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ABSTRACT

of the dissertation for the degree of Doctor of Science

STUDY OF PROBLEMS OF FORMATION OF INFORMATION ECONOMY SECTORS AND EVALUATION OF INNOVATIVE PERSPECTIVES

Speciality: 5306.01- Technological innovation economy

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GENERAL CHARACTERISTICS OF WORK

Relevance and level of development of the topic. Since the second half of the twentieth century, the growing role of information and telecommunications in the socio-economic life of society, the growing demand for information, knowledge, and technology has made the production of Information and Communication Technologies (ICT) and science-intensive high-tech products a key sector of the world economy. As a result, the process of replacing the industrial economy with the post-industrial period and the Information Economy (IE) began. The need for research on the scientific and methodological basis for the formation of new technological economic sectors and the improvement of management mechanisms, based on the rapid development and widespread use of ICT, has been steadily increasing. The coronavirus pandemic, which has posed a serious threat to the economy, real management system, service sector, and social life of all countries since the beginning of 2020, has once again proved the importance and irreplaceability of the formation and development of IE sectors.

The Development Concept of Azerbaijan[1] adopted in the last decade focuses on the formation of effective new technological economic sectors and the transition to a stage characterized by the advantages of innovative development, improvement of relevant economic structures, process management systems, methods, and tools. The application of high technologies, including smart machines and systems, the transition of economic development to an innovation-based model, further development of telecommunications and information technologies as a base area of the new economy, digitalization of the economy, the rapid development of ICT

[1]"Azerbaijan 2020: Vision for the Future" Development Concept. Baku, december 29, 2012. http://www.president.az https://president.az/files/future_az.pdf.

infrastructure, the ICT industry in the Strategic Road Maps (SRM) [2] of the country designed to increase capacity on a regular basis.

These issues are directly related to the development requirements of the Global Information Society (IS) and the National Strategy[3] for IS Building in Azerbaijan, which are accepted as the development ideology of the third millennium. Thus, in the period of formation of the new IS and IE, information, technology, and knowledge are considered to be a factor of competitiveness and development of most countries of the world. Therefore, there is a need to study the problems of the formation of IE sectors, to improve its scientific-theoretical, methodological bases, and to develop a new system of indicators and indices to assess the level of development at various regional-sectoral levels. One of the urgent issues is the development of their formation methodology, calculation methodology, and recommendations for solving existing problems in this area. Therefore, the technological features of IE and its main base, the ICT sector, should be studied and perspective areas of development should be identified. Sectoral-regional problems of ICT-based development of economic activity must be solved. The formation features of the National Innovation System (NIS) in the new economic environment should be analyzed and development trends should be identified. Mechanisms for organizing and managing the activities of the main driving innovative structures of the economy need to be improved. E-commerce technologies and payment systems should be developed in accordance with international and regional regulatory mechanisms. IE sectors should be formed in accordance with the requirements of the green economy, the ecological and economic balance, the course of sustainable innovative economic development, increasing the level of inclusion, 4.0 components of the

[2] Strategic Road Map for the National Economic perspectives of the Republic of Azerbaijan. Baku, december 6, 2016, 111 p. https://president.az/articles/21953..

[3] National Strategy for the Development of the Information Society in the Republic of Azerbaijan for 2014-2020. Baku, april 2, 2014. https://president.az/articles/11312.

Industrial Revolution. Such issues, as well as at the international level, are important and relevant in the diversification of our national economy, its more sustainable development on a scientific and technological basis. They were regularly referred to the important and topical research directions of the Institute of Information Technologies of ANAS during 2002-2020.

In connection with the research aspects of the problem and the degree of development, it should be noted that the foundations of the information and knowledge economy were laid in the 50-60s of the twentieth century by Western scientists J. Schumpeter, F.Hayek, and F. Makhlup. In those years, F.Makhlup presented the sphere of production and dissemination of knowledge as a sector of the economy[4]. According to his initial concept of the information sector, the country's GDP included the prices of information products and services sold in the market. M.Porat and M.Rubin continued this work and proposed the concept of the second information sector. The scientific direction of IS, which was introduced to the scientific literature by F.Makhlup and T.Umesao in the USA and Japan at that time and laid the beginning of the relevant theory, was later developed by M.Porat, Y.Masuda, T. Stoner, R.Kats. This scientific direction was significantly developed by the Spanish-American economist M. Castels [5] in his monograph published in 1996-1998 and later by other authors [36, 37].

The research work of foreign scientists, including Russian, was of great importance in the development of IE and its sectors. Some aspects of IE, as well as innovative processes, are to some extent reflected in the scientific work of many Azerbaijani scientists. However, due to the multi-disciplinary nature of the problem and its

[4] Machlup F. Production and dissemination of knowledge in the United States. -M.: Progress, 1966, pp.462.

[5] Castells M. Information Age: Economy, Society, and Culture: Per. from English under scientific. ed. O.I. Shkaratan. -M.: GU HSE, 2000, pp.608

urgency, this topic has not been fully developed in doctoral dissertations in economics, management, and technology in recent decades.

Although a long time has passed since the emergence of the concept of IE, there is still no single and stable definition of this direction of economic theory. Only a few scholars at different times have initiated a conceptual definition of the nature and problems of IE. An analysis of scientific sources on the problem in international databases shows that the explanations offered by IE researchers are ambiguous and sometimes differ to some extent [23]. Many issues related to the detailed study and understanding of the problems of the formation of IE, the definition of its structure, and the comparative analysis and development of existing scientific and theoretical approaches in appropriate fields are still relevant today [13, 17, 26, 32, 44, 22, 36, 37, 47, 52, 42, 43].

The purpose and issues of the research. The purpose of the dissertation is to develop the scientific-methodological, theoretical foundations of the information economy, the development of conceptual solutions to the problems of the formation of its traditional and new sectors, and the assessment of innovative perspectives.

The following issues have been studied in order to achieve the goal set in the dissertation:

1. Identify the problems of modern formation, management goals, and strategic directions of development of IE and ICT by studying the scientific and theoretical bases, features, development trends in advanced foreign countries;
2. Analysis of the current situation on the development of economic activities on the basis of ICT in the sectoral-regional aspect, identification of problems, and development of directions for their solution;
3. Identification of features and development trends of innovative processes and formation of the National Innovation System in the conditions of IE;

4. Research of theoretical and methodological aspects of the problems of commercialization of innovations and innovative processes and development of solutions;
5. Development of indicators, criteria for modeling the management and operation of innovative structures, and the establishment of a multi-level model of product/service manufacturing;
6. As a result of the study of e-commerce technologies and payment systems regulation mechanisms and development problems in IE, identification of development trends in this field and development of problem-solving directions;
7. Research of problems of its greening in ensuring sustainable development of IE, determination of directions of application of green technologies and development of indices for assessment of the state of application of green technologies in this field;
8. Development of methodology for assessing the level of inclusive development of IE and assessment indicators and methods related to the transition to an inclusive innovative economy;
9. Research of the impact of ICT in the development of innovative economy and identification of factors, criteria, and development of relevant econometric models influencing the processes of ICT production/services;
10. Defining the directions of formation of traditional and new sectors of IE and development of indicators and composite index for measuring the level of perspective development of sectors;
11. Assessment of innovative perspectives of IE sectors and development of recommendations through the development of appropriate methodology and method.

Research methods. Systematic analysis, computer modeling, information theory, uncertainty decision-making theory, multi-criteria optimization and analysis methods, economic-mathematical modeling, economic analysis methods, and technologies were used to solve the problems in the dissertation.

Object of research. Traditional and new sectors of the country's economy formed on the basis of wide application of ICT were selected as the object of research in the dissertation.

Subject of research. The research subject of the dissertation is the issues of improving the mechanisms, models, methods, and processes of increasing the level of digitalization of the development of traditional and new sectors of IE.

The main provisions of the defense. The following main provisions are defended in the dissertation:

1. Research of formation features, strategic goals of ICT sphere and IE sectors and identification of their development trends, management problems;
2. Identification of problems of ICT-based development of regions and areas of economic activity and development of directions for their solution;
3. Identification of NIS formation and development trends, and construction of models of commercialization stage of innovative processes;
4. Development of indicators, criteria, and models of interaction and activity of innovative structures;
5. Identify problems of development of modern e-commerce technologies and payment systems and develop directions for their solution;
6. Development of directions for solving the problems of application of green, inclusive, and cyber security technologies in ensuring sustainable socio-economic development;
7. Establishment of a multi-level index system to measure the greening of IE and the level of inclusive development;
8. Development of a system of composite indices and indicators for the analysis and measurement of IE;
9. Development of a model for assessing the innovative perspectives of IE and recommendations for the development of its sectors.

The scientific novelty of the research. The scientific innovations of the dissertation work are as follows:

1. Innovative features of IE sectors and ICT, problems of infrastructure and institutional formation were studied, their potential directions of development were identified, and scientific-theoretical, methodological bases were improved;
2. The conceptual model of formation and perspective stages of development of modern economic systems depending on production resources, means, high technologies, human capital is developed and management problems are defined;
3. Directions for improving the efficiency of ICT-based management of regional, economic activity, and technological innovation sectors have been proposed;
4. Conceptual model of ICT-oriented housing and communal services activity and innovation process measurement indices were proposed, models of effective management of innovative structures and stages of innovation commercialization were developed;
5. Improvement of regional regulation mechanisms of e-commerce technologies and perspective development directions were proposed in the conditions of IE, the necessity of the single payment system was substantiated and directions of formation of new business models were proposed;
6. The directions of the greening of sustainable economic development, increasing the level of inclusion and cyber security have been identified and their measurement indices have been proposed, calculation methods have been developed;
7. A multi-level composite index system for measuring the information economy has been proposed and a model for assessing the innovative prospects of the IE sectors has been developed.

The theoretical and practical significance of the research. The economic generalizations, recommendations made in the dissertation, as well as the proposed methodologies, indices, indicators, criteria, models, methods, and algorithms can be used at different levels of management, production and service areas,

development of state programs, and strategies, action plans. The management models used in this work can be used in the activities of various sectors of the information economy and innovative structures. The practical significance of the work is that the scientific and practical results obtained on the basis of the proposed methods and models can increase the efficiency of various structures. The scientific and practical results of the work can be used in highly qualified training systems and universities.

Approbation and application. The main scientific-theoretical and practical results of the dissertation were presented at more than 100 scientific conferences in 2002-2020, also reported and discussed at 40 international and dozens of national conferences held in cities such as Ankara, Prague, Osaka (Japan), Moscow, Astana, Almaty, Minsk, Kyiv, Tashkent, Novosibirsk, Sochi, Voronezh, Tbilisi, Vinnytsia, Kharkiv, Baku and others. The materials of these conferences were published in article format. Many of them are indexed in the international Web of Science (WoS) database, as well as in other international databases.

