

A Conceptual Approach to the Formation of an Intelligent Digital Innovation Economy

Alovsat Garaja ALIYEV

Institute of Information Technology, Baku, Azerbaijan

alovsat_qaraca@mail.ru

This paper analyzes the essence of the conceptual approach to the intellectual digital innovation economy, which will be formed based on the normal development of the digital economy. It is noted that most researchers of the economy of the modern era use many different concepts such as knowledge, digital, Internet, post-industrial, virtual, network, information, electronic, intellectual, etc. in their works. Scientific approaches to the study of the development problems of the intellectual economy formed in the new era are classified. As a result of summarizing existing scientific works, a new approach to the system of economic relations using modern innovative information technologies, the intellectual information environment efficiently developed with ICT, and the newly formed intellectual digital innovation economy are proposed. With the help of digital technologies, priority directions for developing information infrastructure, and Global digital space, including new business models, have been proposed. By using the concept of Industry 4.0 and "smart structures" as the driving force of the digital transformation of industrial development, taking advantage of the use of the "cyber-physical system" as a unified complex of information resources, systems, and physical processes and the Internet of Things, cloud, Big Data, artificial intelligence technologies, new recommendations on the formation of the economy were given.

Keywords: Digital economy, Digital transformations, Conceptual approaches, Priority directions, Digital technologies, Digital innovation economy, Intellectual economy

DOI: 10.24818/issn14531305/27.2.2023.01

1 Introduction

The digital information economy, formed after the industrial stages of economic development in recent years is one of the promising directions of the development of the national economies of different countries in the global digital space [1].

In the role of the main prerequisites for the formation and rapid development of a new type of public economic relations:

1. globalization of the world economy;
2. integration of world capital markets;
3. transnationalization of innovative production;
4. transformation of business methods;
5. increasing the competitiveness and differentiation of companies;
6. innovativeness of organizational structure;
7. application of digital technologies;
8. activation of e-business and electronic commerce, etc. such processes are

performing.

The scale of the development process of the digital information economy can be compared to the 2nd industrial revolution of the 18th and 19th centuries, which fundamentally changed the whole world, stimulated economic growth in many countries and changed the development paradigm itself.

The modern transition to the digital information economy is becoming the main factor of GDP growth [2]. This is related not only to the effect obtained from the automation of existing processes, but also to the introduction of new, breakthrough business models and technologies, including digital platforms, digital ecosystems, deep analytics of big data, and Industry 4.0 technologies [3].

2 The problem statement, analysis, and generalization of existing scientific research

There is a serious need to clarify the principles, priorities, features, goals, and criteria of the intellectualization of production

and economy based on the Industry 4.0 platform and innovative technologies of the current ICT-based digital economy [4-7]. This is confirmed by the relevance of various aspects of the problem of the development of the knowledge and technology economy.

