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Digital Development Analysis based on cognitive modeling

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Abstract

The article examines the issue of digital development, which "obliges" the features of the development of modern society and the world economy. Global trends in economic processes are analyzed, as well as future technologies that can change our lives and affect industry. World experience shows that there is a direct connection between the level of informatization and the economic growth of regions. However, high investment rates and widespread implementation of informatization do not in themselves guarantee accelerated economic growth. According to estimates by the Organization for Economic Cooperation and Development, today, in the context of the information boom, regions may invest excessive funds in IT “either in an effort to compensate for a lack of qualifications or due to the absence of a clear market strategy for IT”. At present, the solution to this issue is everywhere faced with the problem of uncertainty, which practically excludes the possibility of using traditional methods of economic and mathematical modeling and decision-making. To take these relationships into account, a fuzzy cognitive map based on rules (Rule Based Fuzzy Cognitive Maps) and a cognitive analysis of the “state of digital development” is carried out. The map can be used for qualitative analysis and solution of a number of key problems related to the selection of priority areas of informatization, studying the dynamics of internal indicators of informatization, assessing the impact of informatization on the main indicators of economic growth of regions.

***Keywords**:* technological progress, innovative development, digital economy, cognitive analysis.

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1. Introduction

The peculiarities of the development of modern society and the world economy increase the role of innovation in the country. In this regard, managing the innovation activities of socio-economic structures, ensuring the digital development of the country is the most important task of our time. One of the necessary stages of management is the diagnostics of innovation activities. The main tasks of diagnostics include, first of all, identifying problems, their qualitative and quantitative identification, as well as determining the possibilities and directions for improving innovation activities. In addition, it is necessary to identify the factors that cause problems, as well as their impact on goals, strategies and other components of the digital

process. The peculiarity of innovation activities is that they are carried out under the influence of numerous factors, mainly of a qualitative nature.

The economy is a complex dynamic system operating in an equally complex and unstable environment. In such systems, networks of cause-and-effect relationships arise, which are characterized by uncertainty and ambiguity in assessing the consequences of certain decisions. G. Simon called such systems (problems) weakly structured. This requires the use of adequate research methods, one of which is cognitive modeling. Cognitive modeling is a method that allows structuring the factors of a complex situation or phenomenon, as well as modeling their development over time. This approach was proposed by R. Axelrod and F. Roberts [6] for weakly structured systems and the study of situations arising during the functioning and development of such systems. In recent years, it has become increasingly widespread [1; 2; 3; 4; 5].

The cognitive approach is aimed at activating the subject's intellectual processes and helping him to fix his idea of a complex problem situation in the form of a certain model. The so-called "cognitive map" of the situation is usually used as such a model, which represents the main patterns of the observed situation known to the expert in the form of an oriented signed or weighted graph, in which the vertices are the key elements of the situation, and the arcs between them are cause-and-effect relationships. In this case, two types of cause-and-effect relationships are distinguished: positive and negative. With a positive relationship, an increase in the value of the cause factor leads to an increase in the value of the effect factor, and with a negative relationship, an increase in the value of the cause factor leads to a decrease in the value of the effect factor. It is essential that the parameters of the key elements and the degree of their mutual influence can be expressed both by quantitative parameters and by qualitative relationships.

The aim of the study is to identify the conceptual mechanism of the influence of innovation on economic growth and formalize this mechanism in the form of cognitive models suitable for practical application in assessing and developing strategies for managing the economic impact of high technologies.

This goal determined the formulation and solution of the following tasks:

- research and development of a methodology for model assessment of the impact of innovation on economic growth indicators in the context of the transition to a digital economy,
- choosing a strategy for managing this influence in the context of a dynamically developing unstable economy;
-management of strategy implementation.

2. Metodology

Modern economic development of the world is distinguished by high rates of scientific and technological progress. In just a few decades, the planet has stepped into the era of widespread use of information, communication tools, as well as robotics.

