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Intellectual Challenges to Economic Globalism

Under Ed. R. Djakons and D. Lukianenko

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Intellectual Challenges to Economic Globalism.
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The monograph presents the results of many years of work of scientists from leading universities of Ukraine and Latvia. The research of the processes of intellectualization was carried out on the basis of fundamental provisions of economic science in the context of the latest trends in scientific, technological, economic and social progress. The phenomenon of intellectual capital, current issues of globalization of intellectual activity and its peculiarities in Europe and East Asia are covered. Particular attention is given to shaping the digital landscape of the knowledge economy.

The monograph is offered for scholars, teachers, graduate students and students, as well as for anyone interested in the problems of becoming an intellectual economy of the 21st century.

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FOREWORD

In today's global paradigm of development, there is a shift towards new resources of progress and prosperity.

Today, the problem of the ability to develop in the paradigm of the knowledge economy is facing virtually every country in the world, including economic leaders. In the United States, where unique conditions for the functioning of complete reproductive scientific and technological cycles in virtually all sectors and fields of activity have been created in the twentieth century, the problem of providing innovative leadership and global competitiveness is constantly being updated at the national level. EU experts also argue that ensuring the steady dynamics and competitiveness of the European economy is only possible if, in the coming years, the development, transfer and use of knowledge through research, education, vocational training and innovation is a key priority for its development. The newly innovative orientation of development models, at one time, ensured the competitiveness of Japan, South Korea, Singapore, Taiwan, Hong Kong. Ambitious are also the modern strategies of Singapore (Intellectual Island), South Korea (E-Korea), China (Capturing the 21st Century with Knowledge) that purposefully transform their economies from productive to intellectually creative, largely set the pace of modern economic development and become innovative modulators of the global economy. India,

Brazil, Russia, the Czech Republic, Hungary, the Baltic States and Ukraine declare their potential to be part of the innovation values of the knowledge economy in their development strategies and programs.

The monograph explores the conceptual issues of shaping the trend of global intellectualization. The concepts and categories of intelligence, intellectual work, intellectual activity, intellectual product, intellectual property, intellectual resource and intellectual potential are generalized and identified. Methodological identification of intellectual capital in the post-industrial knowledge economy is carried out, with the definition of its structural composition at the micro, macro and global levels.

It should be noted that already at the stage of categorical identification there were rather complex methodological problems, on the one hand, regarding common features and differences between human and intellectual capital, their structuring and measurement, and on the other, in the concept of interconnection of human, intellectual, social and network capitals. In the age of open science and innovation, the problem of intellectual property is also very relevant.

Generally speaking, it is about understanding the decisive role of intellectual capital in the universal tendencies of global development - informatization, economic liberalization and democratization, individualization and humanization. It is in this environment that the

preconditions and factors of intellectual competitive leadership are formed.

In the context of business intellectualization, the problem of effective knowledge management in international companies has been actualized and researched. Universities are positioned in the structure of intellectual economy and their competitiveness is shown to be based on close interaction with the state and business. Particular attention is paid to features of intellectualization of economic development of the countries of East Asia. The prerequisites, factors and priorities of the formation of the intellectual ecosystem of the global economy are revealed.

The process of intellectualization of the European Economic Area in the context of localization of global entrepreneurship has been thoroughly investigated. Innovative trends of European regions, prerequisites and state of media clustering of EU regional systems have been identified and illustrated.

It has been shown that information globalization, which dominates practically all world markets, forms the defining imperatives of human development. The global data collection and processing industry is outlined and the prospects for its development are outlined.

The concept of the irreversibility of digital transformation, based on the generalization of modern theoretical developments, highlights its scientific and practical problems. Preconditions, factors and peculiarities of

digital economy development are revealed. The forecasts of further digitization of industries, types and spheres of activity, the likely trend of development of the digital economy towards the onset of virtual reality in the process of creation and dynamic scaling of smart enterprises, cities and communities are presented. It is substantiated that universities play a key role in the formation of intellectual capital, interacting with the state and business in the system of open sciences, education, and innovation. The model of development of digital university with digitalization of management system, educational and scientific activity, development of human capital, infrastructure and creation of digital ecosystem is substantiated.

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CHAPTER 1

The global intellectual capital

1.1. Intellectualization of modern world economic development

A fundamental process that determines the formation of a new post-industrial stage of social development is a comprehensive process of intellectualization, which brings revolutionary changes to all components of the economic system, ways of interaction between the business entities, and the nature of competition itself. The process of intellectualization is accelerating, while transforming the trends and processes of world economic development. Knowledge and information become a key resource for the emerging post-industrial paradigm. Thus, the factor related to the intellectual component of socio-economic processes, namely the intellectual resources that directly determine the parameters of economic growth, creates the foundations for innovative development and the

formation of post-industrial society, is crucial.

The main processes in achieving success by various actors (the state, educational institutions, scientific institutions, enterprises, individuals) are the processes of knowledge creation, dissemination, and use. Ensuring and enhancing the international competitiveness of various actors in a highly competitive global economy is becoming an accumulated set of intellectual resources that are adequate to the requirements of the modern information revolution, which are capable to ensure the innovative character of the country's development, which is the only possible process in today's globalized environment. A society that realizes the idea of replacing the industrial production concept is basing on a qualitatively new economic base - the knowledge-based economy, in which economic well-being is made by high technology, innovative capabilities, and higher level of the society's intellectual development.

The analysis of foreign and national economic literature shows both the great interest in this problem and many issues of present interest related to the intellectualization processes and their influence upon the world economy development, which leave room for scientific research. Various aspects of the intellectualization process development within the framework of the information society formation are presented in the works made by foreign scientists such as A. Toffler, D. Bell, M. Masuda, F. Mahlup. Their conclusions and generalizations are very important for understanding the impact of new technologies upon all spheres of public life, including the international economic relations. They focused on the role of information, knowledge, education, and intelligence in the transformation of the economic and social structure, and in the

processes that are forming a new type of employee.

In the works of such famous scientists as K. Marx, J. Keynes, D. Gelbraith, S. Strumilin, S. Glazyev, D. Bell, V. Inozemtsev, M. Kondratiev, E. Toffler, A. Chukhno, and J. Schumpeter, etc. a high profile is given to issues related to the analysis of the evolutionary processes of society, the transition from one technological mode of production to another, changes in the nature of labour, information components of these processes, quantitative models of evolutionary dynamics, changes occurring in the production system, and the conditions for social progress and economic development in the whole society.

The works by Chukhno, which noticed constantly growing role of information in the economic activity development, and the need to develop the elements of creativity, ingenuity, education, and talent, that is the intellectual component in the course of modern employee's work, deserve a special attention¹. However, the problem how intellectualization makes influence upon the world economy development still needs to be further elaborated, with a focus on their dynamics, driving forces, and peculiarities of these global processes.

The problem how intellectualization makes influence upon the world economy development still needs to be further elaborated, with a focus on their dynamics, driving forces, and peculiarities of these global processes.

1. workforce development accelerates as a result of higher education and increased funding for science and education;
2. the work process changes, as its environment

¹ Chuhno, A. (2001) Postindustrialna economica: teoria, practica i ih znachenije dlja Ukraini // *Economica Ukraini*. – 2001. - №11. – S.42-49

- becomes more information – intensive;
3. the increasing role of information makes changes in the production facilities, which are described by the intangible assets development;
 4. the production process changes due to expansion of production factors;
 5. the industrial relations system is undergoing transformation. Such transformation is manifested in the fact that together with the changing role and quality of the human factor, the labour relations and the relations in the organization and production management are also passing through transformation, which also require management of innovation activity;
 6. then, the gradual transition to an innovative model of economic growth occurs.

We will consider each of these stages development below in more details. The technological revolution and the related informatization of society is the basis for modern evolution of the work content and nature. These processes are global in nature, although they have different dynamics due to the national features of their economies and their level of integration into the international division of labour. Thus, the emphasis shifts from the technical facilities to the human resource reproduction as the main value, which occurs due to the increasing value of the intellectual component in the social resource reproduction process. Qualitative changes are manifested in the diffusion of innovative management processes, in the increasing intellectualization, and informatization of all elements that the productive forces comprise. Moreover, as mentioned quality

factors evolved from price competition factor up to the goods quality factor (since mid 60s), then they evolved to the technology quality (70-s), eventually (80-s -2000-s) to the personnel quality.

Therefore, the old industrial type of economic development is being replaced by the humanitarian type of economic development, which is driven by scientific knowledge, creativity, and intellectual potential. According to A. Toffler, "...we are shifting from a workforce economy to a brain power economy... In the new society, knowledge is a major production factor". "In the current economic context, knowledge becomes the new nucleus of progress. If in the traditional economy the production factors were land, labour, and capital, in the new economy knowledge is the major component of the productive system"². The trend of increasing labour intellectualization accompanies the whole human development process, which is stated by many well-known national and foreign scientists³.

The essence of the intellectualization process and its role in modern society is revealed through a system of basic categories. Summarizing the approaches to the intellectualization process that are most popular and demanded in the current research, we proposed a scheme that ensures methodological identification of the key concepts in this field (Figure 1.1.1):

2 Toffler, A. (1980) *The third wave*. – N.Y., 1980

3 Masuda, J. (1985) *Hypothesis of the genesis homo untelligens* // *Future – G4 - Hand*. - 1985. – vol.1.- №5, p.479; Castels M. (2000) *Informatsionnaja epoha: economic, obschestvo i kultura / Pod red.O.I.Shkaratana*. - M.: GU VSE, 2000; Machlup, F. (1962) *The Production and Distribution of Knowledge in the United States*. Prinception, 1962; Inozemcev, V.L. (2000) *Sovremennoje postindustrialnoje obschestvo: priroda, protivorechija, perspektivi*. M.: Logos, 2000; Bell, D. (1999) *Grjadusceje postindustrialnoje obschestvo. Opir socialnogo prognozirovanija*. - M., 1999; Kenduhov, O.V. (2003) *Znachennja intelektualnogo kapitalu i intelektualnoi praci v genesisi intelektualnoi economici // Economica promislivosti*, 2003, №2 (20), S. 100-104

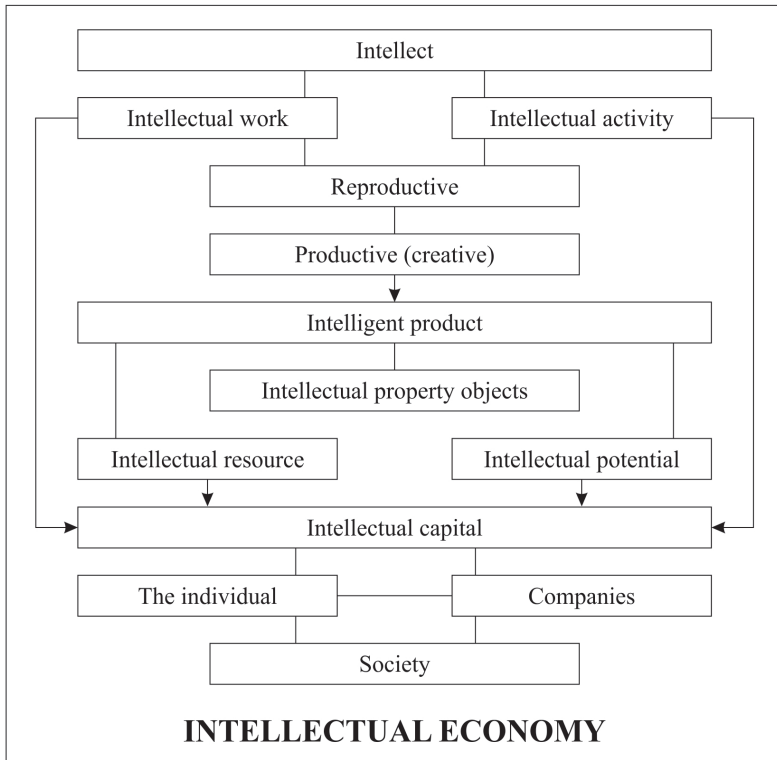


Figure 1.1.1. The methodological definition of the intellectual economy's key concepts

Source: Compiled by the authors

First of all, the concept of “intelligence” is the starting point. There is no single, commonly accepted definition of intelligence. In the economic encyclopedia, “intellect” (from the Latin “intellectus”) is defined as cognition, understanding, mind, ability to think, rational cognition⁴. In S. Ozhegov’s dictionary, the following definition is given: “intelligence is a mental ability, a mental beginning in a person’s existence”⁵.

4 Economichna enciklopedia. V trjoh tomah. Tom 3.- 2002

5 Ozhegov, S.I. (1993) Slovar russkogo jazika. – M., 1993

Generally speaking, despite the differences in the interpretation of intelligence, it is rather a mental energy embodied in knowledge, experience, information, and intellectual property. When mental energy is organized with a focus on creating new values, intelligence becomes a production facility.

The essence of intelligence and, accordingly, the process of intellectualization is a subject for studies in various sciences: biology, psychology, cybernetics, social sciences. In modern context, the study of intelligence is reflected not only in the humanities and technical knowledge, but also in the field of economics, which creates the conditions for its formation, use, and functioning.

As a particular type of human activity, the intellectual work can be reproductive or creatively productive, when an intellectual product is made. The results of intellectual work are the driving force for the material production development, the economic system expansion and complication, and the intellectual-intensive industries deployment. The new quality and level of well-being are linked to the use intellectualization of labour and production processes.

The concept of “intellectual work”, influencing the basic fundamental characteristics of labour, the parameters and patterns of employment formation, is expanding and becoming complicated by its content. The intellectual work should be considered as a process for human informational and transformative activity. The essence and content of this process is in generation and implementation of innovations, which increase productivity, improve quality of life, and make knowledge itself more effective. The production of

common tangible property requires such factors of production as land, labour, capital. And this is not enough when creating intellectual property. For its creation, it is necessary that in the process of work includes an element of creativity, element of invention, education and talent. According to V. Goylo, the intellectual work is “a conscious activity of a human, a group, and the whole society in the generation of knowledge and information about them”⁶. In our view, intellectual work is a human activity aimed at creating material goods, providing services, organizing the functioning of the economy and society and managing them, in which intellectual and mind functions predominate.

Quite often, the problem of intellectualization of work is viewed from a technocratic standpoint, that is, it is narrowed to the computerization and spread of information and communication technologies (ICT). The idea of creating artificial intelligence, which has become the subject of research on various theories, is popular. Generally speaking, the development of artificial systems problem that can perform intellectual work is implemented in two directions. The first one is represented by the researchers of cybernetic school, whose efforts are aimed at modeling the systems that reproduce the human brain functioning. On the whole, it has not yet been possible to create the artificial intelligence that could compete with the natural intelligence⁷.

The second direction combines research in which the term “artificial intelligence” means the development of systems

6 Gojlo, V.S. (1994) Politeconomia intelektualnogo truda // Mirovaja ekonomica i mejdunarodnie otnoshenia. – 1994. - №11. – S.137 – 147

7 Naukovo-osvitnij potencial nacii: podljad u XXI stolittja / Avt. kol.: V. Litvin (ker.), V. Andruschenko, S. Dobgii ta in. — K.: Navch. kniga, 2003 KN. 1: Prioritt intellectu. - 2003. - 608 s.

that enhance the intellectual activity. Thus, in those fields of science and activity, where it is impossible to use mathematical modelling, the logic-linguistic models are presented in electronic computers in the text form⁸. In particular, in the works of I. S. Ladenko, conceptual development of the theory of “intellectual systems”, in which technical facilities and specialists of different spheres are integrated, occurred⁹. At the same time, the development of theories and the implementation of artificial intelligence programs have some obstacles, due to the uncertainty of the concept of the essence of intelligence and its structure. Generally speaking, the technical sciences, including cybernetics, intellect as a mental capacity and thinking as a mental activity are not distinguished yet.

Work intellectualization is primarily manifested in changes in the content and nature of work. The content of the work is determined by the technical and functional side and reflects the balance of its complexity, qualification and scientific level of the workforce, the ratio of stereotyped thinking and creativity, routine and innovation. This is the next way how to use an employee’s physical and intellectual abilities. The complexity of the work content necessarily requires new production facilities, which are the embodiment of complex intellectual functions and, as a result, themselves capable of performing complex, information-rich operations. Modification of the work content leads to qualitative changes in the nature of work: complication of property relations, diversification of objects of property, including information,

8 Ibid

9 Ladenko, I.S. (1998) Vzaimodejstvie kognitivnih nauk v issledovanijah intellectualizacii i umstvennogo truda. V kn. Vzaimodejstvie nauk kak factor ih razvitiia. – Novosibirsk: Nauka, 1998; Ladenko I.S. (1985) Intellect i logica. – Krasnojarsk: Izdatelstvo KGU, 1985. – S.145

strengthening the interdependence between individual and general, globalized labor.

Considering the genesis of the work content, S. G. Strumilin notes that the machine first makes unnecessary physical force, and then the skills of the worker who manages the machine; at the same time, the human intellect is of great importance¹⁰. In the history of mankind, intellect, knowledge have always been the driving forces, and the mechanical work, in the process of which ready know-how is periodically used, was the last. In this regard, in any field of activity, it is possible to distinguish a routine work, which is conducted based on an established scheme, and innovative, creative work, aimed at creating new goods and production methods.

The progress that is observed in the content and nature of work has always been achieved in the result of its subject and social environment development. In all structural elements of the work process, changes, which determine and reveal the process of intellectualization, occur. Modern scientific and technical revolution introduces fundamental changes in the way of work and in the way of interaction of factors of production. There is a radical transformation in the production facilities, labour tools, energy, production technology, and production management. K. Marx pointed out: “Economic epochs differ not in what is produced, but in how it is produced, by what labour facilities”¹¹.

The spread of information technology in the context of the modern scientific and technical revolution is gradually dematerializing production, making it more information-

10 Strumilin, S.G. (1982) Problemi ekonomici truda. M.: Nauka, 1982, S.471

11 Marx, K., Engels, F. Soch., т.23, s.188-189, т.46, ch. II, s.110

intensive, highlighting the post-industrial mode of production through the active use of knowledge and intelligence. The information revolution and the emergence of the information society are also changing the relationship between traditional material and immaterial elements of production. In modern context, microelectronics and “artificial intelligence” bring new trends, saturate traditional technology with intellectual functions.

The emergence and introduction of the fifth generation of computers with embedded intelligence to production creates a further basis for the intellectualization of labour. Artificial Intelligence becomes an integral part of the work process. It is clear that this dramatically changes the place of human in the production process, and the nature of his work. Human labour in the maintenance of machinery in the industrial economy is transformed into the activity of managing and controlling their work. Under these contexts, information becomes a facility that is optimally combining all factors into a single intellectualized production process.

The use of such complex, information-intensive products and production facilities in the production process changes the work process itself. It reduces the proportion of mechanical, routine, physical functions, and, conversely, the need for a creative approach to the work process, analytical and innovative functions, grows. Changing the content of the employee also requires increasing the level of education, skills, intelligence, business qualities, innovation, responsibility and creativity as integral features of the modern worker.

Intelligence and intellectualization cannot be considered only as the accumulation of information, since information alone, without human emotions, is not capable of changing

human culture and contributing to the progress of humanity. It is also impossible to narrow intellectualization only to external forms of its manifestation (spread across the enterprise, industry, economy as a whole).

The intellectualization process is manifested both in the development of new information technologies and in the growth of intellectual labour share in aggregate labour. The concepts of “intellectual labour” and “intellectualization of labour”, though closely related, reflect different phenomena. The intellectual work and the intellectual nature of work indicate on the activity nature that is implemented precisely to develop and use knowledge and information. Intellectual work is a form reflecting activity with predominant performance of intellectual functions, functions of generation, transmission and use of knowledge and information is manifested. On the other hand, intellectualization is a process that has its own dynamics and represents certain changes in the structure of work, which are determined by the increase of qualitative features of an already set parameter of intellectual work and their spread.

The intellectualization of work is associated with the strengthening of theoretical, analytical thinking in human labour. Currently, there is a significant increase in proportion of executive operations in mental work, and they also require a fairly high level of intellectual activity, initiative, self-organization and responsibility. The most widespread point of view is that the intellectualization of labour is to change the correlation of physical and mental functions in the work of production workers.

In the modern process of work, regardless of the place of the worker in the production process, there are several

levels, the nature of which is both physical and intellectual. The intellectual component of the modern work process has considerable variations and different content of creativity. Creative work in its pure form is the prerogative of the field of fundamental and applied scientific research, education, public administration, top-management of large enterprises, etc. At the same time, the elements of creativity become integral as the scientific and technical revolution deepens, not only in all fields of activity, but also at all hierarchical levels.

The process of labour intellectualization is confirmed by an analysis of the increase in the education level of the population occurring in the whole country, by individual sectors of employment, by occupational groups and qualification groups. Specific features of the intellectualization process are increasing the share of mental functions in the process of work, improving the qualification and educational level of employees, increasing the intellectual component in the process of work and the production process generally speaking, the increase in the share of intellectual products.

Thus, intellectualization is a general tendency of socio-economic development of society, which is manifested in the increase of volume and role of intellectual activity. The intellectualization of economy is manifested in the change in the economic structure in the direction of increasing the share of information and intellectually intensive industries, the reduction of low technological and mining industries; increasing the proportion of highly skilled workers; raising the scientific and technological level of the production facilities and increasing the shares of science-intensive and high-tech products in GDP. The intellectualization of work is the

process of changing the nature and character of work, which is manifested in the increase of its intellectual component.

As a result of the work intellectualization, a modification industrial relations system occurs, which, together with the change in the role and quality of the human factor, transforms labour relations, relations in the organization and management of production, which necessarily imply the management of innovation activity, and changes in the social division of labour. One of the peculiarities is that there is a radical restructuring of the production process, which, firstly, requires a significant increase in the educational, professional level of workers, and secondly, is manifested in the increase in value added created.

The defining feature of the present is the growing need for education, retraining of employees - during an active life, a person in the information society is forced to constantly learn, improve own skills and even change profession. The requirements for the intellectual and creative abilities of the person, for his psychophysical features are increasing. There is a problem of unemployed people who are in active age, but their ability to work does not meet the new requirements. The problem of adequate high pay for intellectual labour and the readiness of representatives of other social groups is exacerbated.

An information society focused on intellectual development and immaterial wealth (intelligence, information, knowledge) forms a new paradigm, in which intellectualization becomes a decisive factor. Intellectualization means not only the growth of intellectual functions in the process of work and, accordingly, the improvement of the educational level of employees, but also the strengthening of the cultural and ethical component. Economic activity is increasingly being built on a combination of

economic interests, ethical, cultural and environmental values. Modern sophisticated production requires such an economic mechanism that it gives the individuals greater opportunities to realize their abilities and self-expression. The results of the production process are manifested in the development of innovative activity, which is implemented on the basis of a combination of scientific and technological developments and their introduction into production.

Among the institutes of post-industrial knowledge economy, in our opinion, the most important role is played by the institute of intellectual property, the formation of which in modern sense reflects the evolution, on the one hand, of organizational forms of scientific and technological progress, and on the other, property relations themselves (Figure 1.1.2):

As a key tool for innovation policy, the institute of intellectual property ensures the exchange of intellectual product between creators, intermediaries, end consumers; activates systematic scientific and technical research, inter-subject and interdisciplinary diffusion of innovations, cooperation between subjects of innovation process through technology transfer, integrates resources for joint research, promotes development of new forms of patent-license cooperation of firms, involvement of consumers; extends the boundaries of national innovation systems by reflecting the latest scientific and technological developments in the process of registration and protection of domain names on the Internet, the functioning of electronic patent filing and processing systems, the formation of modern elements of infrastructure, the spread of audit and mechanisms of intellectual property insurance, the development of diverse structures, integration into innovative small and medium-sized business systems; contributes to the development of a

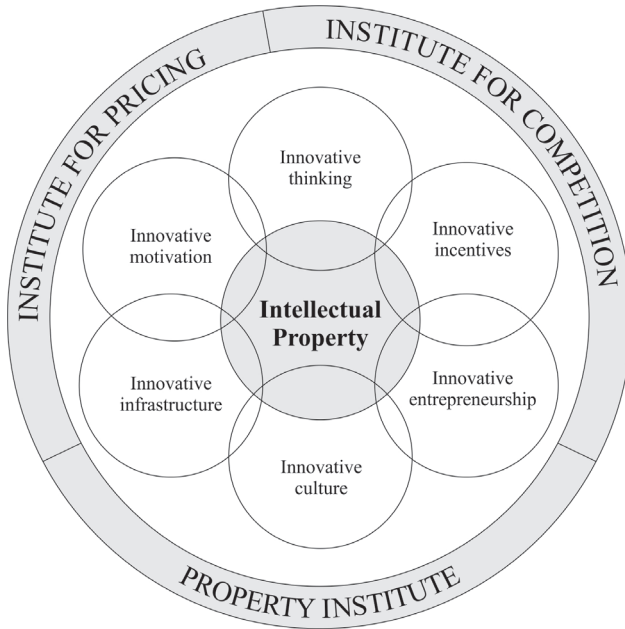


Figure 1.1.2. Intellectual property in the institutional environment of innovative economy

Source: Compiled by the authors

system of financing innovative activities, rationalization of the cost structure based on compensation and capitalization of innovative costs through the realization of intellectual property items, sale of intellectual property rights, signing licensing agreements, enticing national and foreign investments, setting a favourable image of innovative formations, interlacing on intellectual property objects with the latest innovations and economic relations.

It should be noted that among national and foreign scientists, there is no consensus on the essence of the concept of intellectual resources and its relation with such interrelated

categories as “human capital”, “intellectual capital”, “intangible resources” and others. In the economic encyclopedia, “workforce” is interpreted as the ability of a person to work, a set of needs, physical, intellectual and other abilities, acquired knowledge and experience used in the production of material goods and services¹². However, with the advancement of human progress, labour has ceased to be merely a factor in production. Investments in the workforce (such as education, health care, culture, and qualification) form a new quality, which is a new form of human wealth. Therefore, in the modern sense, the concept of “human resources” as the embodiment of all human abilities that can be used in the production process is widespread.

Human capital is considered as a set of the human capabilities that are realized, included in the system of economic relations for the creation of a new product and additional income. The basis of human capital is the natural qualities of a person, which can be developed through investment in its formation. Moreover, these investments bring a high return, which is manifested at the individual level - for a person, and at the public level - for the enterprise and the economy as a whole.

The concept of “intellectual resources” is both broader and narrower in terms of human resources. On the one hand, it necessarily includes human as the primary carrier of intelligence. But not all qualities of human resources can be attributed to intellectual ones. Yes, the purely physical features of human resources can be hardly attributed to a direct component of intellectual resources. On the other hand, intellectual resources include the results of human intellectual activity: new knowledge, new technologies, patents, and so on.

12 Economichna enciklopedia. V trjoh tomah. Tom 3.- 2002

Intellectual resources are becoming a major factor in ensuring economic growth and, generally speaking, the new quality of social development. One of the most important modern trends is that the economy has acquired new, distinctive of the classical era, features. It has become a “brand”, the main features of which are super-informatization, intangible assets, post-traditional pricing formula of the final product. An illustrative example of this is the reflection of the value of intellectual capital and value of the world’s leading companies. Up to 88% of the average company value is now a direct result of the only active source of intellectual capital - its people. The average is at least 50% higher than the Dow Jones Industrial Average (DJIA). At Pfizer Company, the cost of intellectual capital is 11% higher than the market value of the company. Boeing owns intellectual capital that exceeds the company’s value by 7.4% and Apple - by 4.07%. Generally speaking, given the total value of the company, these amounts are quite significant. Moreover, the value of intellectual capital of multinational companies included in this rating is not lower than 50% of the value of the company itself, which confirms the crucial role of intellectual capital in the formation of competitiveness¹³.