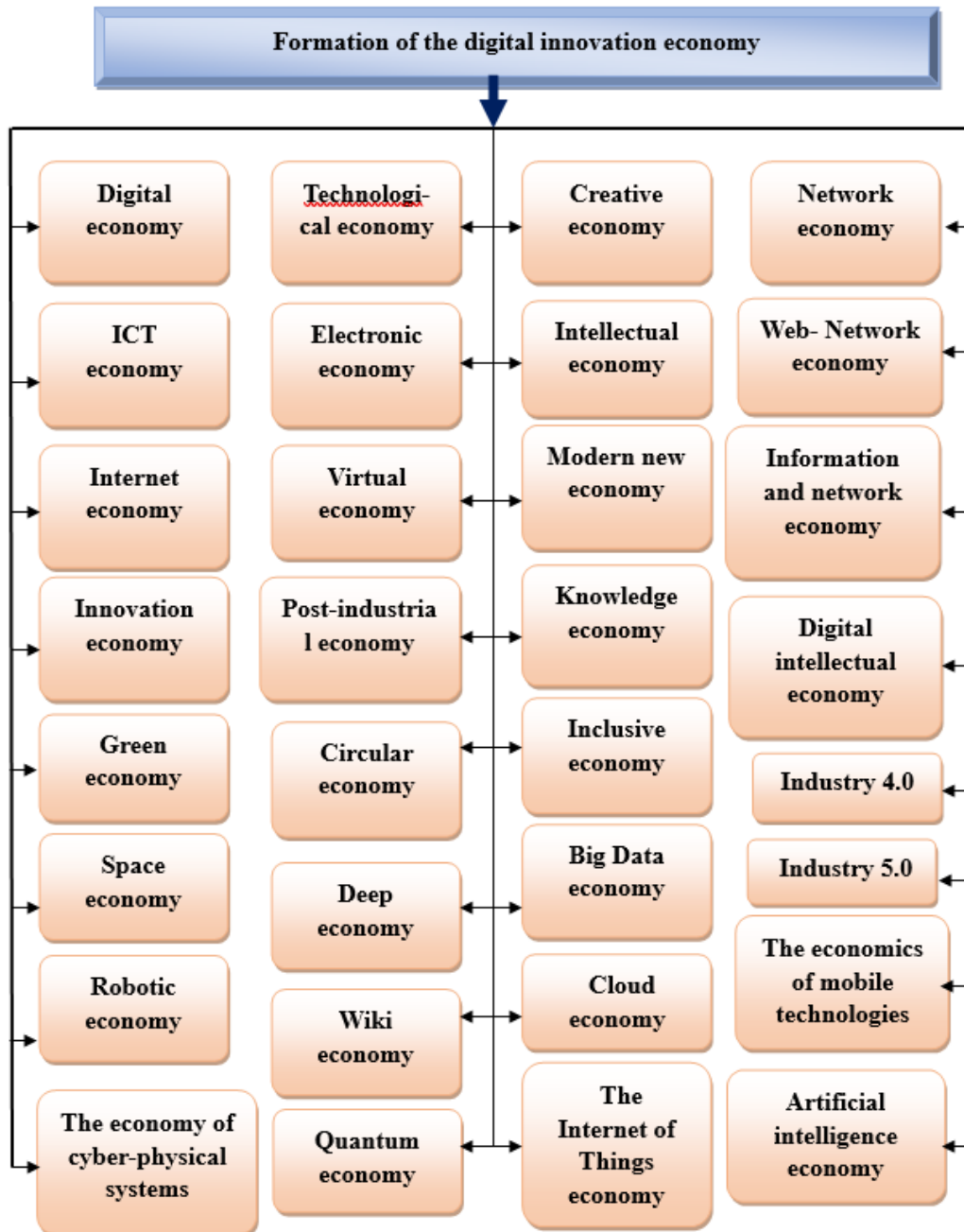


Fig 1. Relevant economic systems forming the digital innovation economy
 (Source: compiled by the author by improving the results of the analysis of economic scientific literature and making additions)

Researchers pay great attention to the formation of evolutionary views on the conceptual apparatus, the study of current trends, and the identification of promising

directions for developing the knowledge economy. The analysis of economic literature shows that there is no unified scientific approach to the

term neither information nor digital innovation economy [8]. Scientists use many different terms to define their meaning (Figure 1). It should be remembered that the term Information economy was first coined in 1976 by M. Porat, who predicted a rapid transition from classical production capital to intellectual property, i.e., information production. The resource that plays the biggest role in the information economy is information. This system includes intangible assets, licenses, patents, etc. is a type of economic system provided by related activities.

Some scholars prefer to talk about the digital economy, which changes the paradigm towards the development of flexible economic organization schemes, where coordination occurs through digital technologies, and develops relations between business subjects. Others focus on the technological development of the production system and the increasing role of information and communications in the process of economic activity.

By systematizing the existing concepts of the digital information economy, which has its own characteristics [9] following approaches can be noted.

- resource-oriented approach. It is based on technology, information resources, that is, data processing, including human resources, that is, human knowledge and creativity arising from information and communication technologies;
- process-oriented approach. Using technology for business operations; New information flows created by ICT; ongoing transformations in technological processes;
- structure-oriented approach. Development of structures based on the transformation process and web-network technologies as components of the digital economy;
- business-oriented approach. Emerging business models as components of the digital economy, i.e., network business and e-commerce.

As a result of scientific research, many existing scientific views on the nature of the

digital information economy can be summarized as follows:

1. as a scientific direction,
2. as a new type of economy,
3. as an integral part of economic theory of a field,
4. as a global and local information environment,
5. as a system of economic relations,
6. as a type of economic activity,
7. as an opportunity to make deep economic decisions.