According to the results of research by scientists and expert assessments, today five global trends are creating new challenges and opportunities for economic development around the world:

- *Shift in the balance of power in the economy*. The integration process leads to the blurring of borders between countries, which allows citizens of many countries to independently determine their place of residence and type of activity. In addition, this leads to intensive growth of commodity markets, capital markets, raw materials, and others. Opening borders helps to reduce or eliminate customs duties, which has a positive effect on the redistribution of production factors, as well as goods and services. According to forecasts, by 2030, 66% of the middle class and 59% of their consumption will be concentrated in Asia [25]. The intensity of investment activity is also increasing.

- *Demographics changes.* This is caused by a higher level and availability of medical care, birth control, and the maturing of the population born during the baby boom. This trend leads to problems in the area of providing for pensioners and the elderly. According to forecasts, the share of the world population over 60 years old in the world by 2050 will be 21% [25]. The number of working-age people is gradually decreasing, which increases the burden on each working person.

- *Urbanization*. Many companies are expanding their geographic presence, and large infrastructure projects are emerging. New segments are being formed: for example, the development of proposals in the field of "smart city". According to forecasts, the share of the world's urban population in 2050 will be 72% [25].

- *Technological progress*. Breakthrough developments in areas such as artificial intelligence, nanotechnology and others lead not only to the creation of new market segments, but also to a radical change in existing business models. The combination of growing Internet penetration, mobile devices, the development of data analysis, the "Internet of Things" and machine learning are changing consumer expectations and demands. According to forecasts, the number of devices connected to the Internet in the world by 2030 will be more than 70 billion [26].

- *Deficit resources and change climate*. The growing demand for energy, water and food is creating new segments – for example: electric vehicles, renewable energy, intelligent infrastructure management systems. According to forecasts, by 2030 we will need 50% more energy, 40% more water and 35% more food [26].

The development of the Internet, information and communication technologies (ICT), sustainable communication channels, cloud technologies and digital platforms, as well as the information "explosion" of data that has burst out of various channels, have ensured the emergence of open information systems and global industrial networks that go beyond the boundaries of an individual enterprise and interact with each other. Such systems and networks have a transformative effect on all sectors of the modern economy and business beyond the ICT sector itself, and are moving industrial automation to a new fourth stage of industrialization.

Bank of America Merrill Lynch examined the future technologies that could change our lives and disrupt established industries worth $13 trillion and make a significant contribution to the next 10-15 year cycle of smart technology development [27]:

- Quantum computers could solve problems that would take traditional computers a billion years to solve;
- 6G download speeds can exceed 400 Gbps;
- Nanosatellites can provide the entire planet with internet;
- Three times more cobalt for electric vehicle production can be extracted from the ocean than from the earth;
- Graphene (the thinnest and strongest material known to man) could have many revolutionary applications;
- Artificial Intelligence could equal human intelligence as early as 2029.

These are just a few of the key technologies of the future that could change our lives and accelerate the impact of global megatrends. Although these technologies seem like distant future ideas, they are not as far away as we think. What seems like it will only happen in 10-15 years could happen much faster. More data , more computing power, and the increasing prevalence of artificial intelligence, will lead to the rapid implementation of breakthrough technologies.

The emerging problems and challenges facing the world require creative solutions. The planet will need to produce more food in the next 50 years than all farmers have produced in the last 8,000 years. Next-generation technologies like vertical farming and lab-grown meat could be the answer. And geoengineering could mitigate global warming for less than 1% of annual global oil capital investment. 5G won't be able to handle the exponential growth in data in the next 10 years. 6G could be up to 400 times faster than 5G.

Using expert forecasts, the combined revenue from these key technologies was estimated to grow to $48.4 billion by 2025 [27]. LiFi (using light to transmit data), deep-sea mining, hyperloop (high-speed vacuum train for long-distance passenger transportation), quantum computers, and graphene have the highest CAGRs through 2025. The largest market sizes in 2025 are expected to be in mass vertical farming, LiFi, quantum computers, and nanosatellites [27].

At all times, technological innovations have had a decisive impact on the formation of global economic trends. Today, the primary stimulator of the expansion and reformatting of international economic relations is the so-called digitalization, which is the result of rapid innovative breakthroughs and scientific discoveries in the field of digital technologies [7].

In studying the impact of digital technologies on the global economy, researchers pay particular attention to four elements:

- Internet things (Internet of Things, IoT);
- Artificial Intelligence (AI);
- 3D printing;
- Blockchain.

