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2.4. Global trends in digitalization and smartization of economies and society

The current level of development is characterized by the dynamism of many spheres of society, including cultural, social and political, which creates the preconditions for transformational changes in global economic systems. It is difficult to imagine the life of a modern citizen or any business entity in a developed country without the use of digital technologies, including various functional and software tools and facilities. They ensure and accelerate the implementation of most everyday human processes and production, management and other business processes. All of this affects the state of the external environment, making it more unstable and volatile, which directly affects the functioning of business and the life of society as a whole. That is why today's challenges require entrepreneurs to continuously improve their business processes, including production, organizational, managerial, technical and technological ones, which will ensure that they maintain their market position and a high level of competitiveness of their products or services in the domestic and foreign markets.

A real challenge for society and business was the impact of the COVID-19 pandemic caused by the SARS-CoV-2 coronavirus, which began in 2019. In response to its challenges, quite significant changes have taken place that have affected the life of many countries and their populations, and there is a need for governments to make prompt decisions to stabilize the situation. The most common measures include the following: the introduction of a state of emergency in countries as a whole or in certain regions or areas; restrictions on travel to/entry into countries and movement within countries; sanitary and epidemiological measures, including the introduction of quarantine zones, temperature checks, cancellation of mass events, closure of educational and cultural institutions; increased role of public administration in emergency situations; new distance forms of education and work; establishment of a Such unprecedented steps have provoked a slowdown in the economic and social development of most countries, including the United States, the European Union, and Asian countries.

It is the above factors that have forced the whole world to reconsider not only its development forecasts and short-term actions in economic and social policy, but also to start formulating its own priorities for the medium and long term in a different way. As a result, the governance models and social behavior of society, as well as other areas of its activity and the country as a whole, have changed.

All of this has intensified the development of such processes as digitalization and smartization, which have begun to be implemented more rapidly in most areas of life in many developed countries.

For Ukraine, the intensification of digitalization and smartization processes has become especially important due to the full-scale invasion of our country by Russian troops, which forced the reformatting of most processes at the level of the state, business and society as a whole.

Global trends in digitalisation and smartification, as well as aspects of the impact of the Fourth Technological Revolution at the micro, meso and macro levels, are considered by many domestic and foreign scholars. Among domestic scholars, it is worth highlighting the works of the following authors: Y. Vlasenko [2], V. Holomovziy [7], M. Kopytko [4], K. Kraus [31], I. Manayenko [7], O. Sohatska [3], V. Filippov [1], and others. Separately, it is worth highlighting scholars who have devoted their research to the tools for ensuring the areas of digitalisation and smartification, in particular V. Burangulova, N. Geseleva, N. Kraus [25], V. Minakova [12], I. Shevchuk [10], and others.

Among the scientific works of foreign scientists devoted to the development of economies and society under the influence of digitalisation and smartification processes, as well as to highlighting trends in their development, it is worth noting the works of the following scientists: A. Amundarain [22], G. Chryssolouris [23], R. Schmelzer [14], S. Kumar [19], R. Shewale [13], Z. Lv [16], J. Howarth [17] and others.

The purpose of the research is to identify global trends in the digitalization and smartization of economies and society.To achieve this goal, the following tasks need to be accomplished: 1) to determine the role and main directions of digitalization and smartization at the present stage of human development; 2) to analyze the state of the processes of digitalization and smartization of the economies and societies of the leading countries of the world; 3) to identify the main trends in the digitalization and smartization of economies and society.

Rapid changes in the economic space raise new questions about the nature and forms of integration of Ukrainian enterprises into the new era, the use of opportunities and prevention of risks associated with the Web 3.0 era [1]. New operating conditions provide both additional opportunities and risks. With regard to the former,

domestic industrial enterprises have the opportunity to take advantage of the new way of life, to level the existing shortcomings of management and to become leaders in the global market. However, on the other hand, the turbulence and riskiness of the new order require a new security-oriented approach to managing this process.

The processes of digitalization and smartization are closely related to Industry 4.0, as well as the following identical concepts: The Fourth Industrial Revolution and the Fourth Industrial Revolution.

Industry 4.0 is the transition to fully automated digital production, controlled by intelligent systems in real time in constant interaction with the external environment, which goes beyond the boundaries of a single enterprise, with the prospect of combining into a global industrial network of objects (things) and services [2].

The term "Industry 4.0" was first proposed in 2011 at the International Exhibition of High Technology, Innovation and Industrial Automation in Hannover (Germany). The essence of this concept should be considered in a narrow and broad sense. As for the first, Industry 4.0 is the name of one of the 10 projects of the German state Hi Tech strategy until 2020.

It describes the concept of smart manufacturing within the global industrial network of the Internet of Things and services. On the other hand, Industry 4.0 describes the current trend of automation and data exchange, which includes cyber-physical systems, the Internet of Things, and cloud computing.

In other words, this is a new level of organization of production processes and management of the value chain throughout the entire life cycle of manufactured products, a change in technological modes with a subsequent rapid increase in productivity and economic growth, the so-called industrial or industrial revolutions.

It is also worth noting that within the framework of the industrial revolution, changes occur not only at the technological level, but also at the social level.

Let's consider the main aspects of each stage of the industrial revolution that preceded Industry 4.0 (Fig. 1).

An analysis of the main technological and social changes has revealed that Industry 3.0 and Industry 4.0 have had the most significant impact on the life of society and the development of economies around the world. The former is more characterized by automation and computerization of production, the widespread use of electronic equipment and personal computers. While the second is more characterized by the creation of a global network by connecting automated computers. This ensures the controllability of production processes and data exchange without direct human intervention.

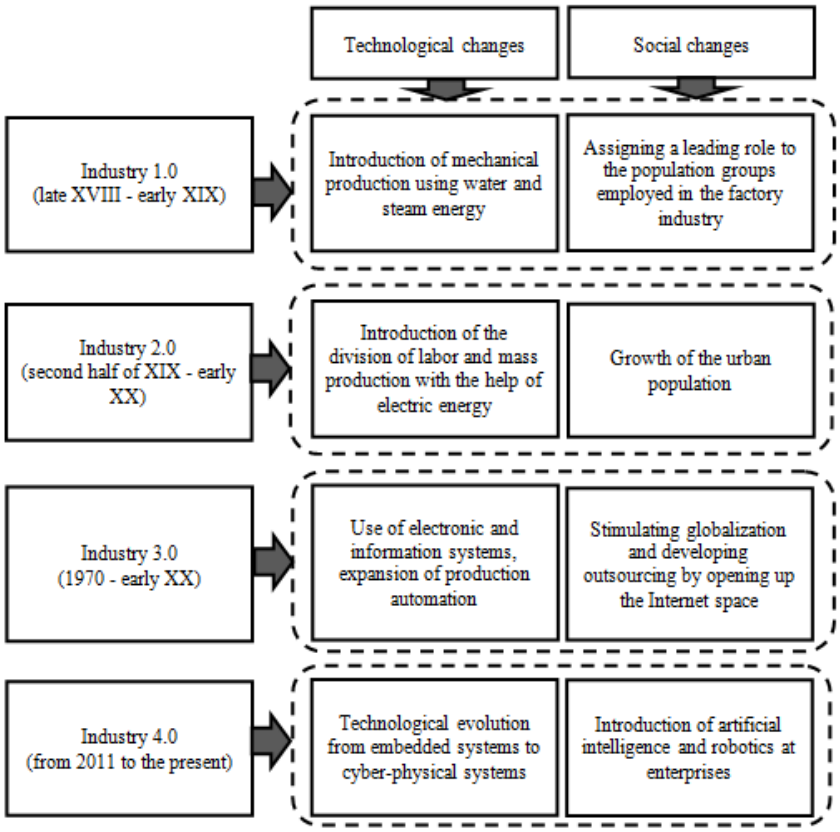

Figure 1. Technological and social changes in the stages of the Industrial Revolution
(*source: created by the author based on* [2-4])

Thus, the structural elements of Industry 4.0 have a rather significant impact on the development of the world's economies and society as a whole, and have not only technical but also economic and social impact. Let us consider its components in more detail (Fig. 2).