The main factors behind this relationship are know-how, patents, copyrights, management technologies, business reputation, brand or trademark. The peculiarity of intellectual resources in relation to other factors of production is in the fact that the costs of these are the nature of long-term investments, the return on which can be obtained much later than from other types of investments.

13 2016 Intellectual Capital Index. URL: <https://talentgrowthadvisors.com/our-big-idea/ici>
<https://talentgrowthadvisors.com/our-big-idea/ici/djia-2016-ici>

Thus, in the current context, the intellectual property is the leading factor in the system of factors that shape the potential of economic development and provide the country's international competitiveness. Intellectual resources create opportunities for breakthroughs in economic and scientific and technological development even for those countries that do not have significant natural resource factors for this purpose. Intellectualization, acting as a global trend, has a specific manifestation in individual economic systems. The manifestation of this tendency in individual national economies is realized as a nonlinear, but at the same time consistent and progressive process of accumulation of intellectual features. Today, we can consider not only the leadership of the USA, Western Europe, Japan, China, and new industrialized countries. In the recent years of the twentieth century, leaders in the international arena included Hungary, Finland, Sweden and Ireland¹⁴. These countries were able to take their competitive advantage in the production and trade of information and communication technology products and to enter the world market. Thus, the intellectual factor has unlimited potential for development, creates for each country the opportunity to realize its internal resources and find competitive advantages in a globalized economic environment.

The development of labour intellectualization processes in transition economies has its own peculiarities. Ukraine is known to have a sufficiently high intellectual and educational potential and today remains an exporter of scientific ideas along with their owners. That is why the problems of reproduction and use of intellectual resources are of particular importance

14 Measuring the Digital Economy - URL: <http://www.ec.europa.eu/>

for Ukraine, which has experienced difficult conditions of transformation of social relations and now faces the challenge of making a breakthrough in the economic and innovative development of the country. The third wave of the scientific and technological revolution, which is manifested in the spread of information technology, has influenced upon national production only partially, which is the lag of almost all branches of material production in terms of technology and technics, and brainpower outflow. Manufacturing and reproduction in the new management context is implemented on the outdated technological base or basing on outdated foreign technologies. The new quality of intellectual resources is a necessary prerequisite for the country's development, while the solution of technical modernisation problems in the national economy provides more opportunities for an innovative breakthrough in a competitive market, which in modern context is possible only due to the development of intellectual resources in the society.

The process of intellectualization, acting as a global feature of modern global development, transforms not only the internal structure of the countries' economies, but also the whole system of external relations, the integration of countries into the new world economic space. This is confirmed by the development of scientific and technical cooperation, the migration of highly skilled labour, the growth of trade in high-tech products, and the change in traditional forms of international economic relations.

The process of intellectualization can be characterized by various indicators, which can be grouped as follows:

1. indicators of human resources development (increase of the level of education of the

- population, increase of the share of population with higher education, number of students, scientists, creative professions, etc.);
2. indicators of adaptability to manufacturing and production development (intellectual capacity, level of computerization, number of patents, etc.);
 3. indicators of production outputs (share of high-tech products, share of innovative enterprises, venture capital, etc.).

Thus, intellectualization is manifested as a constant trend in world economic development, which is highly dynamic and determinative in the new economy formation process in the present context. In order to ensure a country's competitiveness in a highly globalized environment, and the improvement of the achieved positions, it is necessary to provide a targeted selection of people interested in the process of activity and creative work, to create and support favourable conditions for it in different ways. This direction should be of priority for the society, the state, and should be manifested in the formation of a strategic vector of social development on the basis of inclusive intellectualization, creating the conditions for the breakthrough development of education and science, their close interaction with the real sector of the economy. It is necessary to adopt a targeted innovation policy, develop an appropriate climate, image and comfort for the development of human and intellectual resources within national innovation system (Figure 1.1.3).

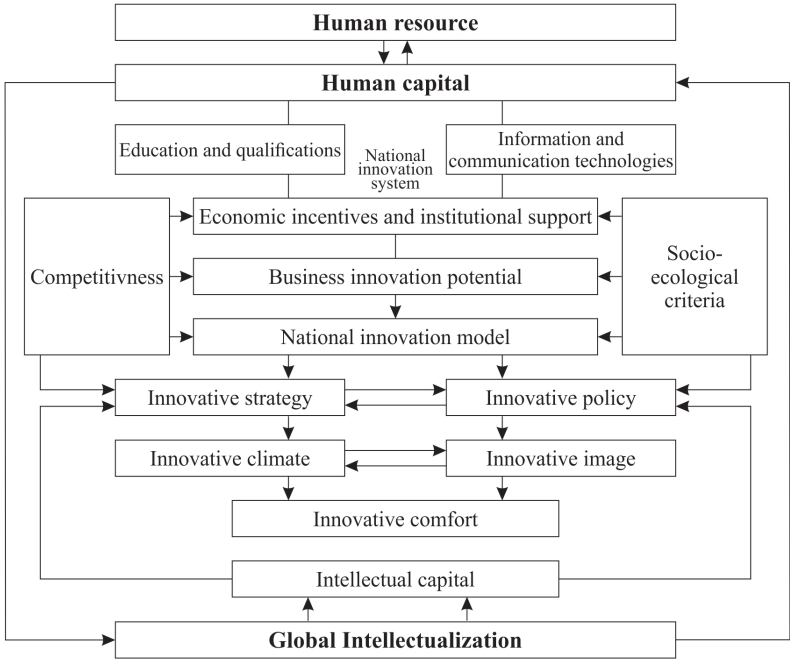


Figure 1.1.3. Intellectual and humanitarian imperative of national development in the globalization context

Source: Compiled by the authors

At the same time, the availability of even considerable intellectual resources is not sufficient, since this potential becomes a real factor of innovative development only if there are effective mechanisms for its realization. Only the inclusion of intellectual resources in the system of economic relations with proper valuation in the market or in society makes them intellectual capital - a key factor in technological, economic and social progress. Further studies of intellectual capital, its structural dynamics, and integrative interconnection with network, creative, and social capital are actualized at the

fundamental and prognostic level in line with the leading trends of global development. The phenomenon of artificial intelligence, capable of qualitatively transforming not only technological, but also socio-economic and civilizational paradigm of social development, requires special research attention.

1.2. Intellectual capital: identification and measurement issues

Formation and development of knowledge-based economy in the early 90's of the last century have largely contributed to an update of matters related to the interpretation of a category of "intellectual capital", definition of the structure and value of intellectual capital. It should be noted that the question of existence of intellectual capital has been already touched upon in 1964 in a work of management guru Peter Drucker "The Concept of the Corporation"¹⁵, in which he spoke about the "knowledge workers". The term "intellectual capital" has been introduced in scientific environment by an American scientist John K. Galbraith¹⁶ in 1969. In a letter to an economist Michael Kalecki dated 1969 John K. Galbraith wrote: "I wonder if you realize how much those of us in the world around have owed to the intellectual capital you have provided over these past decades"¹⁷. In the 90's of the 20th century, thanks to the works by Thomas Stewart¹⁸, the term "intellectual capital" has gained ground.

15 Drucker, P.F. (1964). The Concept of the Corporation. New York, New American Library, 1993

16 Galbraith, J.K. (1969). The New Industrial State: Harmondsworth: Penguin, 1969

17 Feiwel, G.R. (1975). The Intellectual Capital of Michal Kalecki: A Study in Economic Theory and Policy. Knoxville: The University of Tennessee Press, 1975

18 Stewart, T. A. (1997). The intellectual Capital. The New Wealth of Organizations. Nicholas Brealey Publishing, Business Digest, New York, 1997

Thomas Stewart¹⁹ defines intellectual capital as intellectual material – knowledge, information, intellectual property and experience – that can be put to use to create wealth. Theoretical and methodological studies of intellectual capital are also introduced in scientific works by Leif Edvinsson and Michael S. Malone²⁰; they emphasize the importance of intellectual capital in organizations, paying attention to the matters of measuring and management approaches of intellectual capital; Annie Brooking²¹, who has considered the processes of identifying, documenting, and measuring intellectual capital; Adam Smith²², who has proposed the original idea of “human capital”; Hubert Saint-Onge²³, who has created the concept of “customer capital”; Nick Bontis²⁴ has considered conceptual measures and models regarding intellectual capital and its impact on business performance; Karl E. Sveiby²⁵; Daniel J. Knigh²⁶; Goran Roos, Stephen Pike and Lisa Fernstrom²⁷, Olena Grishnova²⁸ and other scientists.

19 Ibid

20 Edvinsson, L., Malone, M.S (1997). *Intellectual Capital: Realizing Your Company’s True Value by Finding Its Hidden Brainpower*. N.Y.: Happer Business, 1997

21 Brooking, A. (1996). *Intellectual Capital: Core Assets for the Third Millennium Enterprise*. London: Thomson Business Press, 1996

22 Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*, Book 2, 1776

23 Saint-Onge, H. (1996). *Tacit Knowledge: the Key to Strategic Alignment of Intellectual Capital. Strategy and Leadership*, 1996, No. 2, p. 10-14

24 Bontis, N. (1998). *Intellectual capital: an Exploratory Study that Develops Measures and Models*. *Management Decision*, 1998, No. 36/2, p. 63-76

25 Sveiby, K.E. (1997). *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*, Barrett-Kohler, San Francisco, CA, 1997

26 Knight, Daniel J. (1999). *Performance Measures for Increasing Intellectual Capital*. *Planning Review*, 1999, No. 27 (2) Mar/Apr, p. 22-27

27 Roos G., Pike S., Fernstro L. (2005). *Managing Intellectual Capital in Practice*. Butterworth-Heinemann, New York, 2005

28 Grishnova O.A., Kozlovskij A.T. (2014). *Intellectualnij kapital Ukraini: integralna ocinka I porivnjalnij analiz*. *Ukraina: aspect praci*, 2014, No 1, s. 3-9

National intellectual capital measurement model and rang of 40 countries have been presented in scientific work by Carol Yeh-Yun Lin and Leif Edvinsson²⁹.

By its nature, intellectual capital is a complex of non-material components, promoting development of innovation scope of activities of an enterprise. The ability to provide innovations is one of the core competencies of successful activity of the company. There is a vast number of researches, which have shown that innovation exerts markedly positive influence on productivity of the company: Joseph Schumpeter (1934³⁰, 1942³¹); Paul Romer³², Gene M. Grossman and Elhanan Helpman³³, Gavin Cameron³⁴, Philippe Aghion, Nick Bloom, Richard Blundell, Rachel Griffith and Peter Howitt³⁵, Viktor Bazylevych³⁶, Olga Miroshnychenko³⁷ and others.

Intellectual capital can be expressed in monetary terms, by determining the cost of intangible assets of the company, its product innovation. The ability to form the intellectual

29 Lin, C.Y.-Y., Edvinsson, L. (2011). *National Intellectual Capital. A Comparison of 40 Countries*, Springer, 2011

30 Schumpeter, J. (1934). *The Theory of Economic Development*. Leipzig: Duncker and Humblot. Translated by R. Opie. Cambridge: Harvard University Press, 1934

31 Schumpeter, J. (1942). *Capitalism, Socialism, and Democracy*, London: Allen and Unwin, 1942

32 Romer, P. (1990). Endogenous Technological change. *Journal of Political Economy*, No. 5, 1990, p. 71-102

33 Grossman, G.M.; Helpman, E. (1991). *Innovation and growth in the global economy*, MIT Press, Cambridge, MA, 1991

34 Cameron, G. (1998). *Innovation and Growth: A Survey of the Empirical Evidence*. Nuffield College, Oxford. [Accessed 22.08.2019]. URL: <http://hicks.nuff.ox.ac.uk/users/cameron/papers/empiric.pdf>

35 Aghio, P., Bloom, N., Blundell, R., Griffith, R., Howitt, P. (2005). Competition and Innovation: an Inverted-U Relationship. *Quarterly Journal of Economics*, 2005, No. 2, p. 701-728

36 Bazilevich, V.D.; Iljin, V.V. (2008). *Intellectualna vlasnist: kreativni metaphizichnogo poshuku: monographia*. Kyiv: Znannya, 2008

37 Miroshnychenko, O. (2013). *The Intellectual Capital of an Enterprise: the Innovative Aspect*. *Informacijos mokslai*, 2013, Vol. 63, p. 31-43

capital defines the intellectual potential of the company, and the knowledge appears as a result of the intellectual potential. The table below illustrates the definitions and components of intellectual capital (see Table 1.2.1).

TABLE 1.2.1. Definitions and components of intellectual capital³⁸

Authors	Definitions and components
Galbraith (Feiwel, 1975; Bontis, 1998)	It is more than just “intellect as pure intellect” but rather incorporated a degree of “intellectual action”. In that sense, intellectual capital is not only a static intangible asset per se, but an ideological process; a means to an end.
Saint-Onge (1996)	It is composed human capital, structural capital, and customer capital
Brooking (1996, p.12)	“Intellectual capital is the term given to the combined intangible assets which enable the company to function.” Intellectual capital is comprised of four types of assets: market assets, intellectual property assets, human-centred assets, and infrastructure assets
Stewart (1997)	It is intellectual material – knowledge, information, intellectual property and experience – that can be put to use to create wealth. It is collective brainpower. It’s hard to identify and harder still to deploy effectively. But once you find it and exploit it, you win
Edvinsson and Malone (1997)	They describe intellectual capital as a knowledge that can be converted into value. It equals the sum of human and structural capital. It encompasses the applied experience, organizational technology, customer relationships and professional skills that provide the company with a competitive advantage in the market.

³⁸ Ibid, p. 33.

Sveiby (1997)	It consists of three parts: individual competence (employees' skills and abilities), internal structure (the organisation's processes and procedures); external structure (the organisation's image and relationship with its customers)
Bontis (1998)	It consists of three elements: human capital (human intellect), structural capital (organizational routines), customer capital (market relationships)
Stewart (2002)	<p>It is just that: a capital asset consisting of intellectual material. To be considered intellectual capital, knowledge must be an asset able to be used to create wealth. Thus, intellectual capital includes the talents and skills of individuals and groups; technological and social networks and the software and culture that connect them; and intellectual property such as patents, copyrights, methods, procedures, archives, etc.</p> <p>It excludes knowledge or information not involved in production or wealth creation. Just as raw materials such as iron ore should not be confused with an asset such as a steel mill, so knowledge materials such as data or miscellaneous facts ought not to be confused with knowledge assets.</p>
Roos, Pike and Fernstrom (2005)	It can be defined as all nonmonetary and nonphysical resources that are fully or partly controlled by the organization and that contribute to the organization's value creation. Intellectual capital is divided into three categories: relational, organizational and human.

Andriessen and Stam (2004, 2008, p. 490)	It can be defined as all intangible resources that are available to an organization, that give a relative advantage, and which in combination are able to produce future benefits. The three types of intellectual capital should be interpreted as follows: human capital, structural capital, and relational capital.
Lin and Edvinsson (2011, p. 4-5)	National intellectual capital mainly consists of five types of component capital – human capital, market capital, process capital, renewal capital, and financial capital.

Source: compiled by the authors

Intellectual capital is an agglomerative category. Most scientists (Saint Onge³⁹, 1996; Sveiby⁴⁰, 1997; Bontis⁴¹, 1998; Roos, Pike and Fernstrom⁴², 2005; Stam and Andriessen⁴³, 2008) indicate three elements as its components: human capital, structural capital, and customer capital (see Figure 1.2.1).

The economist Adam Smith (1776) was the first to propose the human capital concept in the 18th century. He noted: “The acquisition of ... talents during ... education, study, or apprenticeship, costs a real expense, which is capital in [a] person. Those talents [are] part of his fortune [and] likewise that of society.”⁴⁴ The human capital concept was popularized

39 Saint-Onge, H. (1996). Tacit Knowledge: the Key to Strategic Alignment of Intellectual Capital. *Strategy and Leadership*, 1996, No. 2, p. 10-14.

40 Sveiby, K.E. (1997). *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*, Barrett-Kohler, San Francisco, CA, 1997.

41 Bontis, N. (1998). Intellectual capital: an Explanatory Study that Develops Measures and Models. *Management Decision*, 1998, No. 36/2, p. 63-76.

42 Roos G., Pike S., Fernstro L. (2005). *Managing Intellectual Capital in Practice*. Butterworth-Heinemann, New York, 2005

43 Stam, C., Andriessen, D. (2008). Intellectual Capital of the European Union 2008: Measuring the Lisbon Strategy for Growth and Jobs. *Electronic Journal o Knowledge Management*. 2008, Vol. 7, Issue 4, p. 489-500. [Accessed 23.08.2019]. URL: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.690.3325&rep=rep1&type=pdf>.

44 Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*, Book

by Jacob Mincer⁴⁵, Theodore Schultz⁴⁶, and Gary Becker (1962⁴⁷, 1964⁴⁸).

Intellectual Capital		
Human Capital	Structural Capital (or Organizational Capital)	Customer Capital (Relational Capital or External Capital)
<ul style="list-style-type: none"> • Genetic inheritance • Education • Experience • Attitudes to life and business 	<ul style="list-style-type: none"> • Systems • Structure • Strategy • Culture 	<ul style="list-style-type: none"> • Supplier Capital • Alliance Capital • Community Capital • Regulatory Capital • Competitor Capital

Figure 1.2.1. Components and elements of intellectual capital

Source: compiled by the authors

The term “human capital” almost had not been used in the English language until the late 1950’s. After the middle of 20th century, the usage of the term increased until today, with a somewhat greater uptick in the last decade of 20th century than previously⁴⁹. Gary Becker hesitated to use the term “human capital” in the title of his book “Human Capital: a Theoretical and Empirical Analysis”⁵⁰ and used a long subtitle to avoid criticism⁵¹.

Oxford English Dictionary defines human capital as “the

2, 1776

45 Mincer, J. (1958). Investment in Human Capital and Personal Income Distribution, *Journal of Political Economy*, 1958, No. 66, p. 281-302

46 Schultz, T.W. (1961). Investment in Human Capital, *American Economic Review*, 1961, No 51, p. 1-17

47 Becker, G. (1962). Investment in Human Capital: a Theoretical Analysis, NBER Special Conference 15, supplement to *Journal of Political Economy*, No 70, Issue 5, part 2, p. 9-49

48 Becker, G. (1964). *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*. Cambridge, MA: Harvard University Press, 1964

49 Goldin, C. (2014). Human Capital [Accessed 31.08.2019]. URL: https://scholar.harvard.edu/files/goldin/files/human_capital_handbook_of_cliometrics_0.pdf

50 Becker, G. (1964). *Human Capital: a Theoretical and Empirical Analysis, with Special Reference to Education*. Cambridge, MA: Harvard University Press, 1964

51 Goldin, C. (2014). Human Capital [Accessed 31.08.2019]. URL: https://scholar.harvard.edu/files/goldin/files/human_capital_handbook_of_cliometrics_0.pdf

skills the labor force possesses and is regarded as a resource or asset.”⁵² Human capital is defined in the Collins English Dictionary as “the abilities and skills of any individual, esp. those acquired through investment in education and training, that enhance potential income earning.”⁵³ Human capital has connection with investments in people (education, training, and health) and it increases an individual’s productivity⁵⁴.

Staff, which has some knowledge and experience, professional skills, values and heritage represent human capital at the level of enterprise, where human capital is the source of innovation and strategic renewal⁵⁵. Human capital includes both the innate qualities of the person and acquired: his/her level of education, skills received in the course of employment, etc. Human capital has also been defined on an individual level as the combination of these four factors: your genetic inheritance, your education, your experience, and your attitudes to life and business⁵⁶. Human capital cannot be owned by the company.

Structural capital is a technological, information and organizational support for the implementation of the staff capacities in the enterprise. It ensures the effective usage of human capital, contributes to the accumulation and acquisition of new knowledge, perfection of staff competencies through the usage of modern techniques of collaboration, business management

52 Oxford English Dictionary [Accessed 31.08.2019]. URL: <https://public.oed.com/how-words-enter-the-OED/graphic/>

53 Collins English Dictionary [Accessed 31.08.2019]. URL: <https://www.collinsdictionary.com/dictionary/english/human-capital>

54 Goldin, C. (2014). Human Capital [Accessed 31.08.2019]. URL: https://scholar.harvard.edu/files/goldin/files/human_capital_handbook_of_cliometrics_0.pdf

55 Bontis, N. (1998). Intellectual capital: an Explanatory Study that Develops Measures and Models. *Management Decision*, 1998, No. 36/2, p. 63-76

56 Hudson, W. (1993). *Intellectual Capital: How to Build it, Enhance it, Use it*, John Wiley & Sons, New York, NY, 1993

principles, systems, training of specialists, communication systems, principles of organizational culture. Structural capital can be owned by the company and thereby traded. Structural capital is also referred to as organizational capital.

The structural capital of the company consists of four elements⁵⁷:

- Systems – the way, in which the organization processes (information, communication, decision-making) and outputs (products/services and capital) proceed;
- Structure – the arrangement of responsibilities and accountabilities that defines position of and relations between members of an organization;
- Strategy – the goals of an organization and ways it seeks in order to achieve them;
- Culture – the sum of individual opinions, shared mindsets, values, and norms within the organization.
- The structural capital is all that stuff from computer software to policies, procedures, and business practices that allow the human capital be its best⁵⁸.

Customer capital is also referred to as relational capital and external capital. Customer capital defines the image of the company; brands, and the customer database of the company belong to it. It consists of bonds and strong relationships with customers, suppliers, and competitors. One of the main

57 Saint-Onge, H. (1996). Tacit Knowledge: the Key to Strategic Alignment of Intellectual Capital. *Strategy and Leadership*, 1996, No. 2, p. 10-14

58 Ibid

purposes of customer capital formation is the creation of an effective structure of the interaction of consumers and company personnel.

The elements of customer capital include⁵⁹:

- Supplier capital – the mutual trust, commitment, and creativity of key suppliers;
- Alliance capital – reliable and beneficial partners;
- Community capital – organization capabilities and reputation in its surrounding community;
- Regulatory capital – knowledge of laws and regulations as well as lobbying skills and contacts;
- Competitor capital – critical understanding and knowledge about competitors.

Hubert Saint-Onge⁶⁰ noted: “if the structural and human capitals are not minimally aligned, it is the customer who loses. Customer capital is the clients or customers that pay us for what we do and produce – they are our lifeline to the future.”

According to Leif Edvinsson and Michael S. Malone⁶¹, intellectual capital is the combination of two components: human capital and structural capital. Structural capital also includes customer capital (market capital), the relationships developed with key customers, and organizational capital. The organizational capital consists of two elements: innovation capital (renewal & development capital) and process capital. Innovation capital indicates how well a company is preparing itself for the future. Process capital indicates the efficiency of

59 Knight, D.J. (1999). Performance Measures for Increasing Intellectual Capital. *Planning Review*, 1999, No. 27 (2) Mar/Apr, p. 22-27

60 Saint-Onge, H. (1996). Tacit Knowledge: the Key to Strategic Alignment of Intellectual Capital. *Strategy and Leadership*, 1996, No. 2, p. 10-14

61 Edvinsson, L., Malone, M.S (1997). *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*. N.Y.: Happer Business, 1997

the work processes and the commitment of the company to improve the quality of these processes⁶² (see Figure 1.2.2).

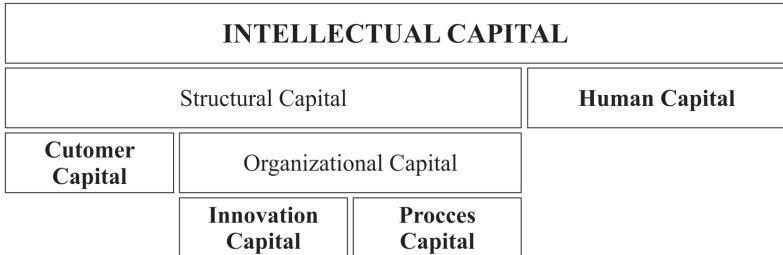


Figure 1.2.2. Components of intellectual capital according to L. Edvinsson and M.S. Malone⁶³

Source: Compiled by the authors

Four components (human capital, customer capital, innovation capital, and process capital) when added together form intellectual capital. This structure of intellectual capital is represented by non-financial building block together with financial building block of Swedish Insurance Company Skandia’s value scheme to estimate the company’s market value⁶⁴. According to Leif Edvinsson, market value of a company is a sum of financial capital and intellectual capital.

Five components of intellectual capital (human capital, market capital, process capital, renewal capital, and financial capital) have been identified by Yogesh Malhotra⁶⁵; Edna

62 Stam, C. (2006). Sustainable Program on Intellectual Capital Education. Centre for Research in Intellectual Capital in Holland University of Professional Education. [[Accessed 23.08.2019]. URL: [http://www.intellectualcapital.nl/publications/The%20IC%20perspective%20\(SPICE-KCT1.2\).pdf](http://www.intellectualcapital.nl/publications/The%20IC%20perspective%20(SPICE-KCT1.2).pdf)

63 Edvinsson, L., Malone, M.S (1997). Intellectual Capital: Realizing Your Company’s True Value by Finding Its Hidden Brainpower. N.Y.: Happer Business, 1997

64 Skandia (1994). Visualizing Intellectual Capital in Skandia, Supplement to Skandia’s 1994 Annual Report, 1994

65 Malhotra, Y. (2003). Measuring Knowledge Assets of a Nation: Knowledge Systems for Development. [Accessed 30.08.2019]. URL: <http://www.kmnetwork.com/KnowledgeManagementMeasurementResearch.pdf>

Pasher and Sigal Shachar⁶⁶; Carol Yeh-Yun Lin and Leif Edvinsson⁶⁷.

Annie Brooking⁶⁸ noted that intellectual capital is combination of four types of assets: market assets, intellectual property assets, human-centered assets, and infrastructure assets (see Table 1.2.2).

TABLE 1.2.2. Components of intellectual capital by A. Brooking⁶⁹

Components	Elements
MARKET ASSETS	<ul style="list-style-type: none"> • Service brands • Product brands • Corporate brands • Champions • Customers • Evangelists • Customer loyalty • Repeat business • Company name • Backlog • Distribution channels • Business collaborations • Franchise agreements • Licensing agreements • Favourable contracts
INTELLECTUAL PROPERTY ASSETS	<ul style="list-style-type: none"> • Patent • Copyright • Design rights • Trade secrets • Know-how • Trade marks • Service marks

66 Pasher, E., Shachar, S. (2007). The intellectual capital of the state of Israel: 60 years of achievement. [Accessed 30.08.2019]. URL:<http://www.moital.gov.il/ic>

67 Lin, C.Y.-Y., Edvinsson, L. (2011). National Intellectual Capital. A Comparison of 40 Countries, Springer, 2011

68 Brooking, A. (1996). Intellectual Capital: Core Assets for the Third Millennium Enterprise. London: Thomson Business Press, 1996, p. 12

69 Ibid

HUMAN-CENTERED ASSETS	<ul style="list-style-type: none"> • Education • Vocational qualifications • Work-related knowledge • Occupational assessments and psychometrics • Work-related competencies
INFRASTRUCTURE ASSETS	<ul style="list-style-type: none"> • Management philosophy • Corporate culture • Management processes • Information technology systems • Networking systems • Financial relations

Intellectual capital can improve the efficiency of the company through the development and use of innovations. One of the first scientists to emphasize the importance of innovation was Austrian economist Joseph Schumpeter, who described innovation as “creative destruction” that is essential for economic growth⁷⁰. Joseph Schumpeter pointed out five forms of innovations⁷¹:

- New product or service;
- New method of production;
- New source of supply;
- New market or application;
- New method of organising your firm or industry.