In connection with the implementation and application of the dissertation, it should be noted that the results of the work in the implementation of the National Strategy on ICT ("Electronic Azerbaijan") (2003-2012), the development of a system of indicators in the field of ICT (2004-2008) within the reports of the Institute of Information Technology, used in the implementation of State Programs on socio-economic development of the regions (2004-2019), in the implementation of the State Program on Poverty Reduction (2007-2019). It was also used in the implementation of the action plan of the National Strategy on IC issues (2014-2020), in the implementation of the action plans of the SRM on the prospects of the national economy (2016-2020). The results of the work were included in the annual reports of the Institute of Information Technologies of ANAS during 2002-2020 and submitted to the Presidium of ANAS.

Scientific publications. On the topic of the dissertation, more than 100 scientific papers have been published. 52 of them are

included in the list of the main editions of the dissertation. Of the scientific papers, 14 were not indexed in WoS. In addition, more than 15 scientific articles have been published in journals indexed in other world print databases such as EconLit, ERIH Plus, INSPEC, and others. All the main scientific works of the author in the dissertation are scientific publications of the Azerbaijan HAC.

Name of the organization where the dissertation work is performed. The dissertation was completed at the Institute of Information Technology of the Azerbaijan National Academy of Sciences.

The structure and scope of the dissertation. The work consists of an introduction, six chapters, a conclusion, a bibliography of 393 titles, 53 figures, 14 tables, and appendices. The main part of the work is commented on 252 pages.

The total volume of the dissertation with a sign. The total volume of the dissertation is 575404 characters, including 456238 characters without taking into account pictures, tables, bibliography, appendices. Accordingly, the total volume of the abstract is 104298 characters, including 86420 characters without taking into account the bibliography.

MAIN CONTENT OF THE WORK

The introduction substantiates the urgency of the work on the basis of the development characteristics of the world and the country's economy, provides information on the state of research of the problem. The purpose of the work, the scientific-theoretical tasks necessary to achieve it were explained, the scientific novelty of the work, the object of research, research methods, and techniques were indicated. The main scientific provisions of the defense, the practical significance of the work, the application of the results of the work were commented on. Relevant information on the structure, scope, approbation of the work, and the author's published scientific works on the subject was also provided.

Chapter I is devoted to "Innovative features and potential directions of development of the information economy and ICT sector". In this chapter, the stages of formation of IE [34, 43], its structural features, and characteristics are analyzed [29, 34, 36, 37]. The role and functions of information in economic development are studied. The scientific-theoretical and methodological bases of IE were analyzed [22, 34]. Trends in the formation and development of IE and ICT in advanced foreign countries have been studied [21, 26, 24]. Strategic development directions and goals of IE have been identified. Based on a comprehensive analysis of the international scientific literature, the course of economic development of the world and the country, a conceptual model of the formation of modern economic systems and perspective development stages is proposed, problems on innovative perspectives of IE sectors are clarified [32, 52, 30, 31]. This chapter also examines the general situation of the ICT sphere in the structure of the Azerbaijani economy, analyzes its infrastructure, problems of institutional formation, and shows the directions of development [5, 13, 18, 21, 25, 47, 48, 9]. The issues of creating a competitive business environment and the production of export-oriented products/services in the ICT sector of the country were considered [20, 30]. The problems of the formation of a single economic information space, its integration into the world information infrastructure were commented on. Innovative directions of the formation of development potential in the ICT sector have been identified [41, 48, 51, 24, 43].

The rapid impact of new technologies in various fields, the process of automated knowledge creation, a new type of Internet-based cooperation, remote control technologies, increased cybersecurity risk management, artificial intelligence, and robotics, an adaptation of management to the requirements of advanced technologies, new technologies are characterized by the development of human capital that can manage.

The formation of the theory of IS economics, the increasing role of scientific knowledge and information in economic development, the

development of information networks have been studied on the basis of the scientific work of many scientists. Relevant theories and concepts such as post-industrial society, third wave, information society, optimal use of resources, problems of asymmetric information in the market, market domination-regulation, which can be attributed to the foundations of IE theory, are also considered in the context of developing theoretical bases of IE [34].

In order to successfully implement the formation of IE in the country, along with developed countries such as the United States, European Union countries, Japan, as well as in developing countries such as China, India, South Korea, and others, the current trends in the development of ICT-based economies have been analyzed and taken into account [43]. The experience of countries such as the United States, Israel, South Korea, etc., that have achieved significant success in the field of informatization of the national economy, was used in the development of models for the transition to a new economy. IE is the basis for the emergence of a new product of the development of civilization and a new global economy as a result of the impact of scientific and technological revolutions. It can be considered as the development of the previous economic systems of society as a result of industrial revolutions.

In this case, the conceptual model [52], which characterizes the perspective stages of development of IE, the dependence of various materials, information knowledge, specific resources, and technical, technological means that affect them, is proposed schematically as in Figure 1. It focuses on the dependence of economic systems on both tangible and intangible resources, as well as the intellectual characteristics of the workforce.

This conceptual model reflects the stages of development and dynamics of the structural and functional relationships of information and knowledge resources based on the requirements of the **DIKW** (Data, Information, Knowledge, Wisdom) - pyramid model.

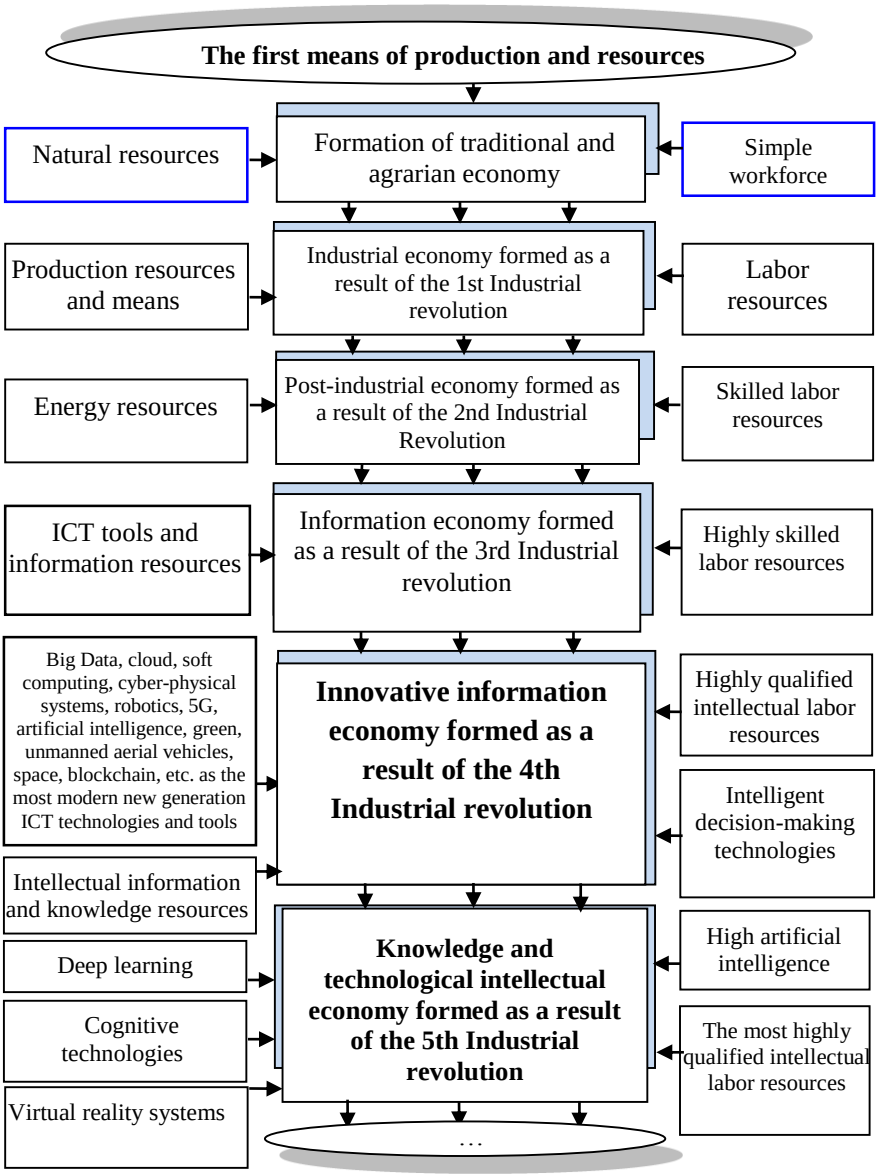

Figure 1. Conceptual model of formation of modern economy and perspective stages of development

The production sector of ICT goods and services makes a significant contribution to economic growth. The application of ICT in the socio-economic sphere creates a multiplier effect and stimulates the innovative development of other spheres. As a result, the information sector is of great importance in the development of the economy. ICT, as a catalyst for development, creates conditions for the revival of real economic sectors. ICT-oriented technological innovations play a very important role in the formation of a new type of economy.

The ICT sector is now one of the largest segments of the global economy. In 2018, according to International Reports[6], Azerbaijan ranked 46th among 140 countries in terms of infrastructure, 69th in terms of ICT usage, 36th in terms of the number of Internet users, and 71st in terms of innovation potential. The results of the output of products/services in the ICT sector, shown in Figure 2, and the state of imports of ICT products in Figure 3, show that in recent years, the average annual growth rate there was 20-25%. The widespread use of ICT has been reflected in increased productivity and GDP growth of more than 80 billion.

When the share of the ICT sector in GDP is in the range of 5-10%, the country belongs to the category of "efficient economy". According to international organizations, the ICT market accounts for 6.5% of world GDP.

According to some forecasts, its share in world GDP may reach 9% in 2025. According to the latest data, the share of the ICT sector in GDP in the United States was 6.4%, and in Japan - 6.8% [7].

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[6] Annual Report 2018–2019. 130 p. World Economic Forum. http://www3.weforum.org/docs/WEF_Annual_Report_18-19.pdf; www.weforum.org.

[7] Measuring the Information Society Report-2018, volume 2, 244 p. Statistical reports. ITU Publications. https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2018/MISR-2018-Vol-2-E.pdf.

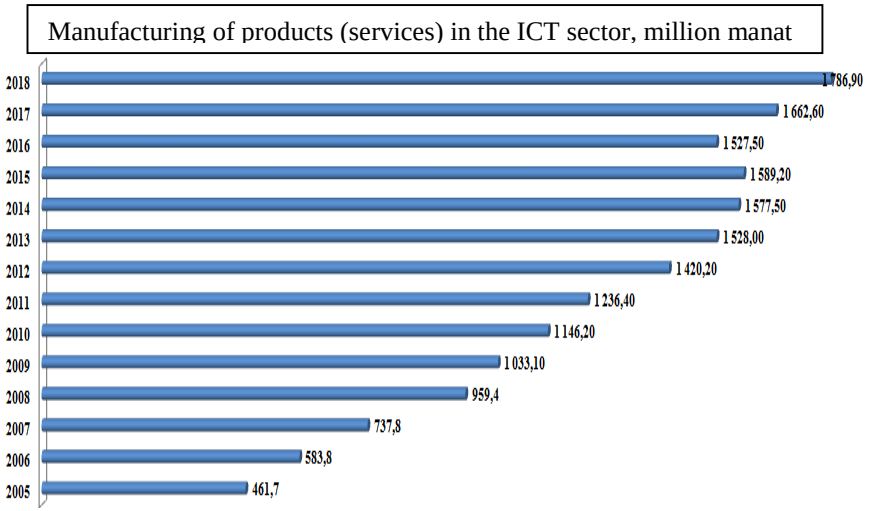

Figure 2. Manufacturing of products (services) in the ICT sector, million manat

One of the tools to stimulate the effectiveness of management and economic development is the operation of economic entities in a single information environment in the field of IE and ICT. The formation of single economic information space of the country, the implementation of recommendations developed for its integration into the world information infrastructure services to increase the normal competitive environment in the field of ICT [47, 48].

