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## INFORMATION AND COMMUNICATION TECHNOLOGIES OF DIGITAL TRANSFORMATION OF THE ECONOMY

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### *Abstract*

The digitalization trend covers all areas of the modern world. Urgency widespread introduction of information and communication technology (ICT) is determined coronavirus pandemic infection COVID-19. The use of technologies is a necessary and enforced tool. The digital companies that already have experience in using digital technologies turn out to be resistant to sudden and non-standard changes in the environmental conditions. The basis and tools of the digital economy ecosystem are the ICT which are called digital nowadays. Digital technologies include big data, quantum technologies, robotics, neurotechnics and artificial intelligence, computer engineering and additive manufacturing, the industrial internet, a blockchain system, virtual and augmented reality technologies. Particular emphasis should be given to the study of information and communication technologies. The promising areas for the development of digital technologies are unmanned vehicles and education. The need for physical distancing has served as an accelerator for rapid technological development and expansion in these areas. The successful international experience in ICT introduction and use for both general and particular tasks should be taken into account. In the article the authors present the results of the research aimed at clarifying and developing the provisions on the role, place and interrelation of information and communication technologies and processes of digital transformation of the economy under present-day conditions, including the challenging COVID-19 epidemiologic situation. The main research methods were the analysis of scientific and research literature, materials published in the media, statistical reports and economic development programs on digital economy and key technologies used.

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**Keywords:** Digital economy, data economy, information and communication technologies, digital technologies, COVID-19.



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## **1. Introduction**

The process of transforming the economy into a digital one began long ago. The COVID-19 coronavirus infection pandemic has served as a powerful accelerator for the development of information and communication technologies. The need to use digital platforms for remote work, distance learning, communication in general, implementation of contactless transactions, maintaining economic relations and processes, has become the most important issue. The concept of security, previously used for transactions, has acquired a new meaning consisting in physical security. Absence of the direct physical contact under restrictions of the complicated epidemiological situation has become a mandatory requirement for all. This aspect refers to both small business and large corporations. The companies that have experience in using digital technologies in their practice have been technically prepared to the unprecedented situation in 2020. Such companies are called digital. The companies focused on digitalization of business processes are technically more resistant to the environmental changes.

The level of economic development depends on the level of ICT development. Information and communication technologies are essential for the survival of many companies in particular, and economy as a whole.

## **2. Problem Statement**

The ecosystem of digital economy can be considered from various viewpoints, but in our opinion, the information and telecommunication technologies are of primary importance. The diversity of existing technologies requires a clear definition of technologies related to the digital economy. The current state and forecasted values of the studied technologies markets are one of the priorities in the research of the digital economy. The COVID-19 pandemic has created the conditions for the enforced accelerated digital transformation. The digital transformation of economic processes is possible due to the use of modern information and communication technologies.

## **3. Research Questions**

The study raised the following questions. What is the conceptual difference between information and digital technologies? What technologies are referred to digital economy? What market size do digital economy technologies occupy? What areas of application and development prospects do the information and telecommunication technologies have? What is the multiplier effect of using the information and communication technologies in the period of the COVID-19 pandemic and afterwards.

## **4. Purpose of the Study**

The purpose of the study is to clarify and develop the provisions on the role, place and interrelation of information and communication technologies and processes of digital transformation of the economy under the present-day conditions.