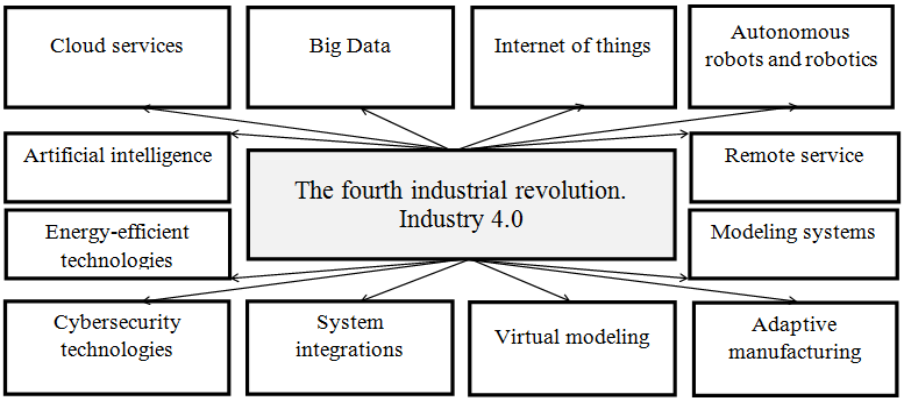

Figure 2. Components of the Fourth Industrial Revolution
(*source: built by the author on the basis of* [3; 5; 6])

It is worth noting that despite the fact that Industry 4.0 provides many opportunities for development in many aspects of society and the main directions of the country's development. However, according to a report by the World Economic Forum, only 25 countries are ready to move to a new level of production and service. These countries include the following: Denmark, the Netherlands, the United States, the United Kingdom, Canada, Poland, the Czech Republic, Slovenia, Austria, Belgium, China, Germany, Estonia, Finland, France, South Korea, Ireland, Israel, Italy, Malaysia, Japan, Singapore, Sweden, and Spain [7].

Thus, the Fourth Industrial Revolution at the present stage of its functioning at the level of the world economy is developing rather unevenly. The main differences include different starting potential of technical, technological and research development. This is why some countries are still at the stage of the third industrial revolution, while others are operating in the second industrial revolution.

According to the American Industrial Internet Consortium, by the end of 2030, Industry 4.0 will reach $15 billion, which is equal to the US GDP [3]. According to the results of the assessment of leading consulting companies, in Europe, the volume of investments in the Fourth Industrial Revolution will amount to more than $140 billion. The increase in their volumes will ensure an increase in income by 2-3% due to increased competitiveness and more efficient management of most business processes.

At the same time, according to forecasts by the consulting company Roland Berger, if the requirements of the Fourth Industrial Revolution are not met, the EU economy will lose about $605 billion in the coming years [8].

The international consulting company McKinsey & Company, which specializes in solving problems closely related to strategic management, in its study notes that the total economic effect of the introduction of the industrial Internet alone by 2025 will reach about $11 trillion per year.

In turn, the World Bank estimates that the digitalization of such four industries as automotive, consumer, electrical, and logistics can create a total value for society and industry of about $20 trillion by 2025 [9].

Let's look at some of the main components of the Fourth Industrial Revolution.

1) Cloud services. One of the most dynamic and growing markets in the IT sector is the cloud services market. According to Gartner, the world's leading information technology research and consulting company, the global cloud services market will reach about $521.8 billion in 2026 [10].

However, according to the leading international consulting and research company International Data Corporation, the global market for public cloud services grew by 22.9% to $545.8 billion in 2022 [11]. The company's analysts divide the cloud market into three main segments: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), which includes applications and software for system environments. Applications are the largest market segment, accounting for 45% of total revenue. The next largest segment is infrastructure as a service with a share of 21.2%. Platform as a service and software for system environments accounted for about 17% each.

The largest cloud providers in the global market are Microsoft, Google, and Amazon, with the latter maintaining its leading position for a long time. Let's take a closer look at the infrastructure of the cloud services market and its dynamics for the first quarter from 2018 to 2023 (Fig. 3).

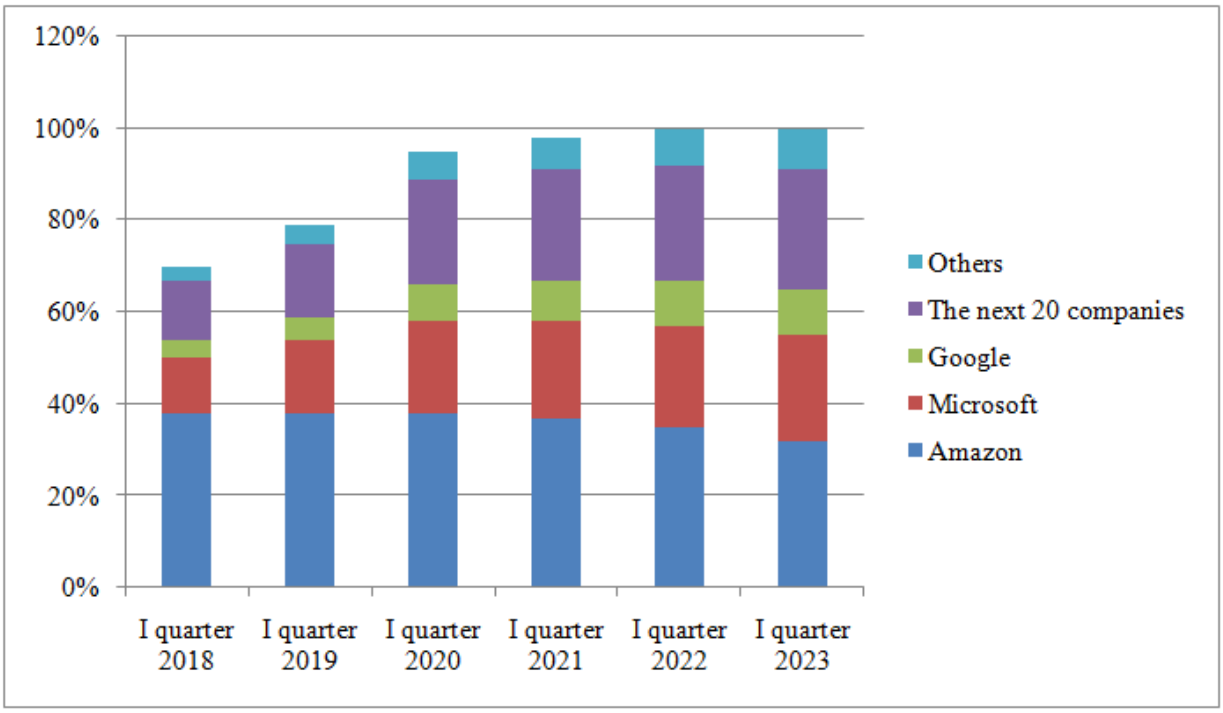

Figure 3. Structure of the cloud providers' market by income level
(*source: built by the author based on* [11])

As can be seen from Figure 3, the largest cloud providers Microsoft and Google have the highest revenue growth rates, maintaining leading positions in the dynamics and having a positive trend to expand their market share. At the same time, the market leader in terms of revenue is Amazon, which has maintained a leading position in the range of 32-34% throughout the analyzed period. Among the second-tier cloud providers, the highest growth rates are demonstrated by such companies as Oracle, Snowflake, MongoDB, Huawei, etc.

Thus, the cloud services market is dominated by the largest cloud providers, which control 72% of the market. Public IaaS and PaaS services account for the bulk of the market. As for the geographical aspect, the largest regions of the positive trend in the development of the cloud services market are North America, Asia Pacific, Europe, the Middle East and Africa, with a growth rate of more than 20%.

This trend is explained by the need of businesses for greater flexibility, mobility, autonomy and efficiency, which requires them to reorient their work to cloud services.

