ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

DIGITAL ECONOMY: INNOVATION AND TECHNOLOGIES

Ihor Rumyk[1]

[1]*Doctor of Science (Economics), Professor, Head of National Economy and Finance Department, KROK University, Kyiv, Ukraine, e-mail: rumykii@krok.edu.ua, ORCID: https://orcid.org/0000-0003-3943-639X*

Citation:
Rumyk, I. (2023). Digital economy: innovation and technologies. *Business model innovation in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 208 p. pp. 99-120, https://doi.org/10.36690/BM-ID-EU-99-120

Abstract. *The digital economy is a type of economy where the key factors (means) of production are digital data: numerical, textual, etc. Their use as a resource makes it possible to significantly increase the efficiency, productivity, value of services and goods, to build a digital society. Digitization is one of the main factors in the growth of the world economy in the next 5-10 years. In addition to the direct productivity gains that companies get from digital technologies, there is a chain of indirect benefits of digitalization, such as saving time, creating new demand for new goods and services, new quality and value. Nowadays, the level of development of digital technologies plays a critical role in the competitiveness of countries and economic unions. The Eurasian Economic Union (EAEU) considers the transition to a digital economy to be the key driver of economic growth. In recent years, EAEU member states have made significant progress in many areas of digital development. The prospects and relevance of digital development of the economies of the EAEU member states were reflected in the Main Directions of the Digital Agenda of the EAEU by 2025, where digital transformation is emphasized as a key factor of development. Harmonization of efforts in the joint implementation of initiatives and projects of the Digital Agenda of the EAEU will allow the expansion of the capabilities of member states, citizens and business entities not only within the EAEU, but also in foreign markets. The effectiveness of joint actions of member states within the Digital Agenda depends on the successful development of their own economies. The implementation of the Digital Agenda will require the creation of digital platforms, network infrastructures, enabling initiatives and projects, building partnerships with those who have chosen the path of digital transformation. Digital transformation means the integration of digital technologies into all areas of business. This integration leads to fundamental changes in the way citizens, enterprises and organizations act, how they provide value for themselves, their employees, customers, partners, achieving their own and common economic and social goals faster, cheaper and with new quality. Digital technologies include the Internet of Things, robotics and cyber systems, artificial intelligence, big data, paperless technologies, additive technologies (3D printing), cloud and fog computing, unmanned and mobile technologies, biometrics, quantum technologies, identification technologies, blockchain, etc. Digitization should be considered as a tool, not as an end in itself. With a systemic state approach, digital technologies will stimulate the creation of jobs, increase productivity, rates of economic growth and the quality of life of citizens.*

Keywords*: digital economy, digital technologies, transformation, financial inclusion factors, digital culture, digital* innovation, *Industry 4.0.*

Business Evolution through Digital Revolution. One of the characteristic features of the transformation of the economy in the context of globalization and the development of the information society, there is a revision of existing doctrines and formation of modern decision-making concepts. In this context, it is of particular importance building a digital economy that enables financial and other services online, therefore, it fundamentally changes the traditional views on various economic processes and relations in society.

Digital economy – an economy based on digital computer technology. Sometimes the digital economy identified with the Internet economy, the new economy, or the web economy. With mutual integration with the traditional economy makes it difficult to clearly delineate these concepts.

That is, the digital economy means the production, sales and supply of products online mode.

European countries and the entire civilized world have been seriously discussing digital transformation for many years and making money from it.

The first things that almost everyone thinks of when they hear the term "digital transformation" are new technologies, Slack instead of faxes, the emergence of brands on social media. The truth is that digital transformation is a much broader, common phenomenon.

Of course, this process is primarily due to the accelerated development of new digital technologies. Hence the name. As in the industrial revolution. The analogy is quite relevant: the industrial revolution did not simply technologize production. During this period, socio-economic paradigms changed, new professions and behaviors emerged. A similar situation is happening now.

The increasing use of digital technologies poses challenges in many areas of public administration (Pylypenko, Matviienko, Putintsev, Vlasenko, & Onyshchuk, 2022). The digital transformation can be thought of as changes caused by three interrelated forces: new technologies, new business models, new habits (Figure 1).

This is a common definition of digital transformation at the macro level. At the micro level, i.e. at the enterprise level, the company's digital transformation is a general change in the company aimed at adapting to the new status quo of the digital age.

Innovation is a fundamentally important recipe for successful adaptation in the age of digital transformation. Digital transformation is changing the traditional way of doing business. There are several reasons for this:

1. Cheaper launch of new technology businesses.
2. Accelerate the spread of new technologies.
3. Effective work with data (insights) for management decisions.
4. Flexibility of modern companies, due to new styles of work and focusing on user needs, not products.

ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

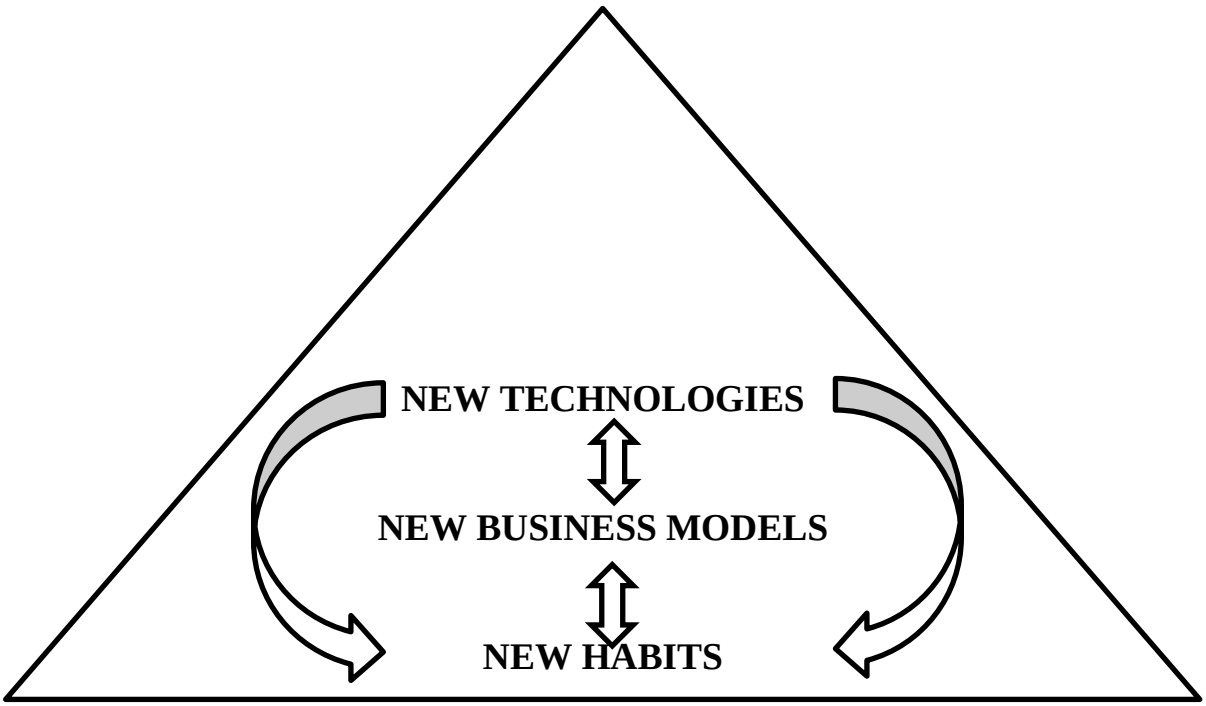

Figure 1. Interrelated forces of digital transformation

Source: systematized by the author

One of the classic examples of digital transformation is banks. New generations of users have grown up with the habit of getting everything online, 24/7, from the couch and via smartphone. This behavior has been shaped by new technologies (the Internet, smartphones) and related new business models (Uber). While banks ignored these needs, young people increased their capital, became attractive to banks, began to search for and find services for their finances. Fintech startups that use cloud technology, artificial internet, good design, focus on relevant services and the last many years have scared the banks, because they are rapidly losing new markets (Garbowski, Lubenchenko, Perederii, Moskalenko, & Rumyk, 2019).

The current state of financial inclusion factors is quite significant (Table 1).

Table 1. Financial inclusion factors in digital world, Jan 2021- Jan 2023

Indicator	Indicator value	
	Jan 2021	Jan 2023
Has an account with a financial institution	68.5%	74.0%
Has a credit card	18.4%	24.5%
Has a mobile money account	4.4%	10.2%
Makes online purchases and / or pays bills online	29.0%	58.8%
Percentage of women with a credit card	17.0%	23.6%
Percentage of men with a credit card	19.9%	25.4%
Percentage of women making online transactions	27.7%	55.2%
Percentage of men making online transactions	30.3%	62.4%

Source: Digital 2021, & Digital 2023

ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

One of the latest fiasco of traditional approaches – the assessment of 19-year-old German fintech Wirecard exceeded the assessment of the world titan Deutsche Bank. Wirecard recognized in time the opportunity to be not a bank, but, in fact, to lease its banking infrastructure for the development of services to those who have a relationship with the client much better (startups, retail).

Music has long been considered the canon of the digital economy. For decades, labels have been selling CDs / cassettes / records and shoveling money. But here came the Internet and Napster. Torrents have appeared. The music industry was rapidly going bankrupt.

This was stopped by a technological visionary – Steve Jobs. Realizing both the desire of people (easy, free access to music and the ability to have it everywhere) and the pain (chaos in the organization, many inconvenient steps) of the user experience of music lovers on the Internet, he invented the iPod, which can store a lot of music. But Apple wouldn't be itself if it didn't create an ecosystem (plus one term for digital transformation) of services around it, namely iTunes for easy digital music purchase and cataloging.

Gradually, the development of the Internet and memory on phones has made streaming possible (which, in theory, is a bit like cloud technology, but in the social model is similar to the trend towards giving up ownership in favor of use). Spotify, Apple Music. The whole philosophy of labels and music recording, income distribution has changed, new concepts of services to artists have appeared. Music has adapted and is earning a lot again. And the main mystery was: what brings more income – streaming or digital sales – and how to properly reward the authors.

World practice has reached the level where digital transformation for companies is a certain path, which consists of known stages. Although each company went through it differently, the overall picture was similar (Figure 2).

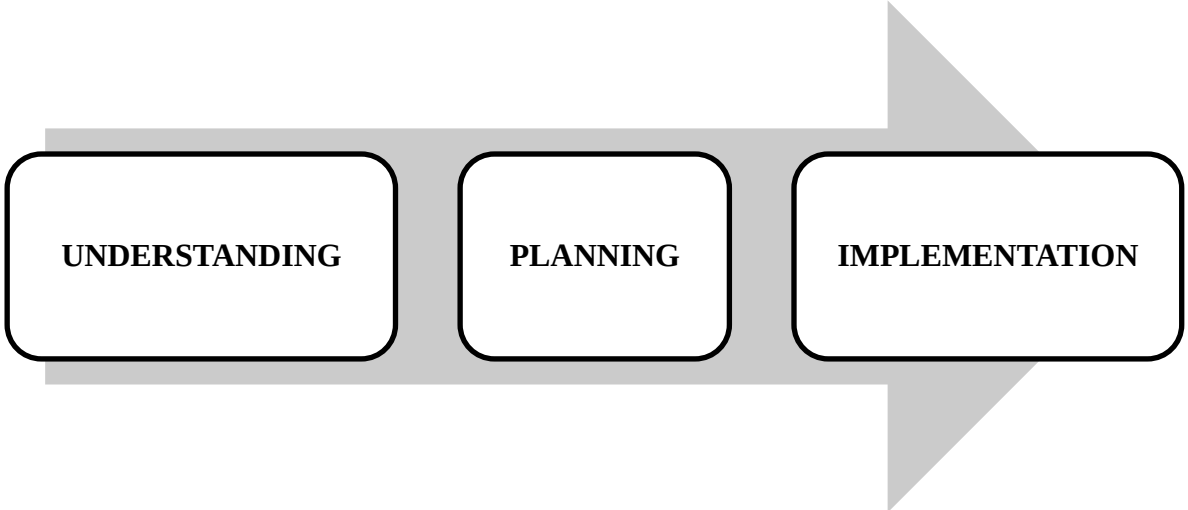

Figure 2. The stages of digital transformation

Source: systematized by the author

The «understanding» stage includes understanding the essence of digital transformation, analysis of one's own needs and business development opportunities.

The «planning» stage includes determining the digital transformation strategy, selecting tools and calculating the quays.

The «implementation» phase includes team selection, launch of innovation initiatives and open innovation activation formats.

At all stages, work with open innovations (i.e. those that come from outside) plays a crucial role. Well-known managerial wisdom says, «Whoever you are, the best people don't work for you». Not using the opportunity to involve external forces in innovation (whether it is customers, universities, researchers, startups or even competitors) is considered wasteful.

Therefore, almost all innovation divisions of global corporations focus on working with startups, and the luminaries of innovation and entrepreneurship consider them the new corporate R&D (Mihus, Denysenko, Rumyk, Pletenetska, Laptiev, & Kupriichuk, 2021).

As a result, innovation outposts/labs/hubs are gaining popularity – separate organizations that collaborate with startups in various formats, as well as other possible participants in the innovation process (for example, universities). Together with startups, these corporate teams build new products, change processes inside, learn from startups, use them as a radar of the future, or simply "buy" talent and make money by selling shares. Some corporations are even building their own startups.

Rapid innovation can be easily seen in many digital products that are used daily. For example, smartphones and the networks they rely on are moving to 5G technology, even though 4G (LTE) networks only became commercially available ten years ago. At the same time, online e-mail and video streaming services are introducing increasingly sophisticated features based on machine learning and AI. These achievements are achieved through a wide range of research and innovation activities.

