

ЕКОНОМІЧНІ НАУКИ

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IMPACT OF INDUSTRY 4.0 ON THE GLOBAL ECONOMY

Summary. The article examined the transformation processes, as well as the opportunities and threats facing the countries of the world during the transition to Industry 4.0 and examined the degree of influence of the fourth revolution on global processes. The scientific and technological development of the world and modern concepts within the framework of Industry 4.0 were investigated, the growth rates and growth rates, the influence of trends on the world economy, the influence of Industry 4.0 technologies on economic indicators and their dynamics was investigated. It was found that there are four basic technologies, because of the implementation of which significant revolutionary changes are expected in the world: the Internet of things, digital ecosystems, big data analytics, digital platforms.

Keywords: Industry 4.0, digitalization, industrial automation market, industrial robots, global dynamic.

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ВПЛИВ ІНДУСТРІЇ 4.0 НА СВІТОВУ ЕКОНОМІКУ

Анотація. У статті було розглянуто трансформаційні процеси, а також можливості та загрози, що виникають перед країнами світу під час переходу до Індустрії 4.0, також було досліджено ступінь впливу четвертої революції на глобальні процеси. Було досліджено науково-технічний розвиток світу, проаналізовано основні теоретичні напрямки та вплив тенденцій на світову економіку, досліджено вплив технологій Індустрії 4.0 на економічні показники та їх динаміку. Було виявлено, що існує чотири базові технології, в результаті впровадження яких очікуються істотні революційні зміни у світі: інтернет речей, цифрові екосистеми, аналітика великих даних, цифрові платформи. Впровадження будь-яких засобів автоматизації, в тому числі технологій Індустрії 4.0, виправдано, якщо це дасть економічний ефект в порівнянні з прийнятими формами виробництва і бізнес-процесів. Практика ряду компаній показує, що комплекс інструментів четвертої промислової революції дозволяє досягати економічно значущих результатів. В усьому світі спостерігається стрімке збільшення кількості угод на ринку злиття та поглинань у світі за участю промислових високотехнологічних компаній. Практично всі сектори, що створюють технології Індустрії 4.0, продемонстрували помітне зростання. Із розрахунків, можна побачити певну нестабільність показників продажів промислових робіт за останні роки. Тенденція переважно є зростаючою, але трапляються випадки зниження показників темпів зростання та приросту. Ці та інші тренди в значній мірі формують майбутнє промисловості, їх слід враховувати як державі, так і бізнесу. Крім того, наведені тенденції свідчать про зростання ряду ринків, що створює нові можливості для компаній, націлених на пошук своїх ніш. Однак, не дивлячись на великий потенціал четвертої революції, перехід до діджиталізації та новітніх технологій може становити низку загроз для глобального ринку. Найпоширенішими загрозами є розроблення рішень, що не є релевантними ситуації на ринку, та безпека даних. Ще однією загрозою є стандартизація, адже більшість компаній потребує відкритих, глобальних стандартів, на основі яких можна вирішувати поточні проблеми.

Ключові слова: Індустрія 4.0, діджиталізація, ринок промислової автоматизації, промислові роботи, світова динаміка.

Problem statement. Our time can be described as the Fourth Industrial Revolution or, as it is also called, Industry 4.0. In modern conditions, the concept of Industry 4.0 has become widespread in the world.

The transition to the concept of Industry 4.0 indicates that in the future such business processes as the supply of raw materials and materials, the development and delivery of goods to consumers and their service will be carried out via the Internet, therefore, the question of studying the features of the transition of countries of the world to Industry 4.0 is of particular relevance.

Analysis of recent research and publications. The ideas of new industrialization are outlined in the works of A. Alekseev, S. Antonov, V. Lifshits, V. Afanasyev, A. Babaeva and others.

R. Baldwin, P. Bianchi, A. Bunfur, S. Yin, S. Luo, M. Muro, D. Rodrik, A. Roiko, G. Bibik investigate the problems and prospects of industrial development in the context of the introduction of Industry 4.0., V. Geyets, Yu. Kindzersky, S. Kraichuk, L. Melnik and others.