2) Big Data. Big Data is a set of information (both structured and unstructured) so large that traditional methods and approaches (mostly based on business intelligence solutions and database management systems) cannot be applied to it [12].

The term "Big Data" was first used in 2008, althoughBig Data existed even before that, theydid not have much value due to the complexity of its processing and the lack of necessary technologies. However, with the active development of platforms for processing multi-gigabit data, the situation has changed radically and Big Data has begun to be used in various fields.

Big Data analytics allows you to quickly and efficiently interpret various information, make forecasts and find patterns, while providing a more accurate end result. Big data itself has no significant meaning for a person, but it needs to be analyzed to achieve any goal. The tools used for data processing are constantly being improved and updated, but we would like to highlight the processes they can provide: classifying objects into groups by identifying their common features; identifying previously unknown and necessary information required for decision-making in various fields; recognizing signals against the background of noise and their subsequent analysis; identifying hidden functional relationships among data; predicting consumer behavior in a particular market segment; collection of necessary information from a large number of sources; creation of neural networks; visualization processes.

Consider the dynamics of the Big Data market in recent years and possible trends in its development in the future (Fig. 4).

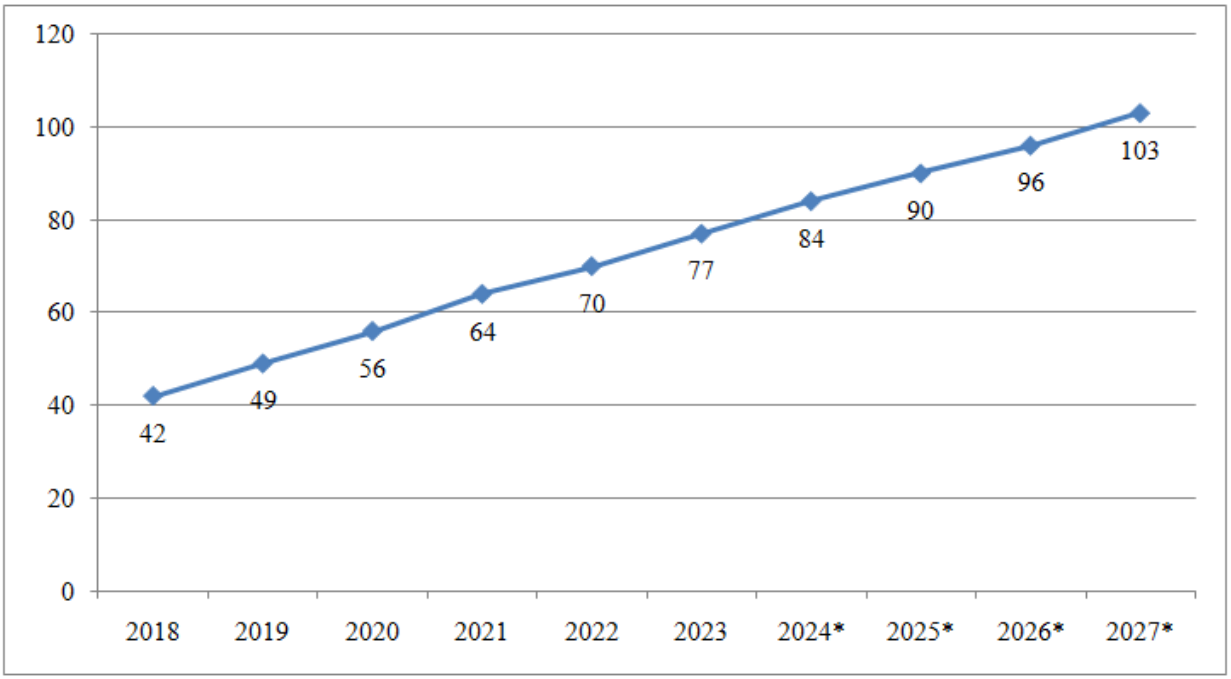

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Figure 4. Big Data market size and forecast of its further development, billion dollars
(*source: built by the author based on* [13])

As we can see from Figure 4, according to analysts of the German online platform Statista, which specializes in data collection, processing and visualization, the Big Data market is expected to grow further. This will happen under the influence of the trends that are already beginning to affect the market volume, namely [12-14]:

- the increase in the volume and variety of data is driving progress in processing and the development of edge computing. There is an acceleration in the generation of data, much of which comes from cloud systems, web applications, smartphones, voice assistants, and other sources. In turn, the use of voice assistants and IoT devices is leading to a more rapid growth in the need for big data management, especially in such industries as finance, healthcare, insurance, retail, manufacturing, and energy. The process of transferring data that needs to be processed directly to devices also has a significant impact. This has led to the need to develop more advanced devices and programs that can collect and store data on their own without the need for networks, storage, or other computing infrastructure;

- the need to store big data is driving the innovative development of cloud and hybrid cloud platforms and the growth of data lakes. The need to process large volumes of data forces businesses to spend more and more resources on this or to resort to the services of third-party organizations. Thus, there is a well-established trend for cloud providers to develop a more favorable data management infrastructure and hybrid approaches that combine aspects of third-party cloud systems with on-premises computing and storage to meet the needs of critical infrastructure. In turn, businesses continue to implement new approaches to data architecture that allow them to ensure the diversity, reliability, and processing of large volumes of data. The trend towards further centralization of data storage in the data warehouse continues. This requires more complex and time-consuming extraction, transformation, and loading processes, which led to the development of the data lake concept. They provide storage of structured, semi-structured and unstructured data sets in their organic format.

- a sharp increase in the use of advanced analytics, machine learning and other artificial intelligence technologies. Traditional data processing technologies are no longer able to process, store, and generate large amounts of data. With the development and implementation of machine learning and artificial intelligence systems, businesses and organizations are increasingly using them. According to a survey conducted by the Enterprise Strategy Group [14], 63% of respondents who have implemented elements of machine learning and artificial intelligence programs in their business processes expect further increases in spending on these tools. As for

machine learning, it makes it easier to identify patterns and anomalies in large data sets, determine their trends, and detect anomalies in large data sets;

- developing sets of practices, processes and technologies that combine an integrated and process-oriented view of data with automation and agile software engineering techniques for continuous improvement in data analytics (DataOps). The rise of DataOps is driven by the need for a methodology and practice that focuses on agile and iterative approaches to dealing with the full lifecycle of data moving through the business environment. This ensures the continuity of the processes of data generation, storage, transportation, processing, management and archiving, without involving separate employees for each of the above business processes.

3) Internet of Things. According to N.V. Geseleva, "the Internet of Things is a set of physical objects comprehensively interconnected by means of modern Internet technologies, which makes it possible to create new, more efficient methods of production and business" [15].

In recent years, the Internet of Things has become one of the most important technologies of the twenty-first century, as it has made it possible to connect everyday objects to the Internet through embedded devices, which ensures continuous communication between people, processes and things. The introduction of the Internet of Things has radically changed the traditional way of life to a more high-tech one. This new paradigm has enabled energy savings, smart industries and smart cities, pollution control, smart transportation, and smart homes.

The introduction of the Internet of Things technology has made it possible to develop the following areas of digitalization and smartization: access to more affordable sensor technology with lower power consumption; a large number of network protocols for the Internet has facilitated the ability to connect sensors to cloud platforms and other "things", making the data transfer process more efficient; development of machine learning and analytics, which has provided a faster and easier process of collecting information; development of conversational artificial intelligence, which has made it possible to use the Internet of Things in the workplace.

With the increasing commercial application of 5th generation (5G) mobile communication technology in cities, the application of the Internet of Things in energy, construction, industry, intelligent transportation, agriculture, logistics, intelligence, high efficiency, and ESER is advancing [16].

Over the past decade, there has been a significant shift from non-IoT devices to IoT devices. Let's look at how these indicators have changed over time (Fig. 5).