To achieve the result, it is necessary to conduct a reliable, comprehensive analysis of this complex socio-economic system on the appropriate grounds, measured on various scales, using the tools of economic and mathematical descriptive modeling (Rumyk, Laptev, Seheda, Akimova, Akimov, & Karpa, 2021).

Patents are often used to protect ICT-related technologies in their respective fields. These include high-speed networks, mobile communications, digital security, sensor and device networks, high-speed computing, large and high-speed storage, high-capacity information analysis, cognition and understanding of values, human interface, images and sound. technologies (Inaba, & Squicciarini, 2017). It is important that patent protection is granted only for a product that brings a new technical solution. Thus, a review of the volume of such patents granted may show the scale of innovation in ICT-related technologies.

ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

Digital innovation is a major driver of digital transformation, leading to radical changes in the ways people interact, create, produce and consume. Digital innovation not only creates new goods and services, but also creates opportunities for new business models and markets and can increase efficiency in the public sector and beyond. Digital technologies and data drive innovation in a wide range of sectors, including education, health, finance, insurance, transport, energy, agriculture, fisheries and manufacturing, and the ICT sector itself.

Key policy domains and indicators of Innovation (Figure 3).

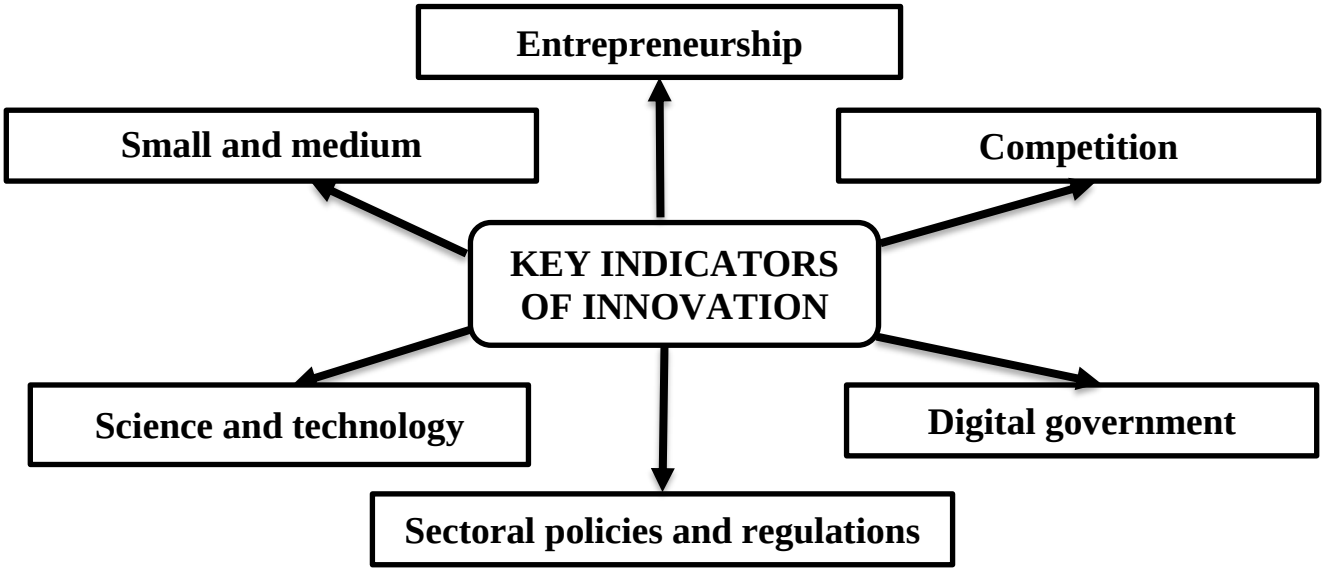

Figure 3. Key policy domains and innovation indicators

Source: systematized by the author

The first two keys and directions is entrepreneurship and small and medium enterprises. Because young firms are an important part of the digital innovation landscape, promoting digital innovation requires a focus on enterprise and small and medium-sized business policies that encourage the emergence and growth of new and young companies. Helping entrepreneurs to start innovative businesses also requires attention to structural factors that contribute to the creation of new businesses and do not impose excessive penalties for the failure of entrepreneurs (McGowan, Andrews, & Millot, 2017). In addition, organizations need to invest in KBC. This is important for innovative business models and new organizational forms that increase the value of additional skills. Digital technologies can help improve access to finance for SMEs and startups through innovative tools such as crowdfunding (OECD, 2019).

The third key and direction is science and technology. Digital innovation relies on the continuous creation of a knowledge base, and basic research in science and technology is crucial in this regard. Public support from universities and other

institutions that conduct basic research can help sow the seeds of future innovation. The public sector also helps to innovate beyond research through partnerships between universities, industry and government. They can provide startups with know-how, equipment and start-up funding to test and scale new technologies. Well-designed incentives to support research and innovation can be useful in this regard. Such incentives include the protection of intellectual property regimes and tax incentives such as tax credits for research and development. Open science initiatives can also be useful for stimulating digital innovation (OECD, 2015).

The fourth key and direction is competition. Market concentration in the digital economy can be another barrier to innovation, emphasizing the importance of competition policy. The regulatory framework may restrict the entry of new players, which is important for stimulating competition, innovation and the spread of technology in the economy. For example, rules that require physical presence may discourage online intermediaries (OECD, 2018). Similarly, the high regulatory burden in some industries, such as banking, can create costs that only existing firms of a certain size can afford. This limits the emergence of smaller business models that often use digital technology.

The fifth key and direction is digital government. Digital government strategies, including open government data, can stimulate innovation and efficiency in the public sector and beyond. Digital technologies can help governments better design, develop and implement policies and regulations; become more efficient; and reduce waste. As the public sector produces and consumes large amounts of data, governments have significant potential to use this data and digital technology for innovation.

The sixth and last key and direction is sectoral policies and regulations. The pace of digital transformation varies across sectors. It may come as no surprise that the ICT and telecommunications sectors seem to have integrated digital assets and know-how into all areas of their business. However, ICT services are ahead of their production counterparts. Looking ahead, digital technologies such as data analysis and artificial intelligence (AI) offer enormous potential for increased productivity in service. This includes improving less knowledge-intensive activities, such as personal transport and housing, where productivity has traditionally been sluggish (Sorbe, Gal, & Millot, 2018). For example, combining patient history with real-time patient data and the use of connected devices can contribute to more personalized care and innovation in the healthcare sector.

Key areas for unleashing innovation.

1. Encourage entrepreneurship by reducing the regulatory burden on startups and making it easier for new and young companies to access finance through a combination of venture, debt and equity financing and digital finance solutions such as platform-based lending.

2. Reassess rules that may not be appropriate for the digital age, such as those that require physical presence or minimal scale, or try to eliminate information asymmetries.

3. Encourage investment in key research and intangible assets, including skills, organizational capital, data, software and patents, for example through R&D tax credits and intellectual property systems that are well suited to the digital age.

4. Promote knowledge through open innovation and open research initiatives, and encourage open public data through, for example, a "default openness" policy to stimulate innovation in the economy.