The listed innovations have a significant impact on the formation of business model, the structure and content of technological processes, the forms and methods of trade relations, and the simplification of trade procedures. Further dissemination of their use will significantly affect productivity, objects, methods, and participants in foreign economic relations, as well as competitiveness.

The digitalization process leads to qualitative shifts in all areas of production, economic and trade activities around the world. The formation of production technological processes using the Internet of Things, artificial intelligence modules and 3D printing allows to reduce production costs and increase the competitiveness of manufactured products [8].

The Internet of Things is currently a rapidly developing economic model. According to GSMA (Global System for Mobile Communications Association) forecasts, by 2025 the number of IoT connections will double and reach almost 25 billion worldwide [28].

The global IoT market, which was valued at $494 billion in 2023, is projected to grow to $2,227 billion by 2028, achieving a compound annual growth rate of 12.6%. This growth trajectory has been driven by advances in technologies such as 5G, artificial intelligence, and edge technology. Globally, the Internet of Things dominates V four subsectors: smart city, industrial IoT, healthcare and smart home [9]

New models of economic interaction have emerged on the basis of information technologies, such as digital platforms, which, according to a number of researchers (Meeker, Parker, Van Alstyne), "are accelerating a new era of globalization." A digital platform is a business model that creates new value by facilitating exchanges between two or more interdependent groups. P. Evans and A. Gawer in their works distinguish four types of digital platforms: operational, innovative, integrated and investment [10].

In recent years, the world's largest corporations have created their own digital platforms for managing suppliers, working with clients, and providing internal corporate contacts for employees around the world. At the same time, a pool of publicly available Internet platforms has formed: these include operating systems, social networks, digital media platforms, and various trading platforms.

In 2025, the market capitalization of the world's largest Internet platforms such as Microsoft (3.41), Nvidia (3.40), Apple (2.99), Amazon (2.18), Alphabet (2.09), Meta Platforms (1.62), Oracle (0.46), Alibaba Group (0.29), Samsung (0.27), Cisco Systems (0.25) reached $ 16.96 trillion, which is higher than traditionally strong sectors of the global economy such as oil and gas production, aviation and automobile manufacturing [11].

The largest digital platforms have user bases comparable in number of subscribers to the populations of major countries in the world. The number of Facebook users exceeds the

population of China or India, Alibaba and Instagram - the population of the United States, Twitter, Skype, Amazon - the population of Indonesia.

Investments by global companies in artificial intelligence solutions will reach $151.1 billion in 2027, according to research organization International Data Corporation (IDC). In 2023, spending in this area amounted to about $20 billion, and will more than double next year. IDC experts expect that in 2027, spending on generative AI will account for 29% of all investments in the AI sector as a whole, compared to 10.8% in 2023. [29]

The emerging global trends of digitalization of economic relations require certain actions, both at the multilateral level and on the part of national governments.

3. Results and discussion

Human capital. Human capital is traditionally understood as a set of acquired knowledge, skills, experience and abilities that affect a person's economic productivity and increase their opportunities in the labor market. In the context of the development of the digital economy, the role of human capital is increasing: it is becoming the most important factor in digital transformation and economic growth, while the requirements for its components and reproduction mechanisms are changing [12]. The main strategic tool of the human development concept is the Human Development Index. The data with the results of the latest study were published in May 2025. Azerbaijan ranked 81st among 193 countries with an index of 0.789 [13].

Innovation. The success of the formation of the digital economy is closely dependent on the state of the national scientific and technological complex, which determines the ability to generate our own innovations and adapt advanced imported technologies. The Global Innovation Index currently represents the most comprehensive set of digital development indicators for different countries of the world. In 2024, Azerbaijan ranked 95th among 133 countries with an index of 21.3 [14].

Business Wednesday. The development of the national economy is highly dependent on the institutional environment and infrastructure, which can hinder or, conversely, accelerate the introduction of new technologies. Positive digital transformations in society are also extremely demanding on the business climate. Obviously, launching a high-tech enterprise is very problematic in the absence of a developed transport and communication infrastructure, ill-conceived government regulation and a low level of protection of property rights. The main tool for determining the state of the business environment in countries of the world is the integrated Ease of Doing Business Index of the World Bank. In 2023, Azerbaijan ranked 34th among 190 countries in the latest version of the Index with a score of 76.70 [15].