World English Dictionary⁷² describes innovation as: 1) something new or different introduced; 2) the act of innovating; introduction of new things or methods.

⁷⁰ Schumpeter, J. (1942). *Capitalism, Socialism, and Democracy*, London: Allen and Unwin, 1942

⁷¹ Schumpeter, J. (1934). *The Theory of Economic Development*. Leipzig: Duncker and Humblot. Translated by R. Opie. Cambridge: Harvard University Press, 1934

⁷² World English Dictionary. [Accessed 23.08.2019]. URL: <https://www.dictionary.com/browse/innovation?s=t>

The Law of Ukraine “On the innovation activity”⁷³ defines innovation, which is used with the following meaning: innovations are newly created (applied) and (or) improved competitive technologies, products or services, as well as organizational and technical solutions of manufacturing, administrative, commercial or other nature, which significantly improve the structure and quality of production and (or) social sphere.

According to legislation of Ukraine⁷⁴ the innovation activity means all scientific, technological, organisational, financial and commercial actions that indeed lead to implementation of innovations or design for this purpose. In Ukraine the innovation activity includes researches and developments not directly associated with the preparation of specific innovation.

The company is considered innovative if it has introduced any type of innovation (marketing, organizational, process or product innovations) for the period of time specified in the survey. Marketing innovations include the introduction of a new method of sale, including significant changes in design or product packaging, its storage, market promotion or sale price fixing, aimed at satisfying customers needs, opening new markets or gaining new positions for product in the market in order to increase sales volume. Introduction of a new organizational method in the enterprise activities, work place arrangement or external affairs are the organizational innovations.

Process and product innovations are included with the technological innovations. Process innovation is the introduction

73 Law of Ukraine “On Innovation Activity” (2002). No. 49-IV of 4 July 2002 (as amended on 23 October 2012). [Accessed 24.08.2019]. URL: <http://zakon2.rada.gov.ua/laws/show/40-15>

74 Ibid

of a new or considerably improved production or delivery method of a product. Product innovation is the introduction of a product or service, which is new or considerably improved in terms of its properties or methods of use.

Managing intellectual capital at the micro level provides the formation and development of its every component, its usage for the development and production of high technology products, innovative services. The formation and operation of intellectual capital in the company is affected by many factors. These factors can be divided into two groups: environmental factors and factors of internal environment⁷⁵ (see Table 1.2.3).

TABLE 1.2.3. Groups of factors, which have impact on the formation and operation of intellectual capital⁷⁶

Groups of factors	Factors
ENVIRONMENTAL FACTORS	<ul style="list-style-type: none"> • company image • relationships with contractors • the level of competition in the market • the saturation of the existing and potential markets • the availability of communication links with outside agencies • their intensity and effectiveness of legislative and regulatory control • the political situation in the country
FACTORS OF INTERNAL ENVIRONMENT	<ul style="list-style-type: none"> • the financial and economic factors and the level of business activity, • organizational methods of enterprise management • the level of research intensity of its products • the availability of specialized software

75 Miroshnychenko, O. (2013). The Intellectual Capital of an Enterprise: the Innovative Aspect. *Informacijos mokslai*, 2013, Vol. 63, p. 31-43

76 *Ibid*, p. 34-35

<p>FACTORS OF INTERNAL ENVIRONMENT</p>	<ul style="list-style-type: none"> • the development of internal communication systems • intellectual capacity of the personnel in the enterprise • its psychological compatibility • the level of conflict in the team
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Source: compiled by the authors

Measurement of intellectual capital is the process of identifying, measuring and managing strategic intangible resources to gain insight in the strength of them in order to manage the strategic resources in the best way⁷⁷.

There are two general approaches for intellectual capital measurement⁷⁸:

- to do a using unique units of measure for each element of intellectual capital at different levels in an organization (in instance, at the work unit level or at the organizational level as a whole);
- to measure the value of intellectual assets in financial terms at the organization level without reference to individual components of intellectual capital.
- The first approach “Component-by-Component Measurement” include two models:
- The Edvinsson/Malone model, which uses the Skandia “Navigator” approach for measuring

77 Stam, C., Andriessen, D. (2008). Intellectual Capital of the European Union 2008: Measuring the Lisbon Strategy for Growth and Jobs. *Electronic Journal o Knowledge Management*. 2008, Vol. 7, Issue 4, p. 489-500. [Accessed 23.08.2019]. URL: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.690.3325&rep=rep1&type=pdf>

78 Luthy, D.H. (1998). *Intellectual Capital and its Measurement*. [interactive]. [Accessed 26.08.2019]. URL: <https://pdfs.semanticscholar.org/ab31/a561613f45a9c1ee3805a5c9be6ad5d1c031.pdf>

intellectual capital. Skandia is a Swedish insurance and financial services company, since 1997 the company publishes supplement its annual report “Visualizing Intellectual Capital in Skandia”⁷⁹. Leif Edvinsson was the corporate director of intellectual capital for Skandia, he developed a framework for reporting as a combination of traditional financial reporting with measures of intellectual capital. The Skandia “Navigator” represents past financial information about an organization and additional information about intellectual capital to understand both an organization’s current and future capabilities. Five focuses is in core of the Skandia “Navigator” according to the Edvinsson/ Malone’s components of intellectual capital: financial, market, human, process, renewal & development focuses (see Figure 1.2.3).

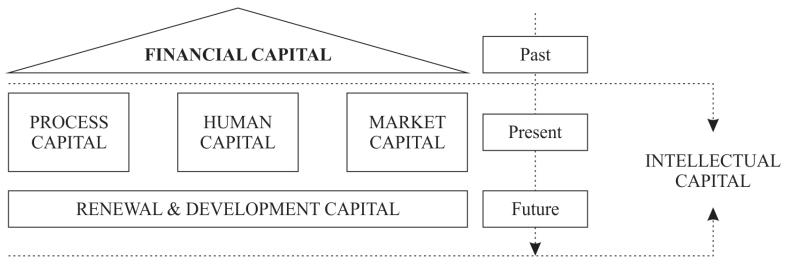


Figure 1.2.3. The Skandia “Navigator”⁸⁰

79 Skandia (1994). Visualizing Intellectual Capital in Skandia, Supplement to Skandia’s 1994 Annual Report, 1994

80 Edvinsson, L. (1997). Intellectual Capital: Realizing Your Company’s True Value by Finding Its Hidden Brainpower / L. Edvinsson, M.S. Malone. – N.Y.: Happer Business, 1997, p. 68

- The Brooking model – “Dream Ticket”/ Intellectual Capital Audit was presented in 1997⁸¹. The components of the model listed in Table 2. Seven elements are in a core of the Brooking model: the goal, intellectual capital, “dream ticket”, audit, index, target, and measures. The “dream ticket” is the set of intellectual assets to achieve the organization’s goal. The audit provides information about the strengths and weaknesses of the intellectual assets of the organization and it is the basis to construct index to compare audit results with the “dream ticket” for each intellectual asset. The status of the intellectual asset can be high if it matches the “dream ticket”; or the asset may be given a score as low as zero if the asset is very weak in comparison with the “dream ticket”. A target represents the status and category of all organization’s intellectual assets and is divided into four quadrants. The target provides information about a situation with intellectual assets whether the situation is expected to become better or worse⁸².

The second approach “Organization Level/Financial Basis Measurement”⁸³ is based on three measures of intellectual

81 Brooking, A., Board, P., Jones, S. (1997). The Predictive Potential of Intellectual Capital, *International Journal of Technology Management*, Vol. 16, No 1/2/3, p. 115-125

82 Luthy, D.H. (1998). *Intellectual Capital and its Measurement*. [Accessed 26.08.2019]. URL: <https://pdfs.semanticscholar.org/ab31/a561613f45a9c1ee3805a5c9be6ad5d1c031.pdf>

83 Ibid

capital suggested by Thomas Stewart⁸⁴:

- Market-to-Book Ratio provides information about difference between book value and market value of the company (the market price per share of common stock multiplied by the number of shares outstanding) and gives approximate intangible measure of intellectual capital, which are not presented in the company's balance sheet;
- Tobin's q is a measure developed by James Tobin⁸⁵ in 1969, a Nobel prizewinning economist, to predict investment decisions. It can be calculated by using the company's book value, adding back accumulated depreciation, than making appropriate adjustments for price changes in different classes of company's assets from the time of purchase. If Tobin's q is higher than 1 and greater than the other similar companies' q then the analysed company can produce higher profits than the competitors;
- Calculated Intangible Value was used by the Internal Revenue Service in the U.S. (IRS) for calculating the fair value of intangible assets for tax purposes. IRS Ruling describes the process of calculating, which was discussed and illustrated by Thomas T. Stewart⁸⁶ (1995) and David H. Luthy⁸⁷ (1998).

84 Stewart, T. A. (1997). The intellectual Capital. The New Wealth of Organizations. Nicholas Brealey Publishing, Business Digest, New York, 1997, p. 224-229

85 Tobin, J. (1969). A general equilibrium approach to monetary theory. Journal of Money, Credit and Banking, No 1(1), p. 15-29

86 Stewart, T.A. (1995). Trying to Grasp the Intangible, Fortune, October 2, 1995, p. 157-161

87 Luthy, D.H. (1998). Intellectual Capital and Its Measurement. [Accessed 26.08.2019]. URL:

At the global level results of intellectual capital measurement have been presented by Christiaan Stam and Daan Andriessen (2004⁸⁸, 2008⁸⁹); and Carol Yeh-Yun Lin and Leif Edvinsson⁹⁰.

In 2004, Stam and Andriessen⁹¹ published the report “Intellectual capital of the European Union” and introduced results of intellectual capital measurement for 15 countries and for 27 countries of the European Union in 2008⁹². The authors have identified three components of intellectual capital: human capital, structural capital, and relational capital. They added a second layer of classification. Each components of intellectual capital are monitored from three perspectives to emphasize importance and differences between past, present and future developments:

- Assets give an indication of the present power of a country and provides an outlook of the current main assets.
- Investments give insight into the future power of a country to maintain or strengthen its present

<https://pdfs.semanticscholar.org/ab31/a561613f45a9c1ee3805a5c9be6ad5d1c031.pdf>

- 88 Andriessen, D.G., Stam, C.D. (2004). The intellectual capital of the European Union, Measuring the Lisbon Agenda, Center for Research of Intellectual Capital, Diemen, 2004. [Accessed 22.08.2019]. URL: https://www.academia.edu/35340674/The_intellectual_capital_of_the_European_Union
- 89 Stam, C., Andriessen, D. (2008). Intellectual Capital of the European Union 2008: Measuring the Lisbon Strategy for Growth and Jobs. Electronic Journal of Knowledge Management. 2008, Vol. 7, Issue 4, p. 489-500. [Accessed 23.08.2019]. URL: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.690.3325&rep=rep1&type=pdf>
- 90 Lin, C.Y.-Y., Edvinsson, L. (2011). National Intellectual Capital. A Comparison of 40 Countries, Springer, 2011
- 91 Andriessen, D.G., Stam, C.D. (2004). The intellectual capital of the European Union, Measuring the Lisbon Agenda, Center for Research of Intellectual Capital, Diemen, 2004. [Accessed 22.08.2019]. URL: https://www.academia.edu/35340674/The_intellectual_capital_of_the_European_Union
- 92 Stam, C., Andriessen, D. (2008). Intellectual Capital of the European Union 2008: Measuring the Lisbon Strategy for Growth and Jobs. Electronic Journal of Knowledge Management. 2008, Vol. 7, Issue 4, p. 489-500. [Accessed 23.08.2019]. URL: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.690.3325&rep=rep1&type=pdf>

power, organizations should make investments in their potential constantly.

- Effects show future developments and the extent to which the country has made its intangibles productive during the previous period⁹³.

In total, Stam and Andriessen have used 38 indicators, which have been combined into one value. The European Commission's perspective has been used to identify indicators for intellectual capital estimation and perform a multidimensional value measurement. The author used the 3x3 matrix of the intellectual capital monitor (a combination of indicators from all three components and all three perspectives). Measures in itself do not have interpretation. They use to compare of measures of one country against another, or of one period against another, that provides meaning to the figures.

Lin and Edvinsson⁹⁴ consider intellectual capital as “future earning capabilities”. It is about “an opportunity in waiting, about sustainability, thinking ahead and adding values”⁹⁵. According to authors, “national intellectual capital is comprised of the knowledge, wisdom, capability, and expertise that provide a country with a competitive advantage over other countries and determine its potential for future growth”⁹⁶. Lin and Edvinsson focused on 40 countries and identified five components for intellectual capital measurement: human capital, market capital, process capital, renewal capital, and financial capital. Each of the five components of intellectual

93 Ibid, p. 490

94 Lin, C.Y.-Y., Edvinsson, L. (2011). National Intellectual Capital. A Comparison of 40 Countries, Springer, 2011

95 Ibid, p. 5

96 Ibid, p. 5

capital have been rated by the authors on a 10-point scale, based on a comparison of the factors that form the corresponding partial index. The total level of the country's intellectual capital index is calculated as the sum of the estimates of all five pre-calculated indicators of the corresponding components of national intellectual capital.

At the present stage of economic development, the success of a company and nation depends on the level of intellectual capacity, which is determined by the efficient usage of intellectual capital as one of the main strategic resources in today's economic environment. In addition, the development and intake of intellectual capital are inextricably linked to the information flows in the process of information exchange between the various elements of business management systems, as well as the interaction of the company with its environment.

The specific feature of intellectual capital management is manifested in the fact that it is the product of intellectual activity, and creative efforts. Information and knowledge are in its core. Knowledge can be defined as the information stock obtained in the course of training, research and by other means; this is in privacy of a person, company, and society as a whole.

Market value of a company depends on financial capital and intellectual capital. Most scientists identify such components of intellectual capital: human capital, market capital, process capital, renewal & development capital.

The two groups of factors have impact on formation and operation of intellectual capital: environmental factors and factors of internal environment. The authors have offered classification of these factors.

There are two levels for measuring of intellectual

capital: micro (at the work unit level or at the organizational level as a whole) and macro (at the global level). Each of them has different approaches for intellectual capital measurement, which were considered in the paper. In instance, a common characteristic of “Organization Level/Financial Basis Measurement” methods is that they all use capital market values to estimate the aggregate value of intellectual capital without reference to individual components of intellectual capital; a common characteristic of approaches for measuring intellectual capital at global level is building the country’s intellectual capital index. Finally, different measurement approaches have been examined how intellectual capital can be estimated at the component-by-component, organization, and global levels.

1.3. Intellectual global competitive leadership

Common economic conditions are transformed under the influence of globalization and knowledge economy formation, which are accompanied by aggravation of competition at all levels, rapid change of competitive positions, significant stratification of the competitive environment, and change of rules and methods for competition. The economic globalization in a dominant trend in the world development at the start of the third millennium, which pulls the implementation and strengthening interpenetration and coherence of national economies on the one hand, and to strengthen the processes of regionalization and integration on the other hand. All these processes take place against the background of intellectualization that provides effective participation of the national economies to transnationalization processes

and inclusion of innovative waves. In order to strengthen the interaction and interdependence of national economies, these trends require a special attention to new phenomena and processes that have a dramatic transformative character from different levels of the global economic entities.

Under the present highly competitive environment, not only economic development, but first of all - achieving leadership positions, which is a tool of competition, is an important task for any country. Identifying leadership becomes important both to individuals (in politics, business and other circles), and at the level of companies, and national economies. In the present context, the understanding of leadership, which is perceived much broader than psychological phenomenon, has undergone substantial changes; leadership becomes an element of the collective management process and, as evidenced in practice, is increasingly moving into the economic analysis field at different levels of the social order. Leadership is a competitive advantage, being not only an objective, but also a competition tool that is capable to bring higher economic returns.

In modern economic conditions, rapid and constant change in competitive positions, changes in the rules and methods of competition make it necessary to review the place and role of many economic and management processes. Together with increasing interdependence and interpenetration of national economies, these processes result in further stratification of the competitive environment.

Under classical approach, leadership is perceived rather as a psychological process or operating results. The leadership in its modern sense ceases to be the object of study purely in psychology and management aspects. The

nature of leadership is changing, and therefore its role in the contemporary environment is changing as well. The transition to a sixth technological wave is markedly different by the emergence of new competitiveness factors for a company or a country based on intelligence, application of the latest achievements, and new technologies. New factors are not simply related to human resources; the basis of the new factors is intellectual activity, its results in the form of the latest achievements and technologies, and their application. The strength of the intellectual component in leadership takes on a new meaning in the new context, which requires to explore its nature and forms of manifestation at various levels. The challenges of modern globalization caused by the extreme aggravation and complication of competition factors, the emergence of a knowledge society, the spread of ICT, make tangible adjustments to the manifestations of leadership. The leadership features now become good opportunities to change and implement its potential in the conditions of emergence of the knowledge economy.

In most scientific approaches, the study of leadership at the individual level prevails, when it is considered purely as a manifestation of personal activity. It is noteworthy that its economic component and economic characteristic in manifestations of leadership qualities remain beyond the attention of scientists. The economic impact of leadership, competitiveness, new market conditions, and the ways of doing business have shaped the need for leadership research to a new level. The economic effect of leadership, competitiveness, new market conditions, and the ways of doing business have shaped the need for leadership research to a new level. The

complication of the subjective basis of leadership is manifested in the separation of such basic types both as individual and institutional (or organizational) leadership. The subject of manifestation of individual leadership is an individual who influences himself and others. The subject of institutional leadership is an organization that influences itself and other organizations. This approach reflects the division of human activity into personal and social-group, which is substantiated in the works of V.G. Kremen⁹⁷.

The economic nature of leadership is most often manifested at the organizational level, which is displayed not only in establishing control of a market or region, but also in actively influencing other enterprises, organizations, or institutions. Moreover, the possibility of such influence is important not in itself, but above all to determine the future development of the organization itself. Within the framework of P. Senge's theory of self-developing organization, the organizational leadership is defined as the ability of a particular community to determine its future and, above all, to support the process of change that is needed. "The source of leadership is the ability to sustain the creative tension and energy that arises when people tell the truth and convey to others their ideas of the future and the understanding of the present"⁹⁸.

In economic theory, providing organizational leadership is possible on the basis of internal processes, because it is formed "at all levels of the organization" (K. Blanchard)⁹⁹,

97 Kremen, V.G.(2008) *Philosophia upravlinnjavlinnia / V.G.Kremen, S.M.Pazinich, O.S.Ponomarjov. – Kharkiv: NTU «KPI», 2008. – 524 s*

98 Senge, P. (2003) *Tanec peremen: novije problemi samoobuchajushcihsja organizacij / Senge P., Kleiner A., Roberts Sh, Rossc R.B., Smit B.J. – M.: ZAO «Olimp-Biznec», 2003. – 624 s*

99 Blanshar, K. (2008) *Liderstvo: k vershinam uspeha / K.Blanshar – SPb.: Piter, 2008. –*

and in the form of counteracting external factors. According to M. Kets de Vries, leadership organizations are very sensitive to the environment. That is why they are united, have a strong structure, a shared vision of the world and a system of thinking. They “are supporters of distributed leadership, encouraging leadership at all levels of the organization. They support continuous innovation, which is the source of organizational life. They encourage an optimistic mood of employees, produce a culture of learning, the reality of mistakes, the perception of diverse thinking and actions. They produce a systemic perspective, and forming a synergistic effect”¹⁰⁰. Organizational leadership is manifested as a competitive advantage that secures a position in the market for a company. Thus, leadership within a company is considered not as a social phenomenon, within which a person’s position is defined, but as an economic phenomenon that becomes a source of enrichment for the company. In this aspect, marketing and financial indicators and their change depending on changes in the structure and methodology of management, are the measures of organizational leadership effectiveness. The combination of economic activity of the company, which determines the methods of market outreach, competition and aggressive marketing provide leadership positions. Leadership in today’s conditions is both a prerequisite and a effect of competitiveness. However, leadership is not limited to the level of individual and organizational management. Complication of the concept of leadership is manifested in the multiplicity of its

368 s

100 Ke de Vri M. (2003) *Mistica liderstva. Razvitije emocionalnogo intellecta* / Manfred Ke de Vri. – M.: Alpina Publishers, 2003. – 311 s

forms¹⁰¹. The countries that make significant efforts to develop their intellectual potential and implement it in the economy can become the world leaders and retain leadership positions. High values of indicators and dynamics of development of such countries as Germany, Japan, South Korea, Singapore, Taiwan, Iceland, Finland, etc., are supported by considerable investments in research and development, realization of their results in products and services, and also qualitative changes in the spheres of life. In today's world, the leader country is first and foremost an intellectual center, which is an integrator, initiator and organizer of dynamic actions. That is why the issue of leadership in the context of gaining competitive advantage and ensuring competitiveness is becoming relevant.

The transformational tendencies activated in the world economy development such as globalization, networkization, and technologicalization contribute to the formation and development of the global intellectual space. Globally, new players are emerging (new countries, companies, universities, and other institutions), and the range of international exchange facilities is expanding (not only goods and services, but also patented know-how and licenses), new financial flows, and new systems of economic relations between different levels of entities are being formed. These dynamic processes require thorough analysis and identification of common trends in the emergence of a global innovation space.

The formation of a global intellectual space is a complex process that accompanies the current stage of the global economy development. A key feature of the current stage of the

101 Kalashnikova, S.A. (2010) Osvitnja paradigmi profesionalizaciji upravljanja na osnovama liderstva: monografija / S.A. Kalashnikova. – K.: Kyiv.un-t imeni Borisa Grinchenka, 2010. – 380 s

world economy development is the reorientation to innovative development, which is the basis of the Fourth Industrial Revolution. The Fourth Industrial Revolution determines the further orientation of the production development on the basis of robotics use, the expansion of network use and ICT technologies, etc. Characteristics of today's market are the "offshoring" of the labor market, changing the structure of production, development of the opportunities due to high-technology and network technologies, active export of services, the formation of global flows of knowledge, information, patents, and so on.

Overall, the realization of intellectual potential can occur at different levels, but the processes of globalization make it easier for lower-level entities to move to higher levels (from the individual to the global). It allows to solve problems at all levels - individual, public (national), regional and global¹⁰². At the present stage, the hierarchy of competition is complicated. At the same time, the role of the entities in the overall market structure is changing to provide and realize intellectual leadership. The loss of individual entities' positions in the market is associated with a change in the overall structure of both the market and international relations.

In our view, the assessment of intellectual leadership requires a more systematic approach that takes into account the characteristics of intellectual activity. It is believed that intellectual leadership in modern environment should be determined by the basic levels that characterize certain stages of intellectual activity and have their own characteristics. Three levels act as those stages: the level of resources, the level of results of intellectual activity, the level of end results. The

102 The Global Innovation Index 2016 - URL: [http://english.gov.cn/r/Pub/GOV/ReceivedContent/Other/2016-08-15/wipo_pub_gii_2016\(1\).pdf](http://english.gov.cn/r/Pub/GOV/ReceivedContent/Other/2016-08-15/wipo_pub_gii_2016(1).pdf)

level of resources is characterized by the availability of basic intellectual resources. Their availability and general potential characterize the ability of the country (or any other entity) to provide intellectual activity. In addition, the availability of intellectual resources is an important condition for leadership, but it does not yet mean actual leadership. More realistically, it can manifest itself at the next level, characterizing the results obtained by the entity. The level of results of intellectual activity involves a comprehensive evaluation of specific results: patents, licenses, know-how, publications, etc. The final results are those that concern not only purely intellectual activity but also the economy or society as a whole. In our view, only such a systematic approach to assessing each of these levels by a set of indicators makes enables to characterize intellectual activity and to evaluate general competitive positions of different entities. Therefore, all indicators for assessing intellectual leadership take into account either the potential of intellectual resources or the results of intellectual activity realization.

First-level leadership can be defined as resource-based. At this level, the country's ability to achieve intellectual leadership due to the formation of intellectual capacity and the mechanisms for enhancing it are determined. Key development resources are divided into financial, human, and intellectual. Thus, developing a coherent system of indicators for countries' intellectual leadership has a considerable room for improvement, to account for all potential components and reserves of this type of leadership. The intellectualization of the economy in the transition to a "knowledge economy" becomes an objective necessity, which necessitates setting of a system of indicators and development benchmarks. It allows to estimate the current

state of accumulation of intellectual resources, dynamics of their development, prospects of realization; to identify the main directions of increasing the efficiency of their implementation and further intellectualization of the economic system.

The set of indicators that characterize intellectual resources is defined as a system by which indicators can assess the potential of a particular country or any other entity (Figure 1.3.1).

The educational and scientific indicators are both

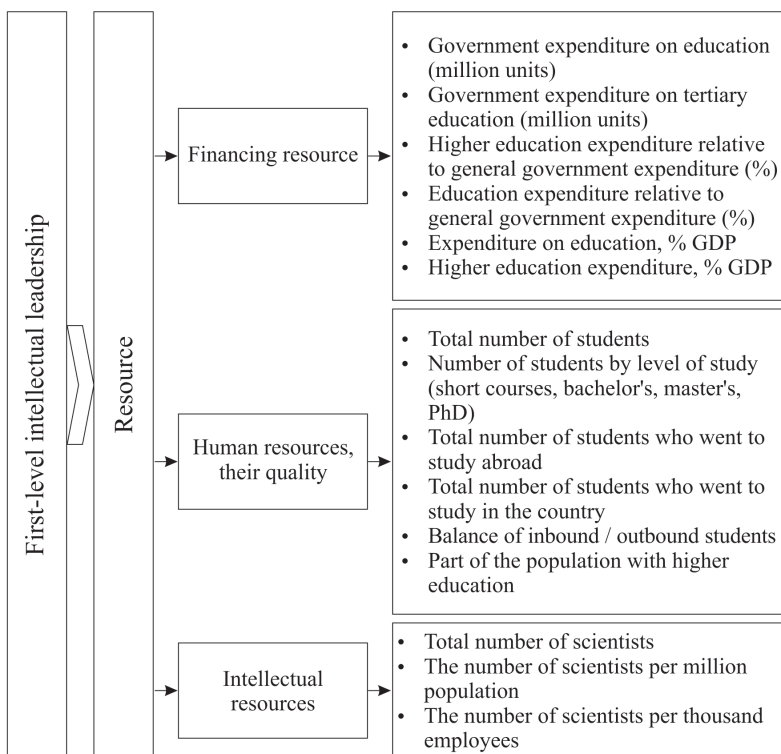


Figure 1.3.1. The system of intellectual leadership indicators of the first level

Source: Compiled by the authors

resources and results, but they are a result-based resource. These include the number of world-class universities, scientific and technical publications, and the number of Nobel laureates. Infrastructure indicators first of all include possibilities of using technologies for development of innovations, the last group of indicators are technological indicators (Figure 1.3.2).