5. Encourage policy experimentation and new business models in a variety of areas, including through flexible regulation and flexible application or enforcement (such as regulatory sandboxes) while protecting consumers (OECD-19, 2019).

Innovation in digital technologies "Industry 4.0". Since the beginning of the 19th century, we have experienced three industrial revolutions. The engine of each of them was a new breakthrough technology: the mechanics of a steam engine, the principle of an assembly line and the speed of a computer. They have been called industrial revolutions because the innovations that caused them not only led to some increase in productivity and efficiency, but completely changed the way goods were produced and work was done.

Today, we are experiencing the fourth industrial revolution, dubbed Industry 4.0, which is taking supply chain automation, monitoring and analysis to the next level with intelligent technology. At the heart of Industry 4.0 is the Industrial Internet of Things (IIoT) and Cyber-Physical Systems – intelligent autonomous systems that use computer algorithms to monitor and control physical “things,” including equipment, robots, and vehicles. "Industry 4.0" makes all parts of the supply chain "smart" - from smart industries and factories to smart warehouses and logistics. But Industry 4.0 is not just about the supply chain. Industry 4.0 connects to back-end systems such as enterprise resource planning (ERP) systems, providing an unprecedented level of visibility and control over an organization's activities. Ultimately, Industry 4.0 is a critical aspect of the digital transformation of any company.

The general definition of Industry 4.0 is the development of digital industrial technologies. The digital transformation of Industry 4.0 allows us to work side by side with machines, using new high-performance approaches.

Industry 4.0 is based on nine technological pillars. These innovations serve as a bridge between the physical and digital worlds and enable intelligent and autonomous systems to function. Organizations and supply chains are already using some of these advanced technologies, but the full potential of Industry 4.0 can only be realized when they are used in combination.

1. Analytics based on big data and artificial intelligence. Industry 4.0 involves the collection of big data from a wide range of sources, from manufacturing equipment and Internet of Things (IoT) devices to ERP and CRM systems, as well as weather and traffic applications. Artificial intelligence (AI) and machine learning-based analytics are applied to real-time data, and the resulting information is used to make better decisions and automate all areas of supply chain management: supply chain planning, logistics management, manufacturing, research and design, enterprise asset management (EAM) and purchasing.

2. Horizontal and vertical integration. The foundation of Industry 4.0 is horizontal and vertical integration. Horizontal integration ensures close interaction of processes at the "local level" - at the production site, between several production sites and throughout the entire supply chain. Through vertical integration, all levels of the organization are connected, and data flows freely from the shop floor to the board of directors and back. In other words, manufacturing is tightly integrated with business processes such as research and development, quality assurance, sales and marketing, and other business units. The fragmentation of data and knowledge is becoming a thing of the past.

3. Cloud computing. Cloud computing is the most powerful tool of the Industry 4.0 concept and digital transformation. The possibilities of modern cloud technologies are far from limited to increased speed, scalability, ease of storage and cost efficiency. They are the foundation for the latest technologies, from AI and machine learning to the Internet of Things, and provide companies with the technical ability to innovate. The data on which Industry 4.0 technologies are built is stored in the cloud, and the cyber-physical systems that form the core of this concept use the cloud for communication and coordination.

4. Augmented Reality (AR). Augmented reality tools that overlay digital content on the real environment are a key component of Industry 4.0. Working in augmented reality, employees use smart glasses or mobile devices to visualize real-time IoT data, digitized parts, repair or assembly instructions, training content, and other information while looking at a physical object, such as a piece of equipment or a product. AR is still in its early stages of development, but is already having a major impact on maintenance, service delivery, and quality assurance, as well as on technician training and security.

5. Industrial Internet of Things (IIoT). The Internet of Things (IoT) – more specifically, the Industrial Internet of Things – is so important to Industry 4.0 that the two terms are often used interchangeably. Most of the physical objects in Industry 4.0 – devices, robots, machines, equipment, products – use sensors and RFID tags to provide real-time data about their state, performance, or location. This technology allows companies to optimize supply chains, design and modify products quickly,

prevent equipment downtime, stay on top of consumer preferences, track products and inventory, and more.

6. Additive manufacturing/3D printing. Additive manufacturing, or 3D printing, is another key technology behind Industry 4.0. 3D printing was originally used as a tool for rapid prototyping, but now offers a wider range of use cases, from mass customization to distributed manufacturing. For example, the use of 3D printing allows you to store parts and products as design data files in virtual warehouses and print them on demand at the time of need, reducing both transportation distances and costs.

7. Autonomous robots. Industry 4.0 has led to a new generation of autonomous robots. Programmed to perform tasks with minimal human intervention, autonomous robots vary greatly in size and function, from drones for inventory scanning to autonomous mobile robots for pick-and-place operations. Armed with advanced software, AI, sensors and machine vision, these robots are capable of performing complex and highly precise tasks, as well as recognizing, analyzing and acting on information from the environment.

8. Simulation/digital twins. A digital twin is a virtual model of a real machine, product, process, or system based on data from IoT sensors. This core component of Industry 4.0 enables companies to better understand, analyze and improve the performance and maintenance of industrial systems and products. For example, a machine operator can use a digital twin to pinpoint a failed part, predict potential problems, and increase uptime.

9. Cybersecurity. With ever-increasing levels of connectivity and the use of big data in Industry 4.0, cybersecurity is of paramount importance. By adopting a Zero Trust security architecture and technologies such as machine learning and blockchain, companies can automate threat detection, prevention, and response, and minimize the risk of data breaches and production delays across their networks.

The market offers a wide range of Industry 4.0 solutions that help thousands of companies transform their digital supply chain, reorganize production, focus on customers and connect all aspects of the organization.

Here are some of the benefits available to companies today:

1. Radical increase in productivity and level of automation. Companies use data to drive decisions across their operations, improving forecasting accuracy, delivering on time, and generating profit-optimized plans.

2. Stability and flexibility in any market or economic conditions. Companies are shaping the digital supply chain of the future with state-of-the-art planning tools.

3. The confidence you need to explore new business models and seize opportunities quickly. With Industry 4.0 solutions, companies are reducing costs, improving market efficiency and connecting supply chains across sea, land and air.

4. Green and sustainable solutions without sacrificing profitability. Customers are becoming more efficient and cost-effective as a result of digital transformation, ensuring that they meet their environmental challenges without compromising other business goals such as profitability and scalability.

Benefits of innovation in digital technologies "Industry 4.0" (Table 2).