The study of IE problems shows that there is a serious need to address the issues of formation and management of innovative structures. It is also necessary to determine the ways of their development by studying the application features of e-commerce technologies and payment systems in IE. In order to ensure the sustainability of IE in the new economic environment, it is necessary to develop directions for its greening, increasing inclusion, solving cyber security problems [29, 49]. Also, appropriate methodologies, technologies, systems of indicators, management mechanisms, methods, and models should be developed and applied to assess the formation of IE sectors and innovative perspectives [37].

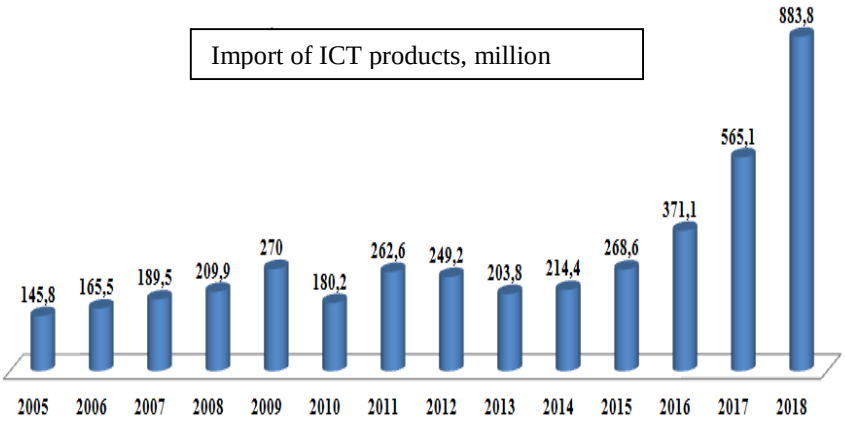

Figure 3. Import of ICT products, million manat

Chapter II is entitled "Problems of development of key sectors and processes of socio-economic activity on the basis of ICT". This section discusses ICT-based development issues in the regions and areas of economic activity [37, 47, 48, 49, 51]. The current state of the Internet economy is analyzed and development prospects are identified [14, 28, 15]. The problems of developing the economy of education, health, socio-cultural spheres on the basis of ICT were studied, and the ways to solve them were shown. The innovation potential of the media economy and e-libraries has been explored and the prospects for commercialization have been identified. Problems of formation of some branches of modern technological innovation economy have been studied and recommendations on their management have been developed [4, 16, 17, 49, 52].

In the new period in the field of ICT, which began in 1993, the necessary infrastructure began to take shape. Beginning in 1998, regulatory laws were adopted in this area. In 2002/03, the National

Strategy for ICT Development[8] was adopted. The formation of ICT as a sector of the economy began to be implemented in many areas, both in the regions and in the field of economic activity. Investments in the development of ICT have increased, ICT projects, international cooperation in the field of ICT has expanded. ICT segments such as e-commerce, e-banking, e-government, e-medicine, e-science, e-education, etc. were developed. The creation of an effective ICT infrastructure in the regions and areas of economic activity have significantly contributed to the development of the national economy, the creation of a favorable business environment, attracting foreign investment to the country, eliminating unemployment [48, 49].

The development of the economy of the social and humanitarian spheres on the basis of ICT is also a priority. Modern education, health, culture, science, management, etc. socio-humanitarian and humanitarian spheres are also considered to be economic spheres. On the one hand, this is due to the fact that they are one of the basic areas of IS, on the other hand, it is related to the opportunities for the economic development of these areas on the basis of ICT. The process of IS development is associated with the intensive emergence of new service and management paradigms. The need for new models and paradigms stems from the realization of IS based on sustainable and secure development. Here, ICT is being developed not only as a scientific direction but also as a technological base of IS.

In the current situation, the criteria for their operation and management for the development and application of intelligent information systems and technologies (IIST) in improving and developing the economic activity of these areas are determined. The influence of ICT and IIST in increasing the effective use of resources

[8] National Strategy on Information and Communication Technologies for the Development of the Republic of Azerbaijan (2003-2012). Baku, february 17, 2003, pp.13

is studied. Based on the application of modern systems such as IIST and typical CRM, ERP, BPM in management processes, it is possible to increase the efficiency of these areas and enterprises and identify development directions. To do this, the following is done:

- Assess the impact of IIST on the efficiency of the enterprise;
- Development and application of methods and techniques for calculating the cost of relevant e-services and other activities in enterprises and on this basis typical information systems such as CRM, ERP, BPM;
- Identification of specific features and directions of development of enterprise management in a single information environment;
- Management of the enterprise in the conditions of "e-government" and development of its innovative activity model;
- Formation and implementation of multi-level innovative organizational and management technologies on the basis of IIST to increase the efficiency of the enterprise;
- Development and implementation of advanced information systems such as ERP, BPM, CRM in enterprises.

Strategic globalization such as the use of modern ICT - global cloud computing systems, IoT technologies, design of intelligent information systems, development of methods for Big Data analitics, the creation of mobile Internet technologies, the formation of virtual reality and cyber-physical systems, 4.0 components of the Industrial Revolution Electronic innovations play an important role in the modernization of society and the diversification of the economy as an innovation potential [49].

There is great potential for technology commercialization in areas such as education, culture, science, health, media, book printing, etc. Appropriate mechanisms and tools are being formed to make structural changes competitive in these areas, the time for mastering and implementing innovations is being shortened, the quality of new products is being improved, and sales markets are being expanded. Existing information systems operate in the context of integration into e-government, international electronic resources.

This chapter also provides an overview of the problems of formation and management of modern technological innovation economy, such as Big Data, space, artificial intelligence, software engineering, cloud, e-media [29, 35, 36, 49, 51].

Chapter III is devoted to "Formation of the ICT-based National Innovation System and management of innovative structures." This section analyzes the socio-economic characteristics of innovations in the new economic environment and the formation of innovation theory. Features of the structure and stages of innovations and innovation processes in the spheres of activity were revealed [16, 17]. The need to create a National ICT-oriented National Innovation System (NIS) was substantiated, its importance and features were explained [2, 25]. Theoretical and methodological aspects of scientific innovation and the commercialization of innovative processes are studied. Models and mechanisms of the commercialization stage of innovative processes have been developed [7, 11, 12]. This chapter also analyzes the main activities of innovative structures [5, 21, 15, 19, 20], their regional distribution, and structural composition. Socio-economic efficiency of innovative structures, their formation, and system of indicators have been developed [17, 44, 9]. An architectural-technological model of effective information provision of management of innovative structures has been developed [19, 31]. A system of multi-level econometric models of product/service manufacturing process has been developed based on the efficient use of limited resources in complex structural innovation enterprises [39].

Socio-economic innovations can be a new or improved product, technological process, as well as advanced organizational-technical, financial-economic, and other solutions in various areas of public relations as a result of relevant activities [16, 17].

The technological base of the economic development model of modern Azerbaijan is ICT-oriented infrastructure, and the main production resource is information, knowledge, technology, and creative people. The solution to all this lies in the creation of such appropriate housing and communal services that allow the use of

global information resources, the adaptation of new knowledge to the needs of the country, their application for national development, and so on. Therefore, the conceptual model of the operation of such housing and communal services has been proposed as the formation of ICT under the influence of the main structures that affect it (Figure 4) based on the priority [2, 25].

The application and use of housing and communal services allow ensuring technological progress and the highest level of competitiveness of the economy in the country.

The application of modern data mining, soft computing, artificial intelligence, mobile technologies in the structure of NIS, dominated by ICT tools, will allow performing important economic functions. ICT-oriented housing and communal services will ensure the country's production structure and its technological base, as well as the improvement of the management system.

The database of conceptual indicators that constitute the information provision of the information model and monitoring system of innovative activity has been identified.

The indicators included in the monitoring system are grouped in several areas. Integrative indicators have been developed based on them.

Generalized macro-level indicators included in the central and sub-databases of the proposed system are included. The model envisages the interaction and coordination of central and sub-bases on important blocks [19, 31].

Directions for solving the problems of commercialization of innovations and innovative processes, consisting of stages such as fundamental, application, analysis of the results of marketing research, and application of innovations to the market, have been developed. The proposed mechanisms and models help to increase the commercialization of innovations, increase their investment attractiveness [7, 11].