State policy and regulation. The development of the digital economy requires the development and implementation of public policy, including the definition of strategic goals and objectives for the use of digital technologies for socio-economic development, the preparation and implementation of action plans and programs, and the assessment and monitoring of the development of the digital economy to provide feedback in the digital transformation management system. The World Economic Forum defines national competitiveness as the ability of a country and its institutions to ensure stable rates of economic growth that would be sustainable in the medium term. The Global Competitiveness Index is made up of 113 variables that characterize in detail the competitiveness of countries at different levels of economic development. Two-thirds of the variables are based on the results of a global survey of business leaders, and one-third are from publicly available sources. The data with the results of the latest study were published in October 2019. Azerbaijan ranked 58th out of 141 countries in the ranking with an index of 62.7 [16].

Informational safety. A sustainable national information security system is one of the key factors in the development of the country's digital economy. Due to high dependence on digital technologies, insufficient attention to information security processes can have a

destructive effect on both the activities of individual citizens and companies, and on the sovereignty and socio-economic development of the state as a whole. The assessment is based on the Global Cybersecurity Index, which is prepared by the International Telecommunication Union. In 2023, Azerbaijan ranked 48th among 191 countries with an index of 89.31 [17].

Digital infrastructure. In the context of the development of the digital economy, the state of the infrastructure is becoming one of the decisive factors in digital transformation and economic growth. Modern digital infrastructure should not only serve the ever-growing needs of the economy, but also be able to ensure a sharp increase in demand with the introduction of emerging digital technologies. Today, the technological basis for the digital transformation of the economy is formed not only by telecommunications networks: the most important components of the digital infrastructure of the modern economy are data processing centers, cloud computing services, fifth-generation communication networks, the Internet of Things, etc. The main tool for determining the state of the digital infrastructure is the Network Readiness Index of the World Economic Forum. The data with the results of the latest study were published in December 2024. Azerbaijan took 7th place among the participants in the rating with an index of 46.08 133 countries [18].

Digital sector. The digital sector of the economy includes economic activities related to the production of ICT equipment, provision of IT services, trade in ICT goods and telecommunications. The digital sector is a producer of goods and services that form the infrastructure and content elements for the digital economy. To conduct a comprehensive assessment of the level of development of the digital sector of the economy in the country, it is necessary to study the various factors affecting its functioning, as well as the level of maturity of the sector - its contribution to the country's economy and competitiveness. The Information and Communication Technology Development Index, which is calculated according to the methodology of the International Telecommunication Union, characterizes the achievements of countries in terms of information and communication technology development. In 2024, Azerbaijan ranked 91st among 170 countries in the latest version of the Index with a score of 80.4 [19].

Digital government. The modern interpretation of digital government differs from what was previously understood as electronic government: if the latter implies, first of all, a convenient system of state and municipal services for citizens and businesses, a high level of automation of interaction with the state, single portals for access to the necessary information and high speed of registration actions, then digital government is, first of all, the use of a colossal amount of data accumulated in all kinds of state information systems. The United Nations e-Government Development Index is This a comprehensive indicator that assesses the readiness and capabilities of national government structures in using information and communication technologies to provide public services to citizens. In 2024, Azerbaijan ranked 74th among 19 countries with an index of 0.76 [20].

Digital citizens. The use of digital technologies by citizens and households is one of the important areas and at the same time a factor in the development of the digital economy. The inclusion of citizens in the processes of digital transformation and their active use of the latest digital technologies creates demand in the market of the digital sector of the economy and is an important source of digital innovation in all areas activities, producing goods and services for the population. To increase the level of use of digital technologies by citizens, it is necessary to develop the infrastructure of access to digital technologies, carry out a set of measures to popularize digital goods and services, and implement measures to increase the level of citizens' trust in digital technologies and platforms. Without the necessary level of accessibility, it is impossible to achieve social and economic effects for citizens and households. The indicators for assessing and monitoring of this component are the use of a computer, mobile (portable) devices and availability of access to broadband Internet. In the list of countries ranked by the number of Internet users in 2023, Azerbaijan ranked 62nd among 170 countries in the world with a percentage of 86.0 [22].