Table 2. Benefits of "Industry 4.0"

Benefits	Description
Smart Products	Develop connected products that analyze their state and can share information about health, location, usage level, storage conditions, and more. The data exchanged by these intelligent products will help you improve everything from product quality and customer service to logistics and research processes. They can also predict service needs, receive remote updates, and unlock opportunities for new service-based business models.
Smart factories	The smart factory is characterized by a high level of digitalization and autonomy, and allows to take full advantage of advanced technologies such as big data, artificial intelligence, robotics, analytics and the Internet of things. Also referred to as Factory 4.0, such manufacturing is able to self-correct, leverage Smart Manufacturing Processes 4.0, and deliver custom-made products at minimal cost and on a large scale.
Intellectual assets	Nearly every physical asset being put into production today has built-in sensors that, when connected to the Internet of Things and analytics tools, can revolutionize the way enterprise assets are managed. By working with smart assets, technicians can monitor asset performance in real time, predict and prevent downtime, apply dynamic and predictive maintenance, take advantage of digital twins, and tightly integrate assets and business processes.
New opportunities for employees	But no matter how autonomous your systems become, you will always need people. Empower them with technologies such as artificial intelligence and real-time access to sensor data so they always know what's happening on the production floor and are ready to make quick decisions and fix problems as they arise. Wearable devices and augmented reality applications can also help them with problem solving, health monitoring and security.

Source: What is industry 4-0, 2023

Industry 4.0 technologies digitalize production and create individual solutions available to small and medium-sized businesses. Inventory accounting and predictive maintenance help to reduce the cost of materials and the overall maintenance of facilities, which is especially important now - during the cycle of high prices for raw materials and rising labor costs.

However, there is an area that can nullify any positive results in terms of intensification and savings - this is management. A lot of materials have been written about this, from journalism to non-fiction. But engineers creating new industrial technologies have found a solution for such problems.

ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

HR business processes lend themselves to digitalization no worse than production ones. The result of work on the formalization of management processes and procedures was the emergence of a new management concept of the class corporate software – Business Process Management, or simply BPM. And to support these business processes, it became possible to configure process applications without involving professional developers – for this, a new class of corporate software is used – Business Process Management System using No-Code / Low-Code technologies.

Like other Industry 4.0 products, the new software has become a "bridge" from programmers to business users. BPM allows you to build procedures and processes through intuitive visual programming. And after their simulation allows you to effectively control online. If ERP systems enable material accounting and allow top management to monitor costs, the movement of raw materials, products, then BPM services also allow online control of exactly how the work of personnel is performed, identify bottlenecks and improve processes.

The effectiveness of the BPM management model cannot be overestimated. The introduction of technology critically increases the speed of internal processes in the company. In addition, BPM allows you to evaluate time costs on the go.

As we noted above, BPM systems do a good job with the routine, which is no less in business processes than in the production pipeline. Nevertheless, office work requires higher education, because although lawyers, accountants, and managers perform almost mechanical work every day, they are responsible for their decisions and for quality. In many professions, such as banking, there are special protocols that require the creation of committees for any process of little or no importance – it is so dangerous to make a mistake. If the computer will do the checking of key points, who will be responsible in case of failure?

Every time we talk about optimization, we understand: someone may be superfluous. After all, labor resources are saved! Who is at risk of being left without a job when a BPM system is implemented?

Saves not a human resource, but a temporary one. The key tasks of top management are strategic, while due to inefficient control over the processes, the "OS" eats up their valuable time.

According to the Harvard Business Review, 72% of leaders of the world's largest enterprises consider the speed of adoption of new technologies the main constraint on business growth. Now it is not so much businesses that compete, but the models for managing these businesses. And the introduction of BPM systems allows you to improve models, grow and develop. The ability to expand and grow, rather than save on staff, is a key aspect of BPM as part of Industry 4.0 technologies."

Another driving force of the digital economy is the proliferation of digital platforms. There have been many digital platforms in the world in the last decade,

which use business models based on data and transform existing sectors of the economy. Digital platforms act as mechanisms that allow different parties to interact online.

However, there are many difficulties in assessing the scale of the digital economy, the value it creates, and the benefits it derives.

First, there is no generally accepted definition of the digital economy.

Second, there is a lack of reliable statistics on its key components and aspects, especially in developing countries.

Although a number of initiatives are already being implemented to remedy this situation, there are some still not enough, and they barely keep up with the rapid development of the digital economy (OECD, 2017).

The World Bank recognizes the lack of adequate macroeconomic statistics that can fully assess the benefits of digital and digital products or cross-border transactions. In this regard, the International Monetary Fund has recently initiated discussions in government, academia and business methods of measuring the digital economy.

Remain unresolved the question of how to assess the contribution of the sharing economy, platforms and the gig economy in GDP and productivity growth.

Depending on the definition used, the size of the digital economy is, according to estimates, from 4.5% to 15.5% world GDP (Table 3).

Table 3. The share of the digital economy in world GDP, %

The share of the digital economy	2016	2025
dollars	11.5 trillion	23.0 trillion
percent	15.5%	24.3%

Source: Digital Spillover, 2017

Almost 40% value added created in global information and communication technology sector (ICT), accounted for by the United States and China. Numeric employed in the ICT sector in the world grew from 34 million people in 2010 up to 39 million people in 2015, at this is the largest percentage (38%) employees work in in the field of computer services. By the same period the share of the sector ICT in general employment increased from 1.8% to 2%.

According to the World bank, the introduction of digital technologies leads to the blurring of geographical and physical boundaries and opens new one's prospects for economic, social and cultural development of countries, as well as to growth of regional and global competitiveness.

Considering the impact of digital technologies on GDP growth in the EU until 2025 The World Bank Group notes that the penetration of the fixed broadband Internet access adds +1.7% to GDP, increase international bandwidth (+0.66% to GDP) and spread e-commerce (+0.88% to GDP) (EAEU, 2016).

ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

The key advantage of the digital economy over the traditional one is the realization of the possibility of automatic control of the whole system (or individual components), as well as its virtually unlimited scaling without loss of efficiency, which allows you to significantly increase efficiency management of the economy (economic activity and resources of the country in different industries) at the micro and macro levels.

This makes it clear that the digital economy is not a separate industry or IT companies that are digital. This is, first of all, the existing economy – all traditional industries and companies (manufacturing, agriculture, construction, transportation, etc.) that are influenced by digital transformations due to technological evolution revolutionize their own production and business processes and gain new opportunities to increase productivity and efficiency of the main (existing) business.

G20 Digital Economy Development and Cooperation Initiative demonstrates that the digital economy is a driving force accelerating global economic development, increasing productivity, creating new markets and industries. She is too opens up new opportunities for inclusive and sustainable growth. However, acceleration of economic development is achieved by those countries and economic associations that systematically build the foundations and mechanisms of leadership in the digital economy.

The rapid development of digitalization is becoming a source not only of new opportunities, but also of serious threats and problems for all segments of the population.

In an environment where half of the world's wealth is concentrated in the hands of 1% of the population, inequality has reached enormous proportions. She including contributes to populist and anti-globalist sentiment in many countries. One may even ask whether pathos is justified business speeches on digitization.

From the point of view of experts of the World Bank Group, despite the presence a large number of successful examples, the impact of new technologies on global productivity, empowerment for the poor population and the middle class, as well as the spread of accountability management has not yet met expectations (Digital dividends, 2016).

