

# РОЗДІЛ I

## *Економічна теорія та історія економічної думки*

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Andriy Syshchuk,  
PhD in Economic Science, Associate Professor,  
Lesya Ukrainka Eastern European National University,  
Department of International Economic Relations and Project Management,  
Lutsk, ORCID ID 0000-0003-2973-203X  
e-mail: [asyshchuk@gmail.com](mailto:asyshchuk@gmail.com)

Viktoria Khirova,  
student of Master specialty,  
«International Economic Relations» of  
Lesya Ukrainka Eastern European National University,  
Department of International Economic Relations and Project Management,  
Lutsk, ORCID ID 0000-0002-7379-8063  
e-mail: [vika.khirova98@gmail.com](mailto:vika.khirova98@gmail.com)

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### NEOTERIC TECHNOLOGIES AS DRIVERS OF NEW INTERNATIONAL ECONOMIC ENVIRONMENT

**Abstract.** The article analyzes the influence of the latest technologies on the formation of key characteristics of the modern international economic environment and its individual components. Using the concept of "post-industrial society" and its economic features as a characteristic of the modern, most developed economies of the world, the revolutionary role of the latest technologies in their accelerated socio-economic transformation, as well as the transformation of the global international economic system, of which these economies are elements, is emphasized. The influence of the basic technologies of Industry 4.0 on international economic relations is investigated, the need to take them into account in the process of the development of the economic policy strategy of Ukraine is argued.

**Keywords:** postindustrial society, international economic environment, Industry 4.0, economic policy, technologies.

Сищук Андрей,  
кандидат экономических наук, доцент,  
Восточноевропейский национальный университет имени Леси Украинки,  
кафедра международных экономических отношений и управления проектами,  
г. Луцк

Хирова Виктория  
студентка магистратуры специальности  
«Международные экономические отношения»,  
Восточноевропейский национальный университет имени Леси Украинки,  
кафедра международных экономических отношений и управления проектами,  
г. Луцк

### НОВЕЙШИЕ ТЕХНОЛОГИИ КАК ДРАЙВЕРЫ ФОРМИРОВАНИЯ НОВОЙ МЕЖДУНАРОДНОЙ ЭКОНОМИЧЕСКОЙ СРЕДЫ

**Аннотация.** В статье анализируется влияние новейших технологий на формирование ключевых характеристик современной международной экономической среды и отдельных ее компонентов. Используя понятие "постиндустриальное общество" и его экономические признаки как характеристику современных, наиболее развитых экономик мира, подчеркивается революционная роль новейших технологий в их ускоренной социально-экономической трансформации, а также трансформации глобальной международной экономической системы, элементами которой эти экономики являются. Исследуется влияние базовых технологий Индустрии 4.0 на международные экономические отношения, аргументируется необходимость учитывать их при разработке стратегии экономической политики Украины.

Актуальность исследования связана с анализом процессом формирования нового международного экономического порядка, который в значительной мере будет определять глобальные тенденции экономического развития современного общества.

**Ключевые слова:** постиндустриальное общество, международная экономическая среда, Индустрия 4.0, экономическая политика, технологии.

Сищук Андрій,  
кандидат економічних наук, доцент,  
Східноєвропейський національний університет імені Лесі Українки,  
кафедра міжнародних економічних відносин та управління проектами,  
м. Луцьк

Хірова Вікторія,  
студентка магістратури спеціальності,  
«Міжнародні економічні відносини»,  
Східноєвропейський національний університет імені Лесі Українки,  
кафедра міжнародних економічних відносин та управління проектами,  
м. Луцьк

## **НОВІТНІ ТЕХНОЛОГІЇ ЯК ДРАЙВЕРИ ФОРМУВАННЯ НОВОГО МІЖНАРОДНОГО ЕКОНОМІЧНОГО СЕРЕДОВИЩА**

**Анотація.** У статті аналізується вплив новітніх технологій на формування ключових характеристик сучасного міжнародного економічного середовища та окремих його компонентів. Використовуючи поняття "постіндустріальне суспільство" та його економічні ознаки як характеристику сучасних, найбільш розвинутих економік світу, розкривається роль новітніх технологій у їх прискореній соціально-економічній трансформації, а також трансформації глобальної міжнародної економічної системи, елементами якої ці економіки являються. Досліджується вплив базових технологічних груп Індустрії 4.0 на міжнародні економічні відносини, аргументується необхідність враховувати його при розробці стратегії економічної політики України.