These and other works highlight various aspects of the new trend in the development of the economy – «Industry 4.0», the problems of its implementation in real production.

In addition, scientists have formed conceptual principles and strategic directions for the development and implementation of the Industry 4.0 concept at industrial enterprises of various types of economic activity, analyzed the prerequisites, advantages and disadvantages of introducing informatization and automation of business processes [1].

Highlighting of previously unresolved parts of a common problem. Technologies in the modern world are developing very quickly. As a result, new social relations are formed, resource priorities and proportions are shifted and rebuilt, the qualitative basis of production is altered, the role and place of a person in society are transformed. Therefore, the study of Industry 4.0 at this stage of globalization is extremely relevant and solving the problems of new threats and barriers is an urgent issue.

Purpose of the article. The purpose of the article is to determine the transformation processes, opportunities and threats that countries face during the transition to Industry 4.0, to determine the degree of influence of the fourth revolution on global processes, to analyze the trends of Industry 4.0 in the present time and to predict the future.

Presentation of the main material. It is believed that the new direction in the development of the industry heralds the fourth industrial revolution. The first was associated with the replacement in the late 18th and early 19th centuries of the muscular strength of workers with the energy of steam and water in the first machines. The second – with electrification and the introduction of conveyor production at the beginning of the 20th century. The third revolution took place in the 60s and 70s of the last century in connection with the development of numerical control (DNC) and microprocessors.

The fourth stage, according to German experts, should be related to the Internet and artificial intelligence. «Smart equipment» in «smart factories» will independently, without human intervention, go online, transmit and receive information necessary for work [2].

Today, both for the national and global economies, the problem of ensuring the effectiveness of digital technologies and enhancing their positive impact on economic growth and socio-economic development of countries is urgent. In this regard, the majority of scientists and practitioners consider it a priority task on a global scale to increase the availability of the Internet, including price.

There are 5 people in the world for every user of a high-speed broadband connection who do not have such a connection. Globally, almost 4 billion people do not have access to the Internet at all. About 2 billion people do not use mobile phones, and almost half a billion people live in areas without mobile communications [3].

Experts identify four basic technologies, as a result of the implementation of which revolutionary changes are expected [1].

1. Internet of things (Internet of Things, IoT). In this technology, the Internet is used to exchange information not only between people, but also between different «things», that is, 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 he or she comes to the «smart home».

2. Digital ecosystems. These are systems consisting of different physical objects, software systems and controllers, which make it possible to represent such an entity. Physical and computing resources in such an ecosystem are closely related, monitoring and control of physical processes is car-

ried out using IIoT technologies. Traditional engineering models coexist harmoniously with computer models.

3. Analytics of big data (Data Driven Decision) or simply Big data (Big data). The huge amounts of information accumulating because of the «digitization» of the physical world can only be efficiently processed by computers (in the future, possibly, quantum) using cloud computing and artificial intelligence technologies. As a result, a person controlling a particular process, situation, situation should receive processed data that are most convenient for perception, analysis and decision-making.

4. Complex information systems open for use by customers and partners (digital platforms). These can be digital platforms and systems for managing business processes, for integrating the Internet of speeches into physical business processes, for analyzing and predicting the state of equipment, etc.

The fourth industrial revolution, in addition to the above areas of accelerated development, may also mean the widespread introduction of 3D printing, printed electronics, the use of distributed ledgers (i.e. blockchain technology, which became popular after the creation of cryptocurrency on its basis), the use of virtual and augmented reality, even the development of autonomous robots, which are not components of automated lines, as it is now, but quite mobile highly intelligent devices capable of working next to people.

Since modern technologies are developing very quickly, companies do not always have time to take timely measures to increase competence on their own.

Therefore, we can note a trend towards an increase in the number of mergers and acquisitions in the industrial sector (Figure 1).

Indicators of the number of transactions over the past 4 years have had a constant upward trend. In the period from 2018 to 2020, the number of M&A deals doubled: from 43 to 86 deals, which indicates the willingness of companies from all over the world to learn from each other's experience and increase their potential.

In 2020, both the number of mergers and the average contract value reached their maximum values, namely 86 mergers and acquisitions worth \$ 1,062 million. It was during this period that one can observe how the world practically burst into the realities of Industry 4.0.

