

INDUSTRY 4.0 DEVELOPMENT ANALYSIS IN UKRAINE: TRENDS AND ISSUES

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Abstract. The relevance of the study is due to the constant development of technology, which ultimately led to a new industrial revolution. Everything starts and ends with the industrial sector. It is the heart of any economy. You can talk all you want about how important each sector of the economy is, but none of them will work without industry. The fourth industrial revolution (Industry 4.0) is the transition to fully automated digital creation, controlled by intelligent systems in real-time in constant interaction with the external environment, going beyond one company, with the prospect of joining a global industrial network of things and services. Industry 4.0 characterizes the current trend in the development of automation and data exchange, which includes cyber-physical systems, the Internet of Things, and cloud computing. It represents a new level of organization of production and management of the value chain throughout the entire life cycle of manufactured products. The purpose of the article is an in-depth analysis of the state of development of industry 4.0 in Ukraine. The object of the study will be the industrial sector of Ukraine, which plays a key role in the development of Industry 4.0. To determine the features of the development of Industry 4.0, the following methods were applied: induction and deduction, comparison and systematization - when characterizing the development of Industry 4.0; synthesis and analysis - to determine the content of the essence of Industry 4.0; morphological analysis - to clarify the essence of the state of development of Industry 4.0; abstract-logical - for theoretical generalizations and conclusions of the study. As a result of the study, key aspects of the development of Industry 4.0 in Ukraine were analyzed. The main trends of its development are defined.

Keywords: industry, development, industrial revolution, analysis, trends

JEL Classification: L16, L60

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Introduction. The pace of modern life compared to the life of previous years has become incredibly high. Constant changes no longer seem to be something unusual, but have become the norm of the modern environment. Everything now has to adapt to the huge number of innovations that occur almost constantly. But at certain moments there are especially many changes and the name of such a phenomenon is the industrial revolution. The prospects for future changes certainly seem bright for Ukraine. However, the fourth industrial revolution may face some difficulties that may significantly affect its global spread in Ukraine. Thus, the problems of transition to "Industry 4.0" are lack of a serious energy base; lack of sufficient material base; lack of appropriate transport infrastructure; cultural barriers, i.e. fear of the new; security issue; a surge in unemployment.

Literature review. Analyzing and summarizing the scientific and practical literature, it should be noted that most scientists [1-3] argue that any revolution is the result when the old cause-and-effect relationships can no longer work following the previous algorithm. The fourth industrial revolution or industry 4.0 is no exception.

A group of scientists [4-6] notes that the efficient and well-coordinated functioning of the industrial sector leads to an improvement in the results of social labor, and creates new jobs and new sources of profit, which, in turn, is a powerful

factor in the fight against poverty and the solution of a large number of social problems such as gender inequality, employment of the younger generation and the generation of pre-retirement age.

Some scientists [7-9] note that Industry 4.0 provides for the formation of specific, innovative intellectual installations that will be endowed with consciousness, implement the processes of forecasting and interaction, as well as independently perform the processes of self-improvement and changing their own functional elements in accordance with the current state of production.

In general, given the scientific achievement of most scientists, today we are in a state where Industry 4.0 has reached Ukraine. This requires new research.

Purposes. The purpose of the article is an in-depth analysis of the state of development of industry 4.0 in Ukraine. The object of the study will be the industrial sector of Ukraine, which plays a key role in the development of Industry 4.0.

Methods. To determine the features of the development of Industry 4.0, the following methods were applied: induction and deduction, comparison and systematization - when characterizing the development of Industry 4.0; synthesis and analysis - to determine the content of the essence of Industry 4.0; morphological analysis - to clarify the essence of the state of development of Industry 4.0; abstract-logical - for theoretical generalizations and conclusions of the study.

