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TECHNICAL AND ECONOMIC FEATURES OF THE FOURTH INDUSTRIAL REVOLUTION

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Аннотация
В статье представлена информация о технико-экономических особенностях четвертой промышленной революции, цифровой экономике, цифровизации и интеграции вертикальной и горизонтальной цепочки создания стоимости, оцифровке товаров и услуг, а также цифровых бизнес-моделях.

Ключевые слова: четвертая, промышленная, революция, цифровая, экономика, интеграции, вертикальной, горизонтальной, стоимость, бизнес-моделях.

Annotation:
The article provides information on the technical and economic features of the fourth industrial revolution, the digital economy, digitalization and integration of vertical and horizontal value chains, digitization of goods and services, as well as digital business models.

Keywords: fourth, industrial, revolution, digital, economy, integration, vertical, horizontal, cost, business models.

Introduction

To date, there is no single interpretation of the concepts of "digital economy" or "digital sector", and no scientific papers have been identified in which between these concepts and the concept of the fourth industrial revolution any either analogy or connection. Below we will offer some of them: The digital economy is a system of economic, social and cultural relations based on the use of digital information and communication technologies.

The digital economy is digital marketplaces that facilitate the trading of goods and services through online e-commerce. The most common formulation characterizes the digital economy in terms of its basis, that is, digital technologies. But the approach chosen for further research is more extended, and considers the digital economy as an economic production, due to the changing nature of labor and the development of means of production and society using digital technologies. From this point of view, the fourth industrial revolution creates a "new" economic environment, is the material basis of the digital economy. On the other hand, it is possible to assess the level of development and efficiency

of the institutions of the digital economy in order to determine the possibility of unlocking the potential of the fourth requested revolution .

The development of technologies of the fourth industrial revolution takes place on the basis of digital technologies and networks deployed during the third industrial revolution. In turn, digital technologies were built thanks to the spread of electrical networks created during the second industrial revolution. It should be emphasized that new technologies in their essence, although they are a continuation of the development of digital developments of the third industrial revolution, are not a continuation of the digital revolution. The technologies described above have the potential to create entirely new sources of value. Today, the latest digital technological breakthroughs, which are difficult to understand and implement in enterprises, will become the basis of an updated infrastructure. Among scientists, there is some blurring of the time frame when describing their periodicals.

It makes sense to consider the research taking into account the different goals pursued by the authors. According to the theory of D. Rifkin, we are witnessing the deployment of the third industrial revolution, which is based on horizontal interaction at all levels ("distributed capitalism"), independent generation of "green" energy and the "energy Internet". At the same time, K. Schwab describes the transition to the fourth industrial revolution with the introduction of cyber-physical systems, the development of artificial intelligence, blockchain technology, as well as nano- and biotechnologies. The presented theories consider the process of technological development from different points of view.

They combine their general conclusions about the impact of new technologies on society, including the nature of work and employment dynamics, the emergence of new types of business models, and the development of a "green" economy. Therefore, further we will refer to both authors, presenting their research as theories that complement the picture of future changes. It is important to understand what is at the heart of the fourth industrial revolution. At its core, it is information technology. Changes will overtake all social production, representing a radical restructuring of the technical foundations of material production, in which science is the leading factor of production. Combining the approaches of scientists, we highlight that the coming revolution is based on the rejection of the use of minerals, the transition to renewable energy sources, combined with the introduction of powerful computers into production, almost complete automation and the transition to digital additive manufacturing. In general, the technological development of the fourth industrial revolution can be divided into 3 main areas: digitization and integration of the vertical and horizontal value chain, digitization of goods and services, and digital business models.

Table 1 . The digitization of economic activity can be defined as the incorporation of big data and the Internet into production processes and goods.

Digitization and integration of the vertical and horizontal value chain	Digitization of goods and services	Digital business models
Automation and use of cyber-physical systems	Artificial intelligence and big data analytics	3D printers and additives
Internet of Things	"Smart" sensors	
Cloud technologies and platforms	Virtual reality technologies	

Active use of cyber-physical systems or CPS is expected - systems for integrating computing resources into physical processes. Production facilities interact with goods and adapt, if necessary, to the new needs of consumers. It is assumed that in the future, a number of production stages will occur without direct human participation.

