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GIS TECHNOLOGY ROLE AND PLACE IN RUSSIAN ECONOMY DIGITALIZATION

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ABSTRACT

The development and active use of information and communication technologies launched the digitalization process, which radically changes the ways of communication and communication technologies. Experts compare the depth and scale of the ongoing changes with the processes of the economy industrialization during the late 19th - early 20th centuries. The article presents the study results of geoformation technology development trends within the framework of the economy digitalization. The authors considered the stages of geographic information system development globally and in Russia. To meet the study's aim, they carried out the analysis of GIS technology implementation and use in various sectors of the Russian economy. Plus, the analysis and synthesis, monographic, comparative analysis are considered. Based on the results obtained, it can be inferred that for the most part international indicators and indices assess the technical aspect of the digital economy formation and development, which is not entirely correct, given the fact that we cope with a tough complex phenomenon. It is associated with the process of social-economic institutions of society informatization, and the process of globalization leads to their transformation at the macro level. The assessment of digital technology implementation level in the country economy at the international level is not made according to individual indicators considered in this study. Complex indicators are used for this, allowing, on the one hand, cover some indicators and give an overall assessment. However, on the other hand, they do not take into account and level out the peculiarities and specifics of individual countries and types of activity development.

***Keywords**: Digitalization, geoinformation technologies, geoinformation system, GIS.*

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1. INTRODUCTION

Widespread digitalization as a process has brought the economy to a new level, which has also become digital now. Nowadays the digital economy is rapidly developing all over the world and covers more and more areas of activity. According to N.S. Rytova, the digital economy can cover everything that can be formalized, i.e., described by logical diagrams. Thus, our reality today is determined by scientific and technological progress and the introduction of new technologies (Rytova, 2018; Polozhikhina, 2020; Ruzikulova et al., 2021).

In a broad sense, the digital economy is the result of a new industrialization (due to the introduction of ICT - information and communication technologies, or the fourth industrial revolution) and the emergence of a new technological order – the Industry 4.0 (Polozhikhina, 2020).

The digital economy of the Russian Federation, like in other countries, is based on the use of modern information and communication technologies, including geoinformation technologies.

Geographic information system (GIS) as a concept and sphere of scientific and practical activity emerged less than a hundred years ago. GIS is a system for collecting, storing, analyzing and graphic visualizing of spatial (geographical) data and related information about the required objects. GIS is an information system that provides collection, storage, processing, access, display and dissemination of spatially coordinated data on terrestrial objects and processes (Anikeeva et al., 2018).

The geographic information system allows you to implement a number of functions, the main of which are determination of an object exact location in space; visualization of the information received for making management decisions; monitoring of natural resources.

2. METHODS

It is recognized at the international level that the spread of new ICTs and the formation of a digital economy on their basis opens up broad prospects for development. But at the same time, it creates new risks (Polozhikhina, 2018).

The World Bank report highlighted the following risks of digitalization:

- cyber security;

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- the possibility of mass unemployment;
- "digital division" increase (a gap in digital education, in terms of access to digital services and products, and, thus, a gap in well-being level) between citizens and businesses within countries, as well as between countries (Kukharev & Fudina, 2021).

The progressive development of digitalization and expansion of information technology use possibilities and, in particular, GIS in all areas of activity requires studying the dynamics and trends of this process, which is almost irreversible.

Research methods used in this work: analysis and synthesis, monographic, comparative analysis.

3. RESULTS AND DISCUSSION

The improvement of GIS is associated with its progressive development and is most often divided by experts into three stages: pioneer (late 1950s - 1960s), state initiatives (1970s and early 1980s), user period (mid 1980s to the present day). Each stage is characterized by the accumulation of theoretical knowledge and the development of tools for practical problem solution. So, already at the first stage of GIS development, the Canada Geographic Information System was developed, making it possible to automate the mapping of Canadian land resources and their classification (Naidu, 2015).

The second stage of GIS development showed that the process of further design of increasingly complex systems requires significant funding, which led to the participation of large state institutions. At this stage, several large-scale geoinformation projects were implemented, the most famous of which is the 1970 US census. For this, the US National Bureau of the Census used a special topological approach based on the presentation of cartographic data Dual Independent Map Encoding (Bernhardsen, 1999; Durugboa et al., 2013; Maguire et al., 1991). At present, almost all national GIS projects are based on the data from population censuses in individual territories, since a significant part of published census data contains information with a spatial component (Gregory & Southall, 2000).