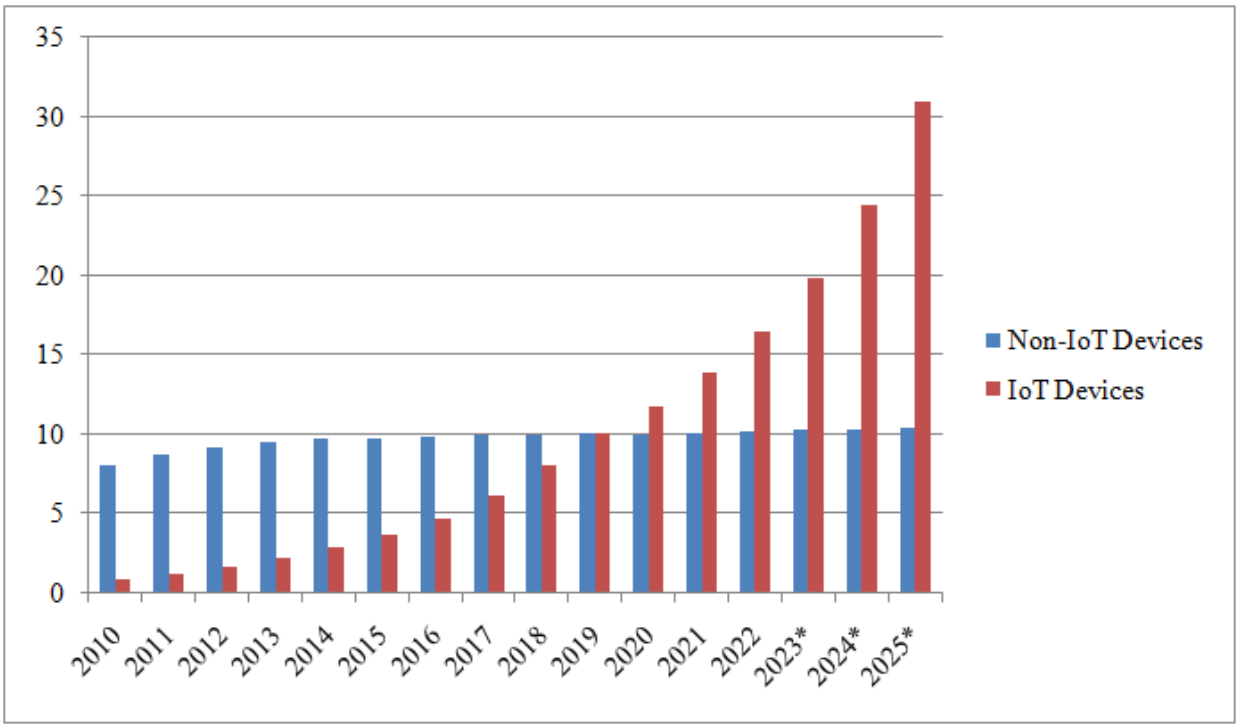

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Figure 5. Comparison of the number of devices connected to the Internet of Things and devices that are not connected to it *(source: built by the author based on [17])*

For comparison, the number of IoT devices as a percentage of the total number of devices in 2010 was only 9%, in 2015 it was already 27%, and by 2025 analysts [17] predict an increase to 75%.

The Internet of Things is important for many sectors of the economy. For the manufacturing sector, it provides the following benefits: monitoring of production lines, which enables equipment maintenance to ensure its preventive inspection. With the help of customized sensors and relevant alerts, manufacturers can quickly check equipment for accuracy or take it out of production for repair, allowing businesses to reduce operating costs, increase equipment uptime, and improve overall asset performance management.

For retailers, IoT applications provide them with the ability to manage inventory, optimize the supply chain, reduce operating costs, and improve customer experience.

For the automotive sector, the benefits of IoT, in addition to the above-mentioned production cycle benefits, include the ability to detect dangerous equipment failures in vehicles already in use, warning drivers in such situations. Developed IoT applications generate this kind of information and provide it to car manufacturers and suppliers. This allows them to learn more about how to keep cars in good working order, and car owners to stay informed [18; 19].

The main trends of the Internet of Things are as follows [17-19]:

- further spread and implementation of smart devices at all levels – state, business, society – which will enable consumers and ordinary citizens to interact in everyday life;
- focusing of the IoT market players on ensuring the prevalence and greater availability of devices, their introduction into the household sphere and use in everyday interaction in society;
- sensors on devices will play a key role due to their ability to generate data from real-world observations, which they will record and document;
- ensuring that IoT devices operate continuously, which will allow observing changes in the environment that may not be noticed by humans.

4) Autonomous robots and robotics. Autonomous robots have become an integral component in some areas of personal assistance and production, which means that their number is constantly growing as they are used in more and more areas of activity. However, the next major challenge for robots is to improve their applications and communication with the external environment for fully autonomous control [20].

There are a number of advantages and disadvantages to engaging autonomous robots and robotics in certain business processes. The main advantage is reducing employee fatigue and minimizing the impact of the human factor in certain business processes. In turn, the key disadvantage is the reduction of interaction between employees, which can negatively affect the organizational climate in the team and reduce the overall level of corporate culture.

A. Krysovaty notes that, according to the World Economic Forum, in three years, 7 million jobs will have to be cut in the leading countries of the world due to robotization, but 2 million new highly skilled jobs will appear [3].

In turn, as for the market size, according to the International Federation of Robotics, the robot market should reach $12.3 billion by 2025 [7]. It is expected that artificial intelligence will be able to replace most of the workforce in the future, which will lead to the fact that only those employees will remain who will be able to program robots to perform the most routine and boring tasks with a high level of accuracy. This is what defines the main advantage for businesses operating in the Industry 4.0 era, namely the creation of goods and services faster, better and more affordable.

A very important aspect of a fully autonomous technology is that it should be able to fully realize the potential of social interaction, which may involve several users of a personal robot [21].

Let us consider the main trends in the development of the autonomous robots and robotics market:

- transition from automation to autonomy. The events of the last three have shown society, business, and the government that we need to continue to encourage companies to find autonomous ways of working. This makes it possible to produce products and provide services faster, cheaper, and in larger volumes through the introduction of autonomous business models;
- work as a service. Businesses, especially large enterprises and companies, have long implemented mobile robots for certain business processes to move parts and components or supply equipment around the plant. Today, however, we can see their implementation in various public sectors, which makes it possible to inform consumers, deliver orders, etc.;
- combining the Internet of Things and autonomous robotics. The combination of the two elements of Industry 4.0 allows robotic systems to use data in near real time. This is possible for the following reasons: The IoT is engaged in monitoring and tracking, which provides feedback through data collection and transmission, increasing the level of robotics productivity; in turn, robotics is engaged in production and autonomous behavior;

- combining autonomous robotic processes and artificial intelligence. The dynamic development of artificial intelligence makes it possible to implement certain elements of its process in many areas, including autonomous robotic processes (RPA). Thanks to artificial intelligence, RPAs can perform tasks that require a certain level of judgment. This will enable them to automate more complex tasks and procedures that can increase their value to the business.

5) Virtual modeling (or virtual simulation). Simulations based on virtual reality (VR) or augmented reality (AR) are key technologies in Industry 4.0 that allow testing and studying new processes before they are launched [22].

Virtual reality modeling is a key technology and element of Industry 4.0 that aims to provide an efficient and cost-effective way to model industrial processes. This technology has proven to be effective in many industrial business processes, including design, training, manufacturing, planning, and process modeling in industries such as mechanical engineering, automotive, aerospace, and others.

As for augmented reality, this area is also developing dynamically. Augmented reality is a technology that allows overlaying digital information on the real world and thus supplementing the real environment with computer information and objects that are displayed in real time and may depend on the real environment itself [23].

Let's consider the volume of the virtual modeling market in the dynamics since 2021 and the forecasts of experts on its development trends (Fig. 6).

