

Trends in Information and Communication Technologies Development in Context of Economy Digitalization



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Abstract The authors of the article made an attempt to study the importance of information and communication technologies in the development of economic processes. There is a significant increase in the speed of dissemination of various achievements of the information and communication industry in the activities of organizations and institutions. The authors analyze the dynamics of the development of information and communication technologies at various levels of management of organizations and institutions, identify the industries with the highest rates of development. In this study, it was impossible to avoid the question of the impact of the achievements of the information and communication industry on the lives of ordinary people and society as a whole. As a result, the emergence of new types of threats to information security was noted. The negative and positive consequences of the digitalization of the economy are identified and recommendations are made for improving the areas that affect the effective solution of the problems of economic sectors digitalization and the processes of society's life, which will have an impact on improving the quality of life in general and will help organizations and the country to improve their positions on the market.

Keywords Digitalization · Economy · Information and communication technologies · Information security · Threats

1 Introduction

The modern development of human life in the domestic and professional aspects is already impossible to imagine without the use of information and communication

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technologies. They improve the quality of life, enable the effective functioning of socio-economic systems, ensure the transformation of all sectors of the economy and, in the long term, ensure high rates of development of various industries. Information and communication technologies have been one of the key drivers of socio-economic development over the past decades [1]. The current situation with the pandemic caused by the COVID-19 coronavirus infection had a great impact on the speed of change in the processes of implementing information and communication technologies in the development of digital economy. All spheres of human activity and the life of society as a whole were affected, including at the deep level associated with the technological way of social development. The speed of the appearance of new IT products on the market allows to make a conclusion about the beginning of information revolution. These processes, of course, pose new challenges to society due to the emergence of new information threats. The peculiarity of this stage is that the issues of ensuring information security are becoming increasingly important not only at the international level, at the national level or at the level of organizations and institutions, but also at the personal level.

2 Methodology

The conceptual approach to the study of the essence of information and communication technologies certainly draws some analogy with the concepts in the field of information technologies. As a common approach, we can note the mention of such components as elements and processes, search methods, methods of collecting and storing, stages of providing and distributing information [2]. The variety of approaches to the essential meaning of these concepts is beyond doubt. However, they all come down to the listing of a number of components of the enterprise information system (techniques, methods, methods, tools, resources) that ensure its effective functioning through the use of technical means, means of communication and software products. Information and communication technologies allow to rationally build organizational processes, ensure the quality of performance of tasks, and identify the causes and reserves of reducing resource costs in organizations and institutions. In addition, the definition of information and communication technologies focuses on emphasizing their role in the process of human interaction with the external environment. The combination of information and communication concepts essentially lays the foundation of human adaptation to modern conditions of digitalization. The use of information and communication technologies makes it possible to ensure the activation and effective use of the information resource accumulated by the society. Increasing the efficiency of the use of the accumulated information resource leads to its more complete use for the development of the economy, especially taking into account the emerging information society.

3 Results

The digital economy is based on the economic activity of people, organizations, institutions and other entities based on the use of information and communication technologies. The development of the digital economy is ensured by the development of information and communication technologies, through their introduction and maximum use in the processes of ensuring interaction between suppliers and consumers of goods and services. Let's consider the use of information and communication technologies in organizations, according to the Russian Statistical Yearbook [3] (Table 1).

According to the data presented, in 2019, there was a decline in a number of components of information and communication technologies in organizations, while in 2018, the growth rates were more dynamic. This is due to the relatively high ratio of organizations that use information and communication technologies in their activities, out of the total number of organizations that provided information.

According to the data, only 53.8% of organizations use servers in their work, despite the fact that it is the server that ensures the security and safety of the main activities of organizations and institutions by storing information, uninterrupted operation of the website, prompt response to user requests, ensuring the operation of the local network, access to the organization's data, and much more.

In the analyzed period, the use of local area networks decreased slightly. They are able to combine several personal computers in a limited area, i.e. within a single organization and provide all employees with access to information, its processing and transmission. The use of information and communication technologies in various fields and spheres of activity is presented in Table 2 [3].

These tables in most cases show a slight increase (up to 1.5% by 2019) and also a slight decrease (up to 1.68% by 2019) in the use of information and communication technologies in various fields and spheres of activity. In general, for all these types of activities, the decrease is 0.6%.