Метою статті визначено вивчення теоретичних основ та практичних аспектів стану міжнародного економічного середовища на сучасному етапі, у розрізі передових технологій, які задають темп та вектор його розвитку. Актуальність дослідження пов'язана із аналізом процесів формуванням нового міжнародного економічного порядку, який значною мірою визначатиме глобальні тенденції економічного розвитку сучасного суспільства.

**Ключові слова:** постіндустріальне суспільство, міжнародне економічне середовище, Індустрія 4.0, економічна політика, технології.

**Formulation of the problem.** The history of mankind is a rhythmic change of civilization cycles, the duration of which is constantly decreasing. Nowadays a completely new type of global economic development is emerging. It is based on the Big Data analysis, full automation of production, augmented reality, artificial intelligence and Internet of things technologies.

**The purpose of the work.** The theory of post-industrial society is today one of the most widespread concepts that adequately comprehend the large-scale changes that have occurred in Western societies over the past thirty years. Its supporters sought to emphasize that the key to modern social progress is rapid technological development based on the transformation of science into a direct productive force, and the measure of such progress is the formation of a comprehensively developed personality and the expansion of

human creativity. The purpose of this article is to analyze the main trends of post-industrial development, the key features of Industry 4.0 and technologies that became drivers of this new revolution in the context of international economic relations.

**Presentation of the main research material.** The fundamental distinguishing features of post-industrial society are: high labor productivity, high standard of living of citizens and the predominant influence of innovative technologies in the economy. The essence of this society is the continuous development of an innovative economy and the continuous growth of the quality of life of citizens.

The concept of post-industrial society can not be unambiguously attributed to the economic, social or political sciences. Its relatively isolated position is determined by the global methodological principles and the scale of the problems covered. At the same time, the concept of post-industrial society has internal contradictions: what is the main driver on the way to post-industrial stage of the development? There three approaches according to dominant criteria, which at the same time are also fundamental features-characteristics of post-industrial society:

1. Proponents of the first approach emphasize the importance of the transition from industry to the service sector (D. Bell, G. Estepin-Andersen).

2. Supporters of the second approach note changes in the nature of industrial production from mass production to flexible specialization (M. Castells, A. Amin, M. Piore. C. Sabel).

3. The subject of special attention within the third approach is knowledge and their importance, which is constantly growing for the economy (P. Berger, D. Hodgson) [10].

But today a new age of innovation is emerging, when advanced technologies are radically changing entire sectors of the global economy at an amazingly fast pace. It is called the Fourth Industrial Revolution.

In a broad sense, 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 value chain management throughout the entire life cycle of products (table 1).

Some countries are using definition Industry 4.0 for their Hi-Tech strategy (for example, Germany), which describes the concept of smart manufacturing based on the global industrial network of Internet of Things and Services.

Table 1

Characteristics of industrial revolutions

Industrial revolution	Period	Innovations	Result
Industry 1.0	End of XVIII – beginning of XIX	Water and steam engines, looms, mechanical appliances, transport, metallurgy	Moving from agrarian economy to industrial production, development of transport
Industry 2.0	Second part of XIX – beginning of XX	Electricity, high quality steel, oil and chemical industries, telephone, telegraph	Electrification, railway tracks, division of labor, current production
Industry 3.0	Since 1970	Digitization, development of electronics, use of infocommunication technologies and software in production	Automation and robotization
Industry 4.0	Since 2011	Global production networks, Internet of Things, renewable energy, 3D printers, vertical farms, food synthesis, self-managed transportation, neural networks, gene modification, biotechnology, artificial intelligence	Distributed production, sharing and consumption networks, direct access of the producer to the consumer, sharing economy