The overall picture of the relationship between the Azerbaijani index for digital economy development indicators and the average and maximum values for 117 countries of the world (Table 1) is presented below in the diagram (Fig. 1). Close to or above average values of integral indicators for Azerbaijan are observed in the areas of business environment, information security, digital sector and digital citizens.

	Human capital	Innovation	Business environment	State policy	Information security	Digital infrastructure	Digital sector	Digital government	Digital citizens
Azerbaijan	74.50	23.30	76.70	62.70	89.31	47.74	79.00	69.37	86.00
Leading country	96.20	67.60	86.80	84.80	99.99	80.30	98.20	97.17	99.00
Average	76.64	33.64	68.92	62.57	71.72	53.08	76.44	70.69	75.72

Table 1. Digital development indicators indices

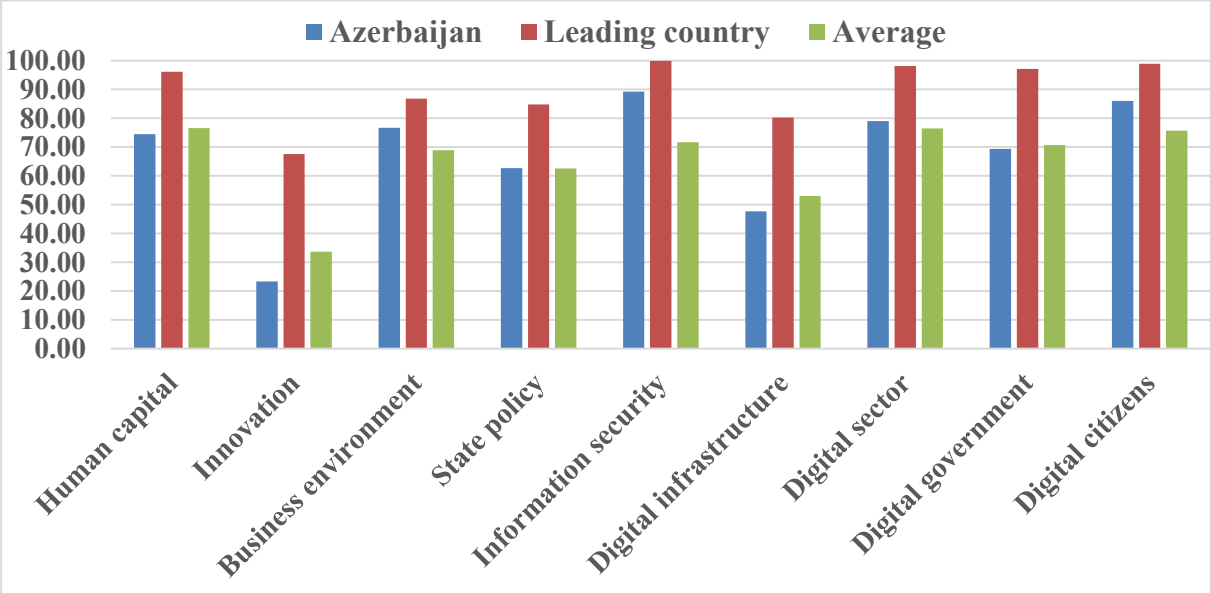

Figure 1. Digital Development Indicators Chart

At the time of studying the correlation dependence between the parameters of socio-economic development of society that interest us, the Center for Humanitarian Technologies published a rating of countries by 176 national economies. As a result of comparing the list of countries by the hyperloop digital development indicators, it was found that 117 out of 193 countries are included in all of them. Thus, when identifying the quantitative value of the closeness of the correlation dependence between nine indicators, we used information on 117 countries of the world.

In the context of cognitive modeling, the target factor of the study was the “state digital development". The experts attributed the following factors to the control factors: "Human capital", "Innovation", "Business environment", "Government policy and regulation", "Information security", "Digital infrastructure", "Digital sector", "Digital government" and "Digital citizens". The experts determined the directions of influence of the factors using cause-and-effect relationships. For example, if "Government policy and regulation" is attractive, then

"investments" can be high; if "digital infrastructure" is not developed, then "the state of the digital sector" is low; if the level of "human capital" is high, then "the state of digital development" is high; if the level of "computer crime" is high, then "the state of the digital sector" is low. The values of the influence of factors in the form of expert assessments underwent a coordination procedure using mathematical statistics.