Table 1 Statistics of the use of information and communication technologies in organizations in 2017–2019 (as a percentage from the total number of studied organizations)

Organizations that used information and communication technologies	2017	2018	2019	Growth rate, %	
				2018/2017	2019/2018
Personal computers	92.1	94.0	93.5	102.1	99.5
Servers	50.6	53.4	53.8	105.5	100.7
Local area networks	61.1	63.9	63.5	104.6	99.4
Email	88.3	90.9	91.1	102.9	100.2
Internet	88.9	91.1	91.2	102.5	100.1
• Including broadband access	83.2	86.5	86.6	104	100.1

Source Authors

Table 2 The use of information and communication technologies in organizations by types of economic activity for 2017–2019 (as a percentage of the total number of studied organizations)

Types of economic activity	2017	2018	2019	Growth rate, %	
				2018 to 2017	2019 to 2018
Agriculture, forestry, and fishing industries	–	–	82.5	–	–
Industries that extract minerals	90.7	88.5	87.5	97.6	98.9
Industries providing manufacturing activities	95.5	94.1	94.2	98.5	100.1
Industries providing various types of energy	94.2	93.5	94.9	99.3	101.5
Industries of water supply and sanitation, as well as disposal of pollutants	85.5	88.8	90.2	103.9	101.6
Construction sphere	88.9	86.2	84.2	96.9	97.7
Trade and repair service industries	94.5	95.2	93.6	100.7	98.3
Logistics transportation and storage industries	93.4	92.8	92.8	99.4	100.0
Industries in the field of services of the tourist business and public catering	90.5	88.7	89.8	98.0	101.2
Telecommunications and communications support industries	97.3	96.6	96.5	99.3	99.9
Insurance and financial management industries	94.9	96	96.4	101.7	100.4
Real estate management services industries	65.6	86.5	87.7	131.9	101.4
Branches of scientific, technical and professional activity	93.1	92.4	92.3	99.2	99.9
Processes administration support industries	89.7	89.3	89.4	99.5	100.1
Field of public administration and social policy	97.2	97.2	97.1	100.0	99.9
Field of higher education	98.4	96.8	95.9	98.4	99.1
Area of medical and social services	96.8	97.1	96.8	100.3	99.7
The area of culture, sports, leisure and entertainment of the population	91.1	91.9	92.4	100.9	100.5
Other activities	93.9	91.2	88.3	97.1	96.9
<i>Total</i>	<i>92.1</i>	<i>94.1</i>	<i>93.5</i>	<i>102.2</i>	<i>99.4</i>

Source Authors

Over the past two years, the largest growth in the use of information and communication technologies has been observed in the field of real estate operations, and accounts for 31.9% in 2018 compared to 2017 and 1.4% in 2019. This pace is also due to the intensive implementation of innovative solutions in all real estate sectors for all stages of the project life cycle—from design and construction to management and operation (Property Technologies). Innovations in the field of design and construction to management and operation (PropTech) are carried out using big data technologies, virtual and augmented reality, artificial intelligence, the internet of things, blockchain and others. Experts note that the volume of investments in the PropTech market in the next 5 years will grow significantly, taking into account the existing trends, since in 2017–2018 more than \$16 million was invested in Russian PropTech, while in 2013 the volume of investments did not exceed 1 million dollars [4].

Since 2015, data processing centers have been intensively developed as areas for hosting server and network equipment. The largest data processing center suppliers in Russia in 2018 were Rostelecom, DataLine, Selectel and others (Linxdatacenter, Ixcellerate, Stack Telecom, DataPro, Servionika, DataSpace, Xelent). The total revenue of Russian data processing center operators at the end of 2018 amounted to 28.5 billion rubles, the growth rate for the third year in a row is about 25% [4].

Today, virtual reality (VR) and augmented reality (AR) technologies, geoanalytic tools, Internet of Things (IoT) technologies, voice assistance, and personalized advertising offers based on big data analysis are beginning to be used in real estate operations. For example, AR and VR technologies allow to conduct a virtual tour of an object under construction, carry out geographically distributed transactions, process scripts, communications and develop soft skills, and use interactive simulations in corporate training [5].

The development of PropTech in the field of real estate operations is due to the need for end-to-end interaction between market participants at all stages of project implementation and to improve the efficiency of the functioning of organizations in this industry [6]. According to statistical reports on the use of information and communication technologies, there is an increase of 5.5% in 2019 by 2017 in the field of activities of organizations for water supply, water disposal, organization of waste collection and disposal, as well as activities for the elimination of pollutions [3]. This fact is explained, among other things, by increasing investments in the development of environmental friendliness of the production sector and ensuring the safety of the population.