3 Conceptual model of development stages of economic systems based on the DIKW approach

The economy of the modern innovative era based on ICT, the rapid impact of new technologies on various fields, the process of automated knowledge creation, a new type of cooperation based on the Internet, remote control technologies, the management of increasing cyber security risks, artificial intelligence and robotization, an adaptation of management to the requirements of advanced technologies, new technologies is more characterized by the development of human capital that can manage. It should be noted that the formation of the theory of the Information Society economy, the increase in the role of scientific knowledge and information in economic development, and the development of information networks have been studied based on the scientific works of many scientists.

Post-industrial society, third wave, information society, optimal use of resources, problems of asymmetric information in the market, which can be attributed to the foundations of the theory of Digital Information Economy, relevant theories and concepts were also examined in the context of developing the theoretical foundations of the digital economy.

In order to successfully implement the formation of the Digital Information Economy at the regional and national level, along with developed countries such as the United States, European Union countries, Japan, China, India, South Korea, etc. Current

trends in the development of ICT-based economies in developing countries were analyzed and taken into account [7].

The USA, Israel, South Korea, etc. have achieved significant success in the field of informatization of the regional and national economy. The experience of countries like As a result of the influence of scientific and technical revolutions, the digital economy is a new product of the development of civilization and the basis for the emergence of a new global economy. It can be considered as the development of previous economic systems of society as a result of industrial revolutions.

In such a case, the conceptual model [10] that characterizes the dependence of the perspective development stages of the Digital economy on various material, information-knowledge, designated resources, and technical and technological means affecting them is schematically proposed as shown in Figure 2 (Aliyev A.G., 2021. Research of problems of formation of information economy sectors and assessment of innovative perspectives. Abstract of the doctoral dissertation). Here, attention was paid to the dependence of economic systems on both material and non-material resources, as well as on the intellectual characteristics of the workforce.

In this conceptual model, the reflection of the development stages and dynamics of structural and functional relations of information-knowledge resources is based on the requirements of the *DIKW* (*Data, Information, Knowledge, Wisdom*) pyramid model.

4 Digital features of the intellectual economy

The digital economy is the construction, analysis, application, etc. of digital models of economic, social, engineering, natural, and ecological systems. based on technologies. Such models should integrate knowledge about man, society, nature, and technology. In the developed digital economy, the main subjects of communication and management processes are data, knowledge, and models.

Models are the highest form of knowledge in which real knowledge is combined with virtual assumptions [6].

The main direction of the development of the digital economy is the most adequate representation of economic systems in the form of models of real and projected information objects. The following stages can be distinguished in the development of the digital economy depending on the means of identification of the information space of the components and participants of the economic activity [6]:

- 1st stage — the creation of the densest possible space of models of real socio-economic and technical systems;
- 2nd stage - the creation of the world of virtual socio-economic and technical systems;
- 3rd stage - the creation of hybrid models of real-virtual socio-economic and technical systems;
- Stage 4 - the creation of tools and structures to distinguish and separate augmented and ordinary reality.

Based on the role of the Internet in the operation and transformation of socio-economic and technical systems, the sequence of development stages of the digital economy can also be presented as follows:

- creation of a barrier-free communication system between people ("internet of people");
- creation of a system of direct interaction between material objects - machines, devices, objects of economic activity ("Internet of Things");
- creation of a system of the continuous interaction of mental models, concepts, provisions, etc. ("Internet of Ideas");
- creation of systems for making and coordinating automated decisions, and ways to move from the current state of the system to any state ("Internet of Processes").

At the end of the second stage, the economy can be expected to be potentially transparent and transparent. The downside of super-transparency may be the lack of incentives to equalize supply and demand and ultimately

reduce competition. In the third stage, a person's inner world will be open to the public, which will make him vulnerable to unnecessary intrusions. The fourth stage threatens to transfer the rights to control the worlds of people, things, and ideas to artificial intelligence.

To date, the most popular system for the implementation of the main economic processes - consumption, exchange, distribution, and production - shows the options for using ICT technologies. These include 1) Big Data in the consumption process; 2) Blockchain in the exchange process, 3) Artificial Intelligence in the distribution process, 4) Flexible systems in the production process, digital twins, etc. includes.