The third level of intellectual leadership is the level of end results, which are revealed not only by themselves but also

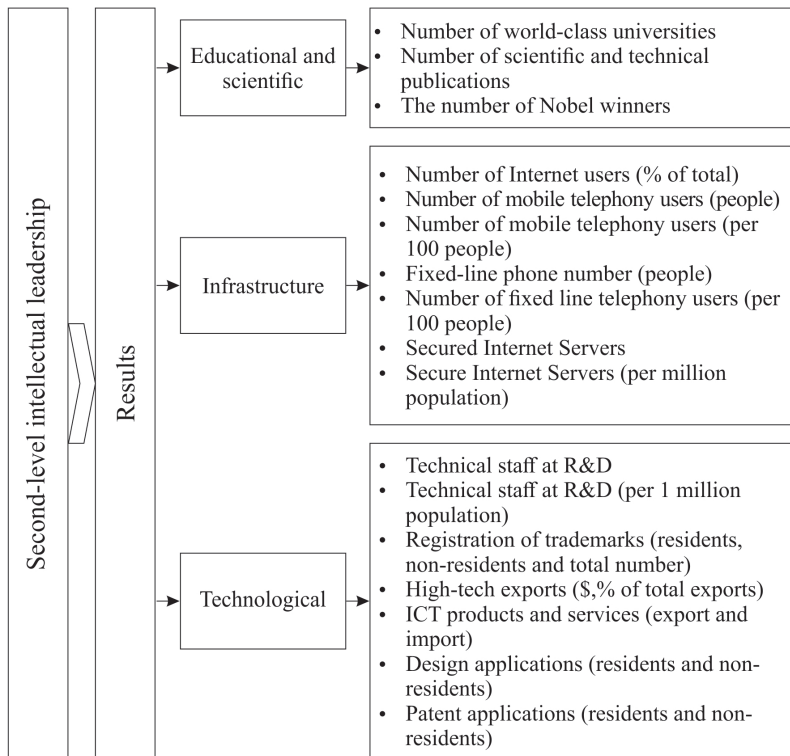


Figure 1.3.2. The system of intellectual leadership indicators of the second level

Source: Compiled by the authors

in relation to economic indicators. Most often, this is recorded by various indexes, rating, etc. At the global level, partial assessment of individual leadership in a generalized format and confirmation of its need for economic growth are found in some recent world indexes. Thus, the Global Innovation Index provides an analysis of the human capital role in the growth of economic indicators, including innovation performance. Another index that takes into account the individual component of leadership is the Global Talent Competitiveness Index, which is entirely based on a study of the human capital situation in the country¹⁰³. Of course, these indexes only summarize the current trends and do not consider individual leadership as a separate element of the economic system.

Confirmation of the importance of intellectual factors in achieving leadership at the global level can be the distinction of this component in the global rankings. Table 1.3.1 provides a summary of the major world rankings and analyzes the proportion of indicators that characterize intellectual activity and human capital components in their effects.

Of course, the list is not exhaustive, but it includes the most important and popular world rankings. All of them reflect the processes of increasing the role of the human factor and its transition to a new level of leadership positions provision. The world's leading countries are demonstrating a creative transformation that becomes a platform for a successful society and a prosperous nation. This is confirmed by a study by the Human Development Index, which examines three components: health and life expectancy; education and access to it; the standard of living estimated by the GNI per capital

103 INSEAD. – URL: <http://global-indices.insead.edu/index.cfm>

by purchasing power parity (PPP) in US dollars. This is a confirmation of the key tendency of modern world economic development - wide intellectualization of production and trade, priority development of science, and spread of complex intellectual labor. It is this that forms the centers of development of world civilization and becomes a prerequisite for the formation of a knowledge-based society.

TABLE 1.3.1. Global rankings and indexes

	Rankings and indexes	An organization that calculates a metric	Indicators	Weight
Intellectual component of human resources	Human Development Index, HDI	UN	<ul style="list-style-type: none"> • Level of education 	1 subindex of 3 5 indicators from 21
	Educational index of the countries of the world	UN	<ul style="list-style-type: none"> • Literacy level index • Share of learners 	2/3 1/3 in total
	The Social Progress Index	The Social Progress Imperative	<ul style="list-style-type: none"> • availability of basic knowledge and literacy of the population • Duration of training for women • Duration of higher education • Global ranking of universities • Inequality in accessibility of education 	5 indicators from 48

Intellectual component of human resources	The Global Innovation Index	WIPO	<ul style="list-style-type: none"> Human capital and research in the sub-index of innovation costs 	1 indicators from 6
	The Global Innovation Index	WIPO	<ul style="list-style-type: none"> Human capital and research in the sub-index of innovation costs 	1 indicators from 6
	The Bloomberg Innovation Index	Bloomberg Rankings	<ul style="list-style-type: none"> Tertiary efficiency (5 %) 	1 indicators from 7
	The Global Competitiveness Index, GCI	WEF	<ul style="list-style-type: none"> Health and primary education Higher education and vocational education 	2 metric groups from 12
	The Legatum Prosperity Index	Legatum Institute	<ul style="list-style-type: none"> Quality of education indicator 	1 subindex of 8
	Satisfaction with Life Index, SWL	OECD	<ul style="list-style-type: none"> Achievement of education 	1 subindex
	Academic Ranking of World Universities (ARWU)	Institute of Higher Education, Shanghai Jiaotong University	<ul style="list-style-type: none"> Takes into account the activities of the leading universities and their scale 	100 %
	Webometrics ranking of world's universities	Cybermetrics Lab Spanish National Research Council, CSIC	<ul style="list-style-type: none"> Considers the activities of the leading universities on the Internet and their scale 	100 %
	World Trade Organization report	WTO	<ul style="list-style-type: none"> Includes enrollment in both primary and secondary education 	2 indicators from 8

The results of intellectual activity	The Global Innovation Index	WIPO	<ul style="list-style-type: none"> • Sub-index of innovation costs • Sub-index of innovative results 	100 %
	The Bloomberg Innovation Index	Bloomberg Rankings	<ul style="list-style-type: none"> • R&D intensity (20%) • High-tech density (20%) • Concentration of researchers (20%) • Patent activity (5%) • Technological capabilities (10%) 	5 indicators from 7
	Rating countries by number of patents	WIPO	<ul style="list-style-type: none"> • Considers specific indicators of intellectual performance 	100 %
	Rating countries by number of Internet users	Based on statistics	<ul style="list-style-type: none"> • Considers specific indicators of intellectual performance 	100 %
	Ranking countries by mobile phone users	Based on statistics	<ul style="list-style-type: none"> • Considers specific indicators of intellectual performance 	100 %
	Rating of countries by level of export of high-tech products	Based on statistics	<ul style="list-style-type: none"> • Considers specific indicators of intellectual performance 	100 %
	The Global Competitiveness Index, GCI	WEF	<ul style="list-style-type: none"> • The level of technological development • Innovative potential 	2 metric groups from 12

Source: Compiled by the authors

Of course, the list is not exhaustive, but it includes the most important and popular world rankings. All of them reflect the processes of increasing the role of the human factor and its transition to a new level of leadership positions provision. The world's leading countries are demonstrating a creative transformation that becomes a platform for a successful society and a prosperous nation. This is confirmed by a study by the Human Development Index, which examines three components: health and life expectancy; education and access to it; the standard of living estimated by the GNI per capita by purchasing power parity (PPP) in US dollars. This is a confirmation of the key tendency of modern world economic development - wide intellectualization of production and trade, priority development of science, and spread of complex intellectual labor¹⁰⁴. It is this that forms the centers of development of world civilization and becomes a prerequisite for the formation of a knowledge-based society.

Thus, we identify three key levels of intellectual leadership, each of which can be assessed according to the indicators identified. Of course, the availability of resources alone does not determine global leadership, but the availability of these resources is a necessary prerequisite for achieving intellectual leadership in the country by expanding its capabilities in a globalized world in a knowledge economy conditions. The resources listed above are not exclusive - they are based on demographic resources, secondary education of population, etc. However, at the present stage of development, literacy and basic knowledge do not become a prerequisite for leadership of the country.

104 Globalnoje ekonomicheskoje razvitije: tendncii, assimetrii, regulirovanije: monographia/ (D.Lukianenko, B.Kolsov, A.Kolot, J.Stolyarchuk i dr.). – K.: KNEU, 2013. – 466 s

Based on the frameworks of increasing the intellectual potential (and resources) of the country, two key approaches can be identified: increasing own resources and involving them from external sources. Own potential is formed first of all by the system of education Overall and higher education in particular. According to UNESCO, there is a significant increase in the number of students in developing countries and overall growth rates are much higher than in developed countries¹⁰⁵. The vast majority of developing countries show at least an average global growth rate. Turkey, India and China show the absolute leadership, with student population growth of more than 200% between 2006 and 2017. Of course, one of the reasons for this increase in student population is population growth, but quantitative trends are not the only reason.

The largest decline in student numbers is demonstrated by Eastern European countries, totaling over 30% of 2005 levels. Moreover, in Latvia, Hungary, Lithuania, the Russian Federation, Poland, Slovenia and Estonia, in Japan and Finland, the decline rates are slightly lower¹⁰⁶. Along with the development of the countries' own intellectual potential, frameworks for involving human potential from the external environment are actively used. In the global market for educational services, centers of both inflow and outflow of young people for training have been formed. The export and import shares of students in countries around the world are significant there. The countries with lower levels of development showed a deficit with emigrant students, i.e. Brazil, Chile, China, Hong Kong, Colombia, Estonia, Greece,

105 Enrolment in tertiary education, total number – URL: <http://data.uis.unesco.org/#>

106 Enrolment in tertiary education, total number – URL: <http://data.uis.unesco.org/#>

India, Latvia, Lithuania, South Korea, Slovakia, Slovenia, and Ukraine showed an excess of students going abroad over the number of foreign students, and a negative balance in these countries has existed since 2005¹⁰⁷. With it, volatility in attractive countries is much lower and shows a steady tendency to increase the balance of student numbers. The increase in the number of foreign students in Russia is due to the attraction of students from Asia, while the European countries have a wider geography of students. Overall, the growth rates are much higher than the decline rates and have a much higher concentration in individual countries.

The following block of indicators covers the financial resources involved in the formation of intellectual capital. This block includes absolute and relative indicators of financing education (including higher education) and science. These include government expenditures on education, higher education and science in monetary terms relative to general government expenditures and relative to GDP. Such a structure makes it possible to analyze not only quantitative but also qualitative parameters of financing and government's attention to the education system. Government expenditures on education as a share of GDP is a very informative indicator that reflects the state's involvement in the processes of primary intellectual potential formation. Overall, in the developed countries expenditures on education averages 5.26% of GDP, while some countries show much higher rates^{108, 109}.

107 Global Flow of Tertiary-Level Students – URL: <http://uis.unesco.org/en/topic/higher-education>; <http://uis.unesco.org/en/uis-student-flow>

108 Global Flow of Tertiary-Level Students – URL: <http://uis.unesco.org/en/topic/higher-education>; <http://uis.unesco.org/en/uis-student-flow>

109 Government expenditure on education as a percentage of GDP, selected countries URL: <http://data.uis.unesco.org/#>

The funding of science in countries is also important. This is the highest stage of intellectual capital formation in the country and, accordingly, the most informative. The distribution of research expenditures in the world points out the obvious centers of expenditures that spend on science most of all, including the countries of North America, Europe and some Asian countries¹¹⁰. The largest share of R&D expenditures is in the countries of South and East Asia, with 37.6% of global expenditures. North America ranks second in terms of expenditures with almost 28%, and European countries are the third with 21.6% of global expenditures. All other regions of the world spend on research not more than 3% in a region, or 12,8% from world expenses. In total, \$1,917.9 billion was spent on R&D in 2015. Analyzing the geographic concentration of R&D, the differences are more obvious there. For example, in 2015, the United States remained the largest investor in the execution of R&D, with \$ 497 billion, representing over 26% of total expenditures. China was the second with a total cost of \$ 409 billion (21% of total). Japan, which allocated 9% or \$170 billion, was the third. Israel has the highest level of government expenditures on R&D in the world, with a value of 4.25%; South Korea ranks second (4.23%). Overall, all Top 10 countries spend about twice of the global expenditures level. Modern economies have a high level of dependence on the skill level of the workforce, the level of investment in research projects and research. Leading industries are becoming those with science-driven activities, which have emerged only in recent years. The generated knowledge flows are defining new trends in financial, business services, education, healthcare,

110 Government expenditure on tertiary education as a percentage of GDP (%) – URL: <http://databank.worldbank.org/data/reports.aspx?source=Education%20Statistics>

pharmaceutical, aviation and space products. These products are becoming integrators for competitiveness in the global market.

The rapid growth and development rates are typical for developing countries, and conversely, the developed countries are showing some slowdowns, which is explained by a sufficiently stable and high level of funding, as well as the depletion of opportunities for development due to linear innovation. However, they are the developed countries that have more opportunities to form the opportunities of non-linear innovation and a new stage of development realization. Such active development of emerging economies is explained by their concentrated attention on science-intensive industries, an increase in the share of applied resources in R&D, and education. Grouping of countries by the level of GDP expenditures on the R&D was made in the table 1.3.2. As noted, only two countries (Israel and South Korea) spend more than 4% on science. Some countries account for more than 3% of GDP, while the vast majority of the developed countries showed 1.0-1.99% and 2.0-2.99% ranges. Unfortunately, our country belongs to the group of countries with the lowest expenditure shares on science.

The last group of indicators includes intellectual resources, which include absolute and relative indicators of the number of scientists (their number per 1 million population and among the employed). These indicators can also be classified as resultive ones, but they still characterize the available human resources potential and in particular, their intellectual component. The analysis of leading countries' structures by the total number of scientific staff and per 1,000 of employed shows significant differences in the list of leaders,

which include China, Japan, Russia, Germany, India, South Korea, France, United Kingdom, Italy, Spain, the Netherlands, Turkey, Poland, Sweden, Switzerland, Belgium, Austria, Ukraine, Czech Republic, and Denmark¹¹¹.

TABLE 1.3.2. Grouping of countries by R&D expenditure,% of GDP, 2017^{112, 113, 114}

> 3 %	2–2,99 %	1–1,99 %	0,5–0,99 %	< 0,49 %
Sweden, Austria, Japan, South Korea, Israel	Germany, Denmark, Finland, Belgium, Iceland, Norway, Netherlands, Slovenia, EU-27, USA, China	United Kingdom, Czech Republic, Italy, Estonia, Portugal, Luxembourg, Hungary, Spain, Ireland, Russia	Greece, Poland, Croatia, Slovakia, Bulgaria, Lithuania, Malta, Cyprus, Serbia, Turkey	Romania, Latvia, Ukraine, Georgia

If the number of scientists per thousand employees is analyzed, the structure of leaders is completely changing. Overall, these trends indicate the formation of three key intellectual centers as the main display of the modern stage of intellectualization. Of course, the resources needed to build intellectual capacity are not only exhausted by these indicators, but these indicators are key to understanding a country's capabilities, increasing its competitiveness, and enhancing

111 R&D spending. Science & engineering indicators 2018 – URL: <https://www.nsf.gov/statistics/2018/nsb20181/report/sections/research-and-development-u-s-trends-and-international-comparisons/cross-national-comparisons-of-r-d-performance>

112 Research and development expenditure (% of GDP). - URL: <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?end=2015&locations=GE-UA&start=1996&view=chart>

113 Science, Technology and Innovation – URL: <http://ec.europa.eu/eurostat/web/science-technology-innovation/data/database>

114 Naukova ta innovacijna dijalnist Ukraini / Derg. Sluzba statistiki Ukraini. – Kyiv – 2018. – 134 s

the prerequisites for achieving intellectual leadership on a macroeconomic level.

Resources are only a necessary prerequisite for the achievement of intellectual leadership, which is reflected in the results of intellectual activity and takes the form of second-level intellectual leadership, which includes indicators reflecting the infrastructural, educational, scientific and technological readiness to innovate and implement intellectual potential. In part, these indicators may indicate both the results of intellectual activities and be the resources or the necessary basis for the formation of new results of intellectual activity.

The first group of second-level intellectual leadership indicators includes educational and scientific indicators, such as the number of world-class universities, the number of Nobel laureates, and the number of scientific and technical publications in academic publications. The presence of world-class universities also indicates the country's capacity to build and develop its own intellectual potential and at the same time, represents the results of intellectual activity. Key university rating evaluations show that the vast majority of these universities are concentrated in the US and Europe. So, according to the Shanghai rating, 16 of the Top 20 universities are located in the United States of America¹¹⁵.

The last indicator, but not less important in the group of educational and scientific, is the number of scientific and technical publications in the cited publications. According to statistics, countries with lower levels of development in recent years are quite actively increasing the number of publications in cited publications, which affects the rank of universities in the

¹¹⁵ Science, technology and innovation: Total R&D personnel selected countries (in Full-time equivalents - FTE and Headcounts - HC).- URL: <http://data.uis.unesco.org/#>

global rankings. Countries with lower levels of development show the highest growth rates. In particular, China has the highest number of publications per year in the world. Leaders China and the US are showing ambiguous growth rates. For example, while the United States stays at almost the same level, then China has grown significantly since 2005. At the same time, Japan, which ranked third in 2005, even reduced its performance by 7% and lost 3 positions in 2016. India occupied the third place in 2016, increasing its performance by 232% over the period. Germany and the United Kingdom show relatively small increases of 24% and 14%, respectively.

Important indicators for securing second-level leadership are a set of infrastructure indicators that characterize the economy's willingness to spread ICTs and access to communications. These include fixed-line and mobile access, Internet access, and availability of secure Internet servers. Overall, these indicators are more technical in nature, but they point out the ability of developing the economy on a new basis. However, even these indicators can indicate the transition to new technologies and the use of these new opportunities. Growth trends can be observed by analyzing the growth of individual Internet users, which grew from 2005 to 2016 to 45% of the global population, showing a 191% increase. According to the World Bank, more than 90% of Internet users of the total population are in Iceland, Luxembourg, Norway, Denmark, the United Kingdom, Japan, South Korea and the Netherlands. By this indicator, the increase is no longer so unambiguous and it is not concentrated only on developing countries.

Another indicator that confirms the country's ability to achieve second-level leadership is the number of reliable

Internet servers. This indicator has a huge growth rate, which is explained by the development of Internet and mobile technologies Overall, as most new phones can perform the functions of a personal computer. However, Overall, the increase in the number of secure Internet services since 2010 is extremely active, which proves the spread of technologies and opportunities for their use.

The third group of indicators covers the performance indicators. They measure the effectiveness of research and innovation and include patents, trademarks, industrial design, ICT goods and services, and high-tech products. One of the most important indicators is patent activity, given that patents indicate the results of scientific and research activities. China, the United States, Japan, South Korea, Germany, India, Russia, Canada, Australia and Brazil became the absolute leaders of 2016¹¹⁶. China is the undisputed leader, exceeding the US by nearly 1 million patents, and showing 1189% increase of patents number registered by residents from 2005 to 2017. However, there are countries where the activity of non-residents significantly exceeds the activity of residents, such as India, Brazil, Canada, Australia, Singapore, Mexico, Israel, New Zealand, Colombia, Chile, and Hong Kong.

One of the most representative indicators of intellectual performance is the implementation of patent activity in practice, which is reflected in the volumes of high-tech products (production, export, import, ICT products and services). According to reports of global organizations, Asian countries' share of high-tech exports has steadily increased and declined

116 Academic Ranking of World Universities 2019 – URL: <http://www.shanghairanking.com/ARWU-Statistics-2017.html>; <http://www.shanghairanking.com/ARWU-Statistics-2019.html>

only in 2009¹¹⁷.

Only Japan has reduced exports of high-tech goods over the selected period, but as a whole, there is a gradual increase. Almost all selected countries cut exports in the 2009 crisis year, due to the effects of the world economic crisis in 2008, but they had quickly restored their levels. China, Asia and the EU are leaders. Among the countries analyzed in our sample, the highest level of exports of high-tech goods converted to exports was totally demonstrated by Singapore, Ireland, and Switzerland¹¹⁸.

The share of exports in the vast majority of leading countries is gradually declining, which is explained not by a nominal decrease in exports of high-tech goods, but by an increase in exports as a whole. Only Switzerland, France and Norway show an increase in exports of high-tech products in the designated TOP-10 ranking. Overall, the increase in this indicator is characteristic mainly for the countries that did not perform too high in 2005 and, accordingly, have considerable potential for growth, namely Turkey, Chile, Slovenia, Poland, Colombia, Slovakia, Russia, Greece, Lithuania, Latvia, Belgium, and Ukraine, but all of them accounted for less than 10% of high-tech exports in 2005. Thus, the maximum growth of 223% in Poland accounts for only 8.7% of exports of high-tech products of total exports in 2016. Exports of high-tech products are a rather powerful trade flow formed mainly by countries with high levels of development. However, even highly developed countries have significant imports of high-

117 Patents by country – URL: <http://databank.worldbank.org/data/source/world-development-indicators#>

118 Science and Engineering Indicators 2018 - URL: <https://www.nsf.gov/statistics/2018/nsb20181/report/sections/industry-technology-and-the-global-marketplace/patterns-and-trends-of-knowledge--and-technology-intensive-industries>

tech products, indicating the formation of specific centers of gravity. Thus, despite the large share of exports, the US and EU are at the same time leading by the level of imports of high-tech products, which in turn proves the specialization and creation of global flows of products of this type and, accordingly, global markets. Leader countries in the export of high-tech products also have a high level of expenditures on R&D, which is sometimes ten times higher than competitors' expenditures. With it, developed countries are investing in improving existing technologies and developing breakthrough innovations. However, countries with lower levels of development should focus on the initial stage of development.

The final effect is the ultimate performance of intellectual activity, which is expressed by the ultimate economic performance of the economic entity, in this case, the economy of the country. The countries' national economies competitive positions and development can be assessed basing on the global indices and ratings, reflecting the country's position on the world economic map, the results of its economic activity and, accordingly, its competitive position with respect to other countries. Each index reflects the performance of the country's economic activity in a particular sector, the results of the intellectual and creative activity implementation are reflected in the Global Innovation Index. Processes of innovative development in the global economy have long ago become an actual subject of scientific research: their factors, frameworks, tools, dynamics, etc. The formation of a global innovation space is a dynamic process that is accompanied by changes in the disposition of the countries of the world, including the most innovative countries. Innovation is gaining weight for all

countries as it becomes the basis for competitive advantage in leading industries. In order to achieve high ranking positions, both resources and results are important: input resources are institutions, human capital and research, infrastructure and market complexity; the results reveal patents, scientific articles, and creative results¹¹⁹.

The Top 20 ranking of the most innovative countries are high-income countries. These countries have been in this position for several consequent years. However, a circle of leaders is gradually merging with some Asian countries, including China, which immediately shifted from 25th position in 2016 to 22nd in 2017. These countries are consistently demonstrating broad innovation opportunities: powerful scientific and engineering systems, active collaboration between education, science and business^{120, 121}. The Global Competitiveness Index is also included in the resultants' indices. The TOP-10 countries by this index have practically not changed in the last decade, which proves the economic stability of the leading economies^{122, 123}.

Another index that clearly shows the intellectual component is the Human Development Index. In the ranking of this index, mainly European countries are leading^{124, 125}. In

119 High-technology exports (% of manufactured exports), selected countries. URL: <http://databank.worldbank.org/data/source/world-development-indicators#>

120 Patterns and trends of knowledge and technology intensive industries – URL: <https://www.nsf.gov/statistics/2018/nsb20181/report/sections/industry-technology-and-the-global-marketplace/patterns-and-trends-of-knowledge--and-technology-intensive-industries>

121 Kulkarni A. Index shows the global innovation gap is growing / Anand Kulkarni. – 2017 – URL: <http://www.universityworldnews.com/article.php?story=2017080106484882>

122 Global Innovation Index 2019 – URL: <https://www.globalinnovationindex.org/gii-2019-report>

123 Global Innovation Index 2007 – URL: <https://www.globalinnovationindex.org/userfiles/file/GII-2007-Report.pdf>

124 Global competitiveness Report 2017-18 – URL: <http://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobalCompetitivenessReport2018.pdf>

125 Global competitiveness Report 2006-07 – URL: http://www3.weforum.org/docs/WEF_

terms of human development, the list of leaders has changed significantly, Singapore and Germany increased their positions by more than 10 points. Finland, Sweden, and Japan lost their positions, leaving the Top 10 ranking. In addition, in 2018, Hong Kong entered the list of leaders, ranking 7th together with Sweden.

The next index that characterizes the performance and opportunities to transition to a knowledge economy is the Network Readiness Index. It is a symbiosis between the technological resources and the results of the technology implementation¹²⁶. Denmark, Iceland and South Korea have lost their positions in the TOP-10 due to a decrease of their positions by an average of 4 points for each. Singapore, Finland, the Netherlands, Norway, Luxembourg, the United Kingdom and Canada showed growth. Even relatively small countries, which demonstrate high activity and efficiency managed to enter into the ranking of top ten countries in the world by various indexes.

Thus, the intellectual leadership expresses itself on different levels and is characteristic for different entities. In today's context, the new entities of intellectual leadership are emerging, and their influence becomes possible due to the formation of global networks. This enables the leadership of small entities and their extremely rapid development, which increases competition in the global market and accelerates economic and technological development. Considerable state policies to form the conditions for the development of such entities can be an incentive to ensure state leadership on the global level. According to research, intellectual leadership

GlobalCompetitivenessReport_2006-07.pdf

126 Global competitiveness Report 2006-07 – URL: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2006-07.pdf

at various levels of manifestation is provided mainly due to the realization of the development of the factors that determine this level. So, we can distinguish three key levels of intellectual leadership: resource, resultant, and final (output). Each of these levels brings together a set of indicators that can assess the potential of a particular country. At the first level, intellectual leadership is represented via ensuring the realization of resource potential (mainly concentrating on the formation of basic advantages and development opportunities). These include the provision of funding for basic educational needs, the availability of human resources and their qualitative characteristics, and the availability of scientific staff of appropriate quality. Investigation of selected countries indicates that a focus on indicators of this level is typical for countries with lower levels of development, as this baseline is necessary for the development of higher level leadership.

Second-level leadership is manifested in the resources that have resulted from the implementation of the primary ones. It is an existing infrastructure that facilitates the involvement or formation of highly qualified staff and the availability of a sufficient base of intellectual property rights that can provide development in the modern conditions. This group includes educational and scientific indicators (country's position on the global map of the educational services market and its competitiveness), infrastructural (availability of necessary basic infrastructural elements providing communication and access to global networks), technological (research and intellectual property rights). At this level, the countries with higher levels of economic development, with a well-developed base, and broad opportunities for leadership are leading.

Third, the final level is not only a prerequisite for leadership, but also to some extent its result, which allows to prove the country's competitiveness on the global economic map. The results of state economic and social policy are reflected in numerous rankings and indexes, which, at the present stage, include more indices of intellectual development or formation of intellectual potential.

CHAPTER 2

Globalization of intellectual activity

2.1. Knowledge management in international companies

The paramount importance of knowledge for creation of product and enhanced efficiency of production process and management makes it a strategic resource of a company¹. With the transfer to knowledge economy, new modalities emerge in all management spheres (management of personnel, finances, production, etc.), resulting from the need to more efficient obtaining and use of knowledge. Knowledge management becomes a separate area and type of management activity, which encompasses operations with knowledge management and is of particular importance for innovations^{2, 3}.