Results. Almost all countries of the world have already realized the fact that sooner or later their industry will switch or have switched to the conditions for the functioning of Industry 4.0 with all its advantages and disadvantages. Already in 2011, at the Hannover Fair, most of the participants declared the particular importance of forming a clear plan for the transformation and adaptation of the existing production system following the modern trends dictated by Industry 4.0. It is clear that, compared to 2011, today the influence of Industry 4.0 has increased so much that not a single modern country with a market economy can ignore this fact and has already proven mechanisms in its arsenal that have enabled national industrial systems not only to survive in new conditions but also adapted them to a qualitatively new state with a constant trend towards improvement and development.

Back in 2013, at the aforementioned Hannover Exhibition, the creation of one of the largest projects in cooperation between the government and scientists "Platform Industry 4.0" was announced. Accordingly, this platform in Germany launched a large-scale program to support entrepreneurship, innovation-active industries and standardization. It should be noted that the main goal of the "Industry 4.0 Platform" was not the formation of new business and industry management mechanisms in the conditions of Industry 4.0, but the creation of a comprehensive policy of stimulation, support in the form of recommendations and providing greater freedom for entrepreneurship, which subsequently became a powerful factor in the development of the Industry. 4.0 in Germany.

Analyzing the German experience in adapting to the conditions of Industry 4.0, it should also be noted that within the framework of the new operating conditions, the RAMI 4.0 architecture (Reference Architectural Model for Industry 4.0 - Reference architectural model for industry 4.0) was created. By itself, RAMI 4.0 can be imagined

as a three-dimensional map, which at the structural and algorithmic level demonstrates to everyone how one way or another it is possible to solve the problems that arise in the process of transformation and adaptation of local parts of the industry of an enterprise or government structures to the conditions of Industry 4.0. Another important goal of creating RAMI 4.0 is the formation of static standards in the process of understanding the main paradigm for implementing all the features of Industry 4.0.

The example of Germany quickly began to spread to all developed countries of Europe and today most of the industry of European countries with developed economies has created powerful mechanisms for adapting to the conditions of Industry 4.0.

The beginning of adaptation of the US industry to the realities of Industry 4.0 began in 2014. As in Germany, for such a complex and complex process, it was decided to create a special Industrial Internet Consortium (IIC, Industrial Internet Consortium), in which leading positions were taken by the largest US corporations. Thus, in the beginning, when Industry 4.0 was not yet so prominent, the US government did not take such trends seriously. The goal of the Industrial Internet Consortium was to gradually and most rationally unite enterprises and technologies that are critical for the creation, accumulation, and further internal dissemination of innovations and advanced ideas.

If we consider the experience of Asian countries in adapting to the conditions of Industry 4.0, then it should be noted that the main defining step that Industry 4.0 launched is that all developed Asian countries realized the importance of forming extensive and more open cooperation with European countries and the USA. Considering that most Asian countries have a type of government that simply does not allow the full development of Industry 4.0, its most obvious manifestation is that in these countries there has been an increased digitalization of existing products, while in Western countries Europe, and the US has been focusing on the production of new, innovative types of goods and services.

Thus, the key features of the manifestation of Industry 4.0 in Asian countries include the following trends:

1. In these countries, one of the most formalized and standardized concepts of Industry 4.0 has been formed today.
2. Compared to other developed countries in the world (for example, Europe and the USA), Asian countries have the most advanced technologies and algorithms for the Internet of things.

Ukraine is suffering from military aggression from the Russian Federation, but the world does not stand still, and today Industry 4.0 is actively being introduced into the activities of many countries of the world. Industry 4.0 has a huge impact on all areas of activity. The technologies that Industry 4.0 brings are enough to have a significant impact on the current system of economic activity in the world.

Industry 4.0 describes the organization of production processes based on technologies and devices that autonomously interact with each other along the value chain: a model of the "smart" factory of the future, in which computer-controlled systems control physical processes, create a virtual copy of the physical world and

make decentralized decisions based on mechanisms self-organization The concept takes into account the growing digitalization of manufacturing industries, where physical objects are easily integrated into the information network, which allows decentralized production and adapt in real-time in the future.