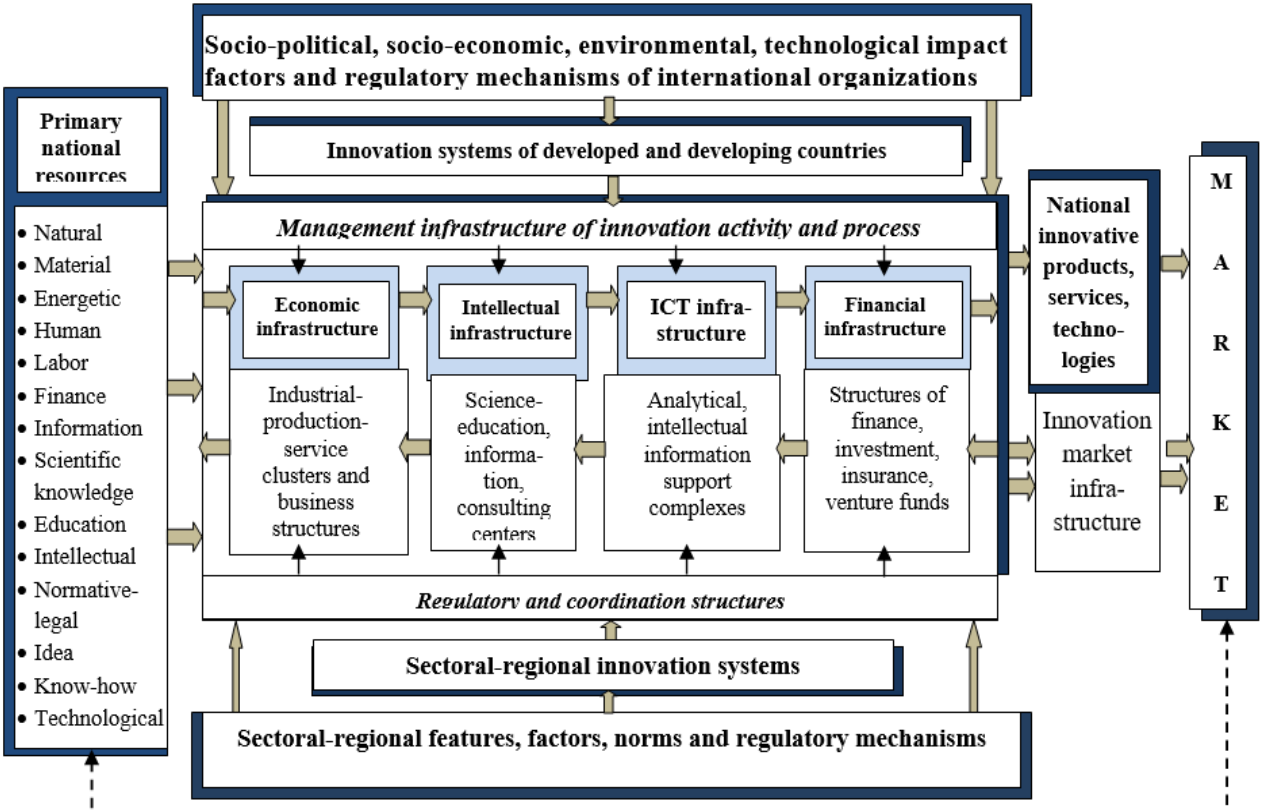

Figure 4. Conceptual model of operation the national innovation system

In order to develop effective information provision of innovative structures, a conceptual model of managing their activities was initially proposed. Based on this model, an architectural-technological model of information interaction of the constituent elements of innovative structures is given. The necessary information resources for various purposes circulating among the innovative structures played a basic role in the development of an effective structural model of its information provision and the formation of a monitoring system [19, 31].

Based on the structural models of the mentioned management and information support systems, the architectural-technological structural model of the network of perspective innovative structures of different profiles of the country was proposed.

On the development of a system of two-level models of the production process in complex structural innovation enterprises, it should be noted that the procedure and algorithm for the creation, organization, and effective management of innovative structures, including technoparks, are iteratively improved. Considering them as a hierarchically structured economic system, the functions of various profile industrial research organizations and companies are dynamically updated.

Innovation structures operate on the basis of multi-level management through the implementation of agreed development plans in the presence of various criteria [15]. Therefore, it can be considered that their activities are carried out by making decisions agreed upon at two levels.

The central governing body of the innovative structure distributes deficits, scarce and limited resources among consumers at minimal cost, using an efficient distribution mechanism. At the same time, using these limited resources, it is necessary to plan the production of various innovative, science-intensive new products so that the prices of additional indicators such as expected profitability, labor productivity, cost, net income meet the preconditions. Under

these conditions, a system of econometric models of the process of production of innovative products/services has been developed, both for the efficient use of limited resources in innovative enterprises [39].

The model of activity of the governing body of the innovation structure (technopark) on minimization of total costs (MTC) (MACROMOD) is expressed as follows:

$$\text{MTC}=\sum_{i=1}^{n} F_i\left(IM_i, r_{i1}, r_{i2},..., r_{im}\right) \to \min \quad (1)$$

$$0 \le P \le \sum_{i=1}^{n} f_i\left(IM_i, r_{i1}, r_{i2},..., r_{im}\right) \le M \quad (2)$$

$$0 \le \sum_{i=1}^{n} r_{ij} \le R_j \quad (3)$$

$$0 \le r_{ij}^{\min} \le r_{ij} \le r_{ij}^{\max} \left(i=\overline{1,n};\ j=\overline{1,m}\right) \quad (4)$$

Here *i* - enterprises, *j* - resources, IM_i - the level of innovation of the economic environment in enterprises, r_{ij} - the appropriate resource capacity. $F_i(...)$ - is the total cost, $f_i(...)$ is the corresponding production function that characterizes the output of the product/service.

Similar to the activity of the governing body of the innovation structure, at the other relatively low level of management - modeling the process of finding an effective plan for the manufacturing of products/services in the enterprise, the optimization criterion was adopted to maximize production in the first enterprise (MICROMOD). Appropriate constraint conditions were set for labor productivity, cost, profitability, scientific and technological innovation capacity, and on this basis, a system of econometric models of the enterprise was established [39]. The relevant parameters included in the models were calculated using package programs. The established model system is formalized as a linear programming problem based on production functions.

Chapter IV is devoted to "Features of application and development problems of e-commerce and payment technologies". This section examines the importance and specific

features of e-commerce and business technologies and systems in the formation of IE. Issues of national, regional, and international regulation of the use of e-commerce systems are analyzed [3, 1, 10]. Existing organizational and economic models of e-commerce systems have been studied, other advanced technologies that can be integrated with them have been studied, and perspective development directions have been developed [8]. Electronic money, payment systems, and technologies have been researched and development trends have been identified. The basics of creating a single payment system have been proposed [6, 23]. Innovative features and development prospects of Internet banking technologies are shown [4].

A one-size-fits-all scientific approach to e-commerce has not yet been established. Although the existing approaches do not create much contradiction in principle, we believe that it is more expedient to differentiate the concepts of e-commerce, e-business, e-economy in terms of scope [1].

Research has shown that important theoretical and methodological issues related to the development of economically sound management, design, and investment issues in virtual business and e-commerce systems have not yet been fully resolved. There are no methods to assess the effectiveness of e-commerce infrastructure, as well as a virtual business. A one-criteria approach is used to solve the problems of existing e-commerce systems. In fact, since most of these issues are multi-purpose, the construction of multi-criteria economic-mathematical models and the application of appropriate mathematical methods for their implementation help to obtain a synergistic effect.

E-commerce processes are regulated by international treaties, conventions, and agreements, as well as other international universal, regional and interregional, sectoral, and functional, as well as non-governmental specialized intergovernmental organizations, along with the G7 superpower semi-formal states [3]. At present, it is not profitable for most countries to obtain digitalized goods and services via the Internet duty-free and completely tax-free. Therefore,

proposals have been made for the development of new effective mechanisms for the protection of intellectual property rights in the context of open cyberspace [10].

In recent years, some measures have been taken to expand foreign trade operations in the Digital Trade Hub as a promising form of e-commerce, increase the business and investment climate and further improve the country's position in international rankings[9]. Effective use of the country's diversified transport and logistics capabilities and achievements in the field of ICT, the export potential has been increased, the scope of cross-border trade, including e-commerce, has been expanded. By adapting the e-commerce infrastructure base to international requirements, the country's leading position as a digital trading hub of regional significance has been further strengthened. A favorable platform has been created for the sale of goods of Azerbaijani origin in domestic and foreign markets and the integration of information about them into international markets[10].

In modern times, a network of electronic money systems operating on a network basis with a public key and electronic signature cryptographic encryption algorithm is being successfully developed. One of the latest is Bitcoin, an innovative payment network with a new type of electronic money. There are also the most commonly used digital money forms such as Etherium, Litecoin, and Dogecoin, etc. like Bitcoin in the market. In the near future, against the background of building a global IS, traditional money will gradually lose its function as a universal means of payment and will be replaced by electronic money. The development of electronic money has already raised the issue of creating a single global currency with the same issuance center.

[9] Decree of the President of the Republic of Azerbaijan on additional measures to strengthen the position of the Republic of Azerbaijan as a Digital Trade Hub and expand foreign trade operations. Baku, february 22, 2017. https://president.az/articles/22892.

[10] https://www.azexport.az

The need to create a single system for settlements is the result of the real activities of leading European countries in a single economic space. Many financial institutions consider it necessary to create a single payment system for settlements in a single currency[11].

In the current context of Azerbaijan's desire to join the World Trade Organization (WTO), the proposals for the widespread use and development of modern e-commerce, electronic payment systems, as well as electronic money systems and technologies to increase the competitiveness of the country's economy show that the normal settlement of trade disputes, domestic market development, reliability Institutional mechanism, and environment should be formed in the field of the payment system, single commercial standards, protection of intellectual property, security of e-commerce, various taxation, customs collection systems, integration of the monetary-financial system into the world financial market, position clarified in national interests should be further clarified [3].

The need to develop Internet banking technologies has made it one of the mechanisms for the formation of IE. Therefore, the synthesis of the latest achievements of ICT and monetary relations has identified areas for improving the security, reliability of Internet banking technologies, the development of a customer-oriented network of individual, science-based, mobile, innovative virtual banking services based on CRM systems [4] .

Chapter V is entitled "Problems and directions of application of green, inclusive and cyber security technologies in ensuring sustainable and resistant socio-economic development." This chapter analyzes the reasons, principles, and tasks of the transition to a green, inclusive and sustainable economy as a new stage of development [27]. International initiatives and practices for building a sustainable economy were considered. The problems of efficient use of natural resources in the formation of a green economy

[11] State Program on Development of the National Payment System in the Republic of Azerbaijan for 2005-2007. Baku, december 9, 2004. http://www.nba.az/download/o_sistemi/dovlet_proqrami.pdf

were analyzed, and their solutions were shown. The application of green, inclusive and cyber security technologies in solving sustainable development problems have been studied [33]. The situation in Azerbaijan in the field of the green and inclusive economy was studied. Problems of the greening of IE were identified, directions of application of ICT on their solution were proposed [38]. Some necessary models for the formation of a green economy and a methodology for assessing the level of development have been studied. Indices of the greening of economic development and measurement of the level of inclusion, proposed with indicators, the method of their assessment are developed [40, 46, 42]. Relevant technologies have been proposed to ensure the cyber security of IE.

In accordance with the development trends of the modern world, the path to the greatest greening and inclusion of the industrial economy goes through ICT, without such information. Therefore, the process of greening the industrial economy must first be considered in the context of the informatization of the economy. In other words, it is necessary to achieve the introduction of innovative technologies for greening the new economy - IE. This, in turn, is the formation and development of green innovative IE [27]. At the same time, as innovative IEs are formed, many problems arise that can be solved through the development and application of appropriate landscaping technologies (Figure 5). Thus, the informatization of society, mass Internet, widespread use of wireless networks, constant use of wireless equipment, rapid electronic, Internet of Things, the application of cloud, fog technologies, increases the level of radioactivity in the environment, can cause serious damage to human health. Therefore, the development and application of appropriate health-promoting anti-radioactive technologies in parallel in the construction of IS is inevitable.

In addition, the current abundance of information places new demands on Big data technology. Thus, the increasing use of computer information networks by people for various purposes creates an increasing abundance of information. As a result, it becomes

increasingly difficult to separate the necessary information from the unnecessary, and over time, the excess of information creates serious problems [27]. Information culture and information retrieval methods should be reworked on the basis of these requirements. Appropriate green technologies must be developed for the efficient and productive use of large amounts of data.