The concept of the Internet of Things has gained popularity due to the development of the network and consists in the interaction of objects with objects, as well as with the outside world, through embedded technologies. The functionality allows you to track and analyze information collected during the operation of machines and equipment, and create intelligent service models. This technology makes it possible to obtain the necessary information about the status of devices, equipment wear, the need for additional work, and other things at any time in order to adjust tasks and processes in production thanks to "smart" sensors that perform the tasks of data conversion, statistics registration and feedback. With the help of the concept, companies, on the one hand, will be able to monitor the quality of finished products, reduce wear of parts to a minimum, thus reducing costs, and on the other hand, control work with customers and receive feedback. To date, the technology continues to develop and is already most fully embodied in "smart" buildings and homes. Around 4.9 million things were connected to the Internet in 2015 worldwide. By 2020, it is estimated that up to 21 billion connected devices will be installed. However, like most modern technologies, the Internet of Things covers almost all major sectors of the economy, including healthcare, education, agriculture, transport, manufacturing, electrical networks and much more. Part of the underlying infrastructure is communication between machines. The mobile association Groupe Spéciale tracks the number of connected machines around the world . Among the G20 countries in June 2017, the United States had the highest connection rate, followed by France and the United Kingdom. Between 2012 and the second quarter of 2017, the number of connections increased by 131% in OECD countries and 272% in the G20. China had the largest share of connections worldwide (44%) at 228 million. With the development of the Internet of Things, a new problem arises - an enormously growing amount of data, including from "smart" sensors, is becoming increasingly difficult to process and store. A possible solution to these difficulties is seen in the active introduction of cloud structures - an information technology concept that implies not only storage, but, no less important, access to the total amount of information, servers,

storage devices and applications. The cloud is a kind of platform for interaction between participants, with the ability to store a huge amount of data, ubiquitous and free access, which will allow uniting market agents interested in interaction. It is assumed that with the development of cloud structures, data exchange will become more accessible, and the data transfer speed will be higher, which will allow large companies to reduce their management costs, and small ones will allow them to achieve significant results faster.

Artificial intelligence (AI) is a term used to describe machines that perform human-like cognitive functions (such as learning, understanding, reasoning, or interaction). It has the potential to revolutionize manufacturing as well as address global health, transportation and environmental issues. The development of technologies related to AI, on average, increased by 6% per year between 2010 and 2015 (Fig. 5). In 2015, around 18,000 patents were filed worldwide. From 2010-2015, Japan, Korea and the United States accounted for more than 62% of patent applications, up from 70% in 2000-2005. During the same period, China also increased the number of patents. Also, new tools using virtual reality technology will significantly affect the production process, which will allow companies to create and test situations, simulate the design process and the assembly line before creating a real product. Modeling of production processes is designed to guarantee cost reduction, the possibility of direct connection from anywhere in the world. Thus, for example, at any time it becomes possible to connect the necessary specialist from another country. J. Rifkin writes about the decline of the industrial era.

One of the foundations for it will be a technological innovation - a 3D printer - a device that potentially allows you to create durable goods on your own without large manufacturing factories.3D printing or “additive” manufacturing is the process of creating full-fledged three-dimensional objects based on their digital model by superimposing layers of source material. This process is the complete opposite of the traditional one, "subtractive" production, in which unnecessary elements are separated from the general array. This technology will significantly reduce initial costs and consumption of materials, and subsequently switch to a full-fledged "green" production. D. C. Moody and B. Nogradi also write about this, emphasizing that humanity will now have the opportunity to create economies based on resource efficiency, thereby moving society away from the use of fossil fuels, which characterized all previous industrial revolutions. It is worth noting that areas such as artificial intelligence, robotics, nanotechnology, 3D printing, genetics and biotechnology, which previously developed in parallel, are now perceived together and complement each other. Whether homes, factories, farms, networks or entire cities, smart systems will solve many of today's major challenges, from supply chain management to climate change, in the future. The World Economic Forum report presented the results of an assessment of the importance of the role of technology in the coming changes, which is based on the opinions of the leaders of the world's leading companies, representing more than 13 million employees in 9 industries. Yes , the mobile Internet and cloud technologies (34%), big data (26%), alternative energy sources (22%) and the Internet of things (14%)40 are seen as the leading drivers of change . K. Schwab41 points out the possible entry into

closer contact between people and governments thanks to the network and platform technologies. It will be possible to express your opinion on various issues, coordinate efforts and even bypass control systems.