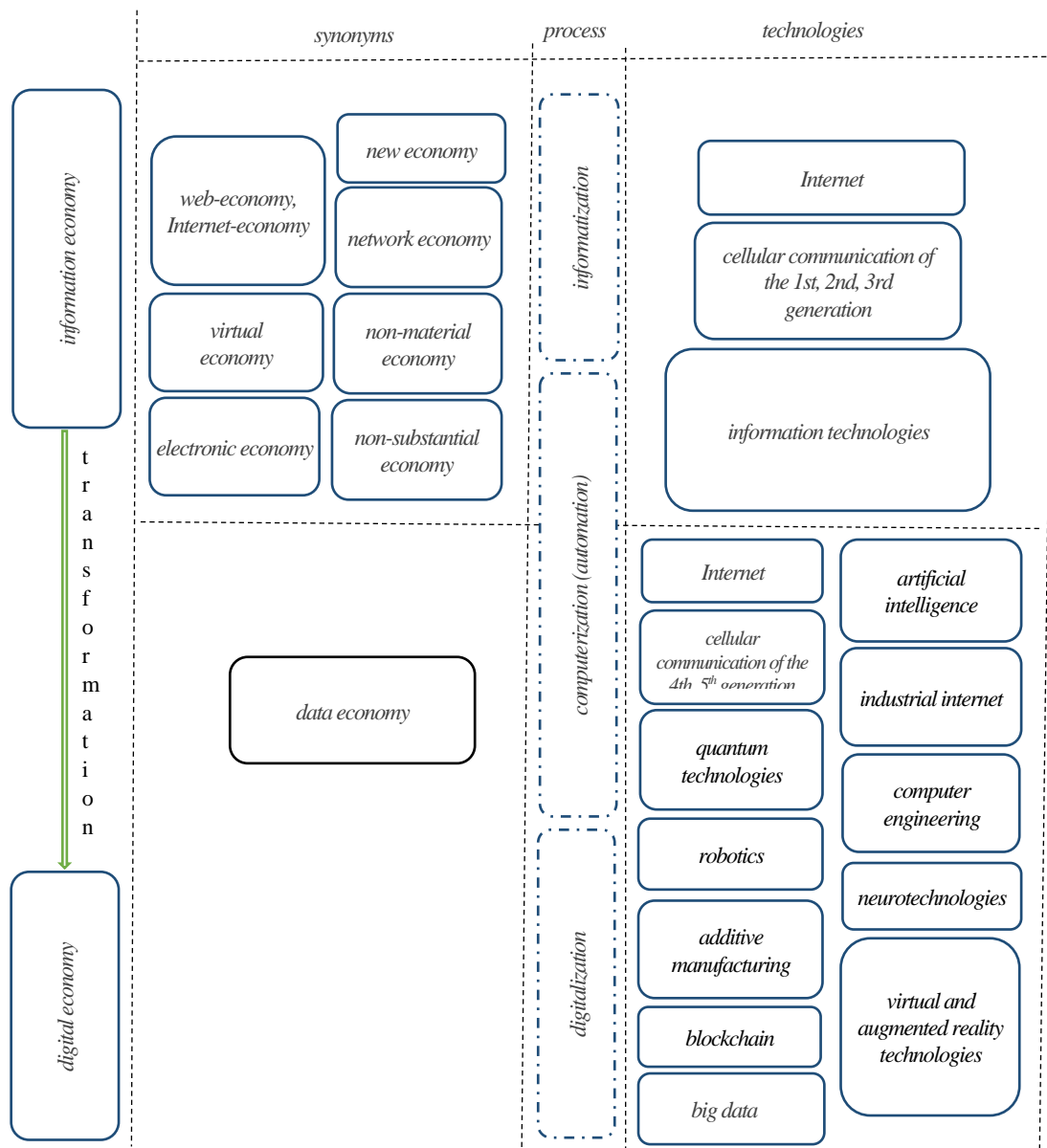
## 5. Research Methods

### 5.1. The Analysis of the Definitions of the Digital Economy

The term of digital economy due to its popularity is one the issues discussed and debated in mass media and modern scientific literature in the field of economic research (Andreyeva et al., 2018; Baranov, 2018; Gretchenko, 2018; Katz, 2017; Negroponte, 1995; Yudina, 2016; Zubarev, 2017).

All authors, without exception, note that information technologies are a basic and integral foundation of the present economy.

The development of information and communication technologies (ICT) and the emergence of the Internet and satellite communication have changed the form of organization of economic relations into electronic and digital direction (Figure 1).



**Figure 01.** Transformation of concepts and processes of the post-industrial economy

Various authors describing the process of formation of the information society and information economy use the concept of “information technologies”, emphasizing the role of information as the most significant resource for a company operation (Grum-Grzhimaylo, 2010; Kalinkina, 2010; Sukhov & Strekha, 2012; Vatolina, 2009). Along with the transition to the concept of the digital economy, the definition of the used technologies also changes into digital ones (Bondarenko, 2017, 2018; Yakutin, 2017; Yudina, 2016). The current processes are transformed. The informatization process associated with the increasing role of information compared to other resources has turned into the computerization (automation) process. The computerization (automation) process presents wide use of personal computers and introduction of ICT into all spheres of activities, as well as automation of workplaces using software products. The next stage is digitalization: the total transfer of all operations into electronic environment.