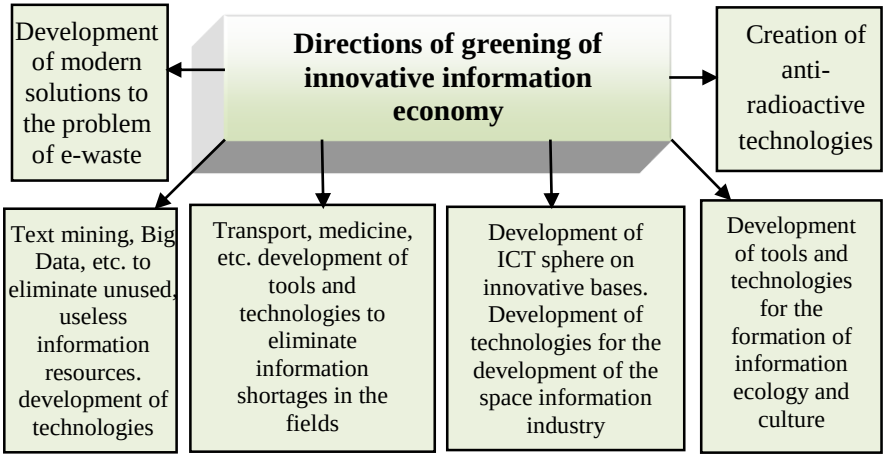

Figure 5. Directions of greening of innovative information economy

One of the main undesirable problems of IS building is electronic waste, which is a logical consequence of mass informatization, and their untimely disposal. There are still very important issues to be addressed in this direction. Certain mechanisms have been developed and suggestions have been made for the timely solution of these problems, which directly contribute to the physical greening of innovative IE [38]. It should be noted that groups of economic, social, and environmental indicators can be proposed as a basis for assessing the level of interaction and development of the elements of the formation of a green innovative economy. The Global Green Economy Index (GGEI) or the Green Economy Benchmark Index (GEBI) or the National Green Economy Index (NGEI) are used for final assessments. Appropriate baseline indicators are used to

calculate them [27]. Despite all this, they do not fully reflect the current situation, regional features, and based on the synthesis and development of these options, we have proposed the Regional Green Economy Index (RGEI) and its sub-indices influencing its formation as follows [29]:

- Level of environmental protection (LEP);
- The specific gravity of green GDP (GGDP);
- The specific gravity of renewable energy (SGRE);
- Environmental Restoration Costs (ERC);
- Level of application of green technologies (LAGT);
- Level of industrial and electronic waste processing (LIEWP);
- ICT Impact Index (ICTI);
- Science-education-technology index (SETI);
- Greening index in social and cultural spheres (GISCS);
- Environmental Use Index of Natural Resources (EUINR).

Thus, it can be noted that:

$$\textit{RGEI= F(LEP, GGDP, SGRE, ERC, LAGT, LIEWP, ICTI, SETI, GISCS, EUINR).} \quad (5)$$

From the analysis, it can be concluded that with the widespread use of ICT, the greening of the IS economy itself should be carried out [27].

The World Economic Forum's (WEF) Inclusive Development Index is based on 12 sub-indicators, with 3 main indicators [12]. However, research has shown that the WFP methodology does not take into account national and regional specifics, as well as many economic indicators. Therefore, a new methodological approach to the assessment of inclusion at the national level has been proposed. Its essence is based on the following indices, sub-indices, conceptual stage, block, and algorithm [46, 42]. At level I, the National Inclusive Development Index (NDI) is proposed as a function of sub-indices that reflect several areas (Figure 6).

[12] The Inclusive Development Index-2018. http://www3.weforum.org/docs/WEF_Forum_IncGrwth_2018.pdf.

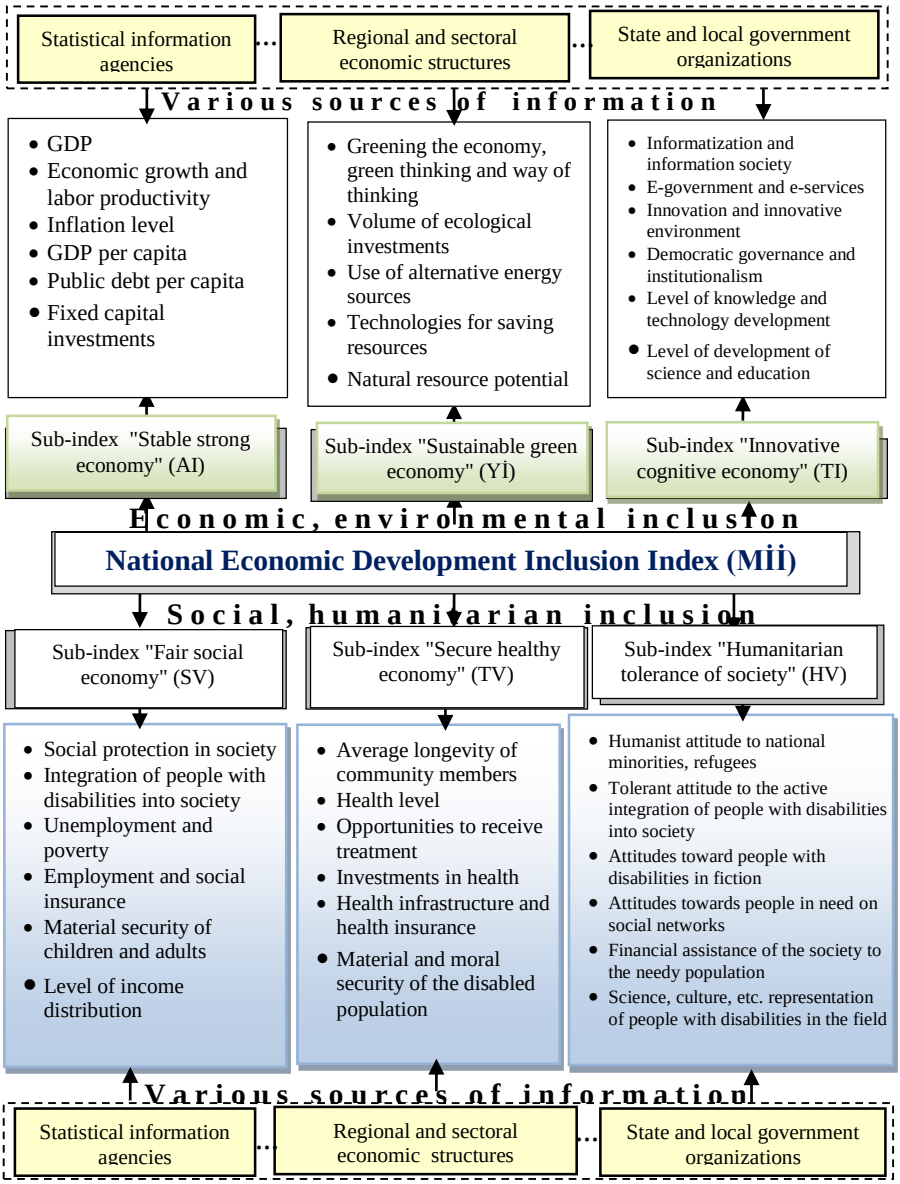

Figure 6. Sub-indices and indicators that shape the level of inclusion of national economic development

In the initial version, it is assumed that the function is linear. In other words,

$$NDI = F(AI, TI, YI, SV, TV, HV) = a_1 \cdot AI + a_2 \cdot TI + a_3 \cdot YI + a_4 \cdot SV + a_5 \cdot TV + a_6 \cdot HV \quad (6)$$

Here, the AI is the "Sustainable Strong Economy" sub-index, which characterizes the most important indicators of the economy.

TI is a sub-index of "Innovative Cognitive Economy", which indicates the level of development of the Informatization and Information Society.

YI is a sub-index of "Sustainable Green Economy" that characterizes the level of the greening of the economy.

SV is a sub-index "Fair social economy" that characterizes the effective application of social protection mechanisms in society.

TV is a sub-index "Secure healthy economy", which reflects the level of health of members of society.

HV is a sub-index "Humanitarian tolerance of society", which indicates the level of humanistic attitude in society.

Each of these sub-indices is formed on the basis of 6 indicators corresponding to them. a1, a2, a3, a4, a5, a6 are the corresponding coefficients (weights) of the variables of the linear function accepted during the initial analysis. During the clarifications, they are taken as weights of the impact of the relevant sub-indices on the overall index (NDI) through expert assessments.

Modern ICT systems have also laid a solid foundation for the economic security of the IE sector. The sustainable level of economic security of the national economy depends on the level of its information security. IE can operate effectively on a platform consisting of the highest ICT infrastructure, means of communication, and cyber-physical systems.

In the digital economy, special hardware and software tools should be developed to prevent the timely security of information resources, systems, products, and services. In addition, it is proposed to apply basic universal technologies that can be used in all economic areas. Thus, it is considered that the information security of the

country's economy can be achieved only on the basis of a systematic approach. There should be a comprehensive use of administrative mechanisms in terms of legislation, as well as effective organizational measures, as well as relevant modern hardware and technologies.

Chapter VI is devoted to "Measurement of the level of formation of the information economy and assessment of innovative perspectives." This chapter provides a comparative analysis of the requirements for the system of indicators for measuring the level of formation of IE and the methodologies of the UN, the World Bank, the European Economic Commission for measurement. The level of formation of IE was studied on complex indicators such as knowledge, education, human development, network training [26, 29, 30]. A method for assessing the impact of ICT in the formation and development of an innovative economy has been developed [32, 34, 36, 41, 24, 31]. The interaction of the constituent elements of the composite index of IE and the process of their evaluation is modeled [50]. Based on the analysis and synthesis of national, regional, sectoral approaches to assessing the level of formation of IE, a method of assessing the innovative perspectives of its sectors were developed, and based on this methodology, assessments were made and recommendations were given [45, 29, 35, 36, 52, 43].

Research to measure the level of development of IE, the economic platform of IS, has been conducted by national statistical offices, regulators, international organizations, research institutes, universities, etc. [29].

The use of *composite indicators* in the measurement system has been proposed [30]. They arise from the combination of individual indicators measured on the basis of multidimensional criteria in a single index. The construction of composite indicators or indices combines a number of stages, depending on the subject of research. In general, many problems related to the methodology of developing composite indices and system of indicators and the source of data

related to them, indicators, as well as the interpretation of the results are still unresolved[13].

The lack of a generally accepted definition of IE also creates problems in assessing its level of development. The indicators analyzed depend on the researcher's approach to IS or IE. It is almost impossible to develop a single-value evaluation criterion. In addition, it is very difficult to estimate the quantity, type, and structure of the components of composite indicators. Thus, each researcher has the opportunity to make individual choices among the indicators, as well as to group them into sub-indices. The creation of composite indices is based on accepted theories, empirical analysis, and the author's research. When their structure is simple, the results are easier to understand and interpret. On the other hand, an increase in the composition of a composite indicator can lead to the use of complex statistical methods.

The Unified Knowledge-Economy Competitiveness Index (UKEC) has been proposed to assess the level of development of the information and knowledge economy (IKE) using four key indices and a fuzzy clustering method[14].