The obvious consequence is the growth of markets and sales of all leading technologies, which is evidenced by the dynamic development of Industry 4.0.

Figure 2 shows the dynamics of growth in the volume of the automation market.

On the chart above, we can see with the naked eye a stable upward trend in the indicator of the volume of the industrial automation market. Over the past 10 years, the indicator has doubled, which indicates the intensification of the introduction of Industry 4.0 technologies.

The industry is now on the cusp of the fourth industrial revolution. Automation is followed by the digitalization of production. The goal is to improve productivity, efficiency, speed and quality, which will lead to more competitive companies on the way to the future of the industry.

The table below shows the calculations of the growth rates and rates of increase in the volume

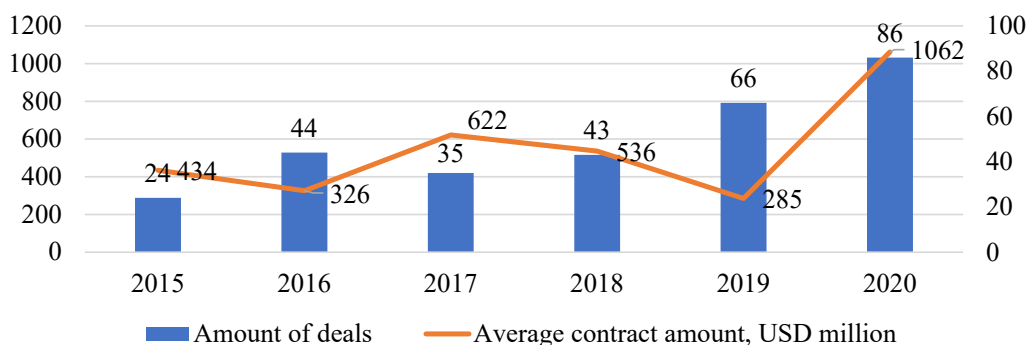


Figure 1. Number of deals in the M&A market in the world with the participation of high-tech industrial companies

Source: compiled by the authors based on the source [4]

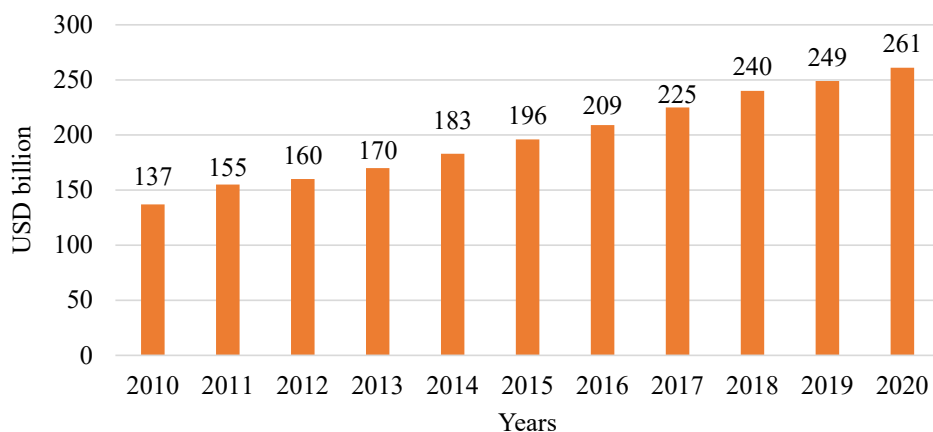


Figure 2. Global dynamics of the volume of the industrial automation market, USD billion

Source: compiled by the authors based on the source [4]

of the industrial automation market in the world (table 1).

Looking at the results of calculations of growth rates and rates of increase, we can see that the rates of increase does not have any negative values, which indicates a stable growth trend in the industrial automation market.

We can research the behavior of the indicator in more detail by depicting its dynamics graphically (Figure 3).

In general, according to the graph above, the rates of increase have approximately equal indicators during the period 2013–2018, which reflects the stable development of the industrial automation market.

