitiveness of machine-building enterprises in the new conditions of the need for technological readiness. It has been identified that Technology 4.0 is one of the priority factors of competitiveness, and industrial leaders have a reasonable need for greater investment in the development of new technologies, as the success of industrial enterprises depends on their digital transformation. In order to improve the activities of machine-building enterprises of Ukraine in international markets, a procedure to increase their competitiveness has been developed, which contains five stages and takes into account the need to perform the following actions: to define the indicators that determine the competitiveness of the enterprise in Industry 4.0; to analyze current goals and their relevance in terms of Industry 4.0; substantiation of necessary measures in the conditions of Industry 4.0; search for a contractor who is an expert in digital transformation of the enterprise; identification of priority measures for digital transformation; transition to the holistic integration of the latest developments of the enterprise; monitoring of internal and external factors of competitiveness. The article identifies the potential benefits that companies can get from the implementation of the proposed measures within each stage of the procedure. A promising area of further research is formalization, in particular economic and mathematical modeling, the impact of the introduction of new technologies and digital transformation on the level of competitiveness of machine-building enterprises in international markets.

Keywords: competitiveness; machine-building enterprise; engineering; Industry 4.0, technologies, competitive advantages, innovations

Статтю присвячено питанням підвищення конкурентоспроможності машинобудівних підприємств, що беруть участь у процесах Четвертої промислової революції. Дослідження спрямоване на визначення особливостей процесу забезпечення здатності підприємств конкурувати на міжнародних ринках високотехнологічної продукції. У статті визначено основні технології Індустрії 4.0, підкреслено роль інновацій у

забезпеченні довгострокових конкурентних переваг, а також виокремлено основні складові конкурентоспроможності підприємств машинобудування у нових умовах необхідності формування технологічної готовності. Визначено, що Технології 4.0 є одними з пріоритетних факторів конкурентоспроможності, і лідери промислових підприємств мають обґрунтовану потребу в більших інвестиціях у розвиток нових технологій, оскільки успіх промислових підприємств залежить від цифрової трансформації. Задля удосконалення діяльності машинобудівних підприємств України на міжнародних ринках розроблено процедуру підвищення їх конкурентоспроможності, яка містить п'ять етапів та враховує необхідність виконання наступних дій: визначення показників, які визначають конкурентоспроможність підприємства в умовах Індустрії 4.0; аналіз поточних цілей та їх актуальність в умовах Індустрії 4.0; обґрунтування необхідних заходів в умовах Індустрії 4.0; пошук підрядника, який є експертом цифрової трансформації підприємства; визначення пріоритетних заходів щодо цифрової трансформації; перехід на цілісну інтеграцію новітніх розробок підприємства; моніторинг внутрішніх і зовнішніх факторів конкурентоспроможності. У статті визначено потенційні вигоди підприємств, які вони можуть отримати внаслідок впровадження запропонованих заходів в межах кожного етапу процедури. Перспективним напрямом подальших досліджень є формалізація, зокрема економіко-математичне моделювання впливу впровадження нових технологій та цифрової трансформації на рівень конкурентоспроможності машинобудівних підприємств на міжнародних ринках.

Ключові слова: конкурентоспроможність; машинобудівне підприємство; машинобудування; Індустрія 4.0, технології, конкурентні переваги, інновації

Introduction. In the new age of Industry 4.0 it is quite important for the machine-building industry to build the competitive advantages in the international economic space. Achieving this goal requires the creation and further development of innovation and technological infrastructure aimed at helping enterprises to fully integrate the latest technologies, and there is a need to improve financial and economic indicators to support innovation on a regular basis and implement research and technological results.

The machine-building complex occupies a significant share of the global production and it has a strong potential for further development under Industry 4.0 conditions. It is difficult to run an effective production without the active development of so called 4.0 technologies. Therefore there is a need to identify key issues and obstacles of improving the competitiveness of the machine-building companies, as well as to identify areas for solving problems that hinder the development of Industry 4.0 in the engineering industry as a whole.

The issue of studying the competitiveness of the enterprise, has been raised in the scientific publications of many scientists in various aspects, for instance Porter, Ketels and Delgado [8],[9], Bartling, Fehr, Marechal and Schunk [10], Connor [11], DiazChao, Sainz-Gonzalez and Torrent-Sellens [12], Flak and Glod [13] and other. Scientists have carried out an analysis and the development of scientific provisions for assessing and managing the competitiveness of a company, but the issue of staging the

process of enhancing the competitiveness in conditions of high technological development remains insufficiently studied.