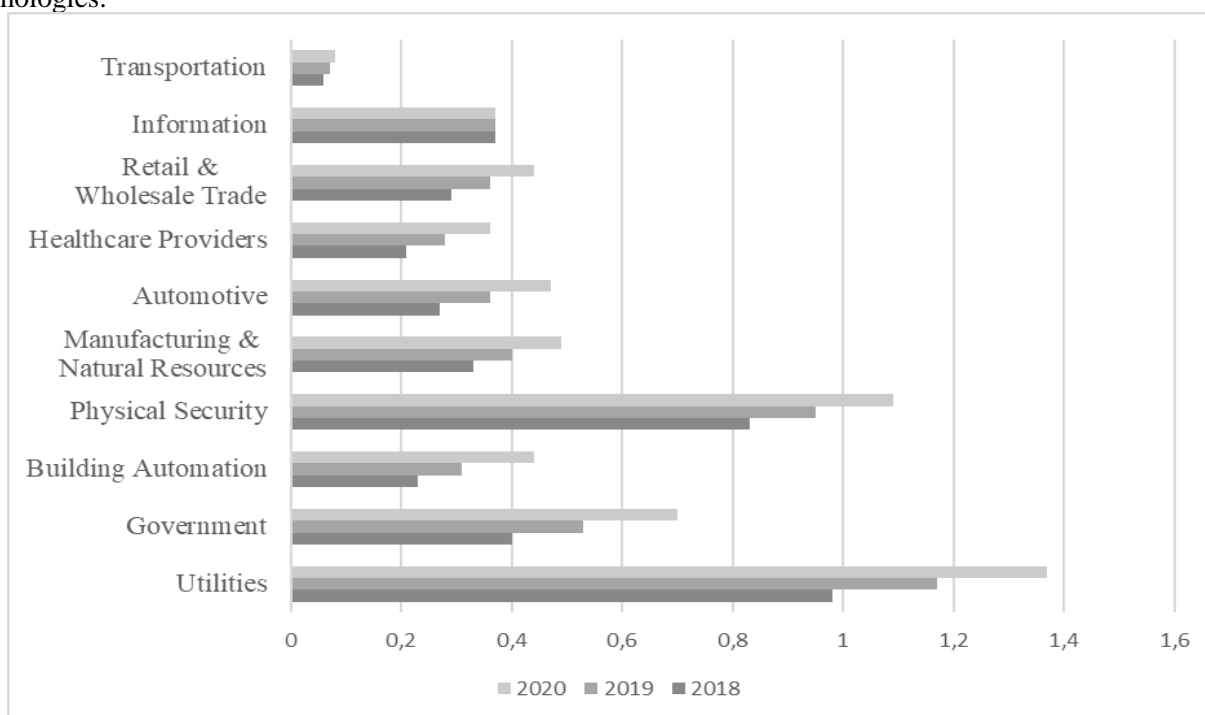
Source: [5].

The genesis and further development of the concept of post-industrial society were a response to the new realities of socio-economic development. In studies of post-industrial trends in general, it is possible to determine the vector for fragmentation and detailing of this issue. That is why experts identify four basic technologies, the implementation of which is expected revolutionary changes [9]:

— **Internet of Things.** The Internet is used to exchange information not only between people, but also between all kinds of “things”: machines, devices, sensors, etc. On the one hand, things equipped with sensors can exchange data and process them without human intervention. On the other hand, a person can actively participate in this process, for example, when we are talking about “smart home”.

According to a new update to the International Data Corporation (IDC) and Gartner, Inc. the enterprise and automotive Internet of Things (IoT) market will grow to 5.8 billion endpoints in 2020, a 21% increase from 2019. By the end of 2019, 4.8 billion endpoints are expected to be in use, up 21.5% from 2018 [1].

Building automation, driven by connected lighting devices, will be the segment with the largest growth rate in 2020 (42%), followed by automotive and healthcare, which are forecast to grow 31% and 29% in 2020, respectively. In healthcare, chronic condition monitoring will drive the most IoT endpoints, while in automotive, cars with embedded IoT connectivity will be supplemented by a range of add-on devices to accomplish specific tasks, such as fleet management [1]. At Figure 1 shown the main segments that use IoT technologies.