But in the period from 2011 to 2014, there was a sharp decrease in the indicator by almost 4 times, and, despite the «jumps» in the graph, the indicator still tends to systematic growth.

Almost all sectors creating Industry 4.0 technologies have shown significant growth. A separate ex-

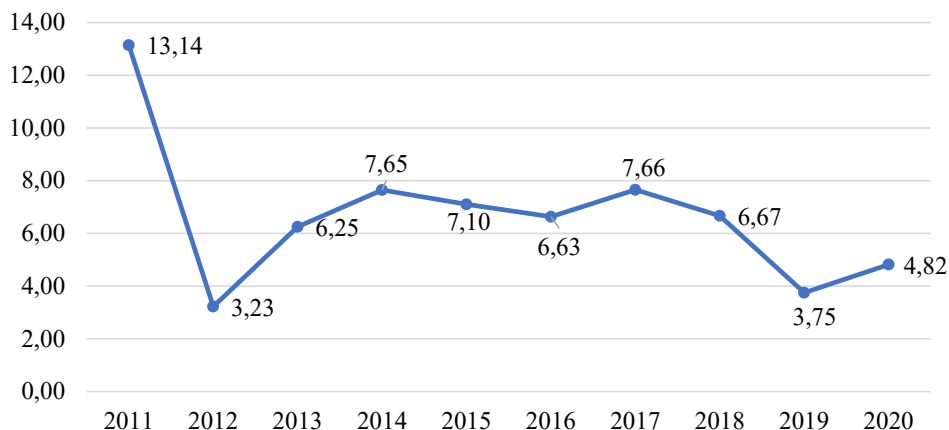


Figure 3. Dynamics of indicators of the rates of increase of the industrial automation market, %

Source: authoring

Table 1

**Calculation results of analytical indicators of the dynamics
of the industrial automation market**

Years	Industrial automation market size, USD billion	Growth rate, %	Rate of increase, %
2010	137	-	-
2011	155	113,14	13,14
2012	160	103,23	3,23
2013	170	106,25	6,25
2014	183	107,65	7,65
2015	196	107,10	7,10
2016	209	106,63	6,63
2017	225	107,66	7,66
2018	240	106,67	6,67
2019	249	103,75	3,75
2020	261	104,82	4,82

Source: authoring

Table 2

**Table The results of calculations of indicators of growth rates and rate
of increase in sales of industrial robots**

Years	Sales volume of industrial robots, thousand units	Growth rate, %	Rate of increase, %
2015	120	-	-
2016	165	137,50	37,50
2017	159	96,36	-3,64
2018	179	112,58	12,58
2019	225	125,70	25,70
2020	240	106,67	6,67

Source: authoring

ample is the dynamics of sales of industrial robots (Figure 4).

On the graph, we see mainly the growth of indicators from year to year. However, the dynamics of indicators is rather unstable, therefore it is rather difficult to calculate the most reliable forecast values for the future.

In 2017, we can observe a decrease in the sales of industrial robots, it amounted to 159 thousand units, but then the indicator began to grow rapidly and already in 2020 amounted to 240 thousand units of industrial robots.

We also investigate the analytical characteristics of the dynamics of sales of industrial robots and a graphical representation of the growth rate (table 2) (Figure 5).

As we mentioned earlier, the dynamics of indicators is quite volatile. We can see that in 2017 the rate of increase took on a negative value, which we can confirm the decline in the sales volume of industrial robots during this period. We can see the most rapid growth over the period under review in 2016 – the market volume amounted to 165 thousand units, and the rate of increase was 37.50%