Research objective. The purpose of the article is to determine the stages of increasing the level of competitiveness of machine-building enterprises in the conditions of Industry 4.0

Methodology. Methods of analysis, synthesis, comparison, combination of historical and logical were used for the research.

Research results. It is Industry 4.0 that makes it possible to combine the world of online technologies with the world of industrial production. The concept of Industry 4.0 provides increasing automation of absolutely all processes and stages of production: from product design to delivery to the end user, taking into account the requirements of the latter. In addition, the provision of after-sales service is provided. An ideal in this case is a well-established production without human intervention, which will ensure maximum efficiency. However, for objective reasons, absolutely robotic production is impossible [1].

Data generation, analysis and transmission are the basis for profiting from Industry 4.0, which provides the network with a wide range of new technologies (fig. 1) to create the added value.

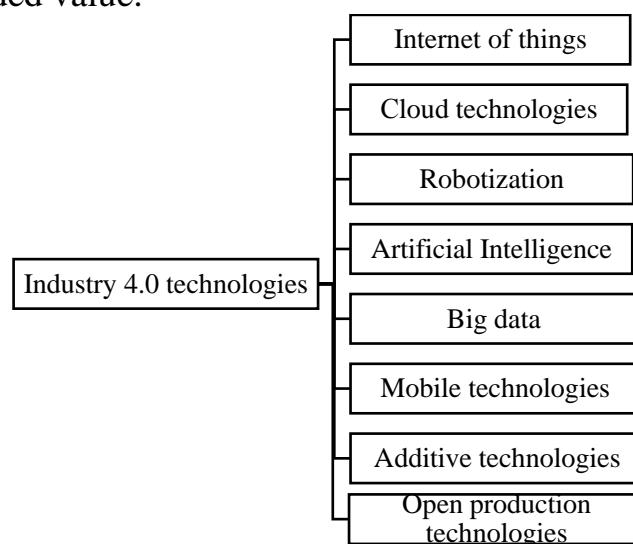


Figure 1 – The main types of Industry 4.0 technologies
 Source: [2, c. 23]

The main components of the competitiveness of machine-building enterprises on the basis of Industry 4.0 are presented in Fig. 2

| | |
|-------------------------|---|
| Interoperability | <ul style="list-style-type: none"> •the ability of cyberphysical systems, people and smart factories to connect and communicate with each other |
| Virtualization | <ul style="list-style-type: none"> •creating a virtual copy of a smart factory by combining the data of many sensors with virtual factory models and simulation models |
| Decentralization | <ul style="list-style-type: none"> •the ability of cyberphysical systems of smart factories to make decisions independently |
| Modularity | <ul style="list-style-type: none"> •flexible adaptation of smart factories to changing requirements by replacing or expanding individual modules |
| Work in real time | <ul style="list-style-type: none"> • the ability to collect and analyze data and provide conclusions immediately |
| Orientation of services | <ul style="list-style-type: none"> • offering services (cyberphysical systems, people or smart factories) via the Internet of services (IoS) |

Figure 2 –Components of the competitiveness of machine-building enterprises on the basis of industry 4.0

Source: completed on the basis of [2]

In conditions of accelerated scientific and technological progress, on the one hand, consumer demand for products with innovative content, which are competitive in domestic and foreign markets, is constantly growing. On the other hand, for their production at machine-building enterprises it is necessary to introduce the latest technologies, modernize enterprises and their technical re-equipment, which requires attracting significant amounts of investment and finding sources of the support, for instance, cooperating with foreign investors.

Technologies 4.0 are among the priority factors of competitiveness and the leaders of industrial enterprises have a justified need for more investment in the development of new technologies, as all or a part of industrial enterprises depend on digital transformation. We have determined that there is a need to figure out the stages of enhancing the competitiveness of the enterprise in the conditions of Industry 4.0. Therefore, we have developed a common procedure which consists of five stages and promotes more effective implementation of technologies and innovations of Industry 4.0 in the enterprise. Also, first of all, this procedure assumes the full interest and involvement of the company's staff and middle managers. As the analysis of the first

two sections has shown, it is the lack of motivation of managers and engineers that become barriers to the introduction of innovative technologies.