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- 1 Smolyar, L.G., Koba, N.V. (2008) Knowledge as a strategic resource of modern enterprise. Bulletin of the National university "Lviv Politechnic". 2008. No.628: Economic and management problems. P. 641–647
 - 2 Nonaka, I. (2006) Company is a creation of knowledge: Knowledge management. M.: Alpina Business Books, since 2006. 476 p.
 - 3 Polyakov, M.V. (2017) Knowledge management in international companies: theoretical and methodological backgrounds, basic areas and mechanism. Efficient economy. 2017. No.7. URL: <http://www.economy.nayka.com.ua/?op=1&z=5690> [Accessed: 29.01.17]

The importance of knowledge management is due to continuously increasing intellectual and innovative component of economic activity, which took hold in XX century (P. Drucker^{4, 5, 6}). This is particularly relevant for international business, which operates in condition of the increasing competitiveness, rapid technological, institutional and market changes on a global scale, and faces maximally complex, dynamic and uncertain business environment. All this requires systemic approach.

Theoretical and methodological background of knowledge management is laid: by teachings of M. Polanyi⁷, M.K. Mamardashvili⁸, V.I. Vernadsky^{9, 10}, methodology of vertical integration of knowledge developed by I.G. Khanin¹¹, microeconomic theory of knowledge management (B. Kleiner, B. Milner)¹², theory of knowledge transformation (I. Nonaka, H. Takeshi, von Koch)¹³, theory of gaining new knowledge

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- 4 Drucker, P. (1999) Post-Capitalist Society. New post-industrial wave on the West. Anthology. M.: Academia, 1999. 631 p.
 - 5 Drucker, P.F. (1969) The Age of Discontinuity: Guidelines to Our Changing Society. New York: Harper and Row, 1969. 393 p.
 - 6 Drucker, P.F. (2001) The Next Society. The Economist. 2001. URL: <http://www.economist.com/node/770819> [ccessed: 15.02.17]
 - 7 Polanyi, M. (1967) The Tacit Dimension. New York: Anchor Books, 1967. 108 p.
 - 8 Mamardashvili, M.K.(2012) Vilnius lectures on social philosophy: (Experience in physical metaphysics). Azbooka; Azbooka-Attius, 2012. 320 p
 - 9 Vernadsky, V.I. (1986) Biosphere and Noosphere. M.: Nauka, 1989. 261 p.
 - 10 Vernadsky, V.I. (1991) Scientific thought as a planetary phenomenon. M.: Nauka, 1991. 271 p.
 - 11 Khanin, I.G.(2009) System-semiotic concept of noospheric city as a cultural, innovative and business center. Problems and prospects for development of cooperation between the countries of South-East Europe within the framework of the Black Sea economic cooperation and GUAM: collection of scientific papers. Donetsk: Donetsk National University. 2009. P. 657-662
 - 12 Popov, Ye.V., Vlasov M.V. Institutional analysis of knowledge economy. URL: <http://www.m-economy.ru/art.php?nArtId=1474> [Accessed: 29.01.17]
 - 13 Nonaka, I. (2006) Company is a creation of knowledge: Knowledge management. M.: Alpina Business Books, 2006. 476 p.

(M. Sheller)¹⁴; concept of organization which is learning (M. Pedler, J. Burgoyne, T. Boydell)¹⁵; concept of knowledge-based company (organization)¹⁶; basic concept of knowledge management (P. Drucker, P. Dretske, T. Stewart)¹⁷; concept of “triple helix” (G. Itskovits)¹⁸, and the best practices at the confluence of informatics and economy (knowledge management tool), special information systems (D. Brooks)¹⁹. All these theoretical and methodological sources enabled singling out the sphere, features of knowledge management, its basic trends and components, strategic and tactical aspects, key processes, organizational elements, etc.

The papers of a huge number of scientists and practitioners are devoted to various aspects in order to ensure efficient operations with knowledge and to manage its obtaining and use. At the same time, the application of knowledge management in international companies is a comparatively new trend²⁰. A need to consider knowledge management in the international companies (or multinational ones – TNC) is due to the following reasons: predominance of the innovative

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- 14 Popov, Ye.V., Vlasov, M.V. Institutional analysis of knowledge economy development. URL: <http://www.m-economy.ru/art.php?nArtId=1474> [accessed: 29.01.17]
 - 15 Pedler, M., Burgoyne, J., Boydell, T. (1994) *The Learning Company: A Strategy for Sustainable Development*. N.Y.: McGraw-Hill, 1994. 224 p.
 - 16 Leon, R.-D. (2014) The sustainable knowledge based organizations – definition and characteristics. *Environmental Engineering and Management Journal*. 2014. URL: http://www.eemj.icpm.tuiasi.ro/pdfs/accepted/278_510_Leon_13.pdf [Accessed: 14.04.2016]
 - 17 Popov, Ye.V., Vlasov, M.V. Institutional analysis of knowledge economy development. URL: <http://www.m-economy.ru/art.php?nArtId=1474> [Accessed: 29.01.17]
 - 18 Itskovits, G. (2010) *Tripple helix. Universities – enterprises –state. Innovations in action*. Tomsk: TUSUR publishing house, 2010. 238 p.
 - 19 Brooks, D. (1990) *Information transformation into knowledge*. NTI. Series 2. M., 1990. No. 7. P. 12-27
 - 20 Goodman, N.R. (2014) *Knowledge Management in a Global Enterprise*. TD Magazine. 2014. P. 28-31; Kalkan, V.D. (2005) *Knowledge Management Challenges for Global Business*. *International Business & Economics Research Journal*. 2005. Vol 4, No.10. P. 19-28

type of competence on the world markets; increasing costs on data obtaining as a scarce resource; accumulation and the increasing importance of intellectual assets; increased demand for intellectual labour and costs on it, etc. There is a need to make changes in all key aspects of the companies' activities (organization structures and culture, personnel development, innovative strategies, technological policy, etc.). It is not only the enterprises, which become the entities introducing knowledge management, but also universities, government institutions, public and international organizations. This is due to their international activities, where the complexity of processes is at maximum level. Knowledge management is also used in case of implementation of the innovative and civil (social) projects²¹.

The experience of the leading world companies demonstrates that knowledge management is focused on addressing the specific problems. The first example is ensuring the efficiency of R&D, especially, if we are speaking of the huge innovations, when there is a portfolio of projects, and the significance of rational distribution and use of resources is increasing. The second example is the problem of personnel adaptation and training, taking into consideration that today the knowledge factor becomes the determining parameter. The third example is a creation of information systems and tools, which allow organizing in a new way the processes, flows and communications, where knowledge becomes the key component. The fourth example is an introduction of the innovative technologies.

21 Polyaniinova, T. (2011) Knowledge Management in a Project Environment: Organisational CT and Project Influences. *Vine*. Vol.41, Iss.3. 2011. P. 34-48. URL: <http://arrow.dit.ie/cgi/viewcontent.cgi?article=1003&context=seschcomart> [Accessed: 14.06.16]

All-encompassing importance of knowledge for the company's activities of became a basis for emergence of knowledge management. In the narrowest sense, knowledge management is understood as a complex of activities in the sphere of obtaining, storage, dissemination and use of knowledge, including traditional management functions (planning, organization, promotion and control). With the expansion of ICT use, knowledge management is more understood as the notion, similar to the information management (achievement of the high level of awareness) and advanced informatization in business processes. Knowledge management is represented as a "dynamic system for identification of critical information, its collection from those who have it, storage and, ultimately, exchange with those who need it, including the employees, clients and other concerned parties"²². In Deloitte's report, knowledge management is understood as "the art of transforming the information and intellectual assets into stable value for the clients of an organization and its people. The key goal of knowledge management is timely to obtain the required information from the right people in order to help people to exchange experience and knowledge as well as to enhance efficiency of the teams"²³.

The content of knowledge management is broader than the same of information resource management, as it encompasses the other resources and processes of the company, and is focused on strategic goals, related to development and

22 Roshanzamir, A., Kardan, A.A. (2014) A Novel KM Framework for Fostering Creativity and Stimulating Innovation. The Sixth International Conference on Information, Process, and Knowledge Management. eKNOW, Barcelona, Spain. 2014. URL: https://www.thinkmind.org/download.php?articleid=eknow_2014_3_30_60137 [Accessed: 01.03.16]

23 Deloitte Touche Tohmatsu Limited. URL: <https://www2.deloitte.com> [Accessed: 09.11.17]

competitive advantages. Therefore, knowledge management should be understood as the goal-oriented and systematic managerial activity, including development of special methods, procedures, and creation of tools for search, obtaining, assessment, storage, transfer and use (transformation) of knowledge, being the essential elements of intellectual capital. In other words, knowledge management is presented as a complex function in respect of all types of works, aimed to enhancement of efficiency and productivity of the company in general to achieve its goals. The subject of knowledge management is the basic processes of knowledge obtaining and using in the Company, which encompasses an application of human capital, information resources and tools.

In general, the modern knowledge management should be related to a systemic process, maintained by ICT, which enables the organization to generate, capture, share and use knowledge implicitly or explicitly to achieve organization's purposes by the way of improving the organizational characteristics²⁴.

J. Girard and J. Girard, analyzing the meaning of knowledge management, point out relatively small distinctions in understanding of knowledge management in different industries where it is used: bookkeeping, aerospace industry, librarianship and archive-keeping, artificial intelligence, content management, security, construction, education, energetics, engineering, finances, management, health care, information and HR management, ICT, law, science²⁵. C. O'Dell and C.J.

24 Nahar, N., Al-Obaidi, Z., Huda, N.(2001) Knowledge Management in International Technology Transfer. Technology Management in the Knowledge Era. IEEE and PICMET, Oregon, USA. 2001. P. 355-364

25 Girard, J., Girard, J. (2015) Defining knowledge management: Toward an applied compendium. Online Journal of Applied Knowledge Management. 2015. Vol. 3, Is. 1. URL:

Grayson define knowledge management as a conscious strategy for knowledge obtaining by people in the required time to improve efficiency of organization's activities²⁶. In the opinion of T. Davenport and L. Prusak, knowledge management is based on the available resources of the organization and consists in the efficient management of information systems, organizational changes and human resources²⁷. D. Arkell, using the example of the company Boeing, defines knowledge management as an integral approach to the efficient use of experience aiming at competitive advantage creation. In Boeing, knowledge management consists of a complex system of processes, tools, methods and techniques, which enable employees to obtain and exchange the information²⁸. A. Macintosh believes that knowledge management includes the identification and analysis of the available and required knowledge resources, and the related processes as well as further planning and control of activities to develop assets and processes to achieve the goals of the organization²⁹. Knowledge management is also presented as a systematic approach, which allows the optimal use of timely, precise and relevant information in organization; facilitates generation of knowledge and innovations, learning, integration of various information sources as well as individual and collective knowledge and experience³⁰.

http://www.iiakm.org/ojakm/articles/2015/volume3_1/OJAKM_Volume3_1pp1-20.pdf
(Accessed: 12.12.16)

- 26 O'Dell, C., Grayson, C.J. (1998) *If only we knew what we know: the transfer of internal knowledge and best practice*. New York: Free Press, 1998. 238 p.
- 27 Davenport, T., Prusak, L. (1998) *PaWorking Knowledge: How Organizations Manage What They Know*. M., 1998. 560 p.
- 28 Arkell, D. (2007) *Get our heads into it*. Boeing: *Frontiers*. Vol. 6, Iss. 6. 2007. P. 13-17.
- 29 Macintosh, A. *Knowledge Management*. URL: <http://www.aiia.ed.ac.uk/~alm/kamlnks.html> [Accessed: 14.06.17]
- 30 Girard, J., Girard, J.(2015) *Defining knowledge management: Toward an applied*

Knowledge management is not only related to obtaining and use of knowledge, but is also implemented to enhance the efficiency of all business processes and potential of the company. It includes preparation and implementation of various activities (events) in the internal and external environment. The approaches of knowledge management can be applied in the existing companies, and can be an element of establishing the new company, particularly the innovative one. Within the company, knowledge management is aimed to ensure human intellectual activity; it deals with information practices and cognitive processes, including a creation of the tools to enhance the capacity in the sphere of communications and data processing.

An understanding of the meaning of knowledge economy is considerably influenced by the understanding of the company (firm) as an institute, which generates and uses knowledge, taking into account that it becomes a priority activity. In knowledge management, creation of the company, its structure, management system, strategy, etc. begins with knowledge and design of the respective knowledge management processes. This is due to the fact that modern companies: 1) introduce special procedures in the sphere of knowledge obtaining and use; 2) create special internal environment with intensive circulation of knowledge; 3) change approaches to the use of human resource capacity; 4) apply special methodologies and tools for work with knowledge; 5) follow the principles of collective progress and introduce new approaches to human resource management.

D. North stated that development of knowledge resources is critical for the purposes of maximizing the firm³¹. Knowledge management is included in achievement of the company's goals in respect of making profit and ensuring sustainable development, and becomes a basis for increasing the efficiency limit. Therefore, knowledge management is included in the sphere of strategic management and, to a significant extent, determines the mission, goals and doctrine of the companies' development.

We should take into consideration the existence of special goals in the sphere of knowledge, respective results and target indicators. Figure 2.1.1 shows the of knowledge management goals and challenges.

In order to address the above-stated challenges, knowledge management performs all management functions according to the pattern, resulting from the specifics of knowledge and intellectual activities. The implementation of all functions involves the expertise, aimed at understanding of its meaning and value, and economic assessment of knowledge. A key entity and, simultaneously, an object of influence in knowledge management are a human, namely: individual employees, collectives, departments, communities. When considering a human, his vital resources and capabilities as well as psychological and behavioral characteristics should be taken into consideration. The distinctive features of different types of knowledge, in particular, the new ones, which are necessary for innovations, should also be taken into account. In the companies, the fundamental scientific knowledge is less in demand. The practical (applied) knowledge, various know-hows and solutions are used systematically and prevail. They are mostly hidden, diffused, distributed between people, non-

31 North, D.C. (1997) *Institutes, institutional changes and economic performance*. M.: Economic book fund "Nachala", 1997. 180 p.

KNOWLEDGE MANAGEMENT GOALS

Generation of innovations based on new knowledge	Enhanced efficiency of resource use	Creation of sustainable competitive advantages	Enhanced efficiency of operations with knowledge
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KEY KNOWLEDGE MANAGEMENT CHALLENGE

- | |
|--|
| <ul style="list-style-type: none"> • Enhanced efficiency of obtaining new knowledge; • Development of innovative capacity and intellectual resources, build-up of knowledge component; • Intangible assets building; • Improvement of organizational culture; • Minimization of risks, etc. |
|--|

<p style="text-align: center;">Basic categories:</p> <ul style="list-style-type: none"> • Knowledge management; • Innovative capacity; • Intellectual resources; • Intangible assets; • Information tools; • Business processes, etc. 	<p style="text-align: center;">Management types:</p> <ul style="list-style-type: none"> • proactive; • adaptive; • systemic; • technical; • information; • social, etc. 	<p style="text-align: center;">Elements of management:</p> <ul style="list-style-type: none"> • plans, management methods; • procedures, instructions; • information systems and tools; • various practices; • assessment methods, etc. 	<p style="text-align: center;">Focus areas:</p> <ul style="list-style-type: none"> • Intangible assets management; • Innovative process organization; • Project management; • Innovative capacity development, etc
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<p style="text-align: center;">Basic approaches</p> <ul style="list-style-type: none"> • planning, reactive; • competence-based; • market; • consultative; • intuitive, leadership; • partnership, expert; • administrative, etc. 	<p style="text-align: center;">Key processes</p> <ul style="list-style-type: none"> • Adoption of plans; • Arrangement of works; • Knowledge obtaining; • Knowledge transfer; • Innovative activity; • Performance assessment; • Monitoring, control; • Audit, etc.
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Figure 2.1.1. Methodological background of knowledge management in the company

Source: Compiled by the authors

formalized and not protected, but are the determining factor for the result.

The know-hows, related to knowledge obtaining and use,

should be singled out in a separate category. It has a special theoretical and methodological aspects, and requires new approach. In terms of knowledge use in the company, it should be divided by the following features: 1) novelty and relevance (in terms of strategy and tactics; importance level and prospects); 2) period of use (long-term, short-term); 3) way of origin and obtaining by the company; 4) place of generation and source, holders (a human, a number of humans, product, equipment, documents, patent, etc.); 5) specifics of control and protection; etc. Knowledge is most often used in the form of certain “mixes” (clusters), which are structured to yield concrete result. “Mixes” are inter- and multidisciplinary. Their organization is strongly dependent on the content and subjective factors.

Concerning certain knowledge, the company can actively cooperate with organizations and private persons, using different modes of knowledge obtaining, for example: involvement of external expertise, purchase of the full package or portion of knowledge, participation in consortiums. There are also different modes of knowledge use based on organizational models (by products, operations, R&D stages, etc.) and routines.

The organizational knowledge as a combination of ideas about operation of the company, its structure and culture. They include various data, know-hows, methodologies, understanding of the procedures which are required for interpretation of in-house information and understanding of the context, as well as the hidden traditions and dominating opinions, which also influence the company’s operation. Organizational knowledge makes the company a single whole; it mostly exists and is shared implicitly. In multinational corporations, it is also formed from organizational knowledge of subsidiary companies and general knowledge, which becomes relevant in different countries.

The specifics of knowledge management in multinational corporations is as follows. Firstly, there is a spatial aspect; knowledge should be managed at the international level within the limits of institutional structure of the corporation in different countries and regions of the world. There are needs to arrange flows of knowledge, distribute technologies, etc. In this context, there is a necessity to distribute functions of parent and subsidiary companies in the strategic and tactical knowledge management, to establish the principles of hierarchy and internalization of knowledge management, taking into account its scale (Table 2.1.1).

TABLE 2.1.1 Ownership complexity indicator (form of ownership) in the largest 100 multinational corporations according to UNCTAD’s ranking³²

Indicators at the group level	Average	Minimum	Median	Maximum
Number of subsidiaries, totally	549	118	451	2082
Number of foreign subsidiaries	370	41	321	1454
Hierarchical depth (number of hierarchical levels)	7	3	6	15
Number of countries in the network	56	8	54	133
Number of subsidiaries in Offshore Financial Centers	68	7	55	329
Number of holding companies	19	0	15	155

32 United Nations Conference on Trade and Development (UNCTAD). URL: <http://unctad.org> [Accessed: 21.09.17]

The geography of knowledge generation is taken into consideration, which enables adapting the strategy to global conditions³³. Knowledge is predominately created locally, therefore multinational corporations, within the framework of global activities, obtains and arrange it aiming at creating the cluster to be used. The spatial aspect is related to a wide range of organizational, strategical, procedural, time and other issues. Management of costs on knowledge, choice of obtaining means, building of the structures and policy of use (for example, the strategy of servicing the market based on combining the export, production, innovative, licensing and investment activities).

Secondly, multinational corporations become a subject of technological transfer, where the challenges arise, in particular, relating to technological advancement of foreign production, coordination of R&D and maximization of profit from proliferation of technology.

Thirdly, multinational corporations have specific multinational environment and culture, which, first of all, determine the specifics of communication and management relationship. Geographic remoteness and mental distinctions require respective institutional and organizational approaches, and strengthening of cognitive and social closeness. In particular, it is related to establishment of single institutes, procedures, practices and systems, which ensure work with knowledge, especially with the use of ICT. The organizational structure of the principles of multinational corporations is specific due to combination of multinational environment and

33 Buckley, P.J., Ghauri, P.N. (2004) Globalisation, Economic Geography and the Strategy of Multinational Enterprises. *Journal of International Business Studies*. 2004. No.35(2). P. 81–98

universal principles. It requires individual assessment with respect to knowledge management, particularly, in terms of overcoming the cultural barriers³⁴.

Fourthly, multinational corporations have specific external environment, which is built around every subsidiary in different countries. It forms very complex system of external communications in the sphere of knowledge and “learning curve effect” of corporation, when there is a multitude of knowledge sources, continuous activity to obtain knowledge and develop in the global landscape that forms wide opportunities for education. Knowledge management practice in multinational corporation is specific in scale and activities in different markets.

Fifthly, multinational corporations perform knowledge management within the framework of competitive strategy at the global level. Due to the increased competition, knowledge management faces the new challenges and targets in respect of formation of “local” and “global” advantages. At the same time, multinational corporations create competitive advantages by means of accumulation and integration of intellectual resources, located in different countries.

Thus, knowledge management is a sign of developing the management activity. In modern conditions, the knowledge management, especially in multinational corporations, starts using global approach, corresponding to the scale and levels of challenges (Figure 2.1.2). The global approach is of particular importance for generation of a unique knowledge and enhancement of its value.

The system approach, which starts to be used in knowledge

34 De Long, D.W., Fahey, L. (2000) Diagnosing cultural barriers to knowledge management. *Academy of Management Executive*. 2000. No.14(4). P. 437-457

management, includes formation of knowledge management system (KMS), combining the multilevel assembly of interacting elements, which ensure obtaining and use of knowledge. While being formed, KMS can be represented as an “assembly line” to deal with knowledge, which harmoniously combines material, human and information resources for efficient knowledge management processes. When considering the multinational companies, it should be noted that the most critical distinction of KMS building is an adaptation to the remoteness of subsidiary companies, taking into account the factor of closeness for cooperation and synergy.

The key principles of KMS creation in multinational companies is: 1) adaptation to spatial dispersion and remoteness; 2) focus on global space of activities and international sources of knowledge obtaining; 3) development of internal institutes, organization culture and tools for communication; 4) consideration of the industrial specifics and geography of the company’s activities; c) creating a variety of approaches and practices of knowledge management, primarily, by means of developing our own ones; 6) ensuring the flexibility of KMS; 7) combination of universal and special (for subsidiary enterprises, markets and branches of knowledge) methods for assessment of knowledge and efficiency of their use, etc. Introduction of KMS requires adaptation of general system of management and human resources.

KMS is aimed: 1) to generate and ensure the innovate business processes in the sphere of knowledge obtaining and use; 2) to facilitate maximum freely circulation of knowledge inside the company; 3) to ensure institutional, cultural and motivational “tuning in” of the team to work in the sphere of knowledge,

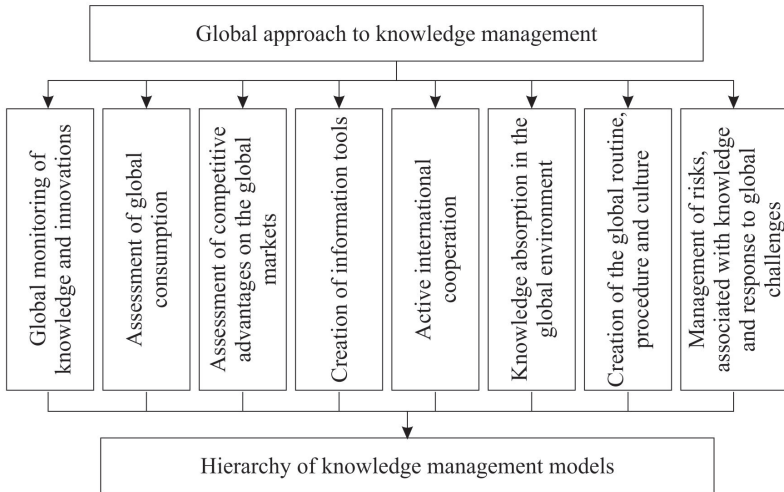


Figure 2.1.2. Characteristics of global approach to knowledge management in multinational company

Source: Compiled by the authors

development of intellectual potential, education; 4) to create favorable environment for intellectual activities of personnel; 5) to create culture and mechanisms for intellectual interaction; 6) to maintain the required level of openness and freedom in the sphere of knowledge; 7) to facilitate addressing the problems of knowledge management, including the wrong assessment of knowledge, uncertainty, improper fulfilment of obligations, risks. KMS has all features of institutional and social systems. For multinational corporations, KMS encompasses corporate innovative system in terms of knowledge base creation for development of innovations, ensuring business processes related to knowledge, in the ongoing economic and innovate activities.

From a functional perspective, KMS includes the following basic systems: 1) doctrinally-methodological (development of

concepts, models of organization, methodologies, techniques and methods of work); 2) management subsystem (development of strategy, plans with different deadlines, mechanisms of resource accumulation); 3) knowledge obtaining (provides the ways and mechanisms of knowledge obtaining or generation, and formation of the required knowledge base); 4) knowledge use (includes all business processes, related to development and introduction of innovations, partially technological, production and marketing operations); 5) development of human resources (including training, mentorship and professional development of personnel); 6) infrastructural (creation and development of infrastructure for obtaining, storage, assessment, dissemination and use of knowledge). Besides subsystems, there can also be considered the component structure of KMS (institutional, organizational, human, information, tool and other components).

The key component of KMS is a mechanism of knowledge management in the company, being understood as an assembly of institutes, methods and tools of knowledge management, aimed at achievement of the company's goals in the sphere of knowledge and in the economic activity as a whole. The key principle for building of such mechanism is a correspondence of its structure and qualitative parameters of the elements to the existing conditions and goals. Figure 2.1.3 shows the key elements of knowledge management mechanism^{35, 36, 37}.

35 Awazu, Y., Desouza, K.C. (2004) The knowledge chiefs: CKOs, CLOs and CPOs. *Europ. Management j.* Oxford, 2004. Vol. 22, No.3. P. 339–344

36 Girard, J., Girard, J.(2015) Defining knowledge management: Toward an applied compendium. *Online Journal of Applied Knowledge Management.* 2015. Vol. 3, Is. 1. URL: http://www.iiakm.org/ojakm/articles/2015/volume3_1/OJAKM_Volume3_1pp1-20.pdf [Accessed: 12.12.16]

37 Polyaniinova, T. (2011) Knowledge Management in a Project Environment: Organisational CT and Project Influences. *Vine.* Vol.41, Iss.3. 2011. P. 34-48. URL: <http://arrow.dit.ie/>

KNOWLEDGE MANAGEMENT MECHANISM IN INTERNATIONAL COMPANY

|
Planning basis of the company's activities

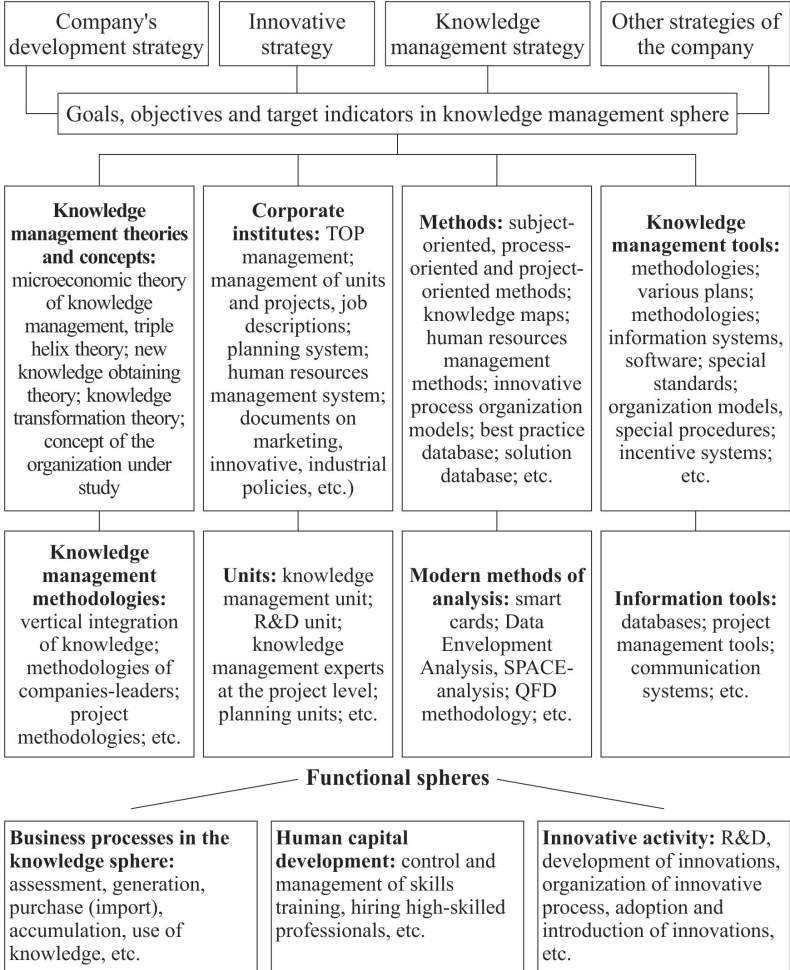


Figure 2.1.2. Characteristics of global approach to knowledge management in multinational company

Source: Compiled by the authors

Knowledge management is applied in the leading companies of the world. Thus, in Apple the knowledge management is considered as the key competence, the element of the company's culture, the basis for innovativeness and an attribute of the brand. Knowledge management is considered as a strong point of the company; it enables creating the innovate products, continuously evolving, maintaining the advantages and constraining the outflow of knowledge. The key elements of knowledge management, being implemented based on ICT, are: data repository; intranet; expert system; various directories; artificial intelligence. Apple places the key emphasis in the knowledge management on organizational culture; they developed a comprehensive policy and methods for generation, collection and adaptation of knowledge for the innovative activity. Knowledge management is used in training of managers. In the company, created by Apple University for dissemination of culture and exchange of knowledge^{38, 39}.