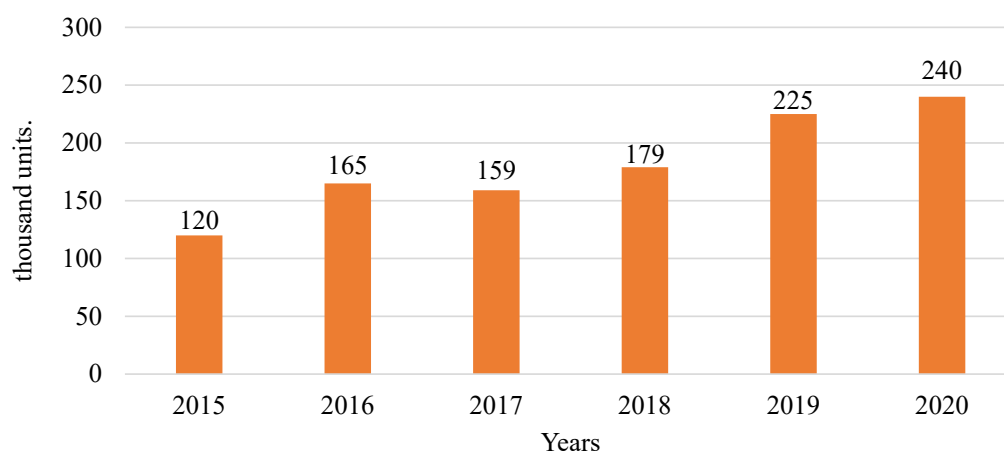


Figure 4. Global dynamics of sales of industrial robots, thousand units

Source: compiled by the authors based on the source [5]

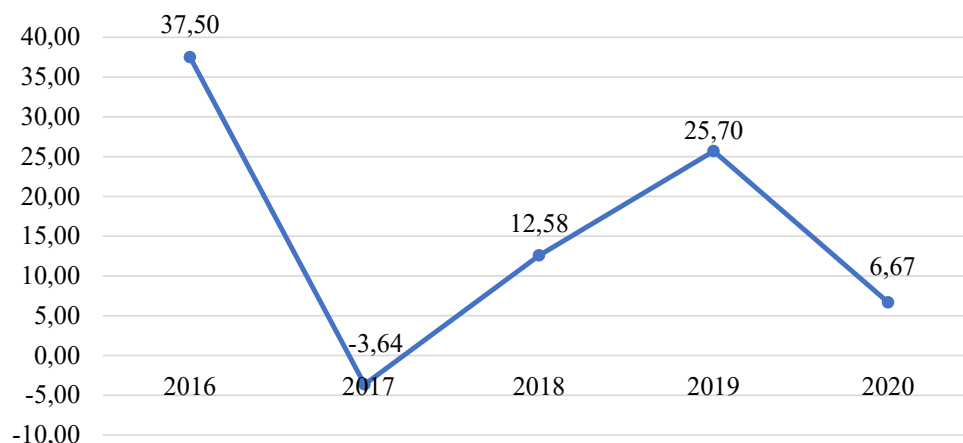


Figure 5. Dynamics of indicators of the rate of increase of sales of industrial robots, %

Source: authoring

From the calculations above, we can see a certain volatility of indicators in recent years. The trend is mainly growing, but there are cases of a decrease in the indicators of «growth rates» and «rates of increase».

In 2017, there is a very sharp decrease in the indicator, it amounted to -3.64%, which indicates a deterioration in the market for sales of industrial robots. From 2017 to 2019, the indicators began to grow rapidly again, but by 2020 the indicator had significantly decreased and acquired a value of 6.67%.

These and other trends are shaping the future of the industry to a large extent; they should be considered by both the state and business. In addition, these trends indicate the growth of several markets, which creates new opportunities for companies looking to find their niches.

However, despite the great potential of the fourth revolution, the transition to digitalization and the latest technologies can pose a number of threats to the global market. The most common threats are the development of solutions that are not relevant to the market situation and data security [6].

Standardization is another threat, as most companies need open, global standards on which to solve current problems.

Conclusions and offers. Summing up the above, it can be noted that Industry 4.0 is developing at a frantic pace, forcing all countries of the world to look in a new way at the processes of globalization. At this stage, the world needs to adapt to the fourth revolution, find balance and cooperate with various participants in economic processes, create new business models and promote production optimization. According to the forecasts of the World Economic Forum [7], most of the technologies of the Fourth Revolutionary will become everyday life in 2027. This meant that not only pink houses would appear, but also pink, artificial goods in offices and supercomputers in pockets. An interesting direction for further scientific research is the analysis of the readiness of the countries of the world for the potential challenges and threats of Industry 4.0, the study of the maturity index and the methodology for implementing the concept of the fourth revolution.

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