**Fig. 1. IoT Market by Segments, 2018-2020, Worldwide (Installed Base, Billions of Units)**

Source: [3].

Why are IoT technologies so important and why do they have such positive dynamic development? IoT allows companies to automate processes and reduce labor costs. This reduces the amount of waste, improves the quality of the services provided, reduces the cost of the production process and logistics. For example, the implementation of the Internet of things in the electric power industry improves the controllability of substations and power lines through remote monitoring. In healthcare segment it allows to improve the disease diagnosis – smart devices control the patient’s health indicators. In agriculture, smart farms and greenhouses themselves dose fertilizers and water. IoT in logistics reduces freight costs and minimizes the impact of the human factor.

— **Digital ecosystems.** These are systems consisting of various physical objects, software systems and controllers. Physical and computational resources in such ecosystem are closely related: monitoring and management of physical processes is carried out using IoT technologies. Traditional engineering models coexist harmoniously with computer ones.

The growing importance of digital ecosystems is due to the emergence of technologies that enable many participants in any processes to interact in the context of their activities and instantly provide any interested parties with the necessary information. The largest players offer "digital platforms" designed to ensure the collection, transmission and analysis of data generated by connected devices, as well as improve the quality of technical and financial-economic decisions.

Key features of the digital ecosystem:

1. The presence of information technology infrastructure and one common information environment for the interaction of participants.
2. Openness and the ability to connect to new members.
3. Algorithmization of the interaction of participants.
4. Mutually beneficial relations of participants (win-win principle).
5. Significance of the number of participants in the activity (scale).
6. Lower costs for ecosystem participants.
7. The actions of participants in the digital ecosystem are mutually beneficial and tend to be jointly supported and strengthened, what creates further opportunities for them that are not feasible outside this ecosystem.

Figure 2 demonstrates the size of the digital ecosystem revenue, based on the revenues of the top 30 companies per category, from 2009 to 2016. In 2016, revenues of the leading devices vendors, such as Sony, Apple, HP, Samsung, and Lenovo, collectively came to about 1.25 trillion euros (Fig. 2).