IBM company created a portal of knowledge management (K-Portal), which enables the employees to search for documents and product details, to accumulate information of their clients and competitors, to submit presentations and projects. A special application is also used to manage intellectual capital of ICM AssetWeb, which is represented by the portal to collect information from different sources and disseminate it within the company. IBM also created the repository of information,

cgi/viewcontent.cgi?article=1003&context=scschcomart [Accessed: 14.06.16]

- 38 Johnson, K., Li, Y., Phan, H., Singer, J., Trinh, H. (2012) The Innovative Success that is Apple, Inc. Theses, Dissertations and Capstones. Paper 418. Marshall University, 2012. 42 p.
- 39 Roshanzamir, A., Kardan, A.A. (2014) A Novel KM Framework for Fostering Creativity and Stimulating Innovation. The Sixth International Conference on Information, Process, and Knowledge Management. eKNOW, Barcelona, Spain. 2014. URL: https://www.thinkmind.org/download.php?articleid=eknow_2014_3_30_60137 [Accessed: 01.03.16]

being a Knowledge Café as a global network of information exchange between employees, online educational portals (“Workplace upon request”, IBM Learner Portal, IBM Skills Gateway, training laboratory for developers, etc.)^{40, 41}.

Microsoft uses the cutting-age approaches to knowledge management, considering it as a part of business planning. The key element of knowledge management is Knowledge-Management Platform, which includes knowledge desk top, knowledge service, special server, connected devices, solutions for partners. The content management is introduced to the sphere of explicit knowledge. The attention is also drawn to ensuring the common use of implicit knowledge, proliferation and exchange of ideas, views, values and judgements. A separate field is synthesis, processing and analysis of data to obtain new knowledge. Moreover, owing to ICT, the best practices are identified, joint activities and exchange of knowledge are ensured, client management and employees development are organized, the network of the external partners are organized, etc. A great deal of attention is paid to social aspects of knowledge management, including: enhanced motivation and organization culture, learning-by-doing, career management, change of motivation, etc. Knowledge management principles form the basis of human resource management, especially management of human competences, efficiency and learning^{42, 43}.

40 Smirnov, Ye.V., Vibly, P.I., Zakharin, S.V. (2017) Prospects for the enhanced cooperation in the sphere of investment and innovation. *Current economic issues*. 2017. No.2 (188). P. 38-43

41 Knowledge Management. IBM, Lotus, 2000. Vol. I. 58. URL: <https://www.scribd.com/document/88589187/IBM-KM-Case-Studies-1>. [Accessed: 15.01.16]

42 Hultkvist, E. (2010) A case study of knowledge management in a large software company: How knowledge workers cope with large amounts of information. University of Oslo, 2010. 81 p

43 Practicing Knowledge Management. Microsoft Corporation, 1999. URL: <http://www>.

Ford Motor Company, based on intranet, replicates the best practice (eBPR) by means of eBusiness Infrastructure. This business process is aimed to collect, proliferate and monitor the value of the best ways of doing business. ICT are used in formation and ensuring the activities of communities in the sphere of knowledge, establishment of coordinating centers and supporting the leaders of communities. The knowledge management activities in the Ford Motor Company include the learning and sharing the best practices, addressing practical problems, accumulating knowledge and supporting decision making^{44, 45}.

By results of the analysis of different companies' activities in different industries^{46, 47}, we can highlight the following widespread practices in knowledge management sphere: 1) creation of training tools for the specialists, online sharing of knowledge; 2) R&D management platforms for development of innovate products; 3) retention and transfer of knowledge in case of restructuring; 4) organizing expert associations, internal consulting, business development services; 5) synthesis of collective knowledge and knowledge sharing between communities throughout the world; 7) training in the fundamentals of knowledge management, etc.

More intensive use of knowledge until its complex

providersedge.com/docs/km_articles/Practicing_KM.pdf [Accessed: 09.10.16]

44 Measuring the Impact of Knowledge Management: Ford Motor Company. APQC, 2003. P. 75-87. URL: public.dhe.ibm.com/services/us/gbs/bus/hcm/rbtt/ford.pdf [Accessed: 05.01.17]

45 Wolford, D., Kwicien, S. (2003) Handbook on Knowledge Management. Driving Knowledge Management at Ford Motor Company. Springer-Verlag Berlin Heidelberg, 2003. URL: https://link.springer.com/chapter/10.1007%2F978-3-540-24748-7_23#page-1 [Accessed: 08.01.16]

46 Knowledge Management. IBM, Lotus, 2000. Vol. I. 58 p. URL: <https://www.scribd.com/document/88589187/IBM-KM-Case-Studies-1>. [Accessed: 15.01.16]

47 Best Practices in Legal Knowledge Management /under the editorship of S. Ramasamy. Ark Group, 2011. 91 p

transformation. Introduction of knowledge management methodologies requires reengineering of all processes in the company and updating of the management system. Almost every management sector in the company, including knowledge obtaining and use, is related to knowledge management. Knowledge management is also an element of all sectors (Table 2.1.2.).

TABLE 2.1.2. Characteristics of relationships between management sectors and knowledge management

Sector	Relation to knowledge management
Strategic management	Strategic goals determine the development areas and, consequently, challenges in the knowledge sphere; knowledge management can have a corrective impact on the goals and objectives, particularly in terms of innovations; knowledge management enables determining the key competitive advantages, key competencies, managing the sustainability of the company, producing efficient development programs.
Innovative management	Knowledge management includes the innovative activities and is subordinate to the strategy of its development; knowledge management directly ensures certain operations (development of new ideas, justification of innovations, R&D, patenting, investments in knowledge, etc.); knowledge management ensures development of global innovations and creation of global innovative networks; knowledge management includes foresight and correction of the innovative strategy, determination of the key aspects (for example, generation or obtaining of knowledge); management of multinational R&D is performed.
Information management	Multinational corporations operate in the global information space, therefore, information management is related to knowledge management in terms of

	organization and information and analytical support of intellectual activities; ensuring business processes, related to knowledge; development of communications, enhancement of the level of employees' awareness; development of special information tools and systems, organization of infrastructure, etc.
Production and technological management	Multinational corporation is focused on global technological trends; knowledge management is related to formation of global value chains; Knowledge management is related to rationalization of technological policy, purchase/development of technologies, provision of these processes; within the framework of knowledge management, there is ensured an adoption of new organization methods, models, study of technological barriers to enter the market, industrial training, obtaining of production know-how; knowledge management is ensured by achievement of the required level and range of competences, transfer of knowledge between production, and marketing units of R&D.
Human resource management	Knowledge management is related to ensuring the development and efficient use of human capital, organization and enhanced productivity of intellectual activities, advancement of organizational culture; knowledge management determines the exchange of implicit knowledge and corrects in-house migration, formation of creative teams and social responsibility in the knowledge sphere.
Intangible asset management (IAM)	The policy in IAM sphere is implemented on a global scale; accumulation of such assets by means of knowledge and their assessment, depreciation and sale; intellectual property protection.
Marketing management	Multinational corporations are customized to global markets and trends, globalized demands; product strategy influences knowledge management, assigning

	<p>the tasks; gathering knowledge on markets, expertise of the market environment; survey of the needs, characteristics of products, development of innovations taking into account market demands; promotion of high-tech products to the new markets; positioning of the company.</p>
Risk management	<p>Knowledge management is related to general risk management, proper monitoring and control of risks in the sphere of human resources and technologies; moreover, knowledge management enables managing specific and new risks, related to knowledge, while retaining the ownership right; within the framework of knowledge management, there should be taken into consideration the risk management aspects, related to the institutes, culture, leadership; current risk management is global that enhances requirements to knowledge in the aspect of information and analysis activities; the risks of multinational corporations in the knowledge sphere are of international nature.</p>
Financial and investment management	<p>Knowledge management is related to investments in knowledge, human capital, ICT; knowledge management is required for enhanced efficiency of finance using in the sphere of knowledge and innovations, minimization of costs and redistribution of capital; within the framework of knowledge management, the efficiency of projects and activities in R&D and innovation sphere is assessed.</p>
Project management	<p>Knowledge management is a part of project management; in terms of projects, it addresses a number of challenges, pertaining to other management sectors; the relationship is apparent in formation of knowledge management system at the level of projects; application of ICT and formation of knowledge base for implementation of particular projects as well as knowledge base for implementation of all projects.</p>

Quality management	Knowledge management is related to creation of knowledge base to manage the quality, explicate know-how, develop standards and guidelines; gathering rationalization proposals by quality as well as arranging activities of professional communities.
Management in security sphere	Knowledge management gives rise to new questions in the security sphere, related to protection of information, intellectual property rights, prevention of knowledge outflow; moreover, knowledge management is aimed to create knowledge base to ensure security in all spheres.

Source: Compiled by the authors

Thus, proceeding from the analysis that was carried out, we can speak of the emergence of global as well as integrated and inclusive approach to knowledge management, based on close relationship with advancement of science. The specifics of knowledge management stems from the nature of knowledge and is identified on a global scale. It is related to transfer and assessment of knowledge.

The key challenges of multinational corporations are, first of all, related to: resource allocation, low-skilled personnel and knowledge management experts; absence of efficient approaches, methodologies, techniques, etc.; low motivation, absence of leadership, poor organization of knowledge management activities; defects of organization structure; absence of efficient relationships of external production, “immaturity” of the company. In this environment, the multinational corporation is more dynamic, therefore these problems are more acute. Additional difficulties also produce: increased uncertainty; huge number of projects; resistance of corporate bureaucracy; absence of general understanding and

cultural distinctions; spatial barriers. When considering certain problems and restrictions, we would like to draw attention to importance of the communicative factor, driven by the nature of knowledge, specific of their obtaining and use.

Implementation of knowledge management involves availability of special strategy within the framework of general development strategy of the company^{48,49}. It is focused on accumulation of knowledge assets, implementation of long-term activities in respect of development of intellectual resources and innovative potential; ensuring the efficient use of knowledge for achievement of the key goals of the company, particularly in the long-term perspective. Strategic knowledge management has respective goals and constituents (plans, decisions) and long-term directions. Within the framework of strategic knowledge management, the company, first of all, chooses between independent generation of knowledge and its obtaining in different forms (as well as various combinations of these ways). Table 2.1.3 shows the types of knowledge management strategies.

TABLE 2.1.3. Types of knowledge management strategies in corporations

Criteria	Types	Content of strategies
By scales	Globalized	Global presence and leadership in the world economy
	Localized	Presence and leadership in global space (national, regional)

48 Zack, M.H. (2002) A Strategic Pretext for Knowledge Management. Third European Conference on Organizational Knowledge, Learning and Capabilities. Athens, Greece. 2002. URL: <http://www2.warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/oklc3/id243.pdf> [Accessed: 05.10.16]

49 Zack, M.H. (1999) Developing a knowledge strategy. California Management Review. 1999. No.41 (3). P. 125-145

By directions	Product	Creation of high-quality products
	Process	Improvement of the quality of all business processes
	Project	Implementation of new projects
	Structural	Improvement of the quality of organizational structure
By the ways of knowledge accumulation	Innovative	Independent generation of knowledge based on innovations
	Simulated	Purchase of knowledge in the form of patents, know-how, etc.
By goals	Preemptive	Groundbreaking development based on new knowledge
	Catching-up	Catching-up development based on local improvements

Source: compiled by the authors

Every type of strategy in the sphere of knowledge has different impact on the content of investment, innovative, human resource and marketing policy of the company. The strategy involves implementation of long-terms activities, combined within the framework of special corporate policy (and is also included in other types of corporate policy), which includes all areas of knowledge management. The implementation of knowledge management policy involves creation of the respective mechanisms and requires ICT tools. The innovative companies use the project model of organizing the activities, according to which knowledge management can be considered at the level of project. Project's knowledge base and all components of knowledge management on the particular context of project activities are formed. At this level, the challenges of knowledge management include coordination with other projects and interaction with the external environment.

Inside the company, all the following entities are engaged in activities in knowledge sphere: top management, middle management, employees (executors). Therefore, knowledge management is implemented almost at all levels. In the multinational corporations, we should divide, first of all, the levels of parent and subsidiary companies, between which the separation of directions and functions take place. The parent company can act based on the centralized model or can increase the independence of subsidiary enterprises, thereby undertaking responsibilities for strategic aspects. Centralization and decentralization have certain advantages and disadvantages, and can be used in different conditions. Secondly, in case of hierarchical performance of knowledge management function, the goal setting and determination of the key competences is carried out at the highest level, tactical – middle management, which organizes, controls and motivates. The lowest level specifies details and performs plans. The employees, apart from self-organization and performance, take part in the knowledge management through self-governing, informing and participation in mentorship. At different levels, there are used different elements of knowledge management: the highest one is strategies, plans, culture, institutes; the middle one – motivation system, knowledge maps, results assessment system, relationship with partners, standards; the lowest one and employees – intellectual resources (knowledge bases, databases), special programs.

When implementing the multilevel approach to knowledge management, it is necessary to focus on such principles as⁵⁰: freedom of creation; maximum freely

50 Roshanzamir, A., Kardan, A.A. (2014) A Novel KM Framework for Fostering Creativity and Stimulating Innovation. The Sixth International Conference on Information, Process, and Knowledge Management. eKNOW, Barcelona, Spain. 2014. URL: https://www.thinkmind.org/download.php?articleid=eknow_2014_3_30_60137 [Accessed: 01.03.16]

circulation of knowledge, optimization of communications; taking into consideration the non-linear development and uniqueness of knowledge; ensuring the flexibility of organization forms (models); achievement of participativity in work with knowledge; combination of individualism and collectivism, enhancement of cooperation, focusing on new knowledge; overcoming the spontaneity of scientific and technical development; taking into consideration non-standard situations; rationalization of control, etc. There is an opportunity to combine the levels and implement the above-stated principles using the information tools.

One of the key challenges, being addressed within the framework of knowledge management, is the policy of knowledge obtaining. This challenge is related to globalization and externalization of the processes of knowledge obtaining, which are implemented based on assessment of their advantages and disadvantages (Table 2.1.4). The advantages of internationalization/externalization essentially depend on the industry, size and potential of the company, determine the specifics of knowledge base formation.

In case of predominance of externalization, the key problem is an organization of work with a huge number of external sources of knowledge, which can be: scientific and

TABLE 2.1.4. Assessment of internationalization or externalization as the processes of knowledge obtaining in the company

	Internalization	Externalization
Preconditions	Own intellectual resources, own centers;	Open strategy, specialization, division of activities.

Advantages	Obtaining of original knowledge;	Reduction in costs and time saving.
Disadvantages	Increasing costs;	Dependence on external sources of knowledge.
Key processes	Development and diagnostics, merge and acquisition, knowledge generation chains, acquisition of skills;	Knowledge absorption, assessment and obtaining, outsourcing, cooperation, alliances, partnership, assessment of usefulness.
Knowledge flows	In-house, Internal knowledge;	external, external knowledge.

Source: Compiled by the authors.

analytical publications, knowledge bases and universities. The company can use different models of work with external sources (partners), including through developing a cooperation and creating the external units. The major factor in case of external obtaining of knowledge (import) is the monitoring, assessment of knowledge value, development of cooperative (network) relationship as well as efficient methodologies for adaptation and adoption of knowledge. The primary types of knowledge import by multinational companies are: acquisition of intellectual property and know-how; hiring the staff; counselling; involvement in professional communities; acquisition of companies, etc.

The internationalization involves creation of the own potential to generate knowledge. In this case, the efficient obtaining of knowledge requires: 1) accumulation and pooling of resources, particularly intellectual, and formation of all components of the innovative potential; 2) continuous facilitation of intellectual activities, rational organization and provision; 3) harmonization of the work of teams and

projects. The externalization and internationalization determine the content of knowledge management within the limits of their objectives.

The knowledge management cannot be implemented technocratically, it is almost always and everywhere social, which has its own specifics in multinational company. The key social issues in the knowledge management includes: 1) creation of favorable internal environment; 2) design of social standards and institutes, instilling disciplines; 3) promotion of intellectual and creative activities; 4) formation and development of formal and informal relationships, being required for intensive work with knowledge; 5) conceptualization and explication of skills, organization of mentorship; 6) formation of the required competencies, creation of human resource development system, overcoming of cognitive gaps; 7) enhanced level of internal and external social responsibility; 8) enhanced productivity of ICT use; 9) improvement of organizational culture, including in the sphere of knowledge and cooperation; 10) promotion of self-organizing in the sphere of knowledge, etc.

The issues of organizational culture are of particular importance for knowledge management in multinational corporations⁵¹. At the level of subsidiary companies, it is essentially dependent on the local culture, and at the level of the entire multinational corporation – on the corporate policy and proliferation of universal standards. The organizational structure should be represented as the structural element, the way of interaction within the company that produces the processes

51 Denison, D.R., Haaland, S., Goelzer, P. (2004) Corporate Culture and Organizational Effectiveness: Is Asia Different from the Rest of the World? *Organizational dynamics*. N.Y., 2004. Vol. 33, No.1. P. 98-109

of integration and coordination, the factor of forming the organizational knowledge and social capital. The importance of culture is growing when working with knowledge, if it is necessary to create the higher level of organization, favorable environment, high quality of solutions and work, freedom of initiatives and creativity, etc. The culture has direct impact on the quality of social relationship, cooperation, management influence. All this determines possible range of barriers and problems, related to organizational culture. Within the limits of organizational culture, it is expedient to identify and assess the maturity of individual fields, for example, the culture of education, work and cooperation⁵². It should be emphasized that in the modern international business, especially in multinational corporations, the objectives are to combine different values (Geert Hofstede, Inglehart Welzel). At the same time, the multinational corporations have such critical factors as global cultural convergence, unique values and rules of conduct standardization of business practices and processes; therefore, in the context of knowledge management, management of cultural changes takes place. It has a direct economic growth, related to time saving, cost reduction and enhanced efficiency of activities. Knowledge management includes the challenges of innovation generation in organizational culture, which creates a need for their own theoretical, methodological and methodical best practices⁵³.

The intensity of work with knowledge is continuously increasing, which requires an advancement of organizational

52 Leybourne, S.A. (2006) Managing Change by Abandoning Planning and Embracing Improvisation. *J. of general management*. Oxford, 2006. Vol. 31, No.P. 11–29

53 Leung, K., Bhagat, R.S., Buchan, N.R., Erez, M., Gibson, C.B.(2005) Culture and International Business: Recent Advances and Their Implications for Future Research. *Journal of International Business Studies*. 2005. No.36. P. 357–378

culture in terms of: 1) building and operation of creative teams, in-house knowledge-intensive communities⁵⁴; 2) advancement of corporate institutes; 3) development of confidence, responsibility, initiative, creative approach; 4) promotion of leadership in the teams, projects, units; 5) ensuring the processes of knowledge sharing, mutual exchange of knowledge, mutual development of competences, proliferation of best practices; 6) development of the capacity for self-organizing, especially the collective one.

At the confluence of knowledge management and human resources policy, there is developed the methodology mechanism for motivational management, which acquires new forms and promotion nature in the knowledge management. Such management is impossible without the changes in worldview and values. Therefore, we can speak of the necessity to develop new approaches to human resource management, which are based on the noospheric concept. This will also enable building a new corporate culture, developing the human readiness for assimilation of knowledge, teamwork, and enhancing their participation in the process of knowledge management.

Motivational management is combined with promotion of in-house entrepreneurship, which, in the modern innovative companies, also involves knowledge sphere (independent R&D of employees, inventiveness, rationalization; grass-roots initiatives; in-house ventures). Representing the employees as in-house entrepreneurs suggests that the company is a certain ecosystem, and provides opportunity to improve organizational, institutional, infrastructural, social, resource and other conditions.

54 Muller, P. (2004) Autorite et gouvernance des communautes intensives en connaissances: Une application au developpement du logiciel libre. Rev. d'economie industrielle. P., 2004. No.106. P. 49-68

In the framework of social aspect, the most critical thing is education of personnel, where, apart from education and social training, the personnel learns corporate values, required for efficient work with knowledge, the activities to develop a personality of a scientist are carried out, the drivers of innovativeness and responsibility in business is developed.

The innovative technologies are the basis for competitive advantages of modern companies. Technological policy of multinational corporations includes the need for continuous update of technological basis, its optimization by the units in different countries. In conditions of globalization, the extent of technological convergence in various foreign units reached its maximum. There is a problem to ensure their synchronous development, widespread introduction of the most recent technologies with maximum changes in market positions. Therefore, there is a number of challenges: 1) targeting and development of new technologies; 2) rapid introduction of technologies at different foreign enterprises; 3) increasing investments in technologies; 4) training of personnel; 5) protection of intellectual property on the world market; 6) efficient international transfer of technologies. The latter includes creation of favorable conditions for international flows of technologies, technological support, strengthening of the foreign units' potential in adaptation and advancement of technologies. Transfer of technologies is understood as an integral set of solutions, agreements and activities, related to transfer of technologies between the companies aiming to maximize the economic results of their use⁵⁵. In the activities

⁵⁵ Nahar, N., Al-Obaidi, Z., Huda, N. (2001) Knowledge Management in International Technology Transfer. Technology Management in the Knowledge Era. IEEE and PICMET, Oregon, USA. 2001. P. 355-364

of multinational companies, transfer of technologies becomes constant and, therefore, requires special planning, organization and support, which are the sphere of knowledge management. Transfer of technologies can have different subject (mostly production technology and patents). However, besides the explicit and protected knowledge, there are also transferred non-formalized knowledge and unprotected know-how. Therefore, the applied nature of technology requires additional communication at the stage of transfer of technologies as well as at the stage of their use. The quality of communication between the parties has an impact on the efficient transfer, which draws attention to use of ICT.

Apart from the internal knowledge management in multinational corporations, there is also the external aspect in development of cooperation, which encompasses the levels of subsidiary structures and parent company. At the modern stage, only the companies, which are involved to the maximum extent in the environment of generation and use of new knowledge, manage to ensure sustainable positions. This explains, for example, a tendency of modern companies to cooperation and emergence of new types of strategies, characterized by the enhanced openness at pre-competition stages. The external cooperation is aimed at timely obtaining of new knowledge at minimum costs on account of optimal combination of different knowledge sources, use of different forms of cooperation, search and hiring the experts in the sphere of science, cooperation with other companies, etc.

Besides cooperation, the company continuously absorbs new knowledge from the external environment on paid or free-of-charge basis. The identification of the sources of

relevant knowledge and search for the professionals, being the knowledge and skills holders, becomes a separate problem. This requires continuous monitoring and analysis of the scientific and technical sphere at the global level.

Multinational corporations cooperate with companies, universities and scientific institutes. The knowledge obtaining “helixes”, created thereby, become international and are focused on the sectors, determined by the company’s sphere of interests. In this regard, within the framework of multinational corporation, there is a certain “strobing”, when the company gradually receives and sends selective impulses concerning the value of one or another knowledge, coordinating the time of different centers’ operation. “Strobing” can become the factor, which encourages cooperation and determines the academic science. At the same time, “strobing” of multinational corporation takes place at the international level, thereby harmonizing the national processes.

The cooperation and many types of knowledge absorption are based on scientific communication that the company participates in. Within the framework of such communication, which acquires a strategic importance⁵⁶, the ideas, hypotheses and theories are promoted. Communication forms and channels are different – the ones, which exist in scientific sector or created by the company itself. Multinational companies are included into scientific sectors of different countries, thereby facilitating the universalization of scientific communication mechanisms.

Within the framework of external cooperation,

56 Persais, E. (2003) Les Competences Relationnelles Peuvent-Elles Devenir Strategiques? Problemes econ. P., 2003. № 2792. P.14-20

multinational corporations can use the model of outsourcing to obtain knowledge. It can be permanent or periodical relationships with universities and scientific institutes as well as SME related to R&D. The outsourcing in knowledge sphere is rapidly globalizing, providing new opportunities and risks, and becoming a sector of knowledge management. By means of outsourcing, multinational corporations obtain knowledge, related to certain territories, and access to local intellectual resources. The outsourcing complements such a way of obtaining off-the-shelf solutions as merge and acquisition.

One of the key elements of knowledge management is an assessment of its efficiency, which has the internal and external aspects. The areas of efficiency evaluation are: 1) completeness of understanding and quality of knowledge assessment; 2) performance of work with knowledge, productivity of using certain clusters of knowledge; 3) cost-effectiveness of using and increase in assets related to knowledge; 4) identification of bottlenecks; 5) productivity of people, working with knowledge (generation, storage, exchange, etc.) and identification of productivity drivers; 6) identification and overcoming of organizational barriers to work with knowledge; 7) performance of certain knowledge management activities and projects. One of the elements of assessing the internal efficiency is quantitative assessment, although it is not all areas that this assessment can be applied to. At the confluence of knowledge management, human resources policy and general management, a system of the Key Performance Indicators (KPI) is formed, which also demonstrates the change of management nature and quality.

Special KPI in the knowledge sphere will encompass almost all traditional sectors being the subject to performance assessment: performance indicators, expenditure indicators, indicators of functioning intensity, productivity indicators, etc. Development of special KPI in knowledge sphere is a separate problem of knowledge management.

Within the framework of assessment of knowledge management performance, the cost accounting is a separate section, which includes different types of costs on obtaining and transformation of knowledge, on in-house business processes to accumulate and adapt knowledge, on learning processes, special structures and communications. Cost accounting creates a separate section of cost management, which takes into account the specifics of knowledge and is built in the innovative activities.

The critical knowledge management spheres are management of explicit and implicit knowledge. These sections encompass all the above-stated aspects and areas, and, in conditions of multinational corporations, acquire certain features. In order to manage the explicit and partially implicit knowledge, it is critical to create special information tools. Management of implicit knowledge is significantly included in organizational culture.

The external efficiency is divided in two directions: 1) general financial and economic results of the company's work, 2) performance of activities in the sphere of knowledge obtaining and use. It is characterized by the system of indicators (Table 2.1.5), which have to be analyzed in dynamics and compared with external indicators.