The essence of the experiment, conducted within the framework of cognitive modeling, is that disturbances were introduced into one or several control vertices of the oriented graph, which spread along its various paths and had a positive or negative effect on the target factor.

The modeling was performed using “scenario analysis” methods [23]. The methods allow generating various variants of innovative scenarios, assessing their impact on goals and, on this basis, selecting a scenario (scenarios). Scenario analysis makes it possible to form a general conceptual model of digital development [4].

The ideological basis of the developed map was a structural model of economic growth developed by analysts from the EIU (Economist Intelligence Unit) group by order of the company "Microsoft" [24]. The model was built on the basis of the results of empirical studies conducted in 60 countries (26 developed and 34 developing), surveys of more than 100 company managers from 18 industries, detailed interviews with leading European politicians, business leaders and prominent scientists.

In the context of the EIU model, the task of developing an informatization (digital development) strategy is to select a specific mutually agreed sequence of strategic steps that ensure such management of the listed key factors that will ensure the desired economic growth, taking into account the structural features of the model and the interfactor relationships inherent in the country.

The EIU model defines:

a) empirical dependence of the economic effect on the use of innovation;

b) a list of factors that can facilitate the implementation of innovation and will play a decisive role in accelerating economic growth;

c) the non-monotonic logic of interfactorial relationships that arise in the process of “embedding” innovation into the country’s economy.

To take these relationships into account, a fuzzy cognitive map based on rules was developed (Rule Based Fuzzy Cognitive Maps). The map rule base describes the entire set of interfactor relationships defined by the EIU model. It also takes into account the “time lag” in the operation of some control factors, such as, for example, the development and implementation of the tax and regulatory framework for the digital sector, the implementation of uniform information security standards, etc. [24].

The results of cognitive modeling of the "state of digital development" clearly indicate that today, in the context of the growing influence of information technologies on all aspects of the socio-economic life of countries, the task of choosing an effective informatization strategy should be considered in conjunction with the development of digital development programs. At the same time, the informatization strategies themselves should be included in digital development programs as an integral and determining condition for their practical implementation.

4. Conclusion

Simulation cognitive modeling of the development of situations made it possible to identify possible scenarios for the development of the innovation system. Based on the obtained scenarios, recommendations can be developed for designing a digital development strategy in the context of their possible socio-economic interactions with adjacent territories, which can then be implemented by decision makers in accordance with the dictating conditions of the external and internal environment. The strategy developed to implement the mission of sustainable digital development will help resolve problems in the field of innovation activity in

the short term. It will create a reliable foundation for the confident growth of innovation processes in the future through the implementation of a set of tasks in the field of innovation policy and employment, education, aimed at increasing competitiveness and ensuring dynamic digital development based on the effective use of human capital, achievements of scientific and technological progress.

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Authors' Contribution Statement

The authors contributed equally to all stages of the preparation of the article.

Authors' Contribution Statement

Gulmammadov Rufat: Contributed to the development of the research concept, conducted data analysis, and participated in the writing of the manuscript.