Intelligence (mathematical, logical, computer, etc. models) will take the place of the fundamental factor of the economy at all levels of the knowledge-based economy. The role of intelligence as the main resource of economic activity will increase. The digital era and the post-digital era based on intelligence as the main resource and result of economic activity will be characterized as a special stage in the development of the economy. Intelligence is usually understood as a person's ability to successfully solve problems in life (Ushakov, 2003). However, in the context of the analysis of the long-term development of society, such a concept should be clarified and expanded in the following directions:

1. The subject of intelligence can be not only a person but also a group of people, a social class, the society of a certain country, or humanity as a whole, as well as an algorithm, program, or device;
2. Intelligence manifests itself not only in the successful solution of problems but also in their adequate formulation, that is, it determines the range of conditions, goals, and acceptable methods for solving problems;
3. The level of intelligence is determined by the depth of the analysis, the reliability of the forecast, and the efficiency of the synthesis in the process of setting and

solving problems;

4. The concept of decision success should reflect the subject's ability to act in changing conditions.

Economic space consists of individuals, economic agents, social groups, economic benefits, goods, etc. technical equipment to support intellectual activity will be a symbiosis of its main components.

Such a symbiosis will affect the concept of the individual because the combination of biological individuals and electronic devices will fundamentally change the relationship between man and the outside world.

The new features of the intellectual economy are as follows [6]: a) the understanding of the result of product production, the subject of circulation and distribution, as well as the subject of consumption; b) the relationship between demand and consumption, the means of achieving the balance between them; c) relationship between competition and cooperation of economic agents; d) a system of making and implementing decisions on economic management.

In the modern economy, goods are differentiated depending on the amount and quality of material, financial, cognitive, and labor resources invested in their production. A distinction is made between so-called science-intensive and simple goods (things). In the intellectual economy, the main component that determines the value of the product for the producer will be the intellectual intensity (an indicator of the amount of intellectual effort spent on the creation of the product). Intellectual intensity will become the main component of the content of any product, ensuring its progress from the stage of production to the stage of consumption.

In a developed intellectual economy, the main factor that determines the balance between supply and demand will be the balance of the four sectors of the economy: object, process, design, and environment. Equilibrium of the four system sectors of the economy is impossible when the level of demand significantly exceeds or is significantly below the level of supply in many periods [6].

Intellectual socio-economic systems (of

natural and artificial origin) play the role of the main economic agents in the intellectual economy. These systems will also include individuals who are inextricably linked to electronic devices (chips) that form part of their bodies. With the implementation of this connection, the possibility of unhindered operation of mechanical devices will actually transform the economy into a field of interaction of intelligent systems. Under these conditions, the competition of agents will be based on the competition of their intelligence.

5 Features and principles of intellectualization of regional and national economies

During the intellectual formation of the regional and national economy, enterprises will become unique research centers that produce new knowledge and intellectually develop themselves and their employees. The main basic principles of the intellectual economy (sustainable, sustainable development, innovativeness, inclusive growth), goals (greening of economic growth, saving resources, intellectualization of the production process, efficient distribution and consumption, reduction of socio-economic threats), development instruments (adoption of various level programs, appropriate coordination bodies, mechanism of sustainable investments, information and high technologies, ecological, social, innovative management, intensive use of renewable energy, quality of education and research) will

be formed according to new conditions. In such conditions, the main function of the society and the state should be that the intellectual level of the society is higher than the level of each of its members.

It is necessary to form the main principles and priorities of the new economy in the directions of intellectualization, institutionalization, environmental nation, and socialization based on the foundations of the intellectual economy, such as the science-education system, ICT infrastructure, innovation system, and institutional environment [10, 11].

As a result of the conducted research, the basic characteristics and principles of the formation and development of the intellectual economy can be proposed as follows:

- Making knowledge and intelligent digital technologies the main driver;
- Accepting public welfare and sustainable inclusive development as the main principle of growth;
- ICT and highly innovative technological systems play a key role in future transformations;
- Formation of digitized processing and recycling as the main methods of smart-intellectual production;
- Global, fast, dynamic, and green nature of production, exchange, and consumption;
- The transformation of scientists and highly qualified intellectual specialists into the main labor resources.