UN OECD experts estimate that investment in knowledge, one of the indicators of the IKE, is a combination of national expenditures on education, R&D and software [15]. The United States is the leader in this indicator (6.6% of GDP). According to the methodology of the European Economic Commission (EEC), the readiness of the IBI in

[13] Golinski M. Analysis of composite indices used in information society research digital information processing and communications // Communications in Computer and Information Science, 2011, volume 188, pp.391-405.

[14] Shami A.A., Lotfi A., Lai E., Coleman S. Unified knowledge economy competitiveness index using fuzzy clustering model/Symposium on Computational Intelligence for Financial Engineering and Economics (CIFEr), IEEE 11-15 april 2011, pp.1-6.

[15] Huseynova A.D. Science and innovation activity: measurement and evaluation, Baku: TUNA, 2020, pp. 374

the country is calculated on the basis of the Global Economic Index (GEI). The World Bank's Knowledge Assessment Methodology defines 2 general knowledge and knowledge economy indices on 109 indicators in 4 groups. The Knowledge Economy Index (KEI), calculated on the basis of a set of indicators characterizing the level of development of science-based economies in different countries and regions, assesses the readiness of countries to move to a knowledge-based development model and determines countries on a 0-10 scale. The ranking of some countries on the development of the knowledge economy is given in Table 1.

Table 1. Rating of some countries on the development of the knowledge economy

Rating	Countries	Knowledge Economy Index	Knowledge Index
1	Sweden	9.43	9.38
2	Finland	9.33	9.22
3	Norway	9.11	8.99
5	Germany	8.90	8.83
7	USA	8.77	8.89
8	UK	8.76	8.61
9	Japan	8.28	8.53
10	France	8.21	8.36
11	Israel	8.14	8.07
12	Russia	5.78	6.96
14	Georgia	5.19	4.49
17	Turkey	5.16	4.81
22	Armenia	5.08	4.84
24	Kazakhstan	5.04	5.40
25	Azerbaijan	4.56	4.96
30	China	4.37	4.57
55	Iran	3.91	4.97
68	India	3.06	2.89

The analysis shows that these indices and indicators do not fully and accurately reflect the situation of the IKE. Each of them has certain shortcomings. There is a reluctance to conduct comparative analyzes to assess the level of IKE. The base groups to be selected for

comparison do not fully meet regional specifics. Therefore, during the economic analysis of the state of formation of the IKE, its sub-areas and stages of development, a group of selected countries, and intra-country regions were proposed [45, 29]. The group of countries selected for comparative analysis and evaluation includes 30 countries, including developed countries (G7, G10, G20), post-Soviet, regional, developing, and similar countries. At the same time, the economic-administrative division known as regional levels within the country was adopted. In order to conduct economic analysis in a more compact field, the sub-sectors of traditional economic sectors and emerging economic sectors, as well as the formed digital sub-sectors of the information and knowledge economy were taken into account [45, 29].

Based on the analysis of the indices of various international organizations, the relevant ratings for the formation of IKE in Azerbaijan are presented in Table 2. Research shows that different international organizations use different methods to perform calculations in accordance with their goals and approaches. However, as can be seen from Table 2, our country has a middle position among the groups of countries that are roughly analyzed in various aspects, assessed on the basis of different indices. This once again confirms that there are many untapped potential opportunities in the country.

The share of the ICT sector in GDP can be considered in many ways: 1) the share of each sector in GDP; 2) growth rate of GDP growth in each sector; 3) the share of each sector in GDP growth; 4) interest rate increase in GDP growth of each sector.

Based on the analysis of the share of the ICT sector in GDP, the impact of ICT on the economy at the level of production was studied. To this end, the standard Cobb-Douglas function includes ICT as a new factor of production, along with labor and capital, which are traditional factors of production. In other words, in the information society, such functions as parameters such as ICT and ICT elasticity coefficient have been added.

Using this function, the impact of the ICT sector on new innovative IEs was assessed, and the relationship between ICT and its traditional factors of production, labor, and capital, was analyzed [32].

Table 2. Rating of Azerbaijan on various indices on the formation of the information and knowledge economy

İndexes	**Years**	**Number of countries**	**İndex price**	**Rating**
Global Knowledge Index	2019	136	45.80	66
Knowledge Economy Index	2018	146	4.56	20 *(Eastern Europe / Caucasus)*
Networked Readiness Index	2016	139	4	53
Global ICT Development Index– ITU	2017	176	6.20	65
Global Competitiveness Index	2019	141	62.7	58
Human Development Index	2015	188	67.58	63
Global Innovation Index	2020	130	30.21	82
Global Entrepreneurship Index	2019	137	30.5	62
Doing Business	2019	190	78.64	25
UND Programme: Education Index	2019	189	0.694	87

Calculations show that the coefficient of elasticity of the ICT factor is 0.391. This shows that a 1% growth in the ICT sector leads to

a 0.391% increase in GDP. This guarantees sustainable economic development. The fact that the elasticity of the labor force for the processing industry is 0.243 and the coefficient of elasticity of the ICT is 0.070 indicates that the widespread use of ICT will lead to a decrease in the demand for labor in the manufacturing industry.

It should be noted that given the fact that the main indicators in IE can be indefinite, approximate numbers, it is proposed to use fuzzy regression analysis to study economic processes through the production function in a fuzzy format.

The structure of the Composite Index System (CIS) has been proposed in a multi-level form to model *the process of estimating the Composite Index* of IE. The general level integratively reflects all the lower levels that follow it, and the parameter that characterizes it is called the composite index of IKE (**IBK**). The composite index is formed as a result of the assessment and has a leading position in the comparative analysis. Thus, as a result of this assessment, IKE receives an appropriate rating. Each subindex is evaluated on a scale (0.10). Weight ratios are initially assumed to be 1. The composite index is taken as the sum of the sub-indices and varies between (0.100). At the same time, in accordance with the scientific and methodological bases developed for the comparative assessment of the IKE composite index (IBK), its calculation can be functionally stated as follows:

$$\mathbf{IBK = F(ISF, SED, NIS, INF, ECO, SPE, SEC, IPP, LMP, STC)} \quad (7)$$

Here **F (...)** represents the form of dependence of the composite index on other indices. The relationship between the main indices and indicators that make up the composite index has been identified. The system of indices, sub-indices, and indicators for the comparative assessment of IKE is divided into different hierarchical levels. The stages of their gradual formation have been identified.

Averages, expert assessments, weights, and appropriate econometric-statistical methods were used in the assessment of indices and sub-indices. The 1st national level consists of the composite

integrative index of IKE, the 2nd level consists of 10 indices, the 3rd level consists of 83 sub-indices and indicators, and the 4th level consists of 320 macro/micro indicators. Level 1, level 2, and level 3 indices and sub-indices are determined on the basis of both the expert assessment and the parameters that make up the next level. Level 4 indicators include both official statistics and other external and internal indicators. Level 4 indicators are more likely to be used by experts to determine level 3 and level 2 sub-indices. In this case, absolute indicators and their specific values are used. Here, the approach is different and is implemented individually, depending on each specific situation.

The system of indicators for the comparative assessment of IKEs meets the objectives set in the process of evaluating the activities of IKE at both regional and international levels [50]. The following methodological approach is proposed to calculate the GDP generated by information and knowledge in any country.

1. Production and service areas corresponding to the official statistical reports of the country - i = 1, 2, ..., n; GDP - GDP of the i-th field;
2. GDP - GDP formed due to industrial production in the i-th field; $GDPS_i = S_i \cdot GDP$
3. GDP - GDP formed due to the production of services in the i-th field; $GDPX_i = X_i \cdot GDP$
4. GDP formed at the expense of information in the i-th field; $GDPİ_i = İ_i \cdot GDP_i$
5. GDP formed due to knowledge in the i-th field;
   GDPBi = Bi · GDPi
   GDP = Bi · GDP
6. GDP - GDP formed due to technology in the i-th field;
   $GDPT_i = T_i \cdot GDP_i$

Here

$$0 \le \{I_i, S_i, I_i, K_i, T_i\} \le 1 \quad (8)$$

$$0 \le (I_i + S_i + I_i + K_i + T_i) \le 1 \quad (9)$$

During the expert assessment of I_i, S_i, I_i, K_i, T_i as weight coefficients, their impact on GDP can be achieved in two ways: 1) indirectly by influencing management, organization, decisions; 2) as an object of purchase/sale of information, knowledge, technology or as a final product, technology, service, innovation.

Thus, the GDP formed at the expense of industry, services, information, knowledge, technology in the country (DIGDP, DSGDP, DIGDP, DKGDP, DTGDP) will be calculated as follows:

1) final GDP (GDP) for the country (state) $FGDP = \sum_{i=1}^{n} GDP_i$ (10)

2) at the expense of industrial production in the country
$$DIGDP = \sum_{i=1}^{n} GDPI_i \quad (11)$$

3) at the expense of service production in the country (12)
$$DSGDP = \sum_{i} GDPS_i$$

4) due to the production of information on the country
$$DIGDP = \sum_{i=1}^{n} GDPI_i \quad (13)$$

5) at the expense of knowledge production in the country
$$DKGDP = \sum_{i} GDPK_i \quad (14)$$

6) due to the production of technology across the country
$$DTGDP = \sum_{i} GDPT_i \quad (15)$$

The indices that make up the IKE Composite Index (IBK) and the composition of the sub-indices and indicators that affect the formation of these sectoral indices are proposed as shown in Figure 7. The weight ratios of the indices forming the composite index were determined as a result of processing expert assessments.

In the process of assessing the innovative perspectives of the information economy sectors, during the systematic analysis of the state of IKE formation at the international and national levels, it was

proposed to accept the functional stages of economic development as 1) agrarian, 2) industry, 3) information, 4) knowledge, 5) intellectual.

In addition, the economic analysis also took into account the selected group of countries, domestic regions, science-based sub-sectors of traditional economic sectors, and the new digital sub-sectors of the IKE.