The World Bank points out that digital technologies are spreading and there are no digital dividends. First, almost 60% of the world's population is still deprived of Internet access and unable to play any significant role in the digital economy. Second, some are predictable the benefits of digital technology are offset by emerging risks.

The UN also recognizes digitalization as one of the four main dangers threatening humanity (Figure 4.4).

ISBN 978-9916-9927-0-8 DOI: https://doi.org/10.36690/BM-ID-EU

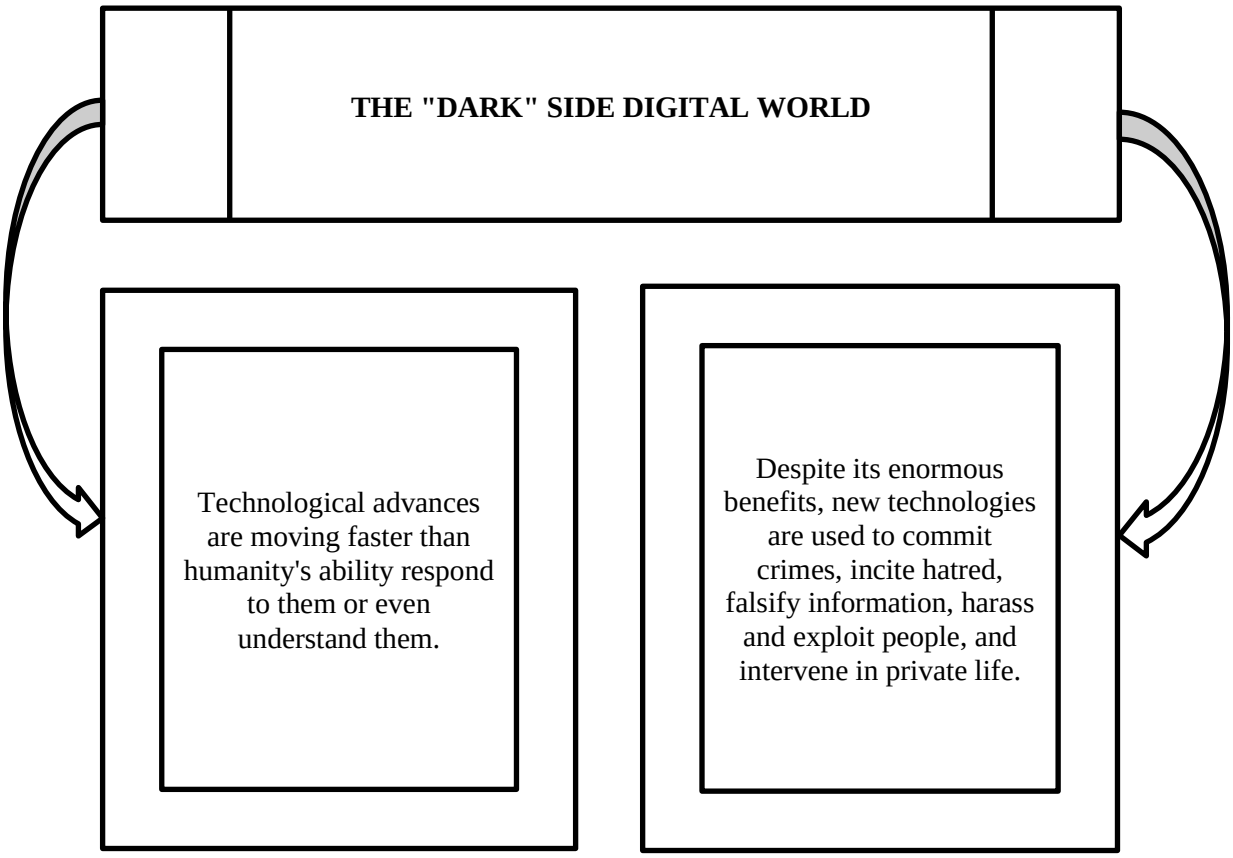

Figure 4. The major threats from digitalization

Source: The Clean Network US Department of State, 2021

Macroeconomic threats of digitalization. Slow productivity growth will threaten progress in raising global living standards, viability of social protection systems and economic viability politicians respond to future shocks.

The world is experiencing a trend of declining global productivity, increasing global inequality and a global crisis management. Among the main causes of the decline are:

- inconsistency and lack of skills;
- reducing spending on science and innovation, especially in the business sector;
- restraint (reduction) of investments in intangible assets;
- demographic factors such as population aging;
- strict conditions and limited access to corporate credit, including innovative;
- reduction of the number of registered new patents (including process patents, in the OECD study).

Increasing tensions between states over technological dominance. One striking example is the trade war between the United States and China, which began in 2018. and which hides the escalation of rivalry between the two superpowers for world

technological dominance when China became active compete in global markets with US IT corporations.

The winner of the technology race will receive decisive advantage in the commercial, geopolitical and military spheres.

The trade war showed on the basis of which superpower technologies plan to secure world dominance – it's artificial intelligence, communication and surveillance systems, autonomous transport.

The United States intends to completely clean up the information and digital space from any Chinese influence. The initiative of the State Department is formalized as the state program "Clean Network" (Clean Network) (*The Clean Network US Department of State, 2021).*

The program contains six areas:

1. "Clean Path". This is a data security plan transmitted over 5G networks to U.S. diplomatic missions abroad and within the country. The State Department insists that the participation of the Chinese corporation Huawei in the 5G project (fifth generation of mobile communications) is unacceptable.

2. "Clean Carrier". Chinese cellular operator's communications pose a threat to U.S. national security, should not have connect to US telecommunications networks and be present in the US communications services market.

3. "Clean Store". Unreliable applications cannot be sold in mobile application stores64 in the United States. To particularly unreliable and dangerous applications from China.

4. "Clean Apps". Unreliable smartphone manufacturers from China may not pre-install or otherwise make critical applications available for download through their stores. US and foreign companies should remove their applications from the Huawei store.

5. "Clean Clouds". Storage and processing of personal information of US citizens and intellectual property of enterprises, including COVID-19 vaccine research should not be in "cloud" systems available to US foreign adversaries through companies such as Alibaba, Baidu and Tencent.

6. "Clean Cable". All submarine cables connecting the United States with the World Wide Web, should not be used to gather intelligence from China. The United States is ready to cooperate with other states to ensure that China's access to submarine cables is blocked worldwide.

Artificial intelligence is not profitable. According to a forecast study in 2019. Forrester, artificial intelligence has been overestimated and in a year there will be disappointment (Ransbotham, Khodabandeh, Fehling, Lafountain, & Kiron, 2019). In particular, a return was predicted 10% of companies are in favor of automated processes that will be carried out with the help of the human factor, and this trend is

largely due to the limitations of AI. Automation definitely speeds up most processes and often eliminates common human errors when it comes to analyzing large data sets or comparing objects. However, automation is only good for business if it helps bring the business closer to the customer.