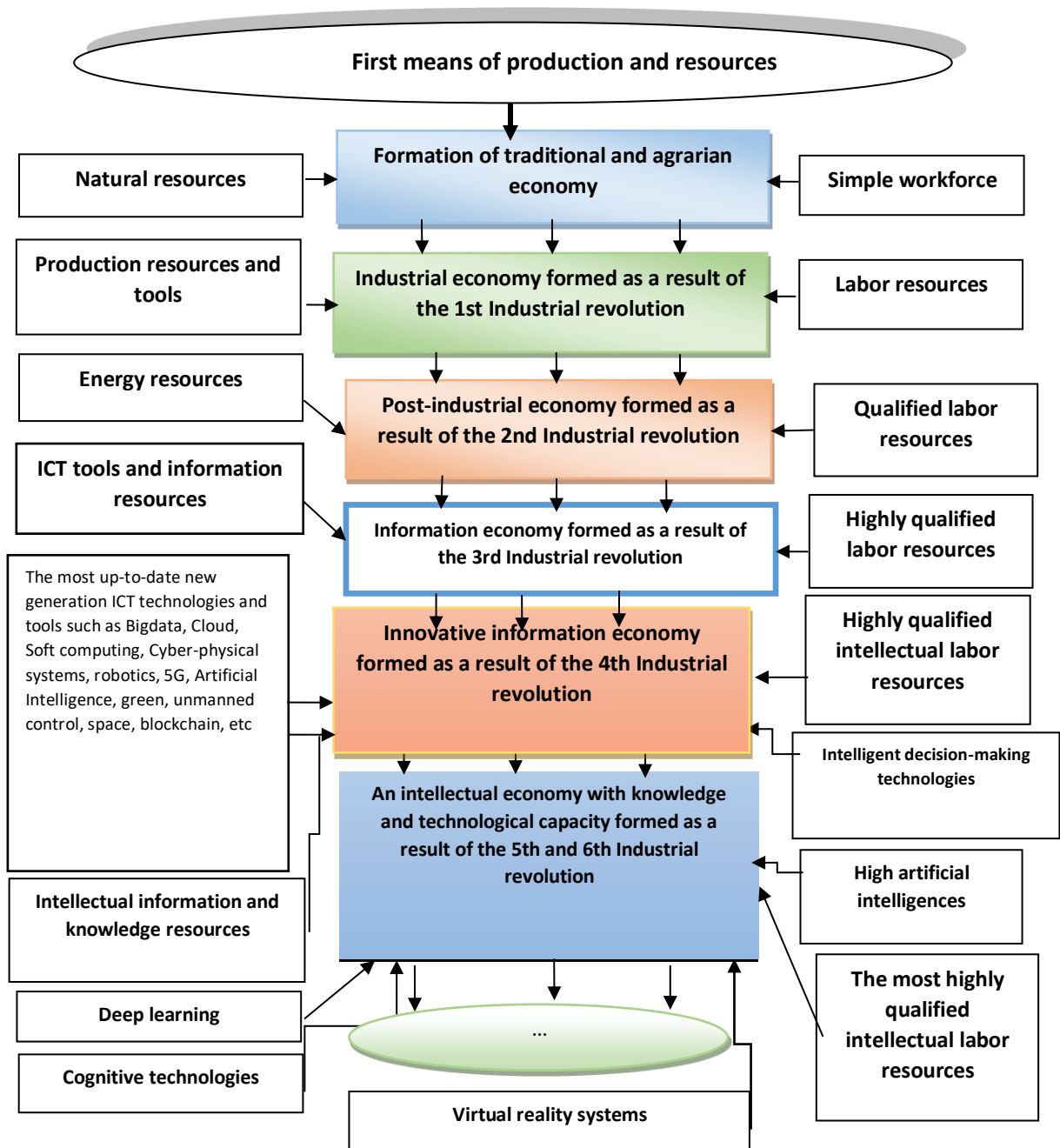


Fig. 2. Conceptual model of formation and prospective development stages of modern economic systems (Source: developed by the author)

Currently, many advanced countries are implementing "Society 5.0" programs to build a Super-smart society based on digital technological innovations aimed at solving serious socio-economic issues [12].