On the other hand, thanks to powerful surveillance systems and information processing computers, there will be new opportunities to increase control over the population. During the third industrial revolution, the Internet drastically reduced the cost of generating and distributing information, then additive manufacturing, with enormous potential for cost reduction, can attract many mini-manufacturers of small and medium-sized companies that will form a new economic market. In the future, production will be based on cooperation between economic agents. The problem of costly and unsustainable supply chains will be solved by redeploying production points. The necessary goods will be produced in close proximity to the points of sale, the creation process itself will be carried out where it is more economically profitable. In the market, cooperation between participants will be carried out through "cloud" technologies, which are already widely used in the IT structure. Business success will no longer be limited by computing power, and researchers will be able to collect, analyze and publish data faster. The main development trend is technological platforms that combine supply and demand, thereby breaking the existing economic structures. J. Rifkin42 also writes about new forms of organization, introducing such a concept as social entrepreneurship. The new model gravitates toward horizontal enterprises, both in communities and in the marketplace. Thus, a new idea is born - a goal that is achieved together. Entrepreneurship and cooperation will no longer contradict each other, but will be seen as a setting for the transformation of economic, social and political life. The management system will radically change: a complete transition to full-fledged automation of the product life cycle. An existing example of such an innovation is the CALS (Continuous Acquisition and Life-Cycle Support) technology, an information environment that provides the most efficient interaction between all agents of the economic and industrial sectors through continuous information support for the supply and life cycle of products. But do not forget that in parallel with the success of the fourth technological revolution, humanity is waiting for a set of broader socio-economic, geopolitical and demographic changes. New opportunities for automation and robotization will change the idea of mankind about jobs, there will be a redistribution of the workforce across sectors of the economy. It is expected that production will return to developed countries, as it will no longer be beneficial to large companies due to inefficient supply chains, excessive environmental damage and other increasing costs. The labor market will take on a different form. From the "market of labor" characteristic of the pre-industrial era, and the "market of labor heads" inherent in the industrial era, in the knowledge economy there will be a transition to a "market of dynamic abilities", where the main object of transactions will be the ability of a person or an established group of people to become an inventor of new knowledge .The modernization of production will increase labor productivity and the quality of products, make production less man-made, thereby raising the level and quality of people's lives.

At the same time, the development of new technologies entails the growth of disproportions in society and increases the unemployment rate. Robotics with innovation will destroy a huge number of jobs, and as a result, will destroy a large part of the middle class - the basis of democratic systems. According to the data published by the global sociological trends in employment, it can be confidently stated that the rapidly developing technologies are significantly changing the situation in the market.

Technological innovations often lead to increased productivity and wealth, but the speed of these changes will put unprecedented pressure on the workforce during the transition phase. Current trends could lead to more than 5.1 million job losses between 2015 and 2020, with a total loss of 7.1 million, two-thirds of which are concentrated in offices and administration, while the total gain will be only 2 million Even assuming that this estimate of job loss of 5.1m by 2020 would be in line with employment growth (albeit in different industries), it is clear that the shift in skills and qualifications required will be a challenge for those in their jobs. still lose 45 . It must be taken into account that the problem of long-term negative and unforeseen impacts is becoming relevant given the speed of development of new technologies, including artificial intelligence and machine learning. To date, the greatest technological threat is seen in the uncontrolled conduct of geoengineering work, in violation of security conditions, private boundaries and the possibility of hacking due to the introduction of quantum computers, in exacerbating the possibilities of online aggression. New technological tools will transform all factors of economic growth. And whether they become a threat or provide an opportunity to improve the material well-being of the nation will depend on the "rules of the game" of the respective country. An important task of this work is to study what will happen to the economic system with the further development and introduction of new technologies, namely, the study of issues of labor productivity and economic growth, aspects of the formation and implementation of innovations, overcoming the "traps" of social development in various conditions for realizing the economic potential of the fourth industrial revolution.

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