The growing demand for the practical application of GIS tools contributed to the transition to the third stage, characterized by the need to create corporate and distributed geodatabases, which were formed based on geoinformation technology commercialization. Besides, this was facilitated by the integration of GIS and database management systems and the development of network applications.

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The impetus for the activation of developments in the framework of geoinformation technologies was given by the appearance of free versions of software products, such as the Geographic Resources Analysis Support System (GRASS) (Nair, 2012), and ArcView 1 for Windows (Kukharev & Fudina, 2021).

During the mid-1980s, they began to develop their own geoinformation technologies in the USSR, but they were not introduced into practice. Although in the early 1990s the first Russian scientific and production center for geoinformation was opened in the Russian Federation, only the development of the Federal Target Program "Electronic Russia" contributed to the creation and implementation of large regional geoinformation systems.

Today, a number of authors note, that we are witnessing the stage of the world geoinformation infrastructure formation, when one of the vectors of modern civilization development was the rapid development of geoinformation systems (Klochkova et al., 2017; Anikeeva et al., 2018; Koshkarev, 2009).

So, A. V. Koshkarev characterizes the period that began in the mid-90s as the beginning of a new era of geoinformatics - the era of infrastructural spatial data (ISD), which replaced the era of GIS (Koshkarev, 2009). In accordance with the GOST R 52438-2005, spatial data infrastructure is “an information and telecommunication system that provides access for citizens, business entities, state and municipal authorities to distributed spatial data resources, as well as dissemination and exchange of data in a publicly available global information network to increase the efficiency of their production and use (Kukharev & Fudina, 2021).

The need to embed the Russian economy into the global geoinformation infrastructure is confirmed by the adoption of the Concept for the Creation and Development of the Spatial Data Infrastructure of the Russian Federation. As noted in the Concept, the creation and development of this infrastructure is conditioned by the objective needs of citizens, organizations, government bodies and local authorities in the effective use of reliable, operational and relevant spatial data (Ilyushina, Sizov & Belenko, 2021).

The analysis of the main parameters of digital technology penetration into all spheres of the Russian Federation economy makes it possible to assess the pace and dynamics of these processes. It is advisable, first of all, to consider the dynamics of the information and communication technologies (ICT) sector development, which is understood as a set of

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organizations engaged in economic activities related to the production, distribution and use of ICTs (Kukharev & Fudina, 2021). Figure 1 shows the dynamics of gross value growth in the organizations of ICT sector, given in billion rubles for the period 2005-2018.

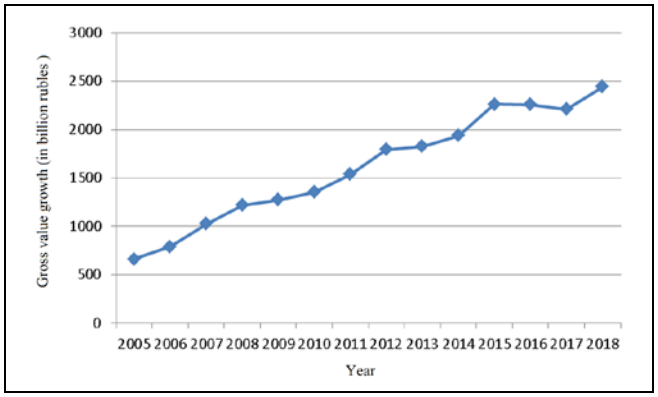

Figure 1: Dynamics of gross added value growth among the organizations of the ICT sector during 2005-2018, billion rubles[1].

The data analysis allows us to note that the volume of added value of the analyzed organizations increased by 3.7 times and showed a steady growth trend in 14 years, which indicates positive trends in the development of information and communication technologies. Nevertheless, the share of this indicator as a percentage of GDP has been fluctuating within 2.6-2.8% over the past ten years, and its growth has not been observed (Indicators of the digital economy: 2020).

If you look at the volume of investments in fixed assets, which also clearly reflect the development trends of these organizations, it can be noted that they increased from 271.5 to 598.3 billion rubles over the same period, that is, 2.2 times, which shows the high investment efficiency in this area of activity. Fig. 2 shows the dynamics of changes concerning the investment volumes in the fixed assets of ICT organizations.