The programs in which regional and national economies will be formed in this direction will, first of all, create new values and services based on the technological innovations of the Industry 4.0 platform [13-15], the Internet of Things, Big Data, artificial intelligence,

robots, sharing economy, mass digitization, it will make it more convenient, more reliable, sustainable and inclusive.

6 Conclusion

The rapid development of digital technologies leads to the formation of the concept of information and digital innovation economy. Studies show that some priority directions for the development of the digital innovation economy can be noted. Thus, the essence of

creating a digital innovation platform as a new business model is to provide relevant services to businesses and the public in order to coordinate the activities of various market participants. The platform allows sellers and buyers of goods (services) to quickly find each other, negotiate and make payments. Digital platforms are increasingly used in commercial and logistics activities. The operation of these platforms reduces the cost of production and exchange processes, eliminates unnecessary intermediary relationships, and increases the efficiency of markets.

Industry 4.0 and the concept of "smart productions and structures" are increasingly being used as the driving force of digital innovative transformation in economic development. The concept of a "cyber-physical system" as a single complex of information resources, systems, and physical processes should also be implemented.

It includes 1) a "supplier-customer" integration system; 2) a single cycle for the completion of business processes and management of information exchange; 3) "computer vision" systems that coordinate industrial robots and their interaction; 4) 3D printing for prototyping and production of small batches; 5) creating/receiving visual "instructions-tips" in the workplace, as well as reality technologies for promoting and selling products; 6) design systems; 7) Big Data analysis for online decision support, etc. must be included.

The use of digital innovation technologies improves the accessibility and efficiency of public services, efficient management in companies, and transparency of the business environment. It also improves the business and investment environment. It serves the development of the business services ecosystem (logistics services, mobile banking).

The process of intellectualization of existing economic systems based on digital innovative transformations will develop regularly as a process characterized by continuous dynamics and will lead to further improvement of the world economic system.

Contributions. The formation and development of intelligent digital innovation economy sectors on the Industry 4.0 platform based on relevant technologies can give a serious boost to increasing the sustainability of the digital economy. Accordingly, the features of the application of the elements of the Industry 4.0 platform and digital transformation technologies in the formation of the intellectual digital innovation economy were studied and analyzed, and relevant recommendations and proposals were developed based on this. A conceptual model of the formation of the intellectual digital innovation economy was proposed. With the application of modern technologies, a new approach to the Digital innovation economy systems, terms, and concepts has been developed.

Artificial intelligence, the Internet of Things, the cloud, Big Data, etc. are the digital technology trends of the modern world. solutions to the issues of application of such technologies can be considered as a contribution to the investigation of solutions to existing problems in economic development. By using these technologies, it is possible to form and develop an intelligent digital innovation economy, its perspective sectors. The proposals presented in this direction can lead to the formation of an intelligent digital innovation economy and more effective results for the economy to be stable and sustainable.

The usefulness of the obtained result and application in practice. The problems of the formation of the intellectual digital innovation economy and prospective development directions can be applied in the development of other regional economies and in the development of solution mechanisms and options.

The analysis of the results of the application of digital innovative technologies in the formation and development of the intelligent digital innovation economy can serve as a platform for a comprehensive assessment of the activity of other economic information systems in general. The application of digital

transformation technologies in the sectors of the intelligent digital innovation economy provides a basis for making appropriate management decisions.

The proposed methodological and conceptual approach to the formation of an intelligent digital innovation economy can be applied in other regional-sectoral economies. This can help to achieve more efficient results in that area and can be characterized as scientific support for management decisions in matters of economic diversification, investments in real economic sectors, and ensuring regional technological sovereignty.