TABLE 2.1.5. KPI of the company’s knowledge management

Efficiency	Area	Groups of knowledge management KPI in multinational corporations
Internal efficiency	Human resources capacity	Proportion of employees with higher education/academic degrees; proportion of employees - patent holders; costs on personnel training; indicators of competences/retraining; etc.
	R&D	costs/external or internal R&D; R&D intensity; number of personnel involved in R&D; science-driven companies; number of submitted patent applications; additional incomes from R&D (customized execution, sale of patents and licenses);
	Intellectual resources	Number of patents supported; number of patents used; cost of know-how and assets of R&D units; cost of intangible assets; cost of knowledge bases;
	Technologies	Number of developed/purchased/introduced technologies; proportion of developed and purchased (introduced) technologies; income from sale of licenses; costs on purchasing of licenses; reduced costs due to introduction of technologies; increasing labor productivity and quality of products;
	Product innovations	Number of product innovations; manufacturing volume of innovative products; duration of the process of innovate product development; profit from the sale of innovate products;
External efficiency	General	Overall financial and economic results of the company’s operation; increased shares of market and profitability; capitalization of the company and cost of individual assets; indicators of competitiveness;

External efficiency	Performance in knowledge sphere	Absolute and relative effect from purchasing of patents, licenses and innovative products; efficiency of certain activities, merges and acquisitions, outsourcing.
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Source: Compiled by the authors

Within the framework of knowledge management, it is critical to assess the cost of knowledge, required at the moment of its purchase-sale and investment. The generally accepted methods for assessment of the cost of intangible assets (profitable, expenditure, market, comparison) do not always provide an understanding of the value of knowledge, including if there are no respective preconditions for assessment (of incomes, expenditures, market entry, analogues). The companies, which have their own assessment methodologies, gain a great advantage. Such internal know-how has a special importance for multinational corporations. We would like to highlight the need for: assessment of the options for knowledge use, extent of innovations; identification of unique characteristics; assessment of knowledge completeness, possible technological changes, etc.

The policy in the sphere of intangible assets (IA) is a separate section of knowledge management (part of IA, consisting of knowledge), which considerably depends on the industry, the type of companies and assets. Building of IA involves not only the increased volume of knowledge, but also improvement of the process of managing this part of assets. In multinational corporations, this process is predominantly centralized, but, for the last years, there are some trends towards decentralization. The policy and approaches to management

and mechanisms of IA development depend on the advantage of the centralized and decentralized model. Management of IA is performed on the global and various national markets, and more and more it takes place at the metalevel. In case of increase, IA as a special tool can be considered as information tools, related to knowledge management, obtaining and use of knowledge. In order to assess IA, there can be introduced a monitoring, which encompasses different indicators of growth, R&D, innovations, efficiency, risks, sustainability and volumes of knowledge.

The standardization and freedom of personnel's activities is balanced in the internal environment of the company. Standards provide unification, economy, acceleration, but they are unable to cover all aspects and situations. The freedom is critical for motivation and creativity, free adaptation – for flexibility and sustainability. They cause certain problems and risks, which depend on the level of organizational culture.

In the world practice, there are being developed certain standards of activities in the knowledge sphere, which consist in the proliferation of outdated concepts and are included in the global knowledge management space, as follows: ISO 9001:2015; ISO/TR 13054:2012; ISO/CD 30401; OECD (Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data; Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development; Canberra Manual: The Manual on the Measurement of Human Resources devoted to S&T; Patent Manual: Using Patent Data as Science and Technology Indicators; OECD Guide to Measuring the Information Society); PAS 2001:2001; PD 7504:2005; PD 7506:2005.

An assessment of the internal and external efficiency

of knowledge management is also critical for determination of the key fields to enhance performance of the company by means of knowledge use. These fields include: 1) development and commercialization of innovations to increase the income of the company; 2) optimization of the global innovative networks and global value chains; 3) advancement of the overall organization structure, business processes and company management system; 4) building-up of the company's capitalization, including by means of IA; 5) improving the employees' skills and enhancement of the overall quality of work; 6) introduction of innovate technologies in production and management. These sectors include the use of ICT by means of social information tools.

2.2. Information tools for knowledge management in the international companies in the context of intensifying the innovative activities

In the modern economy, the company, which generates new knowledge and, based on it, develops innovations that ensure critical qualitative changes in economic systems as well as technological or social (cultural) breakthrough, becomes successful. Knowledge, as a source of competitive advantages of the international business (IB), encompasses all processes related to development and production of products, technologies, business processes, management and marketing. The ownership of knowledge is the most important source of global sustainable (dynamic) competitive advantages (Figure 2.2.1). This includes obtaining, accumulation and transformation of knowledge in the context of innovative activities. The competitive advantages, based on innovations,

are related to: 1) destruction of the old and transition to using the new, and the creative destruction as defined by Joseph Schumpeter; 2) creation without destruction (creative accumulation), without combating the old⁵⁷.

The efficient work with knowledge (KM) should be considered as the competitive advantage of the highest order. This is particularly true for the “aggressive” and breakthrough type of strategy of the innovative activity and requires: 1) development of special plans, doctrines, concepts; 2) maximum consideration of practical experience, problems and needs; 3) preparedness to work intensively, to build fundamentally new business, being well-suited for the social progress; 4) focus on development of multidisciplinary R&D, do not dividing the science into branches; 5) building-up of the innovative capacity, particularly human and intellectual resources; 6) building of the model of innovative activity organization, being adequate for major challenges and introduction of “breakthrough strategy. Knowledge management is critical for creation of all these prerequisites. The intensification of innovative activities improves the quality of knowledge management within the framework of new models, which requires revision of all components of such management.

The modern studies mostly consider a few types of the strategy for innovative (scientific and technical) activity, for example: 1) proactive strategy (R&D, being sufficient to attain or maintain leadership; protection strategy (following the market leaders by reproduction of their achievements, protective actions on account of the lower production lag); absorption strategy (imitation of products and technology,

⁵⁷ Polyakov, M.V. (2018) Knowledge economy: essence, determinants, global landscape: monograph. Dnipro: New ideology, 2018. 688 p

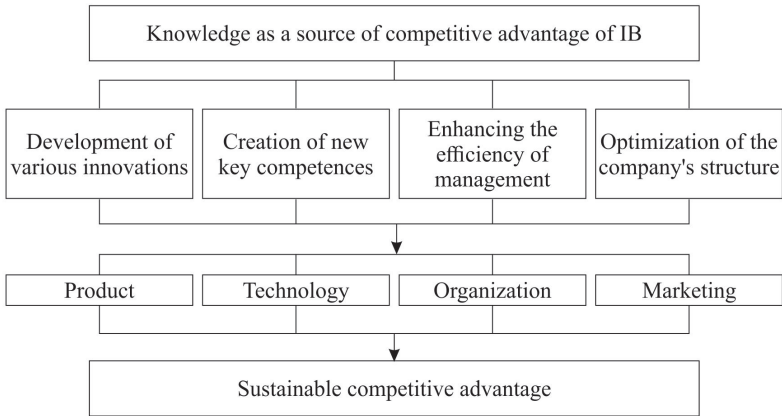


Figure 2.2.1. Formation of competitive advantages of IB by means of knowledge

Source: Compiled by the authors

being far behind the leaders, but providing cost advantages); 2) imitation strategy (borrowing the ideas and purchasing licenses, while focusing on short-term goals); strategy of aggressive specialization (R&D in narrow sense without cooperative researches with other companies); Strategy of aggressive innovations (active conducting of the company's own researches to leave the competitors behind, primarily on account of its own scientific and technological capacity). The existing approaches often do not reflect the nature of activities, which are needed by modern companies and related to creation of fundamentally new products and technologies, bringing about the breakthrough based on the new scientific advances and new ways to achieve the progress.

There is a variety of models of innovative activity organization (specifics of carrying out and arranging the innovative processes, the nature and emergence of innovations,

relationship between the participants, etc.): “demand-pull” (“market-pool”) model (market); “Need Seekers” innovation model; “Market Readers” innovation model; technology push model or model of technology drivers; interactive model of innovative process; chain-link model of innovative process of S. J. Kline, N. Rosenberg; cyclic innovation model of G. Berkhout; innovation funnel model of Wheelwright and Clark; the model of open innovations of Chesboro; network model of innovations^{58, 59}.

Every model, as a certain combination of actions or a set of processes, requires knowledge management and special information tools^{60, 61}. Conceptualization of innovative processes (for example, D. Meissner and M. Kotsemir⁶²) demonstrates a transfer to more active approaches, when the company builds the whole vertical and combination of actions to develop and promote innovations. Moreover, in the modern conditions, there is a trend to proliferate the model of open innovation (H. Chesboro), which includes the active external cooperation and dissemination of ideas⁶³. This is also indicative of the depth of

58 Polyakov, M.V. (2013) The implementation forms of the paradigm model of information development of the world economy: thesis. ... Ph.D. in Economic Sciences: 08.00.02; Dnipropetrovsk, 2013. 204 p

59 Meissner, D., Kotsemir, M. (2016) Conceptualizing the Innovation Process Towards the ‘Active Innovation Paradigm’- Trends and Outlook. *Journal of Innovation and Entrepreneurship*. 2016. Vol. 5, No. P. 1-18

60 Liu, M.C., Liu, N.C. (2008) Sources of Knowledge Acquisition and Patterns of Knowledge-Sharing Behaviors – an Empirical Study of Taiwanese High-Tech Firms. *International Journal of Information Management*. 2008. Vol. 28. P. 423-432

61 Žemaitis, E. (2014) Knowledge Management in Open Innovation Paradigm Context: High Tech Sector Perspective. *Procedia – Social and Behavioral Sciences*. 2014. Vol. 110. P. 164-173

62 Meissner, D., Kotsemir, M. (2016) Conceptualizing the Innovation Process Towards the ‘Active Innovation Paradigm’- Trends and Outlook. *Journal of Innovation and Entrepreneurship*. 2016. Vol. 5, No.1. P. 1-18

63 Chesboro, H. (2007) *Open Innovations*. M.: Pokolenie, 2007. 336 c.; Chesbrough H., Vanhaverbeke W., West J. *Open Innovation. Researching a New Paradigm*. Oxford

changes in arrangement of innovative activities as well as the new model of paradigm innovative development^{64, 65}.

Most of the companies, even the leading ones, are not always efficient enough in development of the huge (radical) innovations. This is due to the fact that, while developing the incremental improving innovations, knowledge is mostly driven, coherent, additive and can be borrowed. In development of huge innovations, there is often no knowledge at all, not to mention the coherence. There is a need to generate absolutely new knowledge. The more is the scale and “radical nature” of innovation, the more difficult it is to implement it in the existing coordinate system (institutes, culture, perceptions and competence). The Companies need to create fundamentally new knowledge and vision that will replace the established procedure in general. At the same time, huge innovations also include considerable scientific and technological achievements, which require a substantial amount of new knowledge.

The transition to a new model is caused not so much by implementation of new ideas, but rather by new (trial) theories – paradigms, which enable overcoming the limits of the existing approaches. Therefore, we suggest the model “Innovative rocket”, which introduces a new form and content of the company’s functioning, combining the conceptual, organizational and management aspects of understanding of the innovative process. Certain companies actually use it in a hidden form, and it can be formalized from the practical

University Press, 2006. 392 p

64 Polyakov, M.V. (2013) The implementation forms of the paradigm model of information development of the world economy: thesis. ... Ph.D. in Economic Sciences: 08.00.02; Dnipropetrovsk, 2013. 204 p

65 Khanin, I.G., Polyakov, M.V. (2016) Paradigm innovations: monograph. Dnepropetrovsk: New Ideology, 2016. 204 p

experience. The model “Innovative rocket” is required to overcome the key barriers while developing the huge innovations: limited scientific knowledge; low concentration of efforts and resources; insufficiently intense communication within the company and in the external environment. Therefore, the suggested model place special emphasis on the initial stage – obtaining of knowledge, and requires uninterrupted interaction with science, which can result in development of the vertical between the theory and practice. The model is based on multidisciplinary approach; it does not involve the division of science into branches, into natural sciences and humanities, which enables creating new scientific theories and breakthrough innovations.

The relevance of the “Innovative rocket” model because most often the innovations are created within the framework of empiric and heuristic activities. However, the breakthrough (systemic) innovations require the objective knowledge, which is impossible without scientific theory. Therefore, there is a necessity to suggest the paradigms, which can be justified in the process of developing the innovation, thereby enabling the creation of a certain cluster of new knowledge. The experiment is always important for a model, there is allowed the actions without sufficient economic rationale.

The “foundation” of knowledge is formed using the multidisciplinary theoretical background, study of the historical trends in development of science and society, exploration of technological trajectories, consideration of changes in the economy and social needs, and, the main thing, due to understanding of practice. The concentration of efforts in the model is ensured through organizational mechanisms and

involvement in development of innovation of a wide range of people with different competencies, including the theoreticians and practitioners. This requires the respective information tools.

The modern theory of innovations is based on the role of the entrepreneur-innovator. Although, today it appears in a new form. The successful implementation of the suggested model is related to availability of high-skilled and motivated personnel, who have multidisciplinary knowledge, incentives and skills as well as a capacity for entrepreneurship. There is created an idea of a new type of human, corresponding to the concept of noosphere, being capable of developing science in the unity of all its fields, and to link it to practice. The special emphasis should be laid to organizational culture and human resources development to enhance the innovative capabilities.

The “Innovative Rocket” stems from the practice and market, involving a formation of better understanding of human needs and social progress. This procedure can be strongly influenced by marketing requirements, but it has to be focused on study of human needs, and not just on products promotion. The main point is an implementation of new knowledge and approaches to meet social needs. Like other models, the “Innovative Rocket” involves development of a certain corporate strategy, the scenario approach and building of R&D and education processes. The model implies high risk, caused by the nature of its activities. This requires additional risk management methods and mechanisms. Taking into account the experience of the companies-leaders, the model involves not only the use of internal capacity, but also active external cooperation. In the external aspect, the model can involve continuous engagement of various concerned parties:

scientists, companies, government agencies, citizen groups and organizations. This also creates a need for mechanisms to structure and ensure interactions, in particular, based on ICT.

The implementation of the model is focused on development of strategies in the area of innovative activities management in different social and economic models. The conceptual form of the model of innovative development “Innovative rocket” is shown on the Fig. 2.2.2, where is the schematic demonstration of cumulative process, which leads from generation of ideas to implementation of a huge innovation. This is triggered by global social problems and deep restrictions, and requires new methods for analysis, investment, marketing, amendments to management system.

The model “Innovative Rocket” creates a concept of the vertical integration of knowledge and the importance of formulating new theories (paradigms). The model involves creation of the foundation of scientific knowledge, theories, technologies and resources. The focus shifts from borrowing and incremental changes to breakthrough in the new quality. The well-known “funnel” of ideas is supplemented by the basis of fundamental and applied knowledge.

The huge (radical) innovations, most often, involve creation of the new market segment (branch), retreat from the existing technologies (the existing ones can be used in case of significant advancement). The new knowledge also requires creation of different context of their use. Therefore, it is proposed to draw attention to social problems and social development.

The “Innovative Rocket” is focused not on the internal processes in the company, but on creation of a new entity, being a significant value, based on new knowledge that is

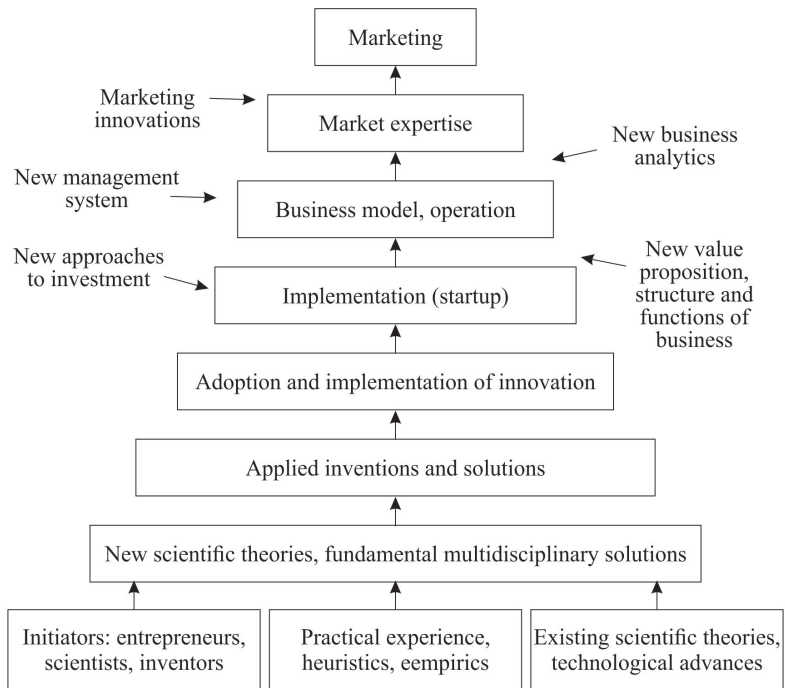


Figure 2.2.2. Conceptual diagram of the model “Innovative Rocket”

Source: Compiled by the authors

more risky. It is difficult to determine the value, which does not replace the existing products. However, the experience in implementation of huge innovations demonstrates that they themselves reformat the market, at least, create its new segment. Therefore, the company can have impact on its external environment in general.

Thus, it should be noted that the presented model encompasses the company’s interest not only in the applied knowledge, which yields direct commercial success. We can

also see that the model can be a result of the company's focusing on global, civilizational, social and economic knowledge. It is related to the trends in the development of international business on a global scale.

In the practice of international companies, they use 5 basic forms of organizing R&D units: 1) sectoral structures (distribution of R&D units by branches of science); 2) product structures (focused on creation of product, dealing with a wide range of activities); 3) project structures (which unites the experts in different fields at the project level); 4) structures, organized by R&D stages (units that R&D stages are distributed between); 5) combined structures. The suggested model represents a new form, which builds a new vertical from fundamental science to practice and marketing. There is produced a complex system of interactions between the theoretical science, applied inventions, practice and marketing. The main point is to focus on the specifics of the particular breakthrough invention.

The model "Innovative Rocket" is globally focused, interactive and can involve the outsourcing, external cooperation at the world level. The understanding of the innovative process is changing. It acquires the cumulative nature and gains a vast amount of new knowledge, relying on a wide range of scientific theories. The innovative process results not only in development of innovations, but also in involvement of scientific theory to obtain new knowledge. This requires improvement of the innovative management, which is closely intertwined with knowledge management, focusing on the development of specific innovations, encompassing various social and economic aspects. In view of the need for

intense internal and external communications, the information tools become a mandatory element.

The issue of creation of the corporate innovative system as a complex of internal institutes and units, which support innovations. In the context of new model, we can speak of revision of the concept of corporate innovative systems and the need to create new type of structures. Taking into consideration the complexity of organization, we need to pay more attention to use of information tools. The new types of supporting structures can be represented by associations of scientists and innovators, technological platforms, scientific councils of the company, etc. Inevitably, the circulation of knowledge becomes relevant.

The use of ICT by business is primarily focused on reduction of transaction (inter-transaction) and information costs, ensuring real-time communications, automation of multiple processes, and collection of data. At the same time, the role of ICT in increasing the opportunities for human intellectual activities is equally important. Within the company, ICT should organize operation of design and R&D units; ensure management of innovative processes and coordination of activities of the units, including at the international level; to manage individual and collective knowledge, ensure cooperation and specialization; ensure in-house knowledge sharing; carry out expertise and formalization of knowledge for its structuring and accumulation; to improve competencies. The ICT create new organizational models, processes, procedures, working methods, etc., which makes them a system component that influences the structure, principles and efficiency levels of activities. The information tools should be considered as

additional drivers for intensification of innovative activities and prerequisite for its routinization, ensuring the intellectual and innovative work^{66, 67}.

The ICT simultaneously individualize the employees' activities and enable ensuring intense interaction, thereby creating a new quality of social environment to facilitate creativity. The ICT enable increasing the level of decentralization and self-organization, and enhancing the managerial influence.

At the same time, the main point, in our opinion, is the augmented capacities of intellectual activities, for example, by means of computing power, special systems of data interaction, accumulation and analysis. It's already today that ICT have developed a new culture of cooperation, created the mechanisms for knowledge accumulation from internal (management of subsidiary companies; R&D units; specific experts and teams; measurement systems; events, HR and assets monitoring systems, etc.) and external (universities; experts; bases of scientific and technological information; other companies; consumers, etc.) sources.

The ICT can be applied to work with different types of knowledge, for example: 1) expert knowledge, being obtained from a circle of experts to solve practical problems; ICT organize interaction with experts, including in different countries of the world; information systems can be used in a search for experts, accumulation of knowledge and creation of expert systems; 2) analytical knowledge, obtained by means of special studies and generalization of the reports of

66 Polyakov, M.V. (2018) Knowledge economy: essence, determinants, global landscape: monograph. Dnipro: New ideology, 2018. 688 p

67 Polyakov, M.V. (2017) Improvement of the innovative tools for knowledge management in international business. Sustainable development of economy. 2017. No.3. P. 51-60

analytical companies; ICT ensure the processes of analytical knowledge obtaining, accumulation and dissemination; 3) organizational knowledge, which is contained in the corporate standards, procedures and structures; the systems, created based on ICT, directly contain this knowledge, ensuring the internal organization and work of personnel, and can be used to study and develop competencies; ICT involves creation of new organizational knowledge based on collective adaptation.

The opportunities, created by ICT, are critical for the knowledge management sphere, as they ensure the key processes of knowledge obtaining, transfer, accumulation and storage, and also enable combining the management of collective and individual activities. ICT systems enable maintaining the activities of the teams, which are focused on intensive obtaining and use of knowledge, and conducting the innovative leadership programs.

Thus, ICT ensure a wide range of prerequisites and factors for (1) productive intellectual activity, (2) accumulation, organization and development of knowledge, being critical for modern companies. Figure 2.2.3 shows the list of the key processes in the sphere of knowledge and innovations, where the ICT are used. This draws attention to the need of special information tools as an element of knowledge management.

Due to the objective reasons, it is particularly important for the international business, especially taking into account easy scalability of such tools to the internal environment as well as to the diversified system of relationships with partners and knowledge sources. In the external environment of the international business, the information systems can be used for: obtaining of education and consulting services, ensuring

various types of outsourcing, building the mechanisms for cooperation with organizations and experts, organization of knowledge sharing, data collection and personnel search.

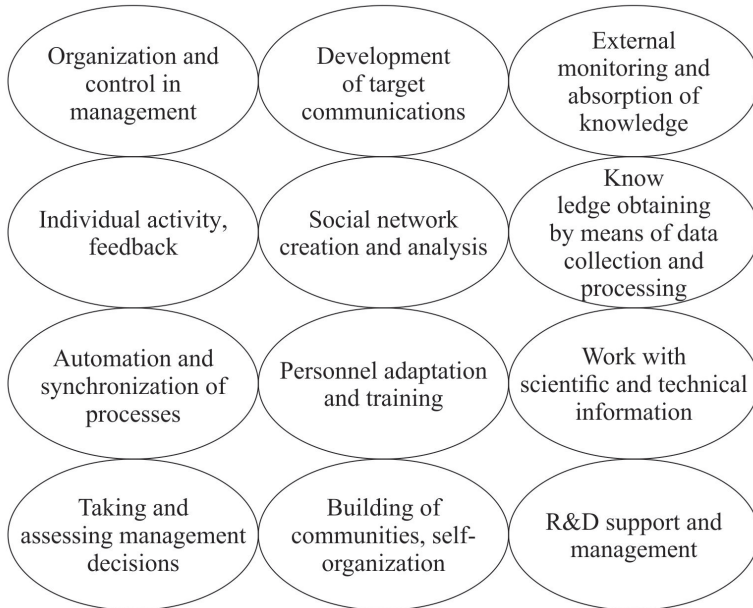


Figure 2.2.3. Key internal processes of the company, related to knowledge that ICT are used for

Source: Compiled by the authors

In view of this fact, ICT provide opportunities for implementation of the model “Innovative Rocket” and respective reorganization of optimization and creation of new practices in the sphere of intellectual activities. The new example of using ICT for implementation of the “triple helix” concept (business-university-state) through activation of interaction between centers, cooperation and exchange of information.

Today, information tools for external environment (for

example, knowledge bases and online learning systems) are primarily focused on clients. Taking into consideration the need for cooperation of science and business, new tools are required for communication and cooperation in the form of, for instance, special portals and electronic platforms. Various types of such portals/platforms (open, closed; multi- bilateral; inter-organizational, social) can include a wide range of specific challenges in the sphere of generation, dissemination and use of knowledge, thereby ensuring management, monitoring and assessment of performance efficiency.

An introduction of the new information tools requires a new institutional provision in all forms of knowledge obtaining and use. It is especially typical for multinational corporations, where the institutional systems, which interact with national institutes of the participating countries, are created. This creates a need for additional institutional convergence within the limits of knowledge management.

Use of information tools is driven by their advantages for time and cost saving, enhanced quality of work and efficiency of processes. However, there are also objective negative implications, which often make use of ICT unreasonable and harmful. The attention should be drawn to the following key problems and shortcomings in the use of ICT: 1) the tools are not able to encompass the whole variety of the required knowledge; 2) there is a fragmentary presentation of knowledge to different people, resulting in loss of its full meaning and value; 3) specialization can become excessive and leads to loss of full vision and disintegration of people; 4) it is difficult to ensure efficient division of labor in terms of knowledge distribution; 5) it can reduce the quality of knowledge, for example, through acceleration of the processes

of its obtaining; 6) the freedom of actions and creativity is limited as a result of total control; 7) emergence of new risks of information loss; 8) there are the objective difficulties related to change of information systems in case of the amended conditions and goals; 9) the competencies in the knowledge sphere are replaced by communicative and compiled skills; 10) there can be observed a reduced level of qualification, de-intellectualization of personnel due to continuous use of intellectual services; 11) there are additional security risks; etc. These problems have to be taken into consideration and determine the areas to improve information support of knowledge management and innovative activity.

Although, the context of the globalized knowledge economy requires from the companies to use information tools for systematic obtaining, sharing, use and commercialization of knowledge. At the same time, these tools often become a basis for the key processes and increase the level of management informatization.

Modern companies use in their practical activities a wide range of information tools and systems, related to knowledge management and ensuring innovations. The most widely spread are the systems of ERP type (Enterprise Resource Planning), being related to knowledge management. It is difficult to make a clear distinction between different systems, particularly in respect of their functions. Such groups of tools, systems and types of software (cloud or local) can be related to the sphere of knowledge management and innovative activities^{68, 69}: corporate

68 Brant, J. (2014) Protecting Trade Secrets to Stimulate Knowledge Flows. GE Reports, 2014. URL: <http://www.gereports.com/post/96609696082/protecting-trade-secrets-to-stimulate-knowledge-flows/> [Accessed: 08.10.16]

69 McKellar, H. (2011) KMWorld 100 Companies That Matter in Knowledge Management. 100 Companies. 2011. Vol.20, Iss.3. URL: <http://www.kmworld.com/Articles/Editorial/Features/KMWorld-100-Companies--That-Matter-in-Knowledge-Management-74019.aspx> [Accessed: 16.02.16]

portals and intranets; systems for communication; systems for automation of document flow; services for organization of joint activities; solutions for management of projects, content, support to decision making (expert systems); data repositories; services for online learning; tools for data analysis and knowledge visualization; electronic directories, repositories, libraries, catalogues; solutions for design of processes; Web 2.0 tools (services for Wiki, search engines); components of knowledge management in special systems (CAD, ARIS, CAD/CAM systems), etc. The most of these tools is multifunctional, for example, it can include social media and knowledge bases. There are created integral platforms for formation of knowledge bases (for example, Microsoft SharePoint, Oracle, Salesforce Service Cloud, Atlassian Confluence).

