Formation of sustainable development of enterprises based on the implementation of the "Industry 4.0"programs

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Abstract

Sustainable development of enterprises is formed on the basis of the introduction of new technologies and the creation of unique developments. The priority directions of scientific and technological development of the country that can make the greatest contribution to accelerating economic growth, increasing the country's competitiveness through the development of the technological base of the economy and science-intensive industries are considered. The results of intellectual activity, new technologies, innovations in the production and management sphere, which have a significant role in the global market. he study reflects the main strategic objectives, key areas and methods in enterprise management to achieve sustainable development in the context of digitalization. The "Industry 4.0" program is a multi-level system based on the idea of integrating physical and intellectual-software processes into a single information space. This program consists of subsystems: product life cycle management; support for large-scale databases; creation of the "Internet of Things" - IoT; construction of "smart" enterprises; formation of cyber-physical systems. The "Industry 4.0" program provides for the digitalization and integration of technological, manufacturing and business processes vertically throughout the enterprise, from product development and procurement to manufacturing, logistics and in-service service. The development strategy of the enterprise provides for the introduction of innovative technologies, full-scale use of intellectual, scientific, and creative resources. Determination of indicators of sustainable development of the organization, identification of new characteristics and indicators in the information space, preparation of the organization's management system for new conditions of work in the market, training of innovative personnel to work in the "Industry 4.0" system

Keywords: digital transformation, digitalization, innovation strategy, technological development, software products, intelligent systems

Introduction

The study reveals the role of new technologies, indicates the need for their intensive implementation in the production sector, analyzes the state of industry in the regions, and reveals the role of digital platforms. The relevance of the study in revealing new opportunities for creating a highly competitive enterprise at all stages of the innovation process, since digital transformation accelerates the processes of transferring knowledge and organizing network communications. The constant exchange of ideas and the sharing of data make the innovation process continuous. The purpose of the study is to analyze the factors of sustainable development of enterprises in interaction with the external environment in the context of digitalization and disclosure of management methods for new technologies. The subject of research is the sustainability of industrial enterprises. The object of the study is the sustainability of high-tech enterprises interacting in a digital environment in a competitive environment in global markets. The efficient use of the possibilities of the external environment ensures the development of the "Industry 4.0" system.

The innovation policy determines the goals, directions, forms of activity of public authorities in the field of science, technology and the implementation of the achievements of science and technology.

Research methods include analysis of scientific publications in the field of sustainable development; forecasting and analytical developments; special domestic and foreign literature; materials of scientific and practical conferences and seminars, round tables; materials of information and analytical agencies.

Analysis of the problems of sustainable development of enterprises shows the importance of constant development of its competitive advantages, which is facilitated by the "Industry 4.0" program. It includes:

1. Intelligent production management systems, including in robotics and the Internet of Things.
2. Systems for monitoring production processes, including sensors for the state of equipment, parameters of raw materials flows and the state of objects being created.
3. Multidimensional modeling of complex products, allowing you to optimize their various parameters.
4. Systems for creating and transforming material objects, including: 3D-program; promising methods of surface treatment. Mechanical engineering technologies are key for this area [1,2].

Advances in these areas can provide visible economic benefits in addressing multiple production challenges. Industrial complexes based on these technologies are regulated by measures of

industrial, innovation, scientific and educational policies. Strategic competitive advantages provide dynamic sustainable development. Consider the UN Member States 2030 Agenda for Sustainable Development. Highlight Goal 9: "Build resilient infrastructure, promote inclusive and sustainable industrialization and innovation. By 2030, modernize infrastructure and re-equip industrial plants to make them sustainable through improved resource efficiency and increased use of clean and environmentally sound technologies and industrial processes, with the participation of all countries according to their individual capacities. Intensify scientific research, build up the technological potential of industrial sectors in all countries".

Innovative development of enterprises (the program "The 2030 Agenda for Sustainable Development of the UN Member States". We highlight Goal 9: "Creating a resilient infrastructure, promoting inclusive and sustainable industrialization and innovation) is a strategic system of innovative, organizational and managerial solutions aimed at achieving its goals and objectives. Advanced manufacturing technology makes extensive use of computer, precision and information components integrated with a high-performance workforce, creating a system that is flexible to respond quickly to customer needs. In the high-tech sector, unique technological solutions appear, on the basis of which new equipment and new equipment are created. Fig. 1 highlights the subsystems of digital transformation.