[1] The graph was developed by the author based on the data of (Indicators of the information society: 2010; Indicators of the digital economy: 2019)

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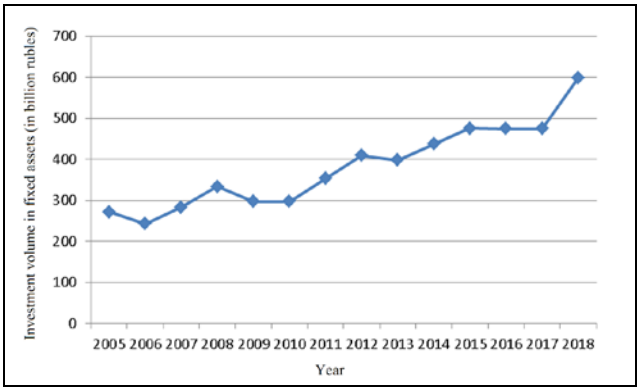

Figure 2: Dynamics of changes concerning investment volume in fixed assets of ICT organizations during 2005-2018, billion rubles[2].

However, it should be noted that the return on investment in fixed assets, if we estimate it as a share in added gross value, steadily decreased from 0.4 rub./rub. in the first analyzed year to 0.21 rub./rub. in 2017. This situation took place during the observation period and during the first 13 years. And only in 2018 this indicator increased again and amounted to 0.24 rubles of capital investments per ruble of added gross value. This suggests that a certain proportion of new products has not been introduced into production yet and is under development.

The basis for one of the most significant high-tech products in the development of spatial data infrastructure was laid by the research work "Development of a system project for the creation of a spatial data infrastructure in the Russian Federation" (Russian statistical yearbook. 2020), commissioned by Rosreestr. It reflects in detail the requirements for the constituent parts of the SDI, highlights the constituent parts of the geoportal and describes the requirements for their functionality.

It is legitimate to note that the level of the Russian economy digitalization is determined not only and even not so much by the indicators of ICT organizations, but by the use of these technologies via organizations in other spheres of the economy and the population. As for the population, during the first ten years (from 2005 to 2014), the level of growth in digital literacy was determined mainly by the growth of household number with personal computers. This indicator increased from 25 to 71%, or 2.84 times.

Further, since 2011, the proportion of the population with Internet access has been calculated. This indicator has grown 2.7 times over the past ten years, from 26% to 69%. A

[2] The graph was developed by the author based on the data of (Indicators of the information society: 2010; Indicators of the digital economy: 2019)

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fairly obvious indicator of digital technology development by the population is the growth of Internet use proportion for state and municipal service receiving, which has also grown almost 2.5 times since 2013 (Indicators of the digital economy: 2020: statistical collection).

The assimilation of digital technologies by the population also makes it possible to use infrastructural spatial data (ISD), which have become available due to free access provision for geodata sets. The main point of entry and access to ISD resources is the geoportal (Antsiferova et al., 2021). The development of such a geoportal provided the population with open access, for example, to such an online service as the Public Cadastral Map.

If we talk about the trends and level of digital technology application in the organizations of various spheres of the Russian economy, it should be noted that technical support for their use has been applied in organizations over the past 10 years. Back in 2013, almost complete and widespread use of personal computers was recorded in the organizations of all types of economic activity. The maximum indicator is 98.8-98.9% in the institutions of higher education and communications, the minimum is 92.0-88.8% in the organizations for the production and distribution of electricity, gas and water, as well as in other types of organizations (Russian statistical yearbook. 2020: Statistical collection).

In subsequent years, to assess the level of digital technology mastery in production and social sphere, they also began to consider the level of the Internet and software product use, calculating the proportion of organizations using digital technologies. The use of GIS technologies in the organizations of various types of activity can be assessed by using the web-GIS trend. It is a geographic information system in the Internet/Intranet, the users of which can view, edit and analyze spatial data using web browsers. Web GIS applications allow a wide range of users to exchange any georeferenced data, thus ensuring a lower cost. Currently, the clouds contain a large number of geoinformation resources: data, maps, models, applications, sites and portals (Kukharev & Fudina, 2021).