As shown in Figure 6, experts estimate that the virtual modeling market will continue to grow. This is due, among other things, to the main trends in virtual modeling, in particular

- increasing the role of immersive educational experience. 2023 is the year of education transformation through the introduction of virtual reality elements. The latter destroys the usual boundaries of learning, because elements of virtual modeling can be introduced both within secondary and higher education institutions;

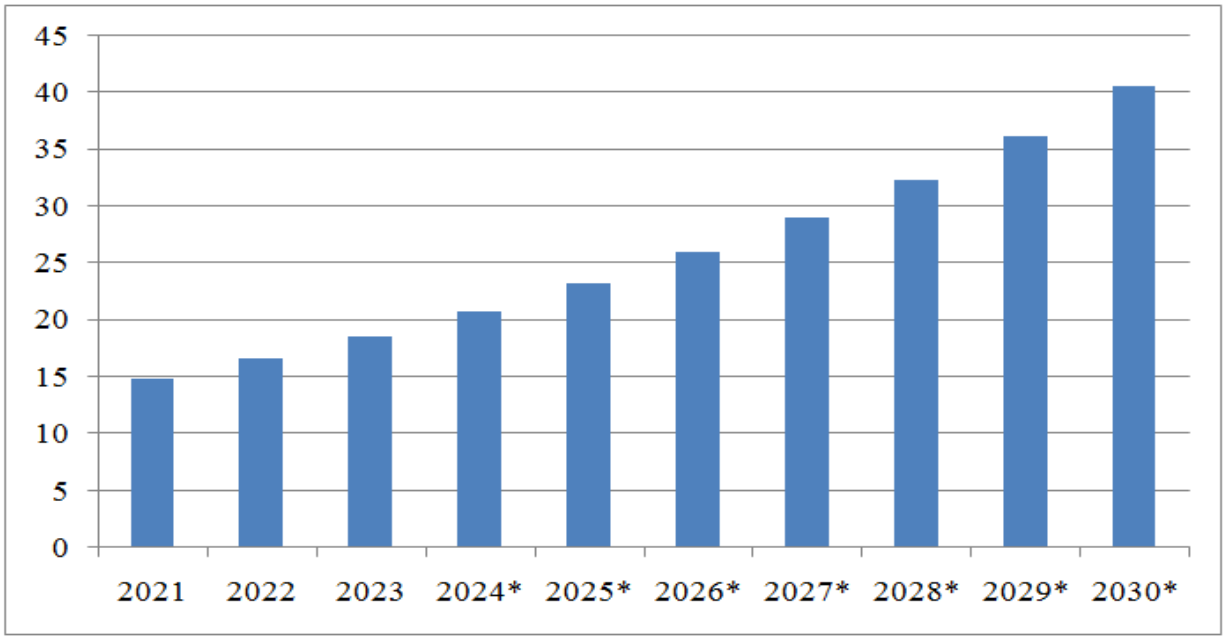

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Figure 6. The volume of the virtual modeling market in dynamics
(source: built by the author on the basis of [24])

- introduction of hyperrealistic virtual reality. Hyper-realism is one of the trends in virtual reality due to the blurring of the boundaries between virtuality and reality as technological advances allow VR tools to simulate real physical sensations. This creates opportunities for future virtual reality to be shaped even more realistically, making it difficult to distinguish between what is reality and what is not;

- expansion of social VR platforms. Virtual reality will not be limited to individual access in the future, and social VR platforms are growing. They are based not only on real-time interaction with each other in a virtual environment, but also on the possibility of attending social events, including performances in theaters, museums, exhibitions, etc. All this forms the basis for an inclusive and social future of virtual reality.

6) Cybersecurity technologies.With the rapid development of digital technologies, digitalization and smartization processes, the issue of ensuring data security in the Internet space has become quite acute. This is due to the fact that in recent years, more and more information has been stored in cloud storage, including personal data, which is being digitized both by government agencies and for personal purposes. At the same time, the security of this data and cloud storage is not absolutely secure and may be affected by external influences or imperfect technical and technological support.

It is worth noting that today there are more than 313 million Internet users in the United States, which is one of the leading online markets in the world [7].

Crimes committed by criminal groups using information technology (IT) include cyberterrorism, threats of physical violence, money laundering, theft of money from bank accounts, fraudulent transactions with plastic payment cards, dissemination of information about drugs via the Internet, etc [25].

That is why the concept of "cybersecurity" and the development of technologies that ensure it have gained particular relevance. Cybersecurity refers to any technologies, tools or measures aimed at preventing possible cyberattacks and minimizing the negative impact of cyberattacks at any level: state, business, or individual. The objects of cyber defense are critical infrastructure facilities, information and telecommunications systems, confidential data, financial assets of individuals, organizations and businesses, as well as computer devices and their applications.

According to analysts [26], the global cybersecurity market will exceed $534 billion by 2032 (for comparison, in 2022 it was $193 billion). Let us consider in more detail how the increase in the capacity of the cybersecurity technology market will affect the income of market participants and identify the main trends in its further development (Fig. 7).

Figure 7 shows that the upward trend in revenues is continuing, which will have a direct impact on the market's capacity and size, as it will continue to be attractive to new entrants to the business environment. This is due to many factors, including the development of online commerce platforms, the emergence and rapid development of the Internet of Things, cloud technologies, artificial intelligence, etc.

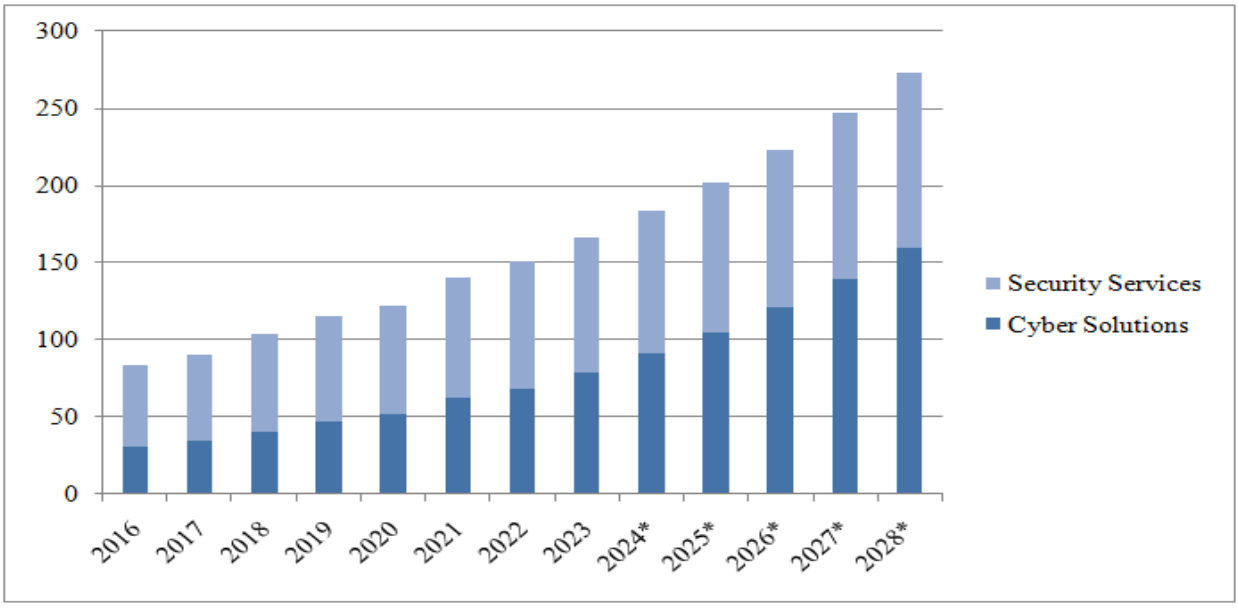

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Figure 7. Revenue in the cybersecurity market in dynamics, billion dollars
(source: built by the author based on [27])

Let us note the main trends in the development of the cybersecurity technology market: - the use of artificial intelligence in cyberattacks. The rapid development of artificial intelligence technologies with the emergence of such platforms as ChatGPT and others should be viewed from two perspectives: as a tool to protect against possible cyber threats, and vice versa - a tool that can directly source them. That is why the further development of artificial intelligence technologies will continue to increase the level of development of cyber defense technologies; - development of cloud-based application security platforms (CNAPP). With the advent of cloud environments, there is a need to develop and implement, and, accordingly, ensure their protection, applications and platforms.