Today, the world is in a special situation where Industry 4.0 has an extremely uncertain impact on the global economy. Discussions are still ongoing about how much Industry 4.0 will change the industrial sector and the regions of entire countries.

Speaking of Ukraine, today we can state its two estates: the first, before the war, when our economy was gradually but effectively developing; and the military, when the entire economy stopped and began to work for military purposes. Today it is difficult to analyze the second state of Ukraine, it takes time when after the end of the war it will be possible to carefully analyze what prospects are possible in our country regarding the new Industry 4.0. That is why our study will be dominated by the analysis of the economic security of the state and Industry 4.0 before the start of the war in Ukraine (it should also be taken into account that after the start of the full-scale invasion of the Russian Federation, a large number of sectors of our economy change the pace of the world and even the type of activity that does not allow, today, analyze it carefully).

Attention should be paid to the fact that in Ukraine there is a very low number of innovatively active enterprises in the total share. This suggests that the industrial sector of Ukraine itself is not interested in innovations, which, in turn, are the main ones for a smooth and direct transition to Industry 4.0 (Fig. 1).

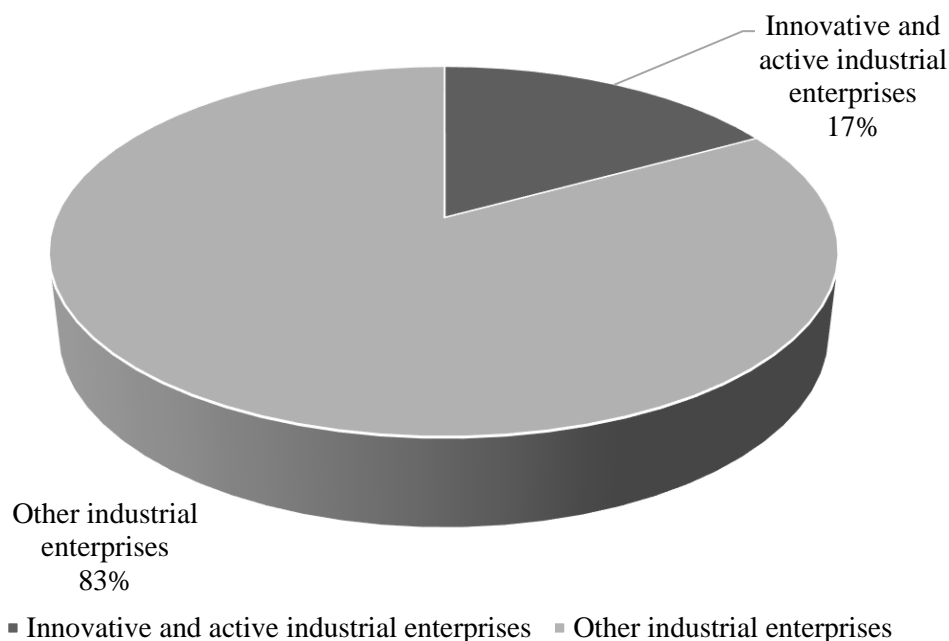


Figure 1. The main share of innovatively active enterprises in the total volume of the industrial sector of the economy of Ukraine in 2020, %

Sources: formed by the author based on [10]

As for the number of introduced innovations, there are a number of problems with them, since the introduction of innovations in products or in technological processes is

a very costly idea that may not bring the desired socio-economic effect. In recent years, the number of innovations introduced into products or technological processes has been constantly changing and we cannot talk about any stable dynamics (Fig. 2).