The analysis of statistical data for 2017 showed that more than 60% of participants carry out banking and other financial transactions, except for the organizations conducting the transactions with real estate, and from 29.4% of water supply organizations to 49% of wholesale and retail trade organizations conduct professional training of personnel. ... An assessment of the Internet use for video conferencing showed that, in addition to the IT and telecommunications industry, where this indicator is the highest (64.5 and 66.7%,

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respectively), a high share was noted in wholesale and retail trade (52.9%), as well as in extractive and manufacturing industries (46.3 and 46.7%, respectively). As for the recruitment of personnel, the leading positions are occupied by wholesale and retail trade (55.9%) and the manufacturing industry (55.6%).

The analysis of software product use is considered in the context of participation in the processes of automated production and/or individual technical means management, the design of training programs and scientific research. On average, the largest share in the business sector is occupied by the use of management software (20.1%), while there is a significant variation in the context of individual types of activity. So, the highest values of 50.2% and 45% are given by IT organizations and manufacturing enterprises, the lowest value (4.9%) is provided by the firms engaged in real estate transactions.

35% of manufacturing and construction organizations use software for design, 25-29% of energy supply, transportation and storage companies, as well as mining companies, use training programs. The largest share of organizations using digital technologies for scientific research (10.6%) are the organizations engaged in professional, scientific and technical activities, which is 2.8 times higher than the average for the entrepreneurial sector.

Thus, in the context of economic activity types, the most prepared for the use of digital technologies are wholesale and retail trade organizations and manufacturing enterprises, in addition to the companies operating in the field of IT and telecommunications. The lowest level is demonstrated by the organizations engaged in the operations with real estate, which is difficult to explain, since, firstly, these are often the firms with a staff of 2-3 people, which are easier to train in ICT; secondly, the practice of assessment requires a database development; thirdly, experts must have a special higher education and use special programs for object evaluation in their work.

If we consider the social sphere separately, we can single out the organizations of higher education that show the highest level of digitalization in the context of electronic document management systems, the use of electronic reference and legal systems, training programs, financial calculations and the solution of organizational, managerial and economic problems. All these parameters vary in the range of 77-84%. In health care and the provision of social services, in addition to the electronic document management system, comparable to the university indicator, the other parameters are 10-20% lower. As for training programs, their share is quite insignificant and amounts to 11.4%.

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An important characteristic of digitalization development is interaction with state and municipal authorities. The data analysis shows that the share of services received from state and municipal authorities in electronic form is slightly more (41.9%). Although this indicator increased by 10% for the entire analyzed period, over the past 6 years the growth rate was only 1.02-1.05, which is clearly not enough to achieve the level of digitalization in developed countries.

A detailed analysis of some indicators characterizing the introduction of modern digital technologies in certain areas and types of activities, the business sector and households allows you to see the features and take into account their specifics. It makes it possible to develop an action plan in more detail and pointwise to increase the intensification of the economy digitalization processes and the use of geoinformation technologies.

The use of GIS technologies in the organizations of various types of activities can be assessed, in particular, by interaction with the Unified State Register of Real Estate (USRRE). On average, this type of interaction in the business sector was carried out by 32.7% of organizations in 2017. More often they interacted only with extra-budgetary social funds for the purpose of reporting (49.5%). In the context of individual types of activity, the largest share of organizations interacting with Rosreestr is demonstrated by the firms providing electricity (42.7%) and manufacturing enterprises (39.8%). Hotels and catering (24.8%) and real estate firms (24.2%) account for the smallest share.

4. CONCLUSION

Baes on the results, the vast territory of our country requires more active implementation of GIS technologies, on the one hand, and taking into account the indicators of their development level in some of the complex indicators, on the other.

Currently, 13 international ratings are used that characterize the problem under study. Our country occupies the highest positions, falling into the first 15-16% of the countries by the global cybersecurity index and the e-government development index. Russia represents the first quarter of countries in terms of ICT and inclusive Internet development indices (Indicators of the digital economy: 2020).

It should be noted that for the most part international indicators and indices assess the technical aspect of the digital economy formation and development, which is not entirely correct, since we deal with a difficult complex phenomenon. It is associated with the process

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of social-economic institutions of society informatization, and the process of globalization leads to their transformation at the macro level. According to the author, additional assessment criteria may be the growth of population digital literacy, the level of GIS technology mastering, and also taking into account the mentality of each country.

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