According to the studies, the share of the information and communication technologies sector in Russian GDP by the end of 2020 reached a record 3.1% (against 2.9% a year earlier) [7]. However, according to the analytical company Gartner data, the global market of information and communication technologies has downward trends in the same volume as the growth of the Russian market (3.2%). Industry experts attribute this to the period of the beginning of the pandemic and the reduction of the budget of organizations, including for equipment, software and services. The growth of the information and communication technologies market in Russia, on the contrary, according to experts, is associated with the demand for digital goods

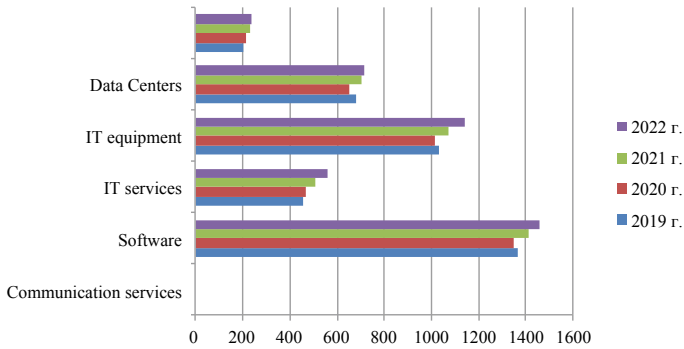


Fig. 1 Trends in spending change on information and communication technologies (in billions of dollars). *Source* Authors based on [7]

and services, as well as planned measures to digitalize the economy and social sphere [7]. Statistics of global spending on information and communication technologies are presented in five components, which include data processing centers (including servers and local area networks), IT equipment (including personal computers), IT services (ready-made solutions in the field of information technologies offered by specialized companies), software (enterprise-level) and communication services (including e-mail and the Internet).

Figure 1 shows data from Gartner analytical company, that measures changes in information and communication technology spending.

The figure shows that the three indicators (communication services, IT services, and IT equipment) showed the greatest changes. The IT equipment segment had the biggest decline in sales (-4.2%), but by the end of 2021, growth of 7.9% is already forecasted. The largest increase in spending on information and communication technologies is observed in the data processing centers parameter and amounts to 4.9% . According to experts, sales volumes for this parameter will continue to grow and will increase by 6.2% by the end of 2021 [7]. Large IT companies continue to strengthen their positions on the market, which have the ability to collect, extract, and analyze information about market trends and changes. This data becomes the knowledge that contributes to the capitalization of the business. Despite the fact that experts predict software sales growth of 1.9% in 2021, by the end of 2022, the growth will be 8.7% . Experts in the field of information and communication technologies determine the absence of changes in the “communication services” sector by the end of 2022 compared to 2021.

The potential for growth in sales of IT equipment may be due to the development of remote education and work, when there was a demand for personal computers and tablets. In addition, there is a demand for cloud services. Growth in corporate-level software, including solutions for information security and personal data protection [7]. These issues should be given special attention. The challenges of modern processes associated with the onset of the pandemic, which occurred at the end of 2019, are accelerating due to the fact that there was a synergistic effect that led to an

increase in the use of remote work opportunities for a huge number of participants in the process, which affected the change in the sustainable functioning of the entire information system at the organization, country and international level. The attention paid to socially significant processes at the level of public discussions leads to an increase in interest in the violation of information security. The distribution of threats, according to the mentioning of them on the Internet from the most frequent to the lack of it, is as follows: phishing threats; remote access security; failures, failures in operation, violation of availability; attacks on organizations and institutions; leakage of personal data. Information security threats determine the need to ensure the security of remote access to information system resources, achieve the sustainable functioning of IT infrastructure facilities, etc. Among phishing threats, there are two types: phishing attacks, the purpose of which is to illegally obtain identification and other private information about a person; financial fraud, aimed directly at unauthorized receipt of money or access to bank accounts. According to various researchers, the number of phishing attacks on users has increased by more than 5 times.

Taking into account the significant increase in the number of users, two tasks should be solved within the framework of ensuring information security. The first is to ensure uninterrupted operation in the event of a peak load on information systems. The second task is to provide mass access to corporate networks of organizations and institutions.

Uninterrupted operation in the remote form of work and training depends on the capacity of the channels of home networks and Internet channels, on the capabilities of the server equipment, its software and information storage. The situation of peak load growth in the context of the pandemic was managed due to the built-in reserves in case of overload, which ensured the stable functioning of information systems in the conditions of the most active use of information and communication technologies.

The use of information and communication technologies by the working-age population for their own use will increase rapidly. This is due to the need to adapt to the new format of work and, in turn, will contribute to the transformation of companies' activities to ensure the possibility of remote employment. It should be noted that the pace of development of the digital economy largely depends on the infrastructure created at the level of each individual country, the introduction of modern information technologies, the availability and speed of the Internet.