Moreover, there are certain varieties of special software (systems or technologies) for knowledge management: solutions for cloud computing; solutions for metadata management; network environment for education; knowledge description languages (XML, RDFS, OWL, etc.); tools for working with knowledge (RACER, FaCT, etc.), knowledge management systems (Web-portals, KMS, etc.). All of them are aimed at providing assistance during collection and application of knowledge, and perform quite a varied set of functions (categorization, management of content, data, tasks, documents, feedback, etc.; discussion platforms, QA, import and integration of data, organizational chart, flow chart, chart of assets, products, etc.)⁷⁰. The above-stated tools can be used in the running activities of the company as well as certain processes (for example, transfer of technologies or designing),

70 Top Knowledge Management Software Products. Capterra. URL: <http://www.capterra.com/knowledge-management-software> [Accessed: 15.11.17]

for particular entities, processes and types of knowledge.

The information tools should be considered as a structural innovation at the level of companies, as they change the whole structure of the company and certain processes. Such tools encompass, first of all, the explicit formalized knowledge, but also have impact on identification, generalization and sharing the implicit knowledge. A development of the tools to work with non-structured and non-formalized knowledge, and creation of new environments for implicit knowledge is the most relevant issue. The information tools change the concept and organization of the employee's workplace, creating his virtual space and new opportunities. In multinational corporations, the information tools are built taking into consideration spatial aspect, and are focused on creation of the company's new environment, integration of the existing resources and maintenance of social interactions.

We would like to focus on the information tools for facilitation of R&D and innovations, formalization of scientific knowledge, support to cooperation and, in general, for catalyzation of innovative capacity by means of reducing the routine operations and intensive communication, which has to take into account the specifics of multinational corporations.

The first one is a proposition to create the Information system to manage R&D within the framework of the project, special unit or company as a whole. The system has to ensure an application of the above-stated tools, but it is a special information tool that will support the chain of knowledge creation as a result of R&D and ensure all management functions. Within the framework of R&D management, the key aspects are: 1) separation by provision of fundamental

researches, applied inventions and experimental works, which produce the main stages; 2) formulation and alignment of objectives within the framework of each type of works (taking into account the inhomogeneity and uncertainty of R&D objectives); 3) development of the base of yielded knowledge and its replenishment by results of R&D; 4) import of knowledge from the external and internal sources. The distinctive feature of the tool is its focus on ensuring new organizational principles, encompassing all stages of the innovative process.

The key blocks of R&D management can be represented by the following subsystems: task management and planning; management of works with application of scenario planning methods, communication tools and consideration of every expert's role; subsystem of knowledge transfer between the types of works, R&D stages, experts, units; resource management subsystem; subsystem for formalization of the results and evaluation of opportunities (alternatives) of their use; project risk management subsystem. Managerial impact through R&D management is ensured within the limits of management function (planning, motivation, organization and control) using respective modules, which corresponds to R&D specification. The system will automate the routine operations, which require certain standards. In general, such system will become a basis for assessment of R&D efficiency in the company.

The second one is a proposition to create a Single information platform for innovative activities (SIP IA), which will create the network space and will encompass all enterprises of multinational corporations. SIPIA is aimed to ensure operation of all units and teams, dealing with development of innovations, thereby creating a basis for knowledge management. Knowledge

management methods and approaches depend on the type of innovations under development and the model of innovative process. Concerning the model “Innovative Rocket”, such tools can be: knowledge base of the organization, project knowledge bases; databases; knowledge formalization facilities; knowledge evaluation methods; knowledge use charts; process presentation facilities; expert systems, etc.

SIP IA is represented as a virtual scientific and practical environment for development of innovations, which unites the teams as communities for intense work with knowledge, R&D and development of innovative projects. Besides knowledge management tools, the following ones can be used to ensure the innovative activities: solutions to arrange activities of labs and teams; tools for monitoring of innovative projects by senior management; discussion forums; library of scientific and technical information. Within the framework of the platform, there can be implemented the online tools for learning and professional training, including mentorship programs.

The third proposition is the Tools for formalization of knowledge (TFK), which are aimed to simplify fixation, systematization, transfer and, respectively, use of knowledge (the main point is an understanding in the course of transfer that is of particular importance for large companies) through formalization of knowledge. TFK can be used primarily for: systematization of R&D outcomes, processing of the sources of scientific and technical information (its generalization and structuring), fixation of the concept of object (for example, subject area with identification of objects, features, events), formalization of knowledge after brainstorming (conferences,

expert survey), fixation of experience and practices. In some cases, it is expedient to use special tools for symbolic, logical and mathematical presentation of tasks.

It is suggested carrying out of formalization of knowledge by means of: 1) templated editor to fix knowledge; 2) directories with an automated update of information; 3) tools for creation of educational (didactic) materials; 4) automated systems for analysis and processing of text data; 5) collection of files, rules, heuristics and procedures, organized by different algorithms, schemes and models of visualization; 6) system of thesauruses in certain fields of knowledge, including their collective advancement.

In order to formalize knowledge, there should be carried out preliminary analytical processing, determination of the thematic meaning and characteristic of content structure. It is suggested using the following basis: logical chains of content disclosing, structurally logical schemes, logical operators, identification of phenomena and notions, concepts, descriptors, thesauruses, data structures, classifiers, requests, identification of methodologies (hypotheses, models, rules, examples, facts), various explanatory materials, etc. This enables conducting explication of knowledge and “constructing” the meaning of certain texts, thereby providing explanation of different contexts. Knowledge charts and schematic representations (for example, global innovative networks with characteristic of business processes in knowledge sphere) can be used as the tools for formalization of knowledge.

It is also suggested introducing in knowledge management the tools for formalization of knowledge

like knowledge a flow chart of the company. It will enable studying various flows of knowledge, users, various sources of knowledge and mechanisms of its transfer taking into account all requirements. By means of this tool, there can be assessed the interactive and information costs in transferring knowledge. It is reasonable to represent scientific and technical data in the form of special matrix, which enable, firstly, assessing the degree of its novelty according to the special scale and, secondly, dividing the categories of scientific and technical information.

A use of several suggested information tools requires assessment of their meaning in the course of knowledge management in the international company (Table 2.2.1). Every tool is aimed to reduce costs, save time and enhance efficiency of processes. An application of every tool requires an adaptation of personnel, development of new competencies and organizational culture. Such processes can be concentrated within the framework of R&D processes and innovative projects, but the general process of skills dissemination within the company is also critical.

The tools suggested as software are the intangible assets of the company (IA) and can be protected as an object of intellectual property. It is reasonable to single out the tools, related to knowledge and intellectual activities, into a specific class. This will enable enhancing the quality of intellectual property and a possibility of commercialization.

TABLE 2.2.1. Role of information tools in the course of knowledge management

	Function	Performance assessment framework
R&D management	Aimed to ensure R&D management functions at the level of project, unit, company; Is a platform which provides tools for organization of R&D and data processing; Information exchange and knowledge transfer, etc.	The tool changes organization of R&D and ensures intensification by means of managing the tasks of organization, informatization, accumulation of knowledge and communication. The efficiency of the system is assessed by the indicators of R&D intensity.
SIP IA	<ul style="list-style-type: none"> • Support to innovative processes at the company's level; • Ensuring knowledge management within the framework of innovative activities; • Maintaining communication and coordination; • Providing access to knowledge sources, etc. 	The tool changes organization of innovative activities. The system ensures intensification by means of creating network space, coordination of all units being involved in innovations, providing various tools for work. The efficiency of the system is assessed by the indicators of the intensity of innovative activities.
TFK	<ul style="list-style-type: none"> • Aimed to facilitate fixation, structuring and transfer of knowledge; • Systematization of R&D findings; • Structuring of scientific and technical information; 	The tool changes the process of knowledge fixation and ensures intensification of work by means of accelerated formalization, simplified exchange and search. The efficiency of the

	<ul style="list-style-type: none"> • Integration of expert, analytical and organizational knowledge. 	tool is evaluated using the indicators of fixation and systematization of knowledge.
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Source: Compiled by the authors

The fourth proposition is transformation into stand-alone tool and development of the corporate knowledge bases (KB) in a new form. They are based on the idea that every company is a sum of individual and collective knowledge, and its accumulation is a fundamental prerequisite of the efficient activities, in particular, development of innovations. The need for KB is caused by systematic activities in knowledge sphere, increasing the demands for coordination and communication, the exchanged amount and complexity of knowledge management. The need for KB is of objective nature due to acceleration and increased competition, increased level of complexity and amount of information resources, continuity of innovations and increased costs on R&D. All this determines the goals of enhancing the efficiency by means of information tool. KB can take a central position in management and ensuring the innovative activities.

The need for KB also stems from the specifics of knowledge, namely, from their cumulative nature, complexity of organization and management. Modern innovative process requires the in-depth development, collection of a huge amount of various knowledge, experience and analytical results. Therefore, KB becomes one of the most critical (apart from the products being manufactured) criteria for classification of the company as belonging to a certain sector (sectors).

The KB, which exist today, are the initial version, aimed,

primarily, to learn and inform, have the upgraded form of libraries, repositories and directories. It is not complete and does not meet the conditions of KE, as there is a demand for new abilities of analytics, management and communications. Moreover, KB should be in close line with specifics of scientific knowledge and should create prerequisites for development of innovations. Therefore, we need more complex KB taking into account the specifics of the model “Innovative Rocket” and its implementation in multinational corporations.

Currently, there is a growing awareness of the importance of KB in terms of economy as well as information and technology. In the context of transition to KE, this tool is mainstreamed almost in all economic sectors and is used in management. KB is identified as information system, formal organization of knowledge, “memory of organization”, repository, communication system, metastructure in the sphere of information and knowledge in the company, etc. KB in informatics is considered as the key component of intelligent systems, which contains the expert knowledge on a certain visual form of representing the knowledge in certain field. The most widespread interpretations of KB are the ones, which represent it as: a technology being used for storage of complex structured and unstructured information, use by computer systems⁷¹; centralized repository for information: public library, database of the respective information on the specific subject⁷²; a collection of data in an organized form, which facilitates analysis using automated deductive processes

71 Network Holographic Dome NHD-EU. European strong infrastructure of Knowledge Society. KFP, 2013. URL: <http://www.nhd-eu.eu/index.php/the-project> [Accessed: 12.10.16]

72 TechTarget. URL: <http://searchcrm.techtarget.com> [Accessed: 19.12.17]

as an expert system; the information that represents collective knowledge of organization and is arranged for convenient search and extraction⁷³.

In a broad sense, KB is presented as a dynamic system of knowledge storage and circulation, which ensures management, operations and interaction in the sphere of knowledge. Apart from knowledge accumulation, KB is supplemented with analytical abilities, which enable knowledge obtaining in several different fields simultaneously, and knowledge (experience) transfer from one field to another one, extending the amount of knowledge in each of them. KB enables organizing the fragmented knowledge into single “mixed” (clusters), required to address specific challenges, i.e. creates certain cycle and vertical of knowledge generation and use, thereby integrating science and practice. In this respect, KB should be understood in terms of: 1) accumulation of individual and collective knowledge;) dissemination of knowledge, providing access to knowledge sources for educational purposes; 3) organization of knowledge management processes and cooperation; 4) support to collective and individual work with knowledge; 5) monitoring and assessment of intangible assets; 6) tool for institutionalization of operations and processes.

In the international companies, KB system is hierarchical and combines KB of subsidiary companies, individual projects and units into a single corporate KB. KB can also be considered as intended for employees and clients. This paper refers to a single corporate KB, which generalizes different types of knowledge to ensure activities of personnel. Spatially, KB encompasses different centers for production and use of knowledge, existing

73 The American Heritage Dictionary. URL: <https://ahdictionary.com/word/search.html?q=knowledge+base> [Accessed: 14.12.17]

in the multinational corporations. KB contribute to ensuring the concentration and direct sharing of knowledge, and the effect of “closeness” of employees at the international level. KB create a new class of information products and mechanism for knowledge dissemination in the course of international scientific and technological exchange, and also become an element of global information space, acting within the framework of institutional structure of multinational corporations.

In the modern perception, KB is created based on ICT, which is a determining factor for its format and nature of access. On account of ICT, KB are used to accumulate and process the digitized data, to automate operations and processes, to accumulate various data, information and solutions (with the respective systematization and search). Therefore, KB becomes an integral tool for intellectual activities and becomes a component of KMS.

Apart from general principles of information system creation (integrity, individualization, practical focus, taking into consideration specifics, enhanced management capabilities, combination of different knowledge, etc.), we should also highlight the principles which correspond to the requirements of innovative activities at the international level, including: 1) taking into consideration the international nature of the company’s innovative activity (global and multinational); 2) facilitation to various (in particular, global and local) innovations; 3) adaptation to the needs of innovators in different countries; 4) taking into consideration the distinctions in formalization of knowledge in different countries, introduction of new forms and standards, which ensure universalization; 5) absorption of knowledge from

different external sources; 6) implementation of the global approach to learning in the company. The introduction of KB is accompanied with organizational activities, creation of new institutes, processes and competencies, related to use and development of the base. This can have different degrees of centralization (decentralization), requires synchronization, consolidation and monitoring at the level of the whole company.

In terms of its function, KB is a basis for: 1) systematization and accumulation of knowledge, required by the company (solutions, technologies, regulations, guidelines, procedures, know-how), through combination of exogenously and endogenously obtained knowledge; 2) organization of activities related to obtaining, integration, distribution and storage of the company's knowledge; 3) facilitation of the processes of new knowledge generation by means of its integration, mixing, assessment, intellectual components, etc. in the context of development of innovations; 4) ensuring free circulation of knowledge between and at the level of subsidiary enterprises, organization of communications and information flows; 5) facilitation of knowledge auditing and analysis of intangible assets; 6) formation of new workflow process and environment, which is supported by organization culture and technological capabilities; 7) formation of horizontal and vertical chains of knowledge organization and use; 8) support of individual and collective intellectual activities, facilitation of duties and routine operation performance.

Most often, creation of knowledge bases is focused on preservation of unique knowledge, gained in the company, which can be lost. While accumulating knowledge, KB serves as an independent driver of innovations, provides

wide opportunities for knowledge management at all levels. It enables strengthening the processes of decentralization and liberalization, combining them with centralized management of access and accumulation processes. Using KB, specific tasks can be solved in the sphere of: enhanced quality of education, adaptation of personnel, development of competencies, elimination of gaps in qualification and understanding, transfer of technologies, development of cooperation and in other aspects related to its purpose. Therefore, there is a systemic importance of KB as a basis for organization and management, which makes it a specific asset by purpose and value.

The importance of KB for the improved implementation of all management functions (improvement of planning, organization, control, motivation) can be considered separately, taking into consideration knowledge factor and in work with knowledge. At the same time, KB is of particular importance for elimination of duplication and coordination in knowledge sphere. It provides enormous opportunities for managerial impact based on high-quality monitoring, assessment of the potential and results, involvement of senior management, better monitoring of interests, problems and needs of the employees, etc.

As the factor of new knowledge generation, KB has to encompass the whole chain in case of obtaining as well as during independent R&D. It becomes a basis for assessment and expertise of knowledge aiming at determining its value. The need for KB is in many aspects caused by necessity of systemic generation of new knowledge, when it is required: to monitor the dynamics and aspects of practical use of knowledge; to generalize and analyze information; to structure knowledge by fields; to raise scientific and practical problems and

“granulate” solutions; to conduct audit of intellectual potential. As a single structure, KB gives birth to search processes within the company as well as in the external sources, aiming to add a certain array of knowledge. Acting as a collective memory, KB enables focusing efforts on obtaining of new solutions. It is about the scientific-applied and organizational knowledge.

As a tool to support intellectual teamwork, KB is considered as a basis for organization, cooperation, coordination and creation of collective memory. As a result, there are the effects of acceleration and economies of scale. There is an opportunity, based on KB, to create the networks of competencies, expert communities, in-house consulting, carrying out different activities (brainstorming), identification of new teamwork practices, and establishment of educating processes. Therefore, KB in multinational corporations should be identified as an international mechanism for knowledge dissemination. In order to ensure the teamwork, KB becomes a basis for application of various information tools (network of interactions, tools for teamwork organization, tools for mass communications, etc.), as well as establishment of contacts for collective initiatives. In order to create KB, it is necessary to settle the issue of access and ability to develop it collectively.

In terms of individual activities, KB is considered as a basis for obtaining of knowledge, adaptation, and development of skills. KB is built on the personalized basis and becomes a foundation for organization of the workplace, providing the employees with a number of personal tools for accumulation and structuring of knowledge, as well as various tools for individual work with knowledge. Within the framework of the workplace, the involvement of employee and his performance

efficiency can be assessed.

The internal structure of KB demonstrates the areas of the company's activities, and organization of innovative processes. This enable taking into consideration the national and global contexts of knowledge development and use. The key functional blocks (modules) of KM are: 1) block of knowledge obtaining and import; 2) block of storage, including different types of knowledge (scientific-technical, practices, bank of solutions, procedures, description of business processes, etc.); 3) block of communications (and creation of groups) including all areas and spheres of interactions; 4) block of teamwork organization in the projects (task management, repository, coordination mechanism, fixation of findings, etc.) including the work with knowledge; 5) block of monitoring and assessment of efficiency; 6) block of informing by senior management, in particular, to specify the strategy, goals and objectives; 7) block of internal consulting, development of competency networks, communities. KB is based on formalization and standardization of operations with knowledge, which ensures its efficiency.

The import of knowledge includes all types of sources, including purchase of technologies and recruitment. In these activities, KB is required for: monitoring and fixation of new knowledge in the external environment, its comparison with the company's intellectual resources, assessment of the value and dissemination of knowledge within the company, facilitation of personnel adaptation. The import of knowledge based on KB can be automated by means of intellectual components, ensuring management of sources and control over knowledge flows, which changes the company's positions in the global information space. In the context of automated

collection of scientific and technical information (and other data) from different countries, we can speak of the varieties of global absorption of knowledge in the international company. At the same time, based on KB, it is possible to maintain special cooperative relationships in the global space, including interaction with a wide circle of experts. Therefore, it is necessary to determine the level of the closed nature of KB. If the company is predominantly an imitator and consumer of external knowledge, KB is used as a basis for organization of monitoring of knowledge sphere, a mechanism for filtration, import and accumulation of knowledge. KB is open and acquires global configuration in order to extend the “field” of knowledge absorption.

Considering KB as a communication tool in the internal and external environment, it should be represented as an interactive system, being essential for development of huge innovations. If knowledge sharing between the subsidiaries of multinational corporations is carried out on paid basis, the corporate knowledge market is created inside the company, based on the KB.

In case of project model of R&D units organization, KB can be used as a framework for unifying the experts of one professional group and for establishment of international competency networks that is of particular importance for multinational corporation. They can also be supplemented with information tool, tailored to the needs of a certain branch of knowledge (for example, collective repository of knowledge, mechanisms for exchange of data, competence development system, mechanism of interaction with experts, banks of solutions).

The networks of competence, which are established within the framework of multinational corporations, are international, particularly taking into consideration the external relations, and should be considered as a mechanism for unifying national competence centers (for example, universities or techno parks). The internationalization of R&D and different forms of international scientific and technical cooperation take place within the networks. The configuration of international competence networks depends on the branch, model of knowledge obtaining and level of development of the external cooperation relations.

Taking into account industrial specifics of multinational corporations, they can create knowledge bases, which are dedicated, respectively, to one or more industries and cover various fields of knowledge. Therefore, knowledge bases become an element of the global value chains according to positions and roles of multinational corporations in these bases⁷⁴. As an element of the global value chains, the corporate knowledge bases are characterized by the corporate ownership, use within the institutional structures of multinational corporations, the global mechanisms for development and interaction with the sources of new knowledge in global space.

Improvement of knowledge bases should be grounded on the close relation of science and practice for identification of needs and real assessment of knowledge value. It involves the intensification of work with knowledge in the company at all levels. Practice becomes the focal point of the process of knowledge base supplementation, determining the fields

⁷⁴ Herstad, S.J., Aslesen, H.W., Ebersberger, B. (2014) On Industrial Knowledge Bases, Commercial Opportunities and Global Innovation Network Linkages. *Research Policy*. 2014. Vol. 43, Is. 3. P. 495-504

and content to be improved. On the other hand, the progress of science is also a factor of knowledge base advancement based on development of knowledge within the framework of theoretic and practical studies. The innovative companies deal with R&D or, at least, interact with science. We should take into account a deep relationship of KB with social processes, its importance for education and corporate environment. Previously we told that creation of KB in the company requires to develop the competence of its development and the employees' skills to make use of it. Moreover, KB itself changes the culture of work with knowledge, and requires the employees' involvement to improve it.

The experience of international companies demonstrates a huge number of problems, related to introduction, operation and improvement of KB (Table 2.2.2). Creating KB makes it more difficult to work with knowledge, systematize and categorize knowledge, produce new processes and practices. There are also new threats, for instance a risk to lose knowledge.

TABLE 2.2.2. Major problems of introduction, operation and improvement of KB

Introduction problems	Operation problems	Improvement problems
<ul style="list-style-type: none"> • Design errors;Lack of training and resistance of personnel; • Difficulty of embedding in the culture of personnel; • Low level of organization, etc. 	<ul style="list-style-type: none"> • Weakness of the skills of KB operation; • Gaps in understanding of knowledge;Non-compliance with requirements; • Low quality of incoming information, etc. 	<ul style="list-style-type: none"> • Low flexibility of data structure; • Low quality of incoming information; • Change in employees' needs; • Ensuring continuity of the process, etc.

Source: Compiled by the authors

In view of the above-stated facts, KB requires the respective process, which has institutional, organizational and social aspects. This process is aimed to make KB an integral tool for the employee’s work, which raises the issues of value and completeness of KB materials, skills, change in the culture of work with knowledge. In case of the high quality of knowledge base, the efficiency of its use requires continuous increase in the level of employees expertise. The prerequisite of the wide use of KB is an enhancement of the level of accumulated knowledge and functional characteristics of the KB itself, which requires the efficient mechanism of its development. It becomes relevant in modern conditions in view of an increase in information resources and globalization. The capacities of the automated collection from global space and analysis of information are extended in digital economy, which creates a paradigm of KB development in different branches.

KB is a critical and valuable intellectual resource of the company, and it has a direct impact on the efficiency of

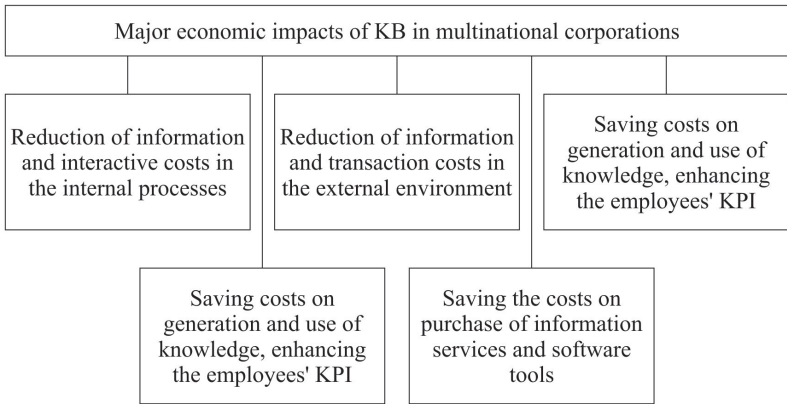


Figure 2.2.4. Major economic impacts of KB

Source: Compiled by the authors

innovations and economic indicators. Figure 2.2.4 shows the major economic impacts of KB.

We should also take into consideration such effects from KB introduction as, for example, reduction of workplaces or refusal from recruitment of new personnel. Multiple effects from KB use are not the direct subject of quantitative assessment. It is primarily related to productiveness of intellectual work.

The assessment of the efficiency of KB use is multi-aspect and involves a combination of: staff survey, development of special system of KPI, analysis of the intensity of resorts to KB, generalization of statistics on objectives. A separate problem is to assess the value of the accumulated knowledge and the quality of replenishing the KB. With the increased use of KB it is expedient to introduce special indicators (methodologies) of assessment of its efficiency and intensive use, in particular, by projects, groups of experts and subsidiary companies, etc.

The foundation for improving the KB is, for sure, a new philosophy of the company's development, noospheric teaching and new culture of intellectual activities. Among the key areas to enhance efficiency of KB is: standardization, assessment of the quality and results of the use, the increased level of the culture of work with KB (with employees' involvement to its development), facilitation of new knowledge circulation. The proactivity in development of employees' competence is essential.

KB is a special IA and it can have considerable impact on capitalization of the company. As IA, KB can be assessed in two aspects: 1) as an individual information product (technology); 2) as an accumulated array of valuable knowledge. Based on it, the approaches to assessment (reassessment) of KB as IA are created. KB with the accumulated array of knowledge can

be commercialized independently.

KB is a special form of knowledge representation in the form of the company's IA, which makes it a part of the global knowledge market. KB ensures formation and use of IA at the international level, first of all, in cooperation between subsidiary companies of multinational corporations in different countries. This implies that KB can be considered as an international asset with the respective nature of replenishment and use. Knowledge as resources of the company has the following economic properties: it has to be updated and can be amortized; it is not self-adjusting; it does not change form and has no physical substance; it can have different terms of use; it can be resold without any losses for the company.

Thus, KMS and all the above-stated tools form a new technological basis for international management in conditions of knowledge economy formation. On the other hand, KM should be considered as a component of international management.

2.3. Universities' role in the intellectual economy structure

The education sector is becoming a key player in the knowledge-based post-industrial economy, and nowadays the global education industry is the world's second largest market after the health care with accounting the cost of national education systems alone. Total spending on education was estimated at \$ 5.5 trillion in 2015, and is expected to increase to \$ 6.4 trillion by 2017, up to 7% annually during 2012–2017.

The higher education sector is the most open and internationalized with annual sales of over \$ 300 billion and

about 15 million customers⁷⁵.

Universities play an integrative role in the formation and development of post-industrial societies: as the intellectual capital concentrates in them, ideas are generated, R&D is organized and implemented, progressive forms of educational innovation activity with direct large-scale and dynamic transfer of new knowledge and resources, the information resource of development is constantly accumulated and constantly updated.

In the intellectual economy, the mission of universities is not only in the accumulation and dissemination of knowledge, but also in the compulsory applied research and its commercialization, which is made possible firstly in world-class research universities. In innovative countries, they provide the full scientific and educational cycles (Figure 2.3.1) and become key actors of national, regional and global innovation systems.

It is necessary to note that the fundamental works issued by Western⁷⁶ and also by national scientists are devoted to the phenomenon of research universities; some systematic and analytical features among them can be noted for the collective monograph “Research Universities: World Experience and Prospects for Development in Ukraine”, which was published in 2014, and “Global Competition in Scientific Research” educational space, which was published in 2016⁷⁷.

Basing on the experience of the leading countries, in the

75 Gajdutski P.I. (2014) NeZalejna economica Ukraini: [monograph] / P.I. Gajdutski. — K.: TOV «Informacijni sistemi», 2014. — 528 s.

76 Schramm, C.J., Crow, M., Merten, A.G. et.al. (2008). The Future of the Research University // Meeting the Global Challenges of the 21st Century. – June 1, 2008. – URL: <http://ssrn.com/abstract=1352645>; Vest C.M. The American Research University from World War II to World Wide Web: Governments, the Private Sector, and the Emerging Meta-University. – Berkeley: University of California Press, 2007. – 140 p.

77 Ilnitski