Replacing man with artificial intelligence on stage of help desk or round-the-clock chat, businessmen risk losing customers. The fact is that most people prefer human contact. So in most cases, people don't have to completely be excluded from the AI cycle. Automation can be used for market analysis and accelerating customer support processes, but direct contact should be made by people. In a balanced relationship between AI and humans, automation should only be used as a first line of response. If the company leaves customers the opportunity to any time to contact an experienced representative, it will save effective balance between the necessary automation and maintaining contact with people.

Cyber-attacks as the main danger. According to a report by the World Economic Forum, cyberattacks are among the five main threats threaten humanity, along with natural disasters and climate change (The Global Risks Report, 2019). In recent years, cybercrime has increased tenfold. Today the main one's risks are typical for the financial and credit industry (in 2018, the loss from cyber-attacks increased to $1.5 trillion, continuing the upward trend, the duration of DDoS attacks has doubled, according to rough estimates, the annual loss global business from cyber-attacks is up to $600 billion), but already a threat can become relevant for almost all industries. Cyber threats are characterized by the fact that they are constantly changing and appear almost daily.

New trends are cryptocurrency fraud and attacks on virtual values in the block chain. The amount of investment in cybersecurity in 2018, for by some estimates, amounted to $96 billion.

Digital divide, Digital inequality and polarization. Inequalities in access to social, economic, educational, cultural and other opportunities are exacerbated by unequal access to information technology.

The problem of "digital inequality" has received an unexpectedly significant response in the world. Polar views were expressed: from the recognition of this problem as one of the global threats to states and societies in the information age before labeling it as contrived, which further enriches computer and telecommunications corporations. Subsequently, the discussions moved to the plane development of practical recommendations for overcoming "digital inequality" as in internationally and on the scale of individual states.

Digital inequality reduces the quality of life: fewer opportunities, poorer health care and education. Digital Inequality is a consequence of other inequalities and at the same time deepens others, historically earlier inequalities. As a result, states that do not

pay attention to stimulating the integration of information technology in all spheres of society will be uncompetitive in the world economy.

The digital revolution has so far had little effect on the lives of the greater parts of the world's population. Only about 15% of the world's population can afford to pay for broadband internet access. The main means of Internet access in developing countries is a mobile phone, which provide about 80% of the world's population. However, almost 2 billion people do not have mobile phones, and about 60% of the world's population do not have access to the Internet.

The problem of professional development. Partly because of new technology complement more skilled work and at the same time replace standard labor operations, forcing many workers to compete alone with one for low-paid jobs.

The shortage of professionals who have the necessary digital skills comes first place among the threats to growth according to company executives, and they agree so that retraining (advanced training) is the best way elimination of this deficit.

Increasing price competition in the labor market. On the one hand, workers from the periphery with approximately the same level of qualification with employees from the center, favorable price competition because they are ready work for lower wages, but on the other hand - Internet technology allow workers from even poorer areas (such as other countries) to enter the market, effectively waging a price war.

In addition, on the labor market with price competition, their services are offered primarily by relatively low-skilled workers, whose work is easily automated. Therefore, winning wages first, low-skilled information workers in the future may be replaced by technology, the creation of which is stimulated by the desire to reduce costs.

A striking example is the market for standard website design services, where standard work is done web programmers have gradually supplanted ready-made solutions (CMS-systems, Content Management System (content management system, etc.). Using such systems, the average experienced user can quickly make a fairly complex website without the help of a programmer (creating the same CMS-systems require highly skilled creative work, so demand for such professionals will only grow).

Increasing gender inequality in the workplace and in society as a whole is recognized as one of the most likely social risks associated with the development of the digital economy. This threat is primarily related to modern gender asymmetric reduction of employment due to the introduction of new technologies, including robotics and AI.

At the same time, in the digital economy, employment in the field of STEM (science, technology, engineering and mathematics) will develop rapidly, i.e. science, technology, engineering and mathematics. Asymmetry of employment in this area in favor of men is typical not only for countries like Ukraine, but and for all OECD

countries. This can be seen in the example of employment in the field of ICT, which traditionally belongs to the "male" activities and where women make up no more than 30%.

Critique of the consumer economy in the "digital world" and the innovative doctrine of "goods as a service". Adherents of digital sharing through Smartphone apps try to prove that owning things is inconvenient.

Critics of this approach insist that a person buys a house, transport, clothing, household appliances and other things when they are economically prosperous and viable. If a person is economically disadvantaged (beggar), then she does not buy things, but tries to share material goods among them beggars themselves, otherwise there will not be enough money for basic needs. "Economy Schering is poverty. A communist collective farm burdened with bourgeois rent".

"Digital Dictatorship". Opportunities are also a matter of serious concern introduction of universal control over citizens through digital technologies, when it is possible to track every step, the word of man, and later - and his thoughts. A few years ago, the news space was blown up by the news: "China is introducing a digital dictatorship." With such headlines, one could see articles on the revolutionary initiatives of the Chinese leadership, when a tough decision to fight corruption throughout society, as well as restoring trust in society.

Digital culture, new technologies and the "power of data" are changing the means through which citizens use public services and exist in civilian space. Digitization increases people's opportunities interact with the state and business and defend their position. At the same Over time, society's expectations, which are gradually becoming accustomed to the benefits of digital tools in everyday life, are rising, and emerging cyber threats change perceptions of security. At the same time, new threats to digital security increase the vulnerability of both governments and individuals.

Digitalization provides a number of benefits for economic development. In particular, the potential of digitalization is confirmed in the OECD report: "Technology, smart applications and other innovations in the digital economy can improve the quality of services provided and help solve problems within the various areas, including health, agriculture, public administration, taxes, transport, education, the environment, etc.".

The high speed of digitization of all aspects of life is due, first of all, its possible positive manifestations and consequences at all levels.

Benefits at the level of the whole society:

- economic and social effects of digital technologies for business and society;
- improving the quality of life, primarily by improving the satisfaction of specific already known and new needs of people;

- increasing the productivity of all social labor by increasing it at the level of individual industries and enterprises;

- the emergence of new models and forms of business that can improve profitability and competitiveness of activity;

- increasing the transparency of economic transactions and ensuring the possibility of their monitoring;

- ensuring the availability and promotion of goods and services as public, and commercial, up to the world scale;

- the emergence of human-replaceable control systems, for example, for enterprises certain classes.

Advantages at the level of individual companies and industries:

- getting rid of intermediaries. Digitization allows manufacturers themselves arrange on their sites the sale of their products or services and reach out to potential customers. Consumers get the same possibility to independently choose the offered goods and services on the servers of airlines, hotels, e-shops, etc.;

- cost optimization, which involves, above all, reducing costs information retrieval, identification and measurement of transaction costs; costs to promote goods and services; costs of concluding and conducting negotiations, etc.;

- acceleration of all business processes, including by reducing time communications;

- reduction of reaction time to market changes, reduction of terms of development products and services and bringing them to market;

- better understanding of their customers and improving product quality and services;

- creation of new products and services, increase of flexibility of the offered products and their high adaptability to new expectations or needs consumer.