## **5.2. The Review and Analysis of the Digital Economy Technologies and Their Development Trends**

The peculiarity and the main tendency of the modern world in general, and the economy in particular, are the decrease in material component of commodities and production and the increase in intangible assets of companies. This is facilitated by the increasing role and importance of information and communication technologies in costs of producing commodities and services, as well as by the emergence and development of new technologies that are specific only to the digital economy. Having studied various reports on the state of the world economy, the key technologies have been identified. Such technologies include big data, quantum technologies, robotics, neurotechnologies and artificial intelligence, computer engineering and additive manufacturing, industrial internet, blockchain, virtual and augmented reality technologies.

The increase in volume of structured and unstructured data is the driving force of the development of big data processing technology. The development and expansion of big data are also facilitated by the decreased cost of data storage, increased availability of cloud services, increased data flow rate, enlarged number of specialists in the sphere of data processing and analysis, and the creation and growth of the Internet of things. The Internet of things is a concept of computer network connecting physical items equipped with the integrated information technologies to interact with each other or with the environment without human involvement. In 2017, the volume of the world big data traffic was 122 exabyte per month; in 2021, the increase by more than 3 times is predicted, the forecast is 396 exabyte per month. In 2018, the volume of digital data was fixed at 33 zettabyte. The volume of digital data is expected to increase by 5 times up to 175 zettabyte by 2025.

Possible practical implementations of quantum technology include quantum computations and a quantum computer, quantum cryptography, quantum teleportation, quantum metrology, quantum sensors and quantum images. In 2017, the global quantum cryptography market size was USD 285.7 million. In 2022, this indicator is expected to reach USD 944 million. In 2017-2025, the compound annual growth rate of the quantum computations market will be 30%. The development of quantum technologies is facilitated by the need for fast and secure information transfer via communication channels, the rising productivity of the electrical engineering, the growth of cybercrimes, and establishing research centers.

In 2018, the expenditure on robotic systems and drones amounted to USD 95.9 billion; in 2023, the expenses will amount to USD 201.3 billion. It is predicted that China will occupy 30% of the global robotics market in 2022. The robotics development rate is determined by the following factors: rising demand for service robots and industrial robotics from companies, mass application of image recognition technologies, demand for use of robots in conditions that are dangerous to human life and health.

Neurotechnologies and artificial intelligence. In 2018, the deep learning market value amounted to USD 3.18 billion, by 2023 the market size will grow by more than 5.5 times and will be equal to USD 18.6 billion. The compound annual growth rate of the artificial intelligence market in 2018-2025 will be 36.6%. The modern economy is characterized by the fact that the sphere of neurotechnologies and artificial intelligence is attractive for investment by companies, there is a need to speed up business processes in companies while reducing costs, the volume of unstructured data is increasing, open artificial intelligence and legislative framework for artificial intelligence are developing.

The additive manufacturing becomes widespread due to increased availability of 3D printing devices, the development of computer engineering technologies, the need to reduce the time for introducing products to the market and the rising demand for customized products. By 2022 2/3 of companies will use the technologies of “digital twins” in production.

The industrial Internet and the Internet of things are developing due to the development of the telecommunication networks of the fifth generation (5G), increased number of connected devices, the process of standardization of the industrial Internet technology, and the demand for unmanned vehicles. By 2025, the number of devices connected to the Internet of things will be 22 billion, and the annual economic effect of the introduction of the industrial internet for the world economy will be USD 11.1 trillion.

The blockchain system is determined by the following factors: the need to increase the transparency of transactions, growth of non-cash payments, and the spread of biometric identification technologies. In May 2019, the market capitalization of the top 100 cryptocurrencies was estimated at USD 250 billion. The compound annual growth rate of the blockchain market will be 74% in 2018-2025.

The virtual and augmented reality technologies complete the line of digital economy drivers. The development of global content media, the need to speed up the data transfer, the demand for visualized data, and the necessity to improve the quality of education make the virtual and augmented reality technologies relevant. In 2021, the consumer expenses on content and application of virtual and augmented reality will amount to USD 11.8 billion. 1.9 billion people will use the augmented reality technology on the mobile devices in 2022. For comparison, in 2016 this figure was 342.8 million people.

## **6. Findings**

The situation in terms of COVID-19, physical self-isolation, and remote work causes the need for unification of digital and real worlds. The boundaries between these worlds are being erased. The current processes are accelerating. The companies that have neglected the gradual digitalization of their activities before are rapidly embracing new technologies. Decision-making time is still one of the most important instruments for effective management. The focus is shifted to the advantages and opportunities of information and communication technologies (table 1).