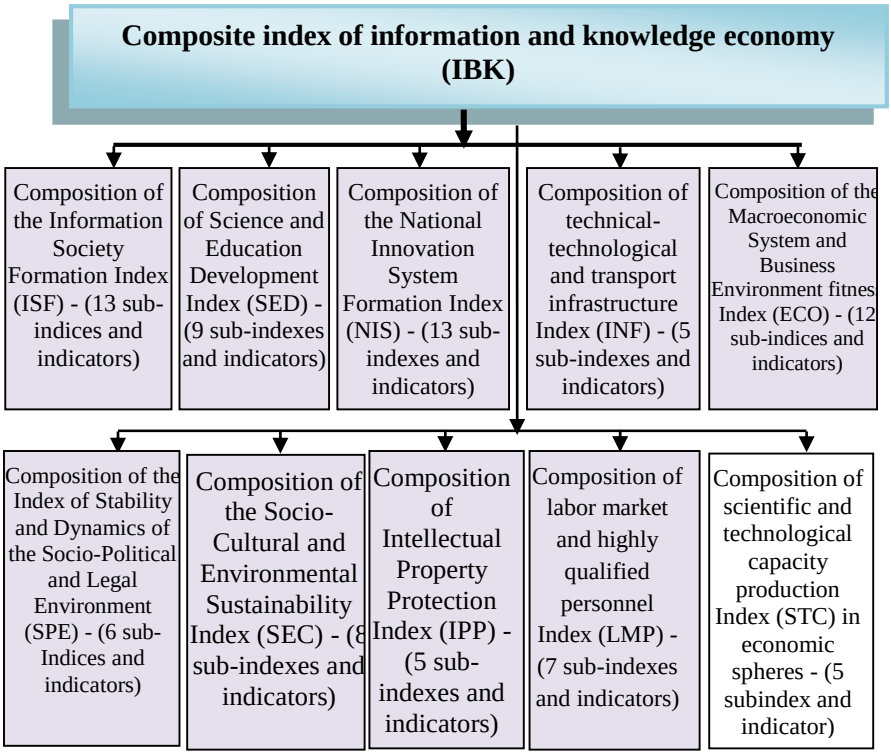

Figure 7. Indices forming the composite index

As the IE sector is not provided with the necessary information resources as a new direction, a methodology for evaluating its innovative perspectives based on the **modified and improved Delphi method** has been developed. Based on it, the algorithmic stages of expert assessments are as follows.

I step. Selection of experts. Each expert is evaluated on a scale (0, 10).

Step II. Determination of expert weights. A group of experts can act on two scenarios. 1) Experts have equal weight. 2) Experts evaluate each other on a scale (0, 10).

Step III. Indicators for assessing the prospects of sub-sectors are also determined by experts. As a result, the following indicators are proposed to assess the innovative prospects of the sub-sectors of IE:

1) the level of innovation of the sub-sector
2) the level of potential development of the sub-sector
3) the level of ability to create new jobs in the sub-sector
4) level of social utility of the sub-sector
5) the level of influence of the sub-sector on the development of other areas
6) the current level of infrastructure provision of the sub-sector
7) the level of necessary staffing of the sub-sector
8) level of export orientation of the sub-sector
9) the level of greenness and inclusion of the lower area
10) the level of competitiveness of the sub-sector

Step IV. Methodology for assessing the prospects of sub-sectors.

1. i - index of direction $i = \overline{i,n}$, j - index of indicator $j = \overline{i,m}$, k - index of expert
   (k = 1, ..., M)
2. PI_1, PI_2,..., PI_n, – *i*-th perspective direction (sub-field) $i = \overline{i,n}$
3. PI_{ij}, – j-indicator (subindex) (), which characterizes the i-th perspective (sub-field), ($j = \overline{i,m}$), $i = \overline{i,n}$
4. PI_{ijk},, - the price set by the k-th expert to PI_{ij}.
5. Since the level of experts is assumed to be equal, ie the weights are considered equal to 1, the average expert scores on the indicators will be as follows:

$$\overline{R_{ij}} = \frac{\sum_{k} PI_{ijk}}{M} \quad i = \overline{i,n} \ , \ j = \overline{i,m} \ . \qquad (16)$$

Then the average price for the directions can be calculated as follows:

$$\overline{R_i} = \frac{\sum_{j} \overline{R_{ij}}}{M}, \quad (i = 1, n) \qquad (17)$$

here, the indicators for the sub-directions are equally important.

Estimates of the values obtained in $\overline{R_i}$ ascending (descending) order $\max \overline{R_i} \geq ... \geq \min \overline{R_{ij}}$ as in the form will show that the sub-areas are sequentially arranged according to their importance. Here it is considered that PI_{ijk} is an expert value on the scale [0, 10]. That's why $\overline{R_i} \in [0,100]$

Step V. As a result of the processing of **expert prices**, it can be calculated as the average price of the i-th sub-field indicator on the final indicator $\frac{\sum_{j} P_{ij} a_i}{\sum_{j} a_j}$.

Step VI. In order to make the expert assessments more accurate, 1) participation of enterprises as experts in economics, ICT, innovations, management, 2) expert competence and professionalism of persons nominated for expertise from relevant enterprises, 3) level of conformity of experts, weight ratio, 4) indicator The level of use in the assessment of perspective sub-sectors of IE, 5) the weighted ratio of the criteria for assessing sub-sectors of IE, 6) the level of feasibility of development of sub-sectors of IE, 7) criteria for the prospects of IE sub-sectors, etc. it is advisable to include other similar indicators and works in the evaluation process by survey.

Step VII. Identify and evaluate sub-areas. The most promising of the sub-areas of İE many possible options are identified by experts. Clustering is carried out on the basis of expert assessments

on the relevant indicators of 100 sub-areas included in the analysis and evaluation process. It was considered expedient to transfer the results to a relatively small number of aggregation groups and present them in the form of the following 15 sub-areas and their corresponding perspective assessments (Figure 8).

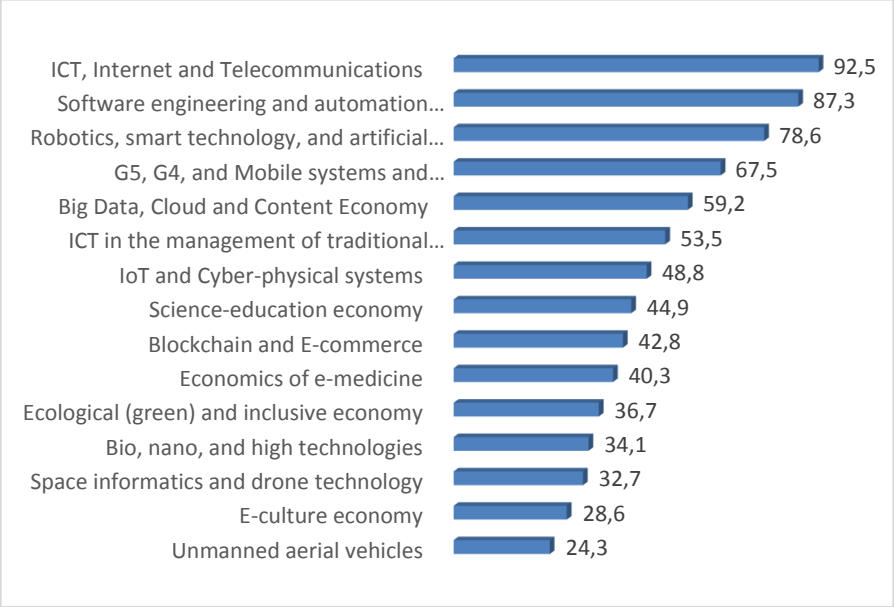

Figure 8. Results of the assessment of innovative perspectives of the information economy sectors

Thus, as a result of the development of expert assessments, both the innovative perspectives of the newest sub-sectors of IE were adopted, and at some regional/sectoral levels of the country 1) IE, 2) ICT potential, 3) innovative product/service production, innovative environment, 4) formation and development of e-commerce and trade, 5) sustainability, greenery, and inclusion of economic development, 6) development of technological innovation economy, 7) innovative perspectives of IE, etc. The evaluation process was defined by appropriate scores and ratings (Tables 3, 4). All this shows that the

country's economy has the appropriate potential for intellectual development and creates a solid foundation for development [52].

During the intellectual formation of the Azerbaijani economy, enterprises will become unique research centers that produce new knowledge and intellectually develop themselves and their employees.

Basic constitutional principles of the intellectual economy (sustainable, resistant development, innovation, inclusive growth), goals (green growth of economic growth, resource-saving, intellectualization of production process, efficient distribution and consumption, reduction of socio-economic risks), development tools (adoption of different levels of programs, relevant coordination bodies, sustainable investment mechanism, information and high technologies, environmental, social, innovative management, intensive use of renewable energy, quality of education and research) will be formed in accordance with the new conditions. In such circumstances, the main function of society and the state should be to ensure that the intellectual level of society is higher than the level of each of its members. This process is becoming the mission of the intellectual elite of society.

It is necessary to formulate the basic principles and priorities of the new economy in the areas of intellectualization, institutionalization, environmentalization, socialization on the basis of the basic pillars of the intellectual economy, such as 1) education system, 2) ICT infrastructure, 3) innovation system, 4) institutional environment.

As a result of the analysis, the main basic features and principles of the formation and development of the intellectual economy are proposed as follows:

- Transformation of knowledge and intellectual technologies into the main driving force;
- Adoption of social welfare and sustainable development as the main principle of growth;
- The key role of ICT and high-tech systems for future transformation;

Table 3. Regional ratings based on the results of expert assessments of the development potential of IE and ICT

Row №, rating	Name of the economic region	Formation and level of development of IE		Level of application and development of ICT		Level of formation and development of innovative product/service production and innovative environment		Formation and level of development of e-commerce and commerce		Formation and level of development of sustainable, green and inclusive economy		Level of development of technological innovation economy		Innovative perspectives of information economy	
		Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating
1	Baku	46	1	45	1	37	1	28	1	55	1	45	1	48	1
2	Absheron	38	2	41	2	31	3	25	2	46	3	39	2	44	2
3	Ganja-Gazakh	34	3	37	4	29	4	22	3	42	4	29	4	41	3
4	Nakhchivan	33	4	39	3	33	2	16	8	54	2	36	3	35	5
5	Mountainous Shirvan	32	5	28	7	14	9	16	9	17	8	13	10	20	11
6	Lankaran	27	6	31	5	20	6	21	4	28	5	26	6	36	4
7	Sheki-Zagatala	26	7	26	9	18	8	19	6	27	6	25	7	34	6
8	Guba-Khachmaz	25	8	29	6	21	5	20	5	19	7	27	5	33	7
9	Aran	22	9	27	8	19	7	18	7	16	9	19	8	21	10
10	Upper Karabakh	15	10	12	10	13	10	10	8	12	10	17	9	23	8
11	Kalbajar-Lachin	4	11	3	11	2	11	3	11	2	11	12	11	22	9

Table 4. Ratings of production/service areas based on the results of expert assessments of the development potential of IE and ICT

Row №, rating	Name of production/service areas	Formation and level of development of IE		Level of application and development of ICT		Level of formation and development of innovative product/service production and innovative environment		Formation and level of development of e-commerce and commerce		Formation and level of development of sustainable, green and inclusive economy		Level of development of technological innovation economy		Innovative perspectives of information economy	
		Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating	Point (0-100)	Rating
1	Public administration	56	1	51	1	24	4	25	2	37	2	42	2	45	2
2	Transport and communication	52	2	45	2	19	6	16	6	26	6	24	7	26	6
3	Health	45	3	31	6	35	2	24	3	35	3	36	4	35	3
4	Oil and gas	42	4	35	4	27	3	19	5	31	5	38	3	31	5
5	Industry	39	5	41	3	36	2	26	1	51	1	46	1	48	1
6	Education	38	6	33	5	22	5	22	4	32	4	34	5	33	4
7	Trade, catering	34	7	21	8	17	7	14	8	22	8	22	8	22	8
8	Culture	26	8	24	7	16	8	16	7	25	7	25	6	23	7
9	Tourism, ecology	18	9	18	10	12	11	12	10	19	9	16	10	21	10
10	Agriculture	15	10	12	11	14	9	10	11	12	11	13	11	19	11
11	Construction	13	11	18	9	13	10	13	9	18	10	18	9	21	9

- Formation of supernational enterprises as developed organizational structures;
- Formation of processing and recycling as the main methods of production;
- Global and rapid nature of production, exchange, and consumption;
- Transformation of scientists and highly qualified specialists into the main labor resources.