All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

References

1. Gulmammadov R.G. Cognitive analysis of strategies for informatization of the digital region // Bulletin of Computer and Information Technologies. No. 4, 2021. P. 23-27.
2. Gorelova G.V. Research of weakly structured problems of socio-economic systems. Cognitive approach. Taganrog, 2020.
3. Erokhin D.V. [et al.]. Modeling of the digital mechanism of an enterprise using fuzzy cognitive maps // Management in Russia and Abroad. 2021. No. 3. P. 95–111.
4. Karaev R.A., Gulmammadov R.G., Safarli I.I., Nagiyev M.A., Abduragimov T.F. Cognitive analysis and management of innovative projects of enterprises // Information and management systems. No. 4, 2021. P. 63-68.
5. Cognitive business analytics//edited by N.M. Abdikeev. Moscow: INFRA-M, 2022. 511 p.
6. Roberts F. Discrete mathematical models with applications to social, biological and ecological problems // M., 2020.
7. Mikhnevich S. I. On some trends in the development of the world economy in the era of digital globalization//Trade policy. Trade policy / 2022
8. Spartak A.N. Consequences of digital transformation for international trade // Foreign trade activity. 2023. No. 5. P. 7–23.
9. Internet of Things Trends in 2024. https://sumatosoft.com/wp-content/uploads /2024/01/Internet-of-Things-Trends-in-2024-Whitepaper-SumatoSoft.pdf (date appeals 02/15/2024)
10. Vectors of Digital Transformation. OECD Digital Economy Papers, 2021. No. 273. January.
11. https :// ru.tradingview.com / markets / world - stocks / worlds - largest - companies (date of access: 30.05.2025).
12. Becker, Gary S. Human Capital. - NY: Columbia University Press, 1964. Shultz T. Human Capital in the International Encyclopedia of the Social Sciences. - NY, 1968, vol. 6.
13. Program development Organizations United Nations (UNDP) / United Nations Development Programme (UNDP): Index human development / Human Development

Index. URL: https://gtmarket.ru/ratings/human-development-index (date of access: 30.05.2025).
14. Global Innovation Index / Global Innovation Index. https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2023/az.pdf (date of access: 30.05.2025).
15. Ranking of countries of the world according to the Doing Business Index. URL: https://www.vsemirnyjbank.org/ru/region/eca/brief/doing-business (date of access: 30.05.2025).
16. Global Competitiveness Index. Humanitarian encyclopedia : Research // Center for Humanitarian Technologies, 2020. URL: https://gtmarket.ru/ratings/global-competitiveness-index/info (date of access: 30.05 .2025).
17. International Telecommunications Union. The Global Cybersecurity Index. URL: https://www.itu.int/en/ITU-D/Cybersecurity/Pages/global-cybersecurity-index.aspx (accessed: 30.05 .2025).
18. Networked Readiness Index. Humanitarian encyclopedia : Research // Center for Humanitarian Technologies, 2020. URL: https://gtmarket.ru/ratings/networked-readiness-index/networked-readiness-index-info (date of access: 30.05.2025).
19. Rating of countries of the world by the level of development of information and communication technologies. Humanitarian encyclopedia : Research // Center for Humanitarian Technologies, 2020. URL: https://gtmarket.ru/ratings/ict-development-index/ict-development-index-info (date of access: 30.05.2025).
20. https://publicadministration.un.org/egovkb/en-us/Data/Country-Information/id/11-Azerbaijan (accessed: 30.05.2025).
21. Ranking of countries of the world by the level of expenditure on health care. Humanitarian encyclopedia : Research // Center for Humanitarian Technologies, 2020. URL: https://gtmarket.ru/ratings/expenditure-on-health/info (date accessed: 02/15/2024).
22. Rating of countries of the world by the level of Internet development. Humanitarian encyclopedia : Research //Center for Humanitarian Technologies, 2020 URL: https://gtmarket.ru/ratings/internet-development/info (date of access: 30.05.2025).
23. Cognitive analysis and management of development of situations // Cross-border international conference. CASC'2007 / Institute of Management Problems. - M., 2007. - 247 p. http://www. ipu-conf.ru, http://CASC&apos.
24. Reaping the benefits of ICT: Europe's productivity challenge. 2004. (Russian translation: "Reaping the benefits of ICT and economic growth in Europe": 3 information document prepared by the Economist Intelligence Unit (EIU) - the analytical service of the magazine "The Economist", commissioned by Microsoft) // http://www.eiu.com.
25. UN report World Population Ageing 1950-2050. https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Report.pdf (date of access: 14.03.2021).
26. Industrial Revolution 4.0. https://www.pwc.ru/ru/assets/pdf/industry-4-0-pwc.pdf (date of access: 14.03.2021).
27. Global IT Market Trends. https://www.tadviser.ru/index.php (date of access: 14.03.2021).
28. Internet of things, IoT, M2M (global market). https://www.tadviser.ru/index.php/%D0%A1%D1%82%D0%B0%D1%82%D1%8C%D (date of access: 15.02.2024).
29. IDC forecasts for digital transformation to 2024 and beyond https://www.interfax.ru/business/937579 (date of access: 15.02.2024).