4 Discussion

Differences in the readiness of certain countries, organizations, and institutions to exist in the digital economy are determined by digital gaps, which in turn are determined by the speed of implementation of information and communication technologies. This mainly concerns such factors as the infrastructure of information and communication technologies and services, the qualifications of employees,

the formation of the regulatory framework and internal regulatory documents of organizations.

Both countries and organizations will be forced to take measures to close the digital divide. In addition, measures will be taken to ensure the compatibility of the various information platforms and to address issues of ensuring the protection of personal data. Very actively and everywhere in the life of ordinary users, the concepts of using smart things and artificial intelligence will begin to be introduced.

The above-mentioned trends will require the search for new ideas. These ideas in the form of startups can be obtained by implementing programs to finance entrepreneurial initiatives based on public–private partnerships in order to select them and further support them.

To manage the processes, the main attention should be paid to the formation of unified scientific and educational platforms, the base of scientific developments, and to ensuring the digitalization of most sectors of the economy. For the digital economy, the pandemic was the driver that led to economic and social development by obtaining sufficient financial support to solve the emerging problems.

Taking into account the new realities, it is necessary to solve the issues of updating the regulatory and legal framework for secure remote access to information systems. Special attention should be paid to further improving software systems and security tools to ensure the availability of public information systems and the protection of personal data. Currently, there are many domestic solutions in the field of information security and international recommendations for the organization of secure remote access, which include the establishment of stable, multi-factor authentication, differentiation of access to a home computer, the use of only secure corporate mail and a trusted cloud, the organization of a trusted communication channel, the presence of an antivirus, and much more. Equally important is training and informing users about information threats and countermeasures in the remote labor process, as well as training users on digitalization and monitoring their behavior. The forms of control over the work of employees by employers are also changing. The main form of the report on the work done remains an oral telephone conversation, the next version of the report was a written report on the work provided to the employer, and the least weight is still occupied by video conferences, video conference using video communication. It can be concluded that the number of organizations and institutions that use video communication for videoconferencing will increase in the near future.

In addition to positive changes, the increased use of information and communication technologies leads to a number of negative consequences. There are new types of stress associated with the widespread introduction and use of information and communication technologies. They are mainly related to the need to increase the speed and volumes of work. The amount of time occupied by work increases, and the boundaries between personal and working time are erased. An insufficiently high level of readiness for such a wide use of information and communication technologies in all spheres of life, a low level of training of users, and technical difficulties in the application of technologies lead to an increase in the tension of performing labor functions. The high rate of obsolescence of knowledge and the emergence of new ones, due to the rapid development of information technologies, causes the need for

their constant updating, the development of new competencies, and the adaptation of existing experience to the current situation.

For further progressive development, it is necessary to determine new development priorities in the digital economy. Innovation becomes the main source of development. The development of IT technologies is based on the updating of software and the introduction of complex algorithms for the operation of systems. These processes are not possible without the support of scientific research, as well as without specialists in these areas. The understanding that most problems of the national economy can now be solved with the help of information and communication technologies accelerates the processes of their implementation in almost all sectors and spheres of the economy. The current situation can be described as unique. We have gained extensive experience in solving problems under difficult conditions and in a short time.

5 Conclusion

The modern information society is characterized by an increasing role of information, an annual increase in the number of people whose professional activities are related to information and communication technologies, including in the system of their production and distribution, increasing informatization and digitalization in various industries and spheres of activity, and the creation of a global information space that provides a high standard of living for society [8]. The possibility of using information and communication technologies greatly changes our lives, making it more convenient. You can access news, information about socio-economic trends, treatment methods, provide training, and much more. Technologies of remote interaction, big data analysis, the development of artificial intelligence, virtual and augmented reality allow to solve many modern problems. However, there continues to be a large array of problems that do not have an effective solution and are under development. The activation of these processes leads to a change in the economic and technological structure, changes the way of management, life and thinking. Information and communication technologies become the basis of the processes. Modern organizations, institutions, and countries are inevitably involved in these events and make efforts to solve all the problems that arise. It can be concluded that in the near future, production, financial, and economic processes will follow the path of evolution and transformation to an even deeper qualitative and quantitative transition to the information stage of society's development. One of the consequences of this evolution will be a leap in the development of the social sphere, which will provide new opportunities and prospects for improving the life of society. Information and communication technologies today are a powerful mechanism for scientific, technical, social and economic progress, allowing individual companies to become leaders within the country, as well as countries in the global world.

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