References

- [1] Decree of the President of the Republic of Azerbaijan “On improving governance in the field of digital transformation”. Baku, April 27, 2021 (in Azerbaijani) <https://president.az/articles/51299>.
- [2] V.I. Lyashenko, A.S. Vishnevskiy. Tsifrovaya modernizatsiya ekonomiki Ukrainy kak vozmozhnost' proryvnogo razvitiya: monografiya. Kiyev: In-t ekonomiki prom-sti NAN Ukrainy, 2018. 252 s.
- [3] K. Schwab. The Fourth Industrial Revolution. Limited, 2017, 192 p.
- [4] V.L. Makarov, A.R. Bakhtizin, Ye.L. Loginov. Primeneniye ekonomiko-matematicheskikh metodov i modeley optimal'nogo planirovaniya v tsifrovoy ekonomike budushchego. Tsentral'nyy Ekonomiko-Matematicheskiiy Institut Rossiyskoy Akademii nauk, Moskva, 2022, 248 s.
- [5] T.V. Mirolyubova, T.V. Karlina, R.S. Nikolayev. Tsifrovaya ekonomika: problemy identifikatsii i izmereniy v regional'noy ekonomike. Ekonomika regiona, 2020, T.16, vyp.2, s. 377-390.
- [6] G.B. Kleyner, Intellectual'naya ekonomika tsifrovogo veka. Tsifrovoy vek: Shagi evolyutsii. Ekonomika i matematicheskiye metody, 2020, tom 56, №1, s. 18-33.
- [7] A.G. Aliyev, Evolution of the economic theory of the formation of sectors of the information economy. XXI International Scientific Conference “Problems of Control and Modeling in Complex Systems” (IPSS of the Russian Academy of Sciences). Proceedings of the XXI International Conference. Samara, Russia, September 3-6, 2019, .in 2 volumes, v.2 pp. 349-353.
- [8] A.S. Kvilinskiy, N.V. Trushkina, N.S. Rynkevich Kontseptual'nyye podkhody k opredeleniyu termina «informatsionnaya ekonomika». Problemi yekonomiki, 2019, №3(41), pp.147-155.
- [9] R. Bukht R. Khiks, Opredeleniye, kontseptsiya i izmereniye tsifrovoy ekonomiki. Vestnik mezhdunarodnykh organizatsiy. 2018. T. 13. №2, s.143–172.
- [10] A.G. Aliyev, Features and development problems of the formation of ICT-based intellectual society and economy. Problems of Information Society, 2021, №1, pp.43–55.
- [11] A.G. Aliyev, Methodological aspects of estimation of ICT-based economic development. International Journal Management Dynamics in the Knowledge Economy, 2018. vol.6 no.2, pp.227-245.
- [12] C. Holroyd. Technological innovation and building a ‘super smart’ society: Japan’s vision of society 5.0. Journal of Asian Public Policy, 2020. volume 14, issue 2, pp.1-14.
- [13] A.V. Bogoviz, et al. Industry 4.0 as a new vector of growth and development of knowledge economy. Springer, Cham: In: Popkova E., Ragulina Y., Bogoviz A. (eds) Industry 4.0: Industrial Revolution of the 21st Century. Studies in Systems, Decision and Control, 2019, vol 169, pp.85-91.
- [14] S. Grabowska. Smart factories in the age of industry 4.0. Management Systems in Production Engineering, 2020, volume 28, issue 2, pp.90-96.
- [15] S.V. Ratner, R.M. Nizhegorodtsev. Analysis of the world experience of smart grid deployment: economic effectiveness issues. Thermal Engineering. New York: Pleiades Publishing, Inc., 2018, vol. 65, No.6, c.387–399.



Doctor of economic sciences **Alovzat Garaja ALIYEV** (born January 8, 1956). Head of department of the Institute of Information Technology of Azerbaijan National Academy of Sciences. He has a total number of 300 scientific articles and 5 books. It has more than 30 scientific publications indexed in the Web of Sciences (WOS), Scopus and other international databases. Alovzat Aliyev continues to conduct scientific research works and deals with issues such as characteristics of ICT application in economical

processes and management authorities, information problems in social economical systems, scientific-theoretical basics of formation of information society, information economy, determination of demonstrative systems in ICT field, research of reasons of establishment of digital differences in the society, study economical basics, problems of informatization of humanitarian fields, humanitarian aspects of ICT. Areas of interest: ICT-based information (digital) and knowledge economy, mobile, cloud, Big Data, artificial intelligence, cryptocurrency and blockchain technologies, sustainable green, inclusive and cybersecurity of economics, Industry 4.0 technologies, innovation management, e-commerce and payment systems, innovation structures, science-industrial techno parks, industrial clusters, science management and commercialization, application of digital twin technologies, smart systems and structures, cyber-sustainable green, inclusive development of the economy, including the oil industry economy, security and cyber sustainability of the non-oil industry potential, increase of the cybersecurity sustainability of information and digital economy.