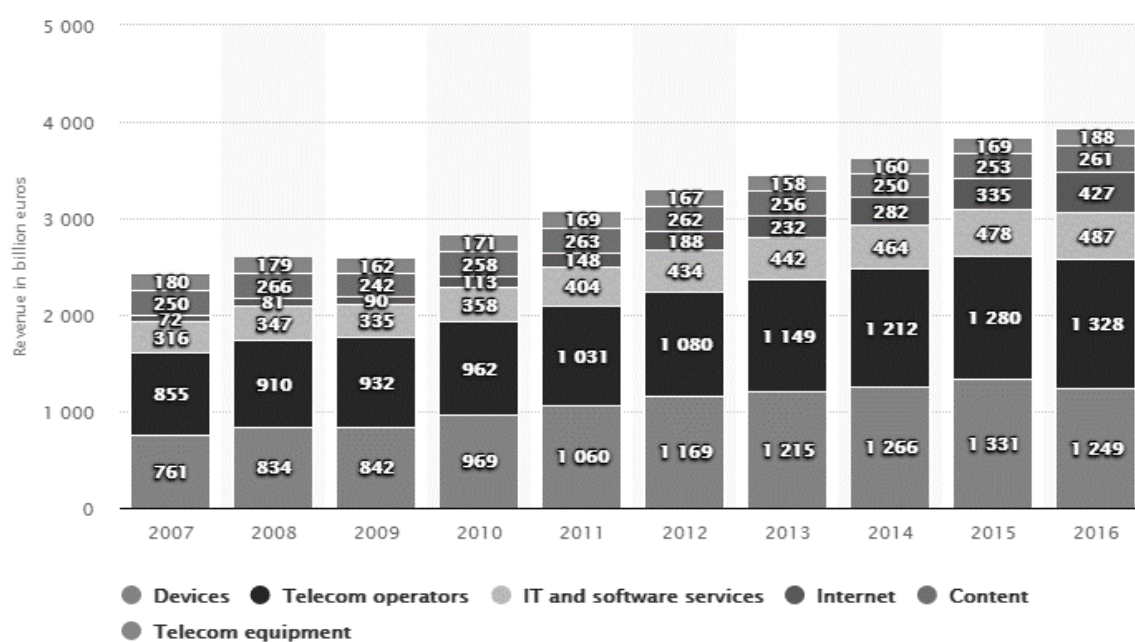


Fig. 2. Revenue from the digital ecosystem worldwide, from 2007 to 2016, by segment (in billion euros)

Source: [3].

— **Data Driven Decision or Big Data Analytics.** The huge amounts of information accumulated as a result of the digitization of the physical world can only be efficiently processed by computers, using cloud computing and Artificial Intelligence technologies. As a result, the person who controls this or that process or situation should receive processed data that is most convenient for perception, analysis and decision making.

Traditional analytics and Big Data analytics have many differences. Although these approaches are an example of direct development, today they are almost opposite processes.

In the modern world, Big Data is a socio-economic phenomenon that is associated with the fact that new technological opportunities have appeared for analyzing a huge amount of data. It is also known that Big Data is a variety of tools, approaches and methods of processing both structured and unstructured data in order to use them for specific tasks and purposes. Such tools, approaches and methods become more and

more important for different spheres. Nowadays there are some industries that have the biggest number of benefits from Big Data implementation (Fig. 3).

Table 2

**Differences between traditional analytics and Big Data analytics**

<b>Traditional analytics</b>	<b>Big Data analytics</b>
Gradual analysis of small data sets	Immediate processing of the entire set of available data
Editing and sorting data before processing	Data is processed in its original form
Starting from a hypothesis and testing it according to the available data	Search for correlations for all data before obtaining the required information
Data is collected, processed, stored and only then analyzed	Real-time analysis and processing of big data as it arrives

Source: [6].

The first one is retail. Retailers are aware of how to use Big Data in their business. They use the information they collect to build long-term and friendly customer relationships. And the profit received reflects the result of the work of a marketer;