**Table 01.** Digital Technologies Opportunities in Material and Non-Material Spheres

Sphere		Digital Technologies Opportunities
Material sphere	Construction	Replacement of complex and dangerous work with robotics.
	Agriculture	Replacement of labour-intensive and time-consuming work with robotics.
	Cargo transport	Use of unmanned vehicles.
	Industry	Use of end-to-end technologies of artificial intelligence, wireless communication, mobile sources of energy, new production technologies, computer engineering, additive manufacturing.
	Forestry	Use of unmanned drones.
	Communication, delivery and sales in material sphere	Videoconferences, creating digital platforms for communication, possibility of remote applications.
Non-material sphere	Science	Discovery of new energy sources, robotics.
	Education	Access to educational and information resources, increasing the competitiveness at labour market, use of artificial intelligence to determine the priorities in choosing the field of study, creation of conditions as close to real ones as possible based on virtual and augmented reality technologies.
	Healthcare	Use of machine learning mechanisms in processing medical data, use of neurotechnologies in rehabilitation.
	Trade	Remote work, the possibility to access new markets, blockchain.
	Social welfare	Access to services, new ways of interaction and communication, remote receiving of various services, including state ones.
	Public catering and foodservice	Targeted advertising of public catering and food service places based on big data, artificial intelligence.
	Housing and utilities sector	Common information database based on big data technologies, replacing routine work with robotics, current satiation control and monitoring systems.
	Passenger transport	Use of unmanned vehicles.
	Administrating authorities	Quantum technologies, common information database based on big data technologies.
	Law enforcement authorities	Common information database based on big data technologies, quantum technologies, neurotechnologies, artificial intelligence, security control and monitoring using unmanned drones.

It should be noted that the authors have not set the goal to limit all the advantages of digital technologies to this list. Obviously, with the technological development more and more spheres and opportunities for digital technologies application appear.

The process of global enforced digitalization is caused by the COVID-19 coronavirus infection pandemic. Adaptation of companies to new rules and overcoming the consequences of the global catastrophe are possible only when using modern information and communication facilities and technologies. Once again China has shown a high level of technological development, including digital technologies. One of the factors of China’s success in fight against the virus was the mandatory use of the “Health Code” mobile application by the population. The application collects and analyzes information on personal medical data received from various location sensors and allows tracking potentially dangerous places that are closed or quarantined. In addition, the application provides the current information about the coronavirus in the city of location. This application is an example of nationwide use of digital technologies.

Until 2019, information technologies were a factor of improving the enterprise competitiveness, a secondary advantage of companies under similar operating conditions after effective planning of activities. The need for companies to go online, knowledge and skills, as well as the ability to use modern digital platforms to transfer the activities into electronic environment are the necessary conditions for the survival of modern companies. There is definitely a direct correlation between the reaction rate to the instant unplanned change in operation conditions and the stability of the company's market position. It depends on the resources the companies have and the qualification of the personnel with appropriate skills and abilities. Instability, uncertainty, variability and ambiguity are the characteristics of the modern world. However, the world situation of the end of 2019 – the beginning of 2020 will serve as a precedent of readiness of companies and countries for various non-standard situations.

The most promising and highly demanded spheres in terms of COVID-19 are the development of unmanned vehicles and distance education. The development of technologies in these areas is rapid now due to the forced necessity to use them under the conditions of self-isolation and remote work. It should be noted that educational digital services and platforms allow more efficient use of the available materials and knowledge.

## 7. Conclusion

Thus, the authors have clarified and developed the provisions on the role, place and interrelation of information and communication technologies and processes of digital transformation of the economy under the threats and challenges arising from COVID-19 regarding the substantiation of ICT as an integrating and universal factor of the global reformatting of the world economy despite the tendencies of separation and localization of the economic systems.

The use of information and communication technologies under the conditions of global catastrophe is one of the efficient ways out of this situation. Digital technologies improve the quality of decision-making processes by improving automated systems and using artificial intelligence, they create the environment for the development of new forms of economic transactions, improve the quality of using the existing resources due to operational control process at all stages of the lifecycle of commodities and services, and accelerate the economic cycles. The enterprises are forced to launch the internal digitalization processes. The main potential of digital future is to change the strategy and goals of the company by introducing new fundamentally different technologies into all spheres. Using information technologies, the companies will be able to achieve a new result that will meet the requirements of the digital world.

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