Cloud environments achieve many goals, including accelerating DevOps development cycles, and cloud security platforms are aimed at more effective control, management, and better protection of cloud applications and platforms; - development of threat impact management. Threat impact management is a risk-based approach to strategic planning of the organization's security at all levels, which aims to identify potential threats, conduct market assessments, which is the basis for setting priorities and implementing strategies to minimize the impact of various risks; - implementing integrated protection systems. Hybrid and remote work, the emergence of cloud technologies and IoT devices have become more sophisticated, widespread and commonplace in most developed countries. This trend will continue to develop under the influence of the development and expansion of 5G mobile networks. As a result, the risk of a growing range of threats and potential vectors of cyberattacks will increase, requiring new solutions and technologies to ensure their security.

7) Artificial intelligence.The development of artificial intelligence technologies began in the middle of the twentieth century, including by the Ukrainian scientist V.M. Glushkov, who in 1970 was engaged in the development of intelligent computer tools. Today, all the world's leading countries, including the United States, Israel, Japan, China, South Korea, Western Europe, and others, are developing artificial intelligence technologies. Artificial intelligence technologies are being actively implemented in such areas of society as healthcare, education, transportation, etc.

The introduction of artificial intelligence elements is becoming increasingly popular among managers and business owners, despite the high cost, complexity of implementation, and risks in use [28].

The main elements of artificial intelligence are Natural Language Processing (a technology that focuses on the interaction between humans and computers using natural language), computer vision (data processing and tools for creating computer machines that can detect and track certain objects), Robotics (designing and implementing robots that can perform tasks autonomously, design, development and implementation of robots that can perform tasks in an autonomous mode), machine learning (technologies that enable the learning ability of robots and machines), Expert Systems (development of computer programs that can imitate the ability of a human expert to make managerial decisions in a particular field).

The survey found that almost 4 out of 10 managers of modern companies, which corresponds to 38% of respondents, note that their organizations have already achieved a significant amount of improvement in automation, advanced communication, artificial intelligence and robotics, which helps to perform mechanical tasks or analysis that were previously performed by humans faster and better. At the same time, about 47% of respondents say that their employers are using Industry 4.0 technologies to increase efficiency by increasing staff tasks [7].

Let's take a closer look at the dynamics of the artificial intelligence market and identify its main trends (Fig. 8).

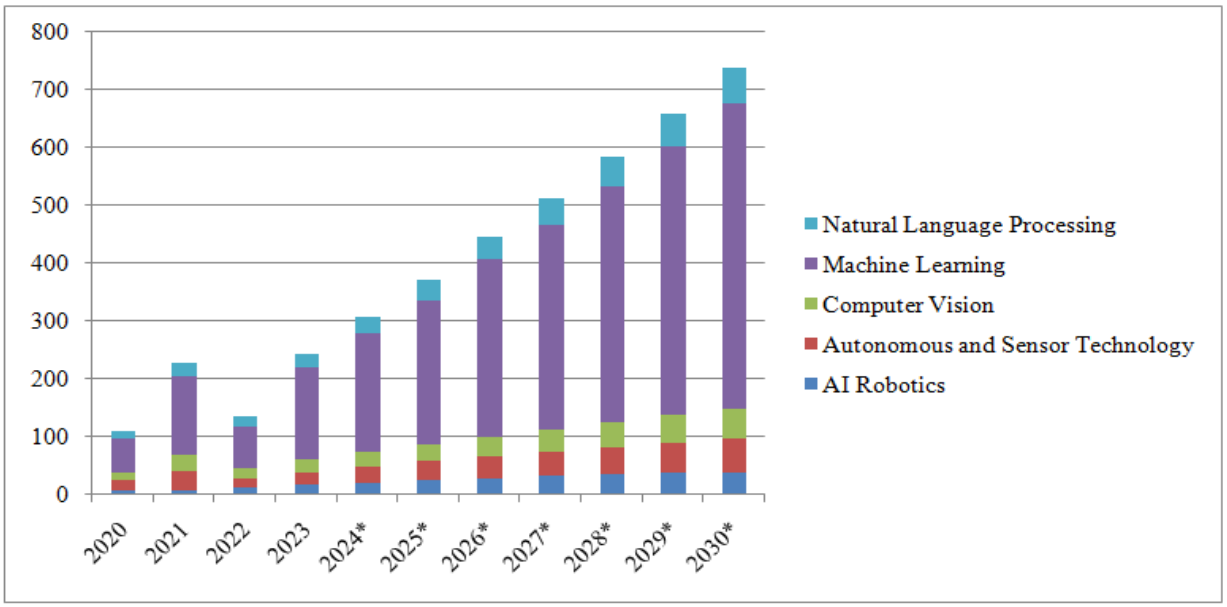

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Figure 8. The volume of the artificial intelligence market in dynamics, billion dollars
(*source: built by the author based on* [29])

As shown in Figure 8, analysts at a German online platform specializing in data collection and visualization estimate that the AI market will continue to grow in all its structural elements. This is explained by many factors. First, the growing level of access to large amounts of data opens up new opportunities for the application of artificial intelligence technologies due to the need for its algorithms to learn and improve. Secondly, the development of cloud platform infrastructure and computing power makes it possible to process its applications more efficiently using artificial intelligence technologies. Thirdly, the growing demand for automation and process optimization in many industries, including transportation, manufacturing, education, and healthcare, is driving the adoption of AI technologies.

Among the most dynamic and promising segments of the digital economy are activities related to the use of computer devices and information technologies, including software development, information processing, computer maintenance, consulting, creation and use of databases and information resources, including the Internet.

Industry 4.0 will have an impact not only on business and society, but will also affect most processes in cooperation with government agencies and provide the state with additional tools to influence the public life of the country. Let's consider what consequences the further development of the industrial revolution will have, including through digitalization and smartization (Fig. 9).

INDUSTRY 4.0

The consequences of the revolution for the state	*The consequences of the revolution for business*	*The consequences of the revolution for humans*
obtaining new tools for controlling the population;	increasing the transparency of business activities;	focusing on a person's personal space;
intensification of "hybrid" forms of interstate conflicts;	growth of consumer expectations;	a qualitative change in the standard of living for the better;
transformation to more "flexible" management;	improving the quality of goods;	changing the criteria for professional success;
redistribution and decentralization of state power;	emergence of new forms of organization;	more time in the online space;
creation of new platforms for cooperation between citizens and authorities.	intensification of innovation activities.	development of human augmentation (strengthening of physical and cognitive abilities).

Figure 9. Implications of Industry 4.0 for the development of the state, business and people

Technologies that have emerged at the intersection of the digital, biological and physical worlds will lead to the formation of new platforms. This will allow citizens to communicate their opinions to the government, interact with individual authorities if necessary, and coordinate their own actions. All of this stimulates reforms and changes in regulatory mechanisms. Modern regulatory systems emerged in politics after the end of the Second Industrial Revolution. However, this approach no longer meets the current requirements that arise in response to the challenges of the Fourth Industrial Revolution.

As for the security situation, changes will take place in this direction, in particular at both the national and international levels. In general, the history of military affairs and national security depends on the development of the technological process. It is worth noting that modern interstate conflicts are increasingly taking the form of "hybrid" conflicts. Technological breakthroughs will reduce the danger of hostilities in the future by creating defense systems and improving the accuracy of weapons.

In relation to the business environment, the impact of the Fourth Industrial Revolution has been reflected in both the external and internal environment. Innovations that appear at an incredible speed disrupt any business plans, forecasts and expectations. The market has become more dynamic due to access to the global network, which stimulates the development of new forms, types and participants in business. This has led to the intensification of all its business processes: research, development, marketing, sales, production, etc. All this has a structural impact on supply and demand. With regard to the former, the growing transparency of business has led to an increase in consumer influence on it: management decisions, methods of delivering goods and services, etc. are changing. As

for the second, new technologies have made it possible to find new ways to deliver goods to consumers. This has had a direct impact on existing supply chains and led to their changes.