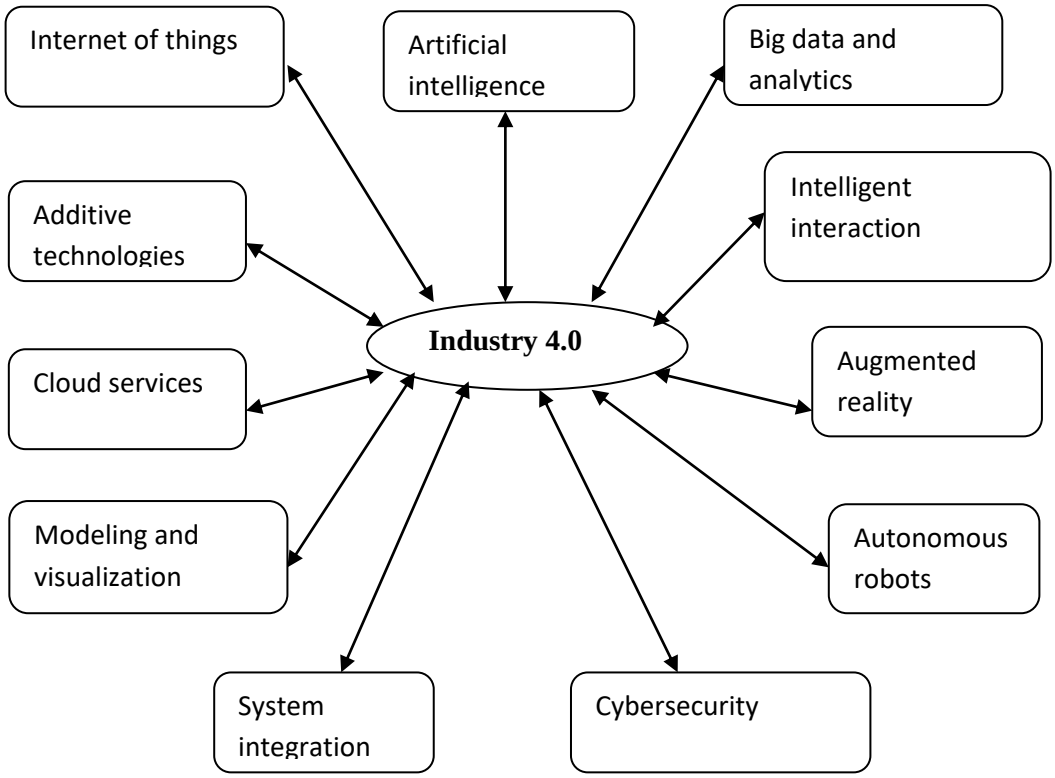

Fig. 1 Use of subsystems of digital transformation.

Digital transformation subsystems are used to make more accurate decisions and automation in every area of production management. Digital technologies are becoming a key component of the economy. Analysis of innovative and digital strategies of various countries shows that the creation of digital technologies and their embedding in the economy is becoming the main goal of innovative development. Analytics powered by big data and artificial intelligence. "Industry 4.0" involves the collection of big data from a wide range of sources - from production equipment and devices of the Internet of Things (IoT) to ERP and CRM systems [3,4]. The big data on which "Industry 4.0" is built is stored in the cloud, and the cyber-physical systems at the heart of the concept use the cloud to communicate and coordinate. The Industrial Internet of Things (IIoT) technology enables companies to optimize supply chains, quickly design and modify products, prevent equipment downtime, stay on top of consumer preferences, track products and stocks - and much more.

Additive Manufacturing / 3D Printing. Additive manufacturing, or 3D printing, offers a wider range of application scenarios, from mass customization to distributed manufacturing. With 3D printing, parts can be stored as design data files in virtual warehouses and printed on demand at the time of need. Augmented reality (AR). Augmented reality tools that overlay digital content on the real environment are a key component of "Industry 4.0". In augmented reality environments, employees use smart glasses or mobile devices to visualize real-time IoT data, digitized parts, repair or assembly instructions. Integration of production and network communications is the main goal of "Industry 4.0". Created on the basis of advanced software, artificial intelligence, including sensors and machine vision, robots are capable of performing complex and high-precision tasks, can recognize and analyze information received from the environment, and act on it. The production process covers the entire cycle of transforming knowledge into an innovative product according to the scheme: science - technology - product - market [5]. The development and diffusion of innovative technologies is very important for achieving the goals of sustainable development of enterprises. "Industry 4.0" is new technologies that unite the physical, digital and biological worlds, affecting all industries and the economy. The possibility of interconnection for various components opens up prospects: the development of "smart manufacturing"; improving the basic competitiveness of the manufacturing industry; introduction of innovations in the production of high-tech equipment. Three levels of digital production: auxiliary systems; cyber physical systems and artificial intelligence. Digital platforms in the manufacturing sector are essential to modernize industries, increase productivity, optimize resource allocation and increase employment. To analyze modern

developments, we will consider the development of new technological directions for creating new equipment, high-speed vehicles and various intelligent control systems for new types of transport. The application of smart digital technologies in practice, the peculiarities of developing tools and methods for digitalizing complex economic systems can be observed in the following industries: 1. The ICT, electrical and electronics (ICT) sector can show significant growth as it is a supplier of many technologies that will be required by other industrial sectors. 2.Vacuum magneto-levitation transport (VMLT), which uses an unconventional method of maintenance - magnetic suspension and stabilization in a vacuum environment [6,7]. 3. Technologies of "Industry 4.0" are used in oil and gas companies. Drilling works are carried out in a fully automatic mode, and new technologies allow autonomous inspection of pipelines, as well as equipment and abandonment of equipped wells. 4. Systematization of technological solutions for the coal industry in Russia, created on the basis of plans for the implementation of the project "Industry 4.0." 5. "Smart production" is being created - highly qualified workers who know practical and information technologies. Smart Manufacturing takes highly skilled workers to a whole new level. Maintenance work requiring high skill levels will mostly be outsourced. 6. Artificial intelligence gradually begins to assist a person in fulfilling his duties, for example, in recruiting personnel (Robot Vera), in driving cars (Cognitive Technologies), in organizing the work of lawyers, in the fire safety system [8].