Technological advantages due to digitalization:

- information sharing and lack of competition in consumption knowledge and information, as the use of a database or knowledge base one consumer does not interfere with their simultaneous use by others consumers;

- accumulation of large amounts of data, their automatic processing and analysis;

- synchronization of information flows, the possibility of point distribution of data throughout the business and, as a result, the ability to track a large number of chains between suppliers and consumers, as well as conducting intellectual and point analysis;

- not just mastering new technologies at the applied level, but the transition to awareness of the potential of new innovations, to create new one's innovative products focused on the development of technological intelligence (for example, data management technologies);

- transition from paper to electronic documents.

Consumer and employee benefits:

- reduction in the cost of payments and the emergence of new sources of income;

- the cost of Internet services is much lower than in the traditional economy (mainly due to reduced marketing costs), which makes services more accessible (both commercial and public). Goods and services become available anywhere in the world to any buyer;

- goods and services take into account consumer preferences and needs as much as possible customers;

- the range of informational, educational and entertaining is significantly expanded services, the level of provision and speed of which are also increasing.

Conclusions. Digital culture, new technologies and the "power of data" are changing the means through which citizens use public services and exist in civilian space. Digitization increases people's opportunities interact with the state and business and defend their position. At the same Over time, society's expectations, which are gradually becoming accustomed to the benefits of digital tools in everyday life, are rising, and emerging cyber threats change perceptions of security. At the same time, new threats to digital security increase the vulnerability of both governments and individuals.

So, to bring the benefits of digital technology to real organizations sectors of the economy were able to fully manifest themselves, they need balanced development. The best case scenario for the future is if new technologies are used not for selected countries and small elites, but for the well-being of most people in the world.

References:

1. Digital dividends (2016). World bank. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/23347/210671RuSum.pdf.

2. Digital Spillover (2017). Measuring the true impact of the digital economy. *Huawei, Oxford Economics*. Available at: https://www.huawei.com/minisite/gci/en/digital-spillover/files/gci_digital_spillover.pdf.

3. *Digital 2021: global overview report.* Available at: https://datareportal.com/reports/digital-2021-global-overview-report

4. Digital 2023: global overview report. Available at: https://datareportal.com/reports/digital-2023-global-overview-report

5. EAEU (2016). Overview Full Final. Available at: https://documents1.worldbank.org/curated/pt/413921522436739705/pdf/EAEU-Overview-Full-RUS-Final.pdf

6. Garbowski, M., Lubenchenko, O., Perederii, N., Moskalenko, N., & Rumyk, I. (2019). Economic and mathematical modeling of loan risks for credit unions. *Journal of Management Information and Decision Sciences, 22*(4), 495-500. Available at: https://library.krok.edu.ua/media/library/category/statti/rumyk_0003.pdf

7. Inaba, T., & Squicciarini, M. (2017). ICT: A new taxonomy based on the international patent classification. *OECD Science, Technology and Industry Working Papers*, 2017/01, OECD Publishing, Paris. Available at: https://www.oecd-ilibrary.org/docserver/ab16c396-

en.pdf?expires=1706556619&id=id&accname=guest&checksum=F8FD4490E3BD515D9914820E6F80F7E2

8. McGowan, A.M., Andrews, D., & Millot, V. (2017). The Walking Dead? Zombie Firms and Productivity Performance in OECD Countries. *OECD Economics Department Working Papers, 1372*, OECD Publishing, Paris. Available at: https://www.oecd-ilibrary.org/docserver/180d80ad-en.pdf?expires=1706557118&id=id&accname=guest&checksum=1612972FC35DA50BD13F794A138711BB

9. Mihus, I., Denysenko, M., Rumyk, I., Pletenetska, S., Laptiev, M., & Kupriichuk, V. (2021). Methodology of corporate financial diagnostics in the period of a crisis. *AD ALTA: journal of interdisciplinary research, 11*(1), 52-55. Available at: https://er.knutd.edu.ua/bitstream/123456789/18302/1/AD_ALTA_2021_11_1_XV_P052-055.pdf

10. OECD (2015). Making Open Science a Reality. *OECD Science, Technology and Industry Policy Papers, 25*, OECD Publishing, Paris. Available at: https://read.oecd-ilibrary.org/science-and-technology/making-open-science-a-reality_5jrs2f963zs1-en#page1

11. OECD (2017). Digital Economy Outlook 2017. *OECD Publishing*. Available at: https://read.oecd-ilibrary.org/science-and-technology/oecd-digital-economy-outlook-2017_9789264276284-en#page2

12. OECD (2018). Maintaining competitive conditions in the era of digitalization. *OECD Report to G-20 Finance Ministers and Central Bank Governors, July 2018*, OECD, Paris. Available at: https://www.oecd.org/g20/Maintaining-competitive-conditions-in-era-of-digitalisation-OECD.pdf

13. OECD (2019). Enhancing SME access to diversified financing instruments. *Strengthening SMEs and Entrepreneurship for Productivity and Inclusive Growth: OECD 2018 Ministerial Conference on SMEs*, OECD Publishing, Paris. Available at: https://read.oecd-ilibrary.org/industry-and-services/strengthening-smes-and-entrepreneurship-for-productivity-and-inclusive-growth_16fe6707-en#page1

14. OECD-19 (2019). *Going Digital: Shaping Policies, Improving Lifes*, OECD Publishing, Paris. Available at: https://read.oecd-ilibrary.org/science-and-technology/going-digital-shaping-policies-improving-lives_9789264312012-en#page4

15. Pylypenko, O., Matviienko, H., Putintsev, A., Vlasenko, I., & Onyshchuk, N. (2022). Government tax policy in the digital economy. *Cuestiones Políticas, 40*(72). https://doi.org/10.46398/cuestpol.4072.15

16. Ransbotham, S., Khodabandeh, Sh., Fehling, R., Lafountain, B., & Kiron, D. (2019). Winning with AI. *Massachusetts Institute of Technology*. Available at: https://sloanreview.mit.edu/projects/winning-with-ai.

17. Rumyk, I., Laptev, S., Seheda, S., Akimova, L., Akimov, O., & Karpa, M. (2021). Financial support and forecasting of food production using economic description modeling methods. *Financial and credit activity: problems of theory and practice, 5*(40), 248-262. https://doi.org/10.18371/fcaptp.v4i35.245098

18. Sorbe, S., Gal, P., & Millot, V. (2018). Can productivity still grow in service-based economies? Literature overview and preliminary evidence from OECD countries. *OECD Economics Department Working Papers, 1531*, OECD Publishing, Paris. Available at: https://read.oecd-ilibrary.org/economics/can-productivity-still-grow-in-service-based-economies_4458ec7b-en#page1

19. The Clean Network US Department of State (2021). Available at: https://2017-2021.state.gov/the-clean-network/

20. The Global Risks Report 2019. 14th Edition, *World Economic Forum*. Available at: http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf.

21. What is industry 4-0. (2023). Available at: https://www.sap.com/ukraine/products/scm/industry-4-0/what-is-industry-4-0.html