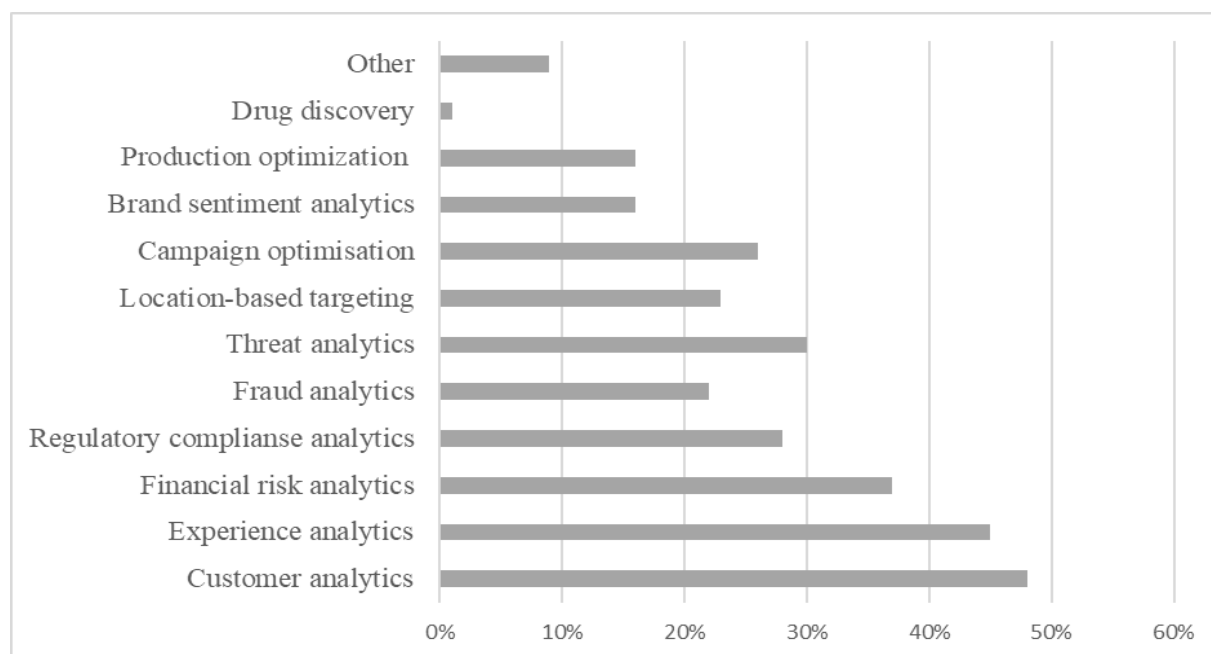


Fig. 3. TOP Big Data use cases in 2019

Source: [6].

On the second place is education. Teachers and professors will be able to modernize the school system, motivate pupils and university students to more successful work. It will also be easier for the teacher and professors to identify the lagging students of the courses, make sure the audience understands the topic and implement a more effective assessment system.

Next is Banking. Every day, bankers are faced with a tremendous amount of information that comes from countless sources. Proper processing of existing information flows will increase customer satisfaction, minimize credit risks and prevent fraud. Therefore, financiers are interested in finding new innovative ways to use Big Data like no other.

Healthcare is also worth mentioning. Medical records, treatment plans, clinical tests, genetic studies and prescriptions of doctors – all this can be combined in one database. Analytics of the collected information will help to draw new conclusions about the applied methods of therapy and improve patient care.

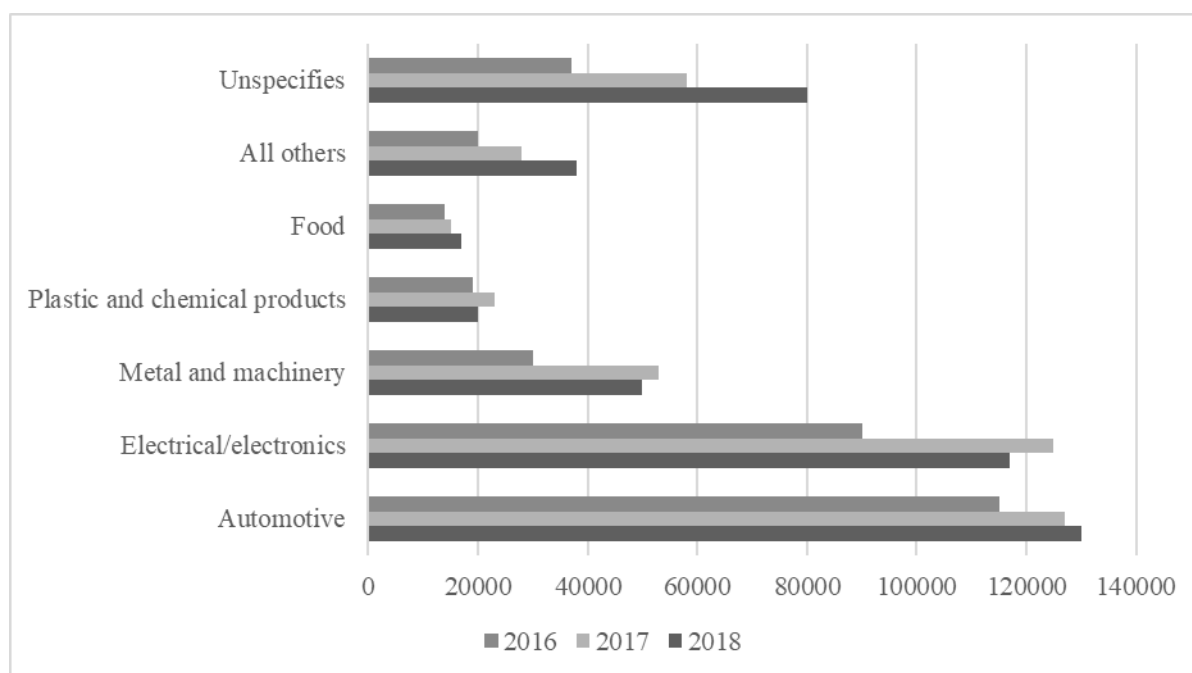
Production is a one more industry of broad Big Data implementation. In conditions of fierce market competition, it is important to minimize raw material costs and improve product quality. Predictive analytics will help to find solutions of these problems.