The Digitising European industry provides access to digital technologies for all companies in all sectors and regions. To this end, the EU seeks to: coordinate national platforms according to "Industry 4.0", create "digital innovation centers" in each region and set standards, encourage leadership on digital industrial platforms, create large-scale pilot projects [10].

"Industry 4.0" is based on the Industrial Internet of Things (IIoT) and cyber-physical systems - intelligent autonomous systems that use computer algorithms to monitor and control physical things. Digital transformation is an integrated implementation of process innovations, significant changes in technology, equipment and software.

Adaptation of automated functions to changes in external conditions, predictive data analytics, digital display of processes, analysis in control systems PMS, MES, etc. Services and production management systems (Manufacturing Execution Systems, MES) are used by industrial enterprises to organize planning, control, monitoring and management the whole production process. Create reports, dashboards, and analytic capabilities to track product release, resource utilization, or equipment performance. With predictive analytics tools, enterprises can analyze and predict processes over time, identify trends, anticipate change, and therefore better plan for the future.

An important parameter of the functioning of a high-tech enterprise and production is a high proportion of the intellectual component, in particular the availability of the results of intellectual activity, objects of intellectual property. The patent landscape primarily helps to determine the development priorities, scientific and technological program, and the competitiveness of technologies. When using a digital platform, analyzing patent information, it is possible to determine the development strategy of the organization, technological, research, investment priorities, to obtain a higher result when conducting research and development and introducing developments into the production cycle [3,11]. With the help of patent technology intelligence, it is possible to conduct competitive analysis, select technology directions for investment and a patenting strategy. Appraisal firms assess the viability of a patent for an invention. The implementation of the "Industry 4.0" project implies the creation of a “smart” industry, which has evolved from the use of embedded information and communication control systems to cyber-physical systems. It is necessary to introduce new technologies of the domestic industrial complex, to ensure the rapid replacement of outdated equipment with progressive ones. Digital transformation is driving a dramatic increase in the productivity and value of enterprises.

The products of those regions that are actively introducing new technologies are effective. It is shown that the industrial revolution led to the creation of digital industries, the automation and robotization of which accelerated production processes and significantly increased quality indicators. Digital transformation is a leading area of technological development in the industry.
It is necessary to ensure the interconnection of strategies, innovations and investments in the system of ensuring sustainable development of enterprises and to use the experience of the "Strategy Europe 2020" program, which was launched in the European Union in 2006 and is aimed at "smart, sustainable and inclusive growth". It is aimed not only at economic growth, but in fact takes into account a large number of social factors and the need to adjust the policies of the EU and the participating countries in the field of education and social security. Three dimensions of sustainable development: social, economic and environmental, it is necessary to comply with their conditions for a high-quality human existence. Industrial cooperation contributes to sustainable development and includes:

- organization of joint ventures for the creation and production of innovative products;
- production agreements (supply of technologies and their adaptation to new materials, production line);
- commercial agreements for the development, installation and maintenance of new production technologies;
- making direct technical investments.

Enterprises with a developed mechanism of sustainable development achieve better results. Key processes of the enterprise: innovative, technological, resource, competitive. The formation and operation of the technological platform is carried out in accordance with the following general principles:

- Focus on solving strategic problems of the development of the national economy, priority state interests, meeting the most important social needs;
- Focus on research and development for solving medium and long-term tasks of the country's socio-economic development;
- The importance of the interests of business, key enterprises and consumers in the management bodies of the technology platform;
- A wide range of considered technological solutions, focus on the development of various technological alternatives;

Conclusions:

A systematic approach to the formation of sustainable development of an industrial enterprise includes the following stages of research:

1. Identification of the main priorities of sustainable development of an industrial enterprise, as a system or its individual activities, structural units, etc., as its individual elements.
2. Definition of the main software products of "Industry 4.0" to manage new technologies.
3. Development of a model for sustainable development of the enterprise.

Conclusion

The implementation of "Industry 4.0" programs raises innovative enterprises to a higher level. Smart manufacturing is becoming the norm in a world where smart ICT machines, systems and networks are able to independently exchange and respond to information to control industrial and manufacturing processes. Science and high technology are essential for a sustainable enterprise. Factors of sustainable development of enterprises determine the main criterion for its existence - competitiveness, technological advantages, profitability, long-term development prospects and sustainability. Technological platforms, which have begun to be widely used in different countries, have become a platform for interaction between scientific and educational institutions, industrial enterprises.

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