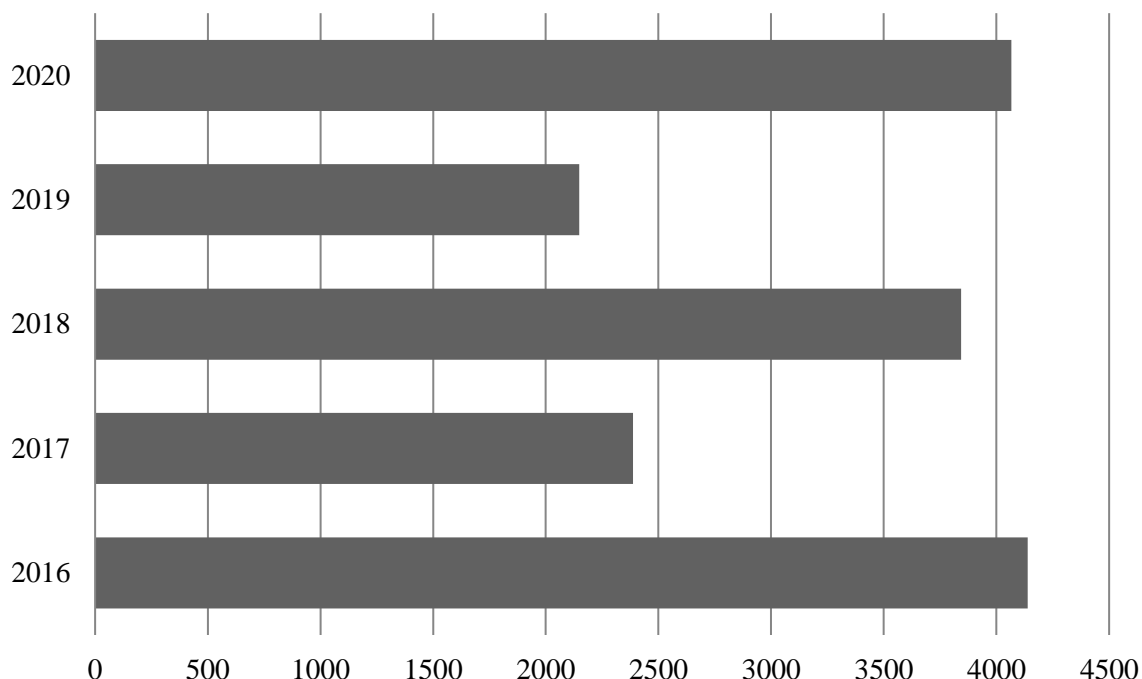


Figure 2. Dynamics of the number of implemented innovations in products or in technological processes of the industrial sector of Ukraine for 2016-2020, units

Sources: formed by the author based on [10]

In general, when analyzing the industrial sector of the Ukrainian economy, one can see low rates of innovation activity. Such a negative trend in innovation can be seen in other sectors of the Ukrainian economy. For example, even advertising activity, which is practically built as a mandatory application of innovations, has a very low share of innovatively active companies.

It should be noted that in modern conditions of development, Industry 4.0 is a new form of manifestation of technologies. Already in the previous subsections, we noted that Industry 4.0 is not exclusively an industrial sector. This is an event covering all socio-economic systems of the country. It is in this context that we can say that each of the components of Ukraine's economic security will experience this impact, but how ready each of them is for it, this question is different and very important.

Discussions. Discussing the results of the study, it should be noted that today it can be argued that Industry 4.0 is not a myth or a distant future, it is here and now. Today, due to the war, Ukraine cannot afford to actively develop innovations and ensure innovation security, however, the world does not stand still and is already demonstrating what Industry 4.0 is capable of, how it will change the industrial sector and the global economy as a whole. An important step in further research should be the analysis of the economic security of the state, without which it is impossible to achieve the effective development of Industry 4.0.

Conclusions. The importance of analyzing the state of development of Industry 4.0 in the world is proved. The state of development of Industry 4.0 in the leading

countries of the world is analyzed. The main levels of influence of Industry 4.0 on the global industry market have been established. The main indicators of the development of the industrial sector of the economy of Ukraine as one of the main elements of the formation of Industry 4.0 are analyzed. A number of problems with innovations and technological development in the industrial sector of the Ukrainian economy have been identified.

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