Currently, many advanced countries are implementing "Society 5.0" programs to build a super-smart society based on technological innovations aimed at solving serious socio-economic problems[16] . This program is constantly creating new values, services based on the technological innovations of the 4.0 Industrial revolution, the Internet of Things, Big Data, Artificial Intelligence, Robots, Shared Economy, Mass Digitalization, making life more comfortable, more reliable, and sustainable.

This chapter also makes relevant assessments of the results of econometric modeling of the level of IE formation on some composite indicators and recommends general strategic development prospects based on them [45, 29, 30].

We would like to note that the issues considered in chapters 1-6, as well as the directions of its intellectualization through informatization and mass digitalization of the economy proposed, as a result, *were adopted by the country's leadership on February 2, 2021, it fully complies with the National Priorities*[17] *and the requirements of the Decree "On Improving Governance in the Field of Digital Transformation" signed on April 27, 2021,*[18] and has the character of scientific support for their implementation.

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The final section of the dissertation reflects the main scientific-methodological, methodological results and recommendations obtained in the process of solving scientific-theoretical problems in the work:

1. The scientific-theoretical, methodological, practical bases of IE have been researched and developed, its modern formation and management problems have been identified [22, 34, 36, 37, 43]. The analysis of the formation and stages of development of IE found that the productivity of key factors in the new economy depends primarily on their ability to generate, process, and use information and knowledge efficiently. It was noted that the IE of the modern era based on ICT is characterized by the rapid impact of new technologies in various fields, the process of automated knowledge creation, and the development of human capital that can manage new technologies.
2. As a result of comparative analysis of the experience of advanced foreign countries, the features, principles, characteristics, development trends of the formation of IE, as well as strategic development directions and goals were identified [24, 26]. It was noted that some different categories and specific features of the information and industrial economy create a new structure of employment in economic development, stimulate the development of new forms of labor, create and distribute new types of products and services.
3. A conceptual model of formation and perspective development stages of industrial, post-industrial, information, knowledge-based economic systems depending on production resources, means, high technologies and human capital has been developed [35, 52]. The structural analysis of this model allows identifying many problems that arise in the development stages of IE. It is possible to conclude that IE is both a scientific theory and a modern practical stage in the development of civilization. This

stage is characterized by the predominant role of creative labor, information, knowledge, and technology, intangible benefits.

4. As a result of the analytical-structural study of technical and technological features, infrastructure, and current competitiveness of the ICT sphere, which is the basic field of IE, the problems of formation of the field and potential directions of development were identified [47, 48]. These, in turn, led to the strengthening of information structures, the creation of relevant information resources and databases, the wider application of science in the field of ICT, the further development of Internet infrastructure and services, taking into account the application of elements of the 4.0 Industrial revolution.
5. On the basis of ICT, the current situation of economic activity, technological innovation sectors in the sectoral-regional aspect were analyzed and directions for solving the problems of their development were developed [14, 28, 51]. Accurate assessment of the current state and level of development of the infrastructure and institutional formation of the ICT sector in the country has provided scientific support for effective decision-making in the field of information policy. The analysis confirmed that the comprehensive development of ICT has a very positive impact on economic growth, the creation of a competitive business environment, and the expansion of the production of export-oriented innovative products/services. It was found that it is possible to increase the efficiency of these sectors and enterprises on the basis of the application of modern systems such as IIST and typical CRM, ERP, BPM in the management processes of many economic sectors.
6. Mutual functions, development trends of infrastructure, and institutional elements of ICT-oriented NIS housing and communal services in the conditions of formation of IE were defined and the conceptual model of housing and communal services was proposed [2, 13]. The conceptual model has led to the establishment of effective links between economic,

intellectual, ICT, and financial infrastructures. ICT-oriented NIS housing and communal services have created conditions for the improvement of the country's production structure and its technological base, management system, the development of the human factor of production. The formation of an effective model of NIS housing and communal services will have a stimulating effect on the definition of the country's innovation strategy and the timely development of some resources and factors.

7. Models and mechanisms of the stage of transformation and commercialization of innovative processes in economic processes and structures have been developed [7, 11, 12, 15, 19, 20]. It turned out that the main driving force of the management mechanism for the commercialization of innovation production is a competitive innovation infrastructure. The quality level of its development determines the sustainability of the innovation process, forms the priority of innovations, contributes to the commercialization of innovative production and the achievement of socio-economic benefits as a whole.
8. Performance models and mechanisms for effective management of innovative structures in the new economic environment have been developed [5, 9, 18, 25, 31, 44]. It became clear that the efficiency of innovative structures is an integral indicator and reflects the final performance of the system. The main criterion of the socio-economic efficiency of the system is the degree of meeting the needs of society. This allows innovative structures to operate on the basis of multi-level management through the implementation of agreed development plans in the presence of various criteria. Therefore, it can be considered that the activity of innovative structures is carried out by making agreed decisions before each stage and level.
9. The state of modern e-commerce technologies and innovative payment systems was studied in IE, their development trends and directions of improvement were identified [1, 3, 4, 6, 8, 10, 23]. It was noted that the combination of e-commerce, business

functions with the stages of the commercial cycle leads to increased efficiency. Therefore, in the current situation, it is important to ensure the development of internationally agreed trade and political norms and rules and to address the problems facing e-commerce in order to determine the country's position in the context of accession to the WTO in the national interests. Appropriate measures should be taken to achieve permanent WTO membership. Both these and the rapid development of ICT require the emergence of new organizational and technological models in the e-commerce system.

10. Indices, indicators, methods, and methodology for assessing the level of development of IE on the basis of green, inclusive, cyber security technologies have been developed in terms of ensuring sustainable and resistant development [27, 33, 38, 40, 42, 46]. At the same time, the direction of economic modernization is focused on such advanced innovative, inclusive technologies that ensure development in order to improve the fertility and accessibility of the natural environment. Building a secure, green, inclusive economy that interacts with the environment and ensures sustainable development is a key way to both protect the environment and ensure long-term sustainable development based on available natural resources and knowledge.
11. A system of multi-level composite indices and indicators for the analysis and measurement of the current state of IE has been proposed [16, 29]. The construction of composite indices, measured on the basis of multidimensional criteria, resulting from the combination of individual indicators in a single index, involves a number of stages. Because it is impossible to develop one-value evaluation criteria and their creation is based on accepted theories, empirical analysis, and author's research, each researcher has the opportunity to make individual choices, as well as to group them into sub-indices. Although the increase in the composition of the composite index has led to the use of complex

statistical methods, their use is important in decision-making processes.

12. A model for assessing the formation and level of development of IE has been developed [17, 21]. A comparative analysis of the existing methods of measuring IE has shown that they have different purposes and do not accurately reflect national-regional characteristics. A separate study of the indices that characterize IE reveals differences in the information that determines their composition and content. Therefore, through the proposed model, it is possible to assess the readiness of the country's transition to a model of development based on information and knowledge at different levels.
13. Multi-level, multi-factor econometric models of the impact of ICT in the development of innovative economy and the processes of production of ICT products/services have been established [32, 35,39, 41]. This is explained by the fact that more research functions have been used in scientific research to assess the impact of ICT on economic development. The results confirmed that economic growth in the context of IE is more related to technological change, the application of knowledge, and innovations than to the traditional factors of production, labor, and capital. Using the improved form of the production function, it was possible to assess the impact of the ICT sector on the new innovative information economy, to analyze the relationship between ICT and its traditional factors of production.
14. The interaction of the components of the composite index of IE and the process of their evaluation are modeled and algorithmized [30, 50]. The number of sub-indices and indicators influencing the formation of sectoral indices has been determined. The Composite Index, which is proposed in a multi-level structure, is a combination of individual sub-indices measured on the basis of multidimensional criteria in a single index. It provides a basis for assessing the weight ratios of sub-indices, the effectiveness of IE, and the extent of its role in society.

15. Innovative sectors of IE were identified by the improved expert method and their development prospects were assessed on the basis of the proposed system of indicators [29, 45]. Functionally, the stages of economic development are perceived as agrarian, industrial, information, knowledge, intellectual. In order to conduct economic analysis in a coordinated manner, the digital sub-sectors of IE have been taken into account more broadly. Other additional indicators were included in the survey process to make the expert assessments more accurate. These have led to an increase in the level of scientific, theoretical, and practical use of the results obtained.
16. Based on the results of the experimental implementation of the proposed methods and models, relevant recommendations for the formation and perspective development of IE were developed [43, 48, 49]. As a result of the analysis of the obtained results and expert assessments, the innovative perspectives of the newest sub-sectors of IE create a serious basis for the development of the country's economy on an intellectual basis. This leads to the development of programs to build a super-intelligent society based on technological innovations and aimed at solving serious socio-economic problems.

The main results of the dissertation are reflected in the following scientific works.

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The personal role of the candidate in published works with co-authors

In the publications [2, 6, 13, 16, 19, 20, 23, 26, 27, 30, 46] the candidate participated in the statement of the issue, conducted the analysis as the main executor on the issue under consideration, and obtained the results.

In [5, 8, 9, 12, 15, 17, 18, 24, 25, 28, 31, 35, 51] publications, the candidate analyzed the issue under consideration, developed models, proposed indicators, obtained results, and commented on the results.

In the publications on information economy sectors and ICT, the candidate conducted a comparative analysis of economic systems, developed organizational and economic models of innovative structures and processes, and studied the problems of creating an innovative environment.

He proposed a methodology and algorithm for indicators for a comprehensive assessment of the effectiveness of the sectors of the information economy and the ICT sphere. He developed the basics of modeling innovative production and management processes, management mechanisms, and management systems of the socio-economic sphere. Conducted a generalized analysis of international experience in relevant fields, proposed composite indicators for the activities of the information, inclusive, green, sustainable economy. Evaluated the innovative prospects of the information economy and made relevant recommendations.

The candidate's personal contribution to the dissertation consisted of indicating the purpose and objectives of the research, substantiating its relevance, choosing research directions and methods, determining the structure, and resolving the issues under consideration.

The proposed structure of the dissertation, the results obtained in the work, the analysis, the proposed indices, indicators, criteria, models, methods, mechanisms, recommendations belong to the candidate. Schemes, pictures, tables are made by the candidate.

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