- **Robotization and Automation of products, processes and services.** World develops really fast and one of the key feature of the global economy at the present stage of the development is the transition from the era of industrial automation to the diverse use of advanced robotic technologies in the economy. The development of the industry facilitates and accelerates the life of society, reducing the costs of production by the minimization of the time of the production cycle, which in its turn increases the profitability of the business. At the same time, the risks of global replacement of "smart person" to "executive robot" are increasing.

The International Federation of Robotics annually monitors the level of robotization in different countries of the world. According to the Federation, since 2018, more than 400,000 units of robots are installed each year in various sectors of the economy [3]. Characterizing the sectoral structure of the robotic process, we can conclude that the automotive, electronic, industrial and chemical spheres are leading in the number of robots integrations (Fig. 4).

The automotive industry is the most active "customer" of industrial robots. Almost 30% of all robotic installations are implemented in this field. From 2013 to 2018, the annual robotization of the automotive industry annually accelerates the pace by 13% [3]. After the economic crisis in 2008/2009, car manufacturers began to transform their businesses. Investments in new production facilities in emerging markets and investments in production upgrades in major car manufacturing countries have become a steady trend.

The robotics of the electrical / electronics industry, covering computers, radios, television and communications devices, medical equipment, has been accelerating its annual growth rate by 24% annually since 2013 [3].



**Fig. 4. Annual installations of industrial robots at year-end worldwide by industries 2016-2018**

Source: [3].

However, in 2018, global demand for robotic electronic devices and components has dropped significantly. The industry was one of the hardest hit by the trade and economic crisis in China and the US, as Asian countries are leaders in the production of electronic products and components. However, in view of the coronavirus pandemic in 2020 and the need to limit direct human contact, the robotization of the electrical / electronic industry is already showing record breaking dynamics.

In 2018, the average density of robotics in the manufacturing industry was 99 robots per 10,000 workers [3]. Numerical indicators indicate that industrial robots are becoming more advanced and innovative technological solutions. They come to the fore because they provide a solid opportunity to compete in the market. As new applications are identified, demand for robotization continues to increase.

Robotization greatly increases productivity. If required, robots are capable of operating 24/7, they do not require interruptions, helping to reduce the production cycle. Robotization of industrial enterprises increases the capacity of production shops, improves the coordination of work processes, which ultimately significantly increases the efficiency of all production. The combination of these factors optimizes the production process, reducing cost and increasing profits for the business owner.

According to Castells M. robotization leads to that fact that the spatial division of labor, which characterizes high-tech production, becomes a global connection between innovative environments, centers of high-skilled production, assembly lines and factories oriented to the market. Also, there are several intercompany connections between different operations in different places of production lines and another series of intercompany relations between similar functions production located in specific places that have become industrial complexes. Management nodes, manufacturing centers and communication centers are defined over the network and clearly expressed in common logic through communication technologies and a programmable, microelectronic-based, flexible integrated production. The functions that must be performed by each industrial network determine the characteristics of places that have become privileged functional nodes [12].

**Conclusions from the research.** So, it should be concluded that today, the material world is connected with the virtual one, as a result of which new cyberphysical complexes are created, combined into one digital ecosystem. The transformation of the manufacturing industry is called a revolution precisely because of the radical changes: the industry is rebuilding business models are changing, new companies are creating.