Table 1 - Procedure for increasing the competitiveness of the enterprise in terms of Industry 4.0

| | | | |
|---------|---|---|--|
| Stage 1 | Collection of data on the micro and macro environment of the enterprise | | |
| | Identify a group of companies that are functioning in the same external environment | Definition of indicators that determine the competitiveness of the enterprise in the conditions of Industry 4.0 | Collection of data on the internal environment of the enterprise |
| Stage 2 | Analysis and assessment of the current situation at the enterprise | | |
| | Assessment of the current competitiveness of the enterprise | Analysis of current goals and their relevance in the context of Industry 4.0 | Analysis of factors that can be influenced and their impact on the competitiveness of the enterprise |
| Stage 3 | Development of a strategy to increase the competitiveness of the enterprise | | |
| | Defining technological and other goals of the enterprise | Justification of necessary measures in the conditions of Industry 4.0 | Development of a list of measures that will turn potential innovative competitive advantages into actual ones |
| | Identify company problems that can be solved with the latest technology | Finding a contractor who is an expert in digital enterprise transformation | MVP development |
| Stage 4 | Implementation of a strategy to increase the level of competitiveness of the enterprise | | |
| | Identification of priority measures in the short term and their implementation | Identification of priority measures in the long run and search for tools for their implementation | Forming a list of innovations that will increase staff productivity |
| | Professional retraining of staff | The transition to the holistic integration of the latest developments of the enterprise | Practical realization of the planned purposes |
| Stage 5 | Enterprise competitiveness monitoring and feedback system | | |
| | Formation of a system of indicators for the implementation of short- and long-term measures | Monitoring of internal and external factors of competitiveness | Development of corrective actions depending on the impact of the development and implementation of new production and resource saving technologies |

Source: developed on the basis of [4;5;6;7;14]

Unfortunately, some companies do not consider IT transformation as a priority for the company, so it is necessary to develop a model to increase the competitiveness of the company, which will include overcoming these barriers and faster introduction of new technologies. There is currently a global problem for industrial enterprises, such as weak integrity and integration in approaches to implementing new strategies that will include digital transformation to increase the competitiveness of the enterprise.

The manufacturing sector is currently working in the digital stage, with high demands on transparent real-time data systems and increased availability of low-cost computing power. There are a number of problems that are relevant today, such as reducing obstacles to the adoption of advanced analytics and the introduction of advanced robotics, 3D printers and augmented reality technologies. Potential benefits from the introduction of innovative technologies are in product quality due to advanced and statistical process control, digital quality management and automation of intellectual and physical work.

According to the results of our study, several ways may be proposed for enhancing the level of competitiveness of machine-building enterprises, focused on effective resource management, which are possible to implement using the innovative innovation potential of manufacturing enterprises as follows.

comprehensive study of consumer demands and analysis of competitors

1. Effective continuous analysis and data visualization: analysis of consumer and company behavior in the market. Comparison of indicators on innovation and efficiency of technology implementation in comparison with the leader. Development of market segmentation by product, consumer and diagnostics of consumer trends.
2. Partnership of enterprises participating in the implementation of Industry 4.0: introduction of technologies for obtaining information from all physical objects.
3. Costs saving: the use of new sources of raw materials, the introduction of automation of production to increase productivity.
4. A comprehensive approach to equipment modernization: introduction of such innovations that can be integrated into a single ecosystem of the enterprise.

Conclusions. According to the results of the study, the research objective was achieved since we have determined the stages of increasing the level of competitiveness of machine-building enterprises in the conditions of Industry 4.0. Due to the difference in activities of enterprises, the study has some limitations. First of all, the obtained results concern the machine-building enterprises which are going to enhance the level of competitiveness on the international market. Due to this, the competitive advantages of these companies depend from their ability to use high technologies for a high-quality production. Another limitation of the study is that target companies may implement the suggested measures only if they have relevant financial resources.

The novelty of the study includes improving the procedure for enhancing the competitiveness of machine-building enterprises in the conditions of industry 4.0, which includes five stages and potential benefits from the implementation of the suggested steps.

The practical significance of the work lies in the possibility of taking into account the proposals in the practical activities of machine-building companies, as

well as consulting companies that help engineering enterprises to develop the competitive strategy.

A promising area of further research is economic and mathematical modeling of the impact of the introduction of new technologies on the level of competitiveness of the enterprise.

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