The impact of the Fourth Industrial Revolution on the main aspects of human life has led not only to changes in them in general, but also to changes in the human being as a person. New information and technological changes will affect his or her qualitative characteristics: the formation of personal space, self-identification, understanding of property and consumption habits, and will significantly change the criteria for professional success. Of particular relevance will be the definition of personal boundaries and the possible loss of control over the dissemination of personal information due to the processes of digitalization and digitalization.

Thus, Industry 4.0 has made significant changes to the way businesses do business and perform its key business processes, including in the areas of cooperation with consumers and counterparties. However, it should be noted that Industry 5.0 has already begun its development.

In 2016, Japan announced the development of the Industry 5.0 concept. It is expected to focus on ensuring cooperation between humans and machines. Human labor will not be replaced by robots and machines, but a person who acquires the necessary knowledge and skills will be able to perform his or her work more efficiently, safely, reliably with the use of advanced technologies. In other words, artificial intelligence, humans, and robotics will become an assistant to humans, not replace them. The key difference is that Industry 4.0 focuses on automation and technology, while Industry 5.0 is aimed at promoting social transformation and human resources.Let's take a closer look at the main differences between Industry 4.0 and Industry 5.0 by the main levels of their influence - government, business, and people - and according to the selected criteria (Table 1).

Table 1

Differences between Industry 4.0 and Industry 5.0[30-33]

Criterion	Industry 4.0	Industry 5.0
At the business level		
Business processes	higher level of process automation, involvement of autonomous machines in business processes for repetitive, precise and dangerous tasks;	focus on customer experience and individualized approach, development of new competencies and skills among service sector employees;
Product/service	a more accessible level of product traceability at all stages of its production, with the use of artificial intelligence, machine learning and the Internet of Things to automate tasks and decisions;	production of a product with a combination of human skills, advanced technologies and creativity;
Labor force	location far from the plant or minimally involved;	location at plants to incorporate the human factor into processes;
Optimization of production processes	use of digital twins and modeling tools;	application of advanced nano- and biotechnologies;
Environmental impact	remote monitoring, real-time data analysis, which increases efficiency and reduces costs;	key priorities include ethical production practices and sustainable development to reduce environmental impact and minimize waste;
At the state level		
Type of economy to introduce the relevant Industry	signs of the network economy, the emergence of the digital economy;	digital economy, formation of the gig economy, advanced virtual and augmented reality;
Technical and technological structure	6th;	7th;
Type of entrepreneurship that will have a strategic impact on the country's development	innovative entrepreneurship;	digital entrepreneurship;
Overall impact on the development of the state	develops industry in line with the requirements of the new industrial era.	is the concept of innovative and digital production, which includes, in particular, smart government.

To summarize the analysis of the differences between Industry 4.0 and Industry 5.0, we note the key point: it is the latter that shifts the focus from "how much does business cost" to "how to better use natural resources." In order to adapt to the new conditions, government agencies, educational institutions, and small and medium-sized businesses must become more flexible and individualized in their approach to change, as they currently have a rather significant gap compared to advanced business structures. As for business, shifting the focus to job creation and employee development requires top management to focus not only on maximizing profits, but also to prioritize human-centered approaches and increase the level of social responsibility.

N. Tymoshenko notes that for more active development of digital technologies and gradual implementation of digitalization processes that will effectively affect the development of economies and society, the following conditions should be created [34]:

- regulatory and legal frameworks that encourage increased competition and market entry for startups, enabling businesses to make full use of digital technologies and innovations;

- acquiring the skills of employees, businessmen, and civil servants to be able to properly and effectively use the capabilities of digital technologies (increasing digital awareness);

- ensuring the interconnection of critical networks, such as telecommunications and banking systems, so that platforms become interoperable, applications and services work across all systems and are accessible to all;

- developing policies for the digital economy based on open government data sharing and Big Data analytics, including establishing data protection regulations, and then ensuring that such regulations are kept up-to-date and relevant as they cover more sectors and services;

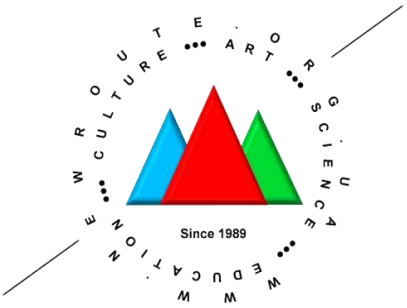
- development of smart security policies (in this case, cybersecurity policies) to protect national information infrastructures and facilitate the rapid exchange of information about cyberattacks, including transnationally.

Thus, an analysis of the current state of digitalization and smartization processes, as well as the impact of the Fourth Industrial Revolution on the development of economies and society as a whole, has made it possible to identify their main trends. It is also worth noting the significant changes that are being formed under the influence of Industry 5.0, which has already begun its development. The latter is a continuation of Industry 4.0, which increases the role of humans in society, improves their capabilities, and changes the focus of its development to social and environmental sustainability. In terms of business, Industry 5.0 will directly affect the already familiar business models of international enterprises, especially high-tech ones. That is why the state has a special role to play, as it has to adapt the key processes of development and life of the country, taking into account new challenges and conditions that are intended to improve the work of business and the lives of all segments of the population.

Sources

1. Filippov, V. Yu.,Yangulov E. P. The use of digitalization and smartization tools to ensure sustainable development of the economy and enterprises. *Management and Marketing as Factors of Business Development in a Recovery Economy:* Proceedings of the International Scientific and Practical Conference, April 18-19, 2023 Kyiv: Kyiv-Mohyla Academy Publishing House., 2023. Vol. 1, pp. 112-114.
2. Vlasenko, Yu., Bukina, T. and Lytvyn, L. “Development of Ukraine's economy in the conditions of the fourth industrial revolution”, *The economy and the state*. 2021.Vol. 1, pp. 53-60. DOI: 10.32702/2306-6806.2021.1.53.
3. The Fourth Industrial Revolution: Changing Directions of International Investment Flows: monograph / edited by Doctor of Economics, Professor O. M. Sohatska. Ternopil: Osadtsa Y. V., 2018. 478 p.
4. Kopytko, M. I., Zaverukha, D. A. Key aspects of the impact of industry 4.0 on the economic security of the state. *Socio-legal studies*. 2021. Issue 4 (14), pp. 117-122. DOI 10.32518/2617-4162-2021-4-117-122.
5. Chepelyuk M. I. Strategic management tools in the context of modern concepts and trends of world economic development: a monograph. Kharkiv: FOP Liburkina L. M., 2021. 396 p.
6. Vinnikova, I. I., Ishchenko, I. A. Forecasts and challenges of the Fourth Industrial Revolution. *Business, innovations, management: problems and prospects:* material. II international scientific and practical conference., 22 April, 2021. Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, Polytechnic Publishing House. 2021, pp. 46-47.
7. Manayenko, I. M., Yatsenko, A. M. Trends and prospects of the fourth industrial revolution. *Business, innovations, management: problems and prospects:* material. II international scientific and practical conference., 22 April, 2021. Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, Polytechnic Publishing House. 2021, pp. 184-185.
8. Golomovziy, V. M., Kalynovska, N. L. Analysis of problems and directions of solving the influence of technical control on the efficiency of the factory machine system. *Effective economy*. 2021. №11.URL: http://www.economy.nayka.com.ua/?op=1&z=9570. DOI: 10.32702/2307-2105-2021.11.96
9. The World Bank. Digital Development. URL: https://www.worldbank.org/en/topic/digitaldevelopment.
10. Shevchuk, I. B., Deputat, B.Y.Economic aspect of using cloud technologies in the activities of public authorities and business structures. *Economy and society*. 2021. Issue №31.URL: https://economyandsociety.in.ua/index.php/journal/article/view/689. https://doi.org/10.32782/2524-0072/2021-31-26.
11. The global market for public cloud services exceeded $500 billion last year. *Business Censor*. 2023.URL: https://biz.censor.net/news/3429374/svitovyyi_rynok_zagalnodostupnyh_hmarnyh_poslug_torik_perevyschyv_500_milyardiv_idc.
1. Minakova, V. P., Shikovets, K. O. Relevance of using the Big Data model in business processes. *Economy and society*. 2017. Issue 10. C. 892-896. URL: https://economyandsociety.in.ua/journals/10_ukr/152.pdf.
12. Shewale, R .65 Big Data Statistics 2023 (Facts, Trends and More). 2023.URL: https://www.demandsage.com/big-data-statistics/.
13. Schmelzer, R.Top trends in Big Data for 2023 and beyond. *Enterprise Strategy Group.* URL: https://www.techtarget.com/searchdatamanagement/feature/Top-trends-in-big-data-for-2023-and-beyond.
14. Geseleva, N. V., Holovach, M. S. Internet of Things as a Component of the Fourth Industrial Revolution. *Effective economy*. 2016. №12. URL: http://www.economy.nayka.com.ua/?op=1&z=5315.
15. Lv, Zh. Practical application of Internet of things in the creation of intelligent services and environments. *Front. Internet Things*. 2020. Vol. 1. URL: https://www.frontiersin.org/articles/10.3389/friot.2022.912388/full.DOI: 10.3389/friot.2022.912388.
16. Howarth, J. 80+ Amazing IoT Statistics (2023-2030). 2023.URL: https://explodingtopics.com/blog/iot-stats/
17. What is IoT? 2023. URL: https://www.oracle.com/internet-of-things/what-is-iot/