It also should be noted that technologies are an element of the productive forces of post-industrial society. Their influence is manifested in the economic part of international relations, in business, social or political spheres. If we are talking about entrepreneurship and business, we can say that post-industrialism sets the following key directions of its development:

1. Rethinking of external communication, building relationships with customers and partners based on specific product that will meet their needs.
2. Customization of business models both for the client and for circumstances and situations. In this case, the business model becomes a sharing omnichannel model.
3. Project management transformation, moving to Agile and LEAN technologies.
4. Rethinking of working with data. It's not just about Big Data but also about deep machine learning and the use of artificial intelligence that even makes decisions in situations with incomplete asymmetric information.
5. Questions of internal relationships and communications. Digital transformation motivates to arrange work with people in a different way, for example, remote or freelance formats [11].

The development of new technologies in the field of artificial intelligence and wireless networks has many advantages for mankind, but also poses many dangers. Information security experts warn that the state and business should now prepare for new digital threats in the future. For example, an increase in the number of transactions conducted over the Internet will conduce companies to store more data on the network. This can make organizations attractive targets, on the one hand, for hackers who want to maximize profits, and, on the other hand, for countries that are planning spyware attacks.

In the future, even more devices will be connected to the Internet. The quantity and speed of information is growing exponentially, and 5G is waiting for mankind soon. This is a hundredfold acceleration in data transfer rates. All people systems will be able to communicate with each other with almost unlimited speed. The proliferation of 5G networks will lead to the emergence of an increasing number of services and they need to be provided with a high level of security because everything that is connected to the network can potentially be hacked.

From the object of interest in science fiction literature, artificial intelligence (AI) has become part of everyday reality. AI systems are introduced not only in complex robots, but everywhere in general: in smartphones, cars, vacuum cleaners, social networks and streaming services. Unchanged, however, were the questions that humanity was asked in connection with this. How close are we to reality in which AI will dominate? How does the introduction of artificial intelligence transform human society? Finally, is it possible that AI will supplant people and take control of the world?

Critics of the concept of post-industrialism also consider the insufficient depth of theoretical constructions and shifting the emphasis on qualitative characteristics without disclosing the mechanisms of



transition to the post-industrial stage of development as weaknesses of this theory. Only the most developed countries took the first steps to the post-industrial stage. For most of the world, this is the distant future to prepare for. This is true, but at the same time we cannot deny the fact that the modern technological revolution is changing the world so rapidly and radically that existing methodological approaches cannot be used to explain the patterns of its development.

For our country equally important question remains: where is Ukraine in this new post-industrial environment? According to Academician A. Chukhno, there are two global factors that affect the implementation of economic policy in Ukraine: the first is a post-industrial revolution, which has no equal depth of transformation in history, and the second is that Ukraine has lagged behind the advanced countries for a whole technological epoch and is at the industrial stage of development [14]. That is why the formation of economic policy considering the processes and trends of formation and development of post-industrial society is an objective necessity. Ukraine should not just be a neighbor with a strong agricultural, IT and metallurgical component, but become a high-tech hub for joint production and simplified transit of goods.

Today, Ukraine is still dominated by the growth factors that are drivers of the industrial society: natural, capital and labor resources, as well as scientific progress. Severe long-term crises have had a serious negative impact on the Ukrainian economy, pushing it back. Therefore, in order to overcome self-isolation and join the general civilizational progress, this country, along with the continuation of market reforms, improvement and strengthening of the market mechanism, needs to carry out technical and technological re-equipment of the economy. It is necessary to stimulate the development of new technologies, conduct scientific and technical work, increase attention to the formation and effective use of human capital, accelerate the development of informatization of society. And although it is too early to talk about Ukraine's approach to post-industrial society, these measures will help speed up this process [10].

One of the consequences of the technological revolution and pandemic is the transformation of production and global supply chains. Robotization, 3D printing and risk insurance will push production closer to markets and high-tech labor. This is the chance for Ukraine. These trends can be used as an opportunity. Ukraine already has a number of advantages: geographical location, highly educated workforce, deep and comprehensive free trade area with the EU. Establishing the production of high-tech goods in Ukraine and their export to the largest market in the world (EU) is a mega-project of Ukraine for the coming years [13]. The main thing is to use these opportunities correctly.

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