18. Kumar, S. Internet of things is a revolutionary approach for future technology enhancement: a review. *Journal of Big Data*. 2019. Vol. 6.URL: https://journalofbigdata.springeropen.com/articles/10.1186/s40537-019-0268-2/.
19. Hockstein, N. G., Gourin, C. G., Faust, R. A., Terris, D. J. A history of robots: From science fiction to surgical robotics. *Journal of Robotic Surgery*. 2007. Vol. 1, pp. 113-118. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4247417/
20. Misaros, M., Stan, O.-P., Donca, I.-C., Miclea, L.-C. Autonomous Robots for Services – State of the Art, Challenges, and Research Areas. *Sensors*, 2023, Vol. 23. URL: https://www.mdpi.com/1424-8220/23/10/4962. https://doi.org/10.3390/s23104962.
21. Ottogalli, K, Rosquete, D, Amundarain, A, Aguinaga, I, Borro, D. Flexible Framework to Model Industry 4.0 Processes for Virtual Simulators. *Applied Sciences*. 2019. URL: https://www.mdpi.com/2076-3417/9/23/4983.
22. Nee, A. Y. C., Ong, S. K., Chryssolouris, G., Mourtzis, D. Augmented reality applications in design and manufacturing. *CIRP Ann. Manuf. Technol*. 2012, 61, 657-679. URL: https://www.sciencedirect.com/science/article/abs/pii/S0007850612002090.
23. Simulation Software Market Size, Trends, Growth, Report 2030. URL: https://www.precedenceresearch.com/simulation-software-market.
24. Kraus, K., Kraus, N., Shtepa, O. Digital transformation of cybersecurity at the micro level under martial law. *Innovation and Sustainability*. 2020. Vol. 3, pp. 26-37. https://doi.org/10.31649/ins.2022.3.26.37.
25. Cyber Security Market Size Is Valued At US$534 Bn by 2032: Data Analysis by Experts at Market.Us. 2023. URL: https://finance.yahoo.com/news/cyber-security-market-size-valued-104600974.html/
26. Cybersecurity – Worldwide. 2023. URL: https://www.statista.com/outlook/tmo/cybersecurity/worldwide/.
27. Kuziomko, V., Burangulova, V., Burangulova, V. Possibilities of using artificial intelligence in the activities of modern enterprises. *Economy and society*. 2021. Vol. 32.URL: https://economyandsociety.in.ua/index.php/journal/article/view/808. https://doi.org/10.32782/2524-0072/2021-32-67.
28. Artificial Intelligence – Worldwide. URL: https://www.statista.com/outlook/tmo/artificial-intelligence/worldwide/.
29. Yashchuk, I. Industry 5.0: Paradigm shift in the industrial sector – a person in the center of attention. *Mirror of the week*. 2023. URL: https://zn.ua/ukr/TECHNOLOGIES/industrija-50-zmina-paradihmi-v-promislovomu-sektori-ljudina-v-tsentri-uvahi.html
30. Kraus, K. M., Kraus, N. M., Shtepa, O. V. Industry X. 0 and Industry 4.0 in the context of digital transformation and innovation strategy of national economy development. *Effective economy*. 2021. Issue 15. URL: http://www.economy.nayka.com.ua/pdf/5_2021/93.pdf.
32. Rivak, N. O. Industry 5.0: transition to sustainable and human-centered industry. *Socio-economic problems of the modern period of Ukraine*. 2022. Issue. 3 (155). C. 41-46. URL: https://ird.gov.ua/sep/sep20223(155)/sep20223(155)_041_RyvakN.pdf.
33. Bashynska, I. Management of smartization of business processes of an industrial enterprise to ensure its economic security. Schweinfurt: Time Realities Scientific Group UG (haftungsbeschränkt). 2020. 420 p.
34. Tymoshenko N. Y., Melekh N. V. Global causes and current trends in the development of digital innovations in Ukraine and the world. *Priazovsky economic herald.*Issue 6 (17). 2019. URL: http://pev.kpu.zp.ua/journals/2019/6_17_ukr/18.pdf.



УДОСКОНАЛЕННЯ НАПРЯМІВ РОЗВИТКУ УКРАЇНИ В УМОВАХ СУЧАСНОЇ СВІТОВОЇ КОН'ЮНКТУРИ

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Колективна монографія присвячена актуальним питанням удосконалення напрямів розвитку України в умовах сучасної світової кон'юнктури. Досліджуються сучасні проблеми в сфері педагогіки, психології, соціології, соціальних комунікацій, філософії, культурології, мистецтвознавства, архітектури, історії, філології, фізичного виховання, спорту, географії, рекреації, туризму, економіки, національного та світового господарства, маркетингу, менеджменту, державного управління, політики, юриспруденції, національної та цивільної безпеки. Монографія буде корисною науковцям, викладачам, здобувачам освіти, а також широкому колу осіб, які цікавляться питаннями розвитку сучасного суспільства.

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Над колективною монографією працювали автори, які представляють наступні профільні наукові, навчальні, науково-педагогічні, творчі та мистецькі заклади та установи (інформацію подано мовою оригіналу рукопису автора): Odesa Polytechnic National University, Vinnytsia Technical Vocational College, Бориспільська міська рада Київської області, Генетичний центр материнства та дитинства професора Микитенка, Інститут демографії та проблем якості життя НАН України, Інститут мистецтв Рівненського державного гуманітарного університету, Кам'янець-Подільський національний університет імені Івана Огієнка, Київський національний університет будівництва і архітектури, Київський національний університет імені Тараса Шевченка, Комунальна науково-дослідна установа «Науково-дослідний інститут соціально-економічного розвитку міста», Комунальний заклад вищої освіти «Рівненська медична академія» Рівненської обласної ради, Луцький національний технічний університет, Львівський національний університет імені Івана Франка, Мелітопольський державний педагогічний університет імені Богдана Хмельницького, Навчально-науковий Інститут управління, економіки та бізнесу, Наукового товариства історії дипломатії та міжнародних відносин, Національний педагогічний університет імені М. П. Драгоманова, Національний університет «Львівська політехніка», Північноукраїнський інститут імені Героїв Крут Приватного акціонерного товариства «Вищий навчальний заклад «Міжрегіональна Академія управління персоналом», ПрАТ «Вищий навчальний заклад «Міжрегіональна Академія управління персоналом», Сумський національний аграрний університет, Херсонський державний аграрно-економічний університет, Херсонський державний університет.

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Удосконалення напрямів розвитку України в умовах сучасної світової кон'юнктури

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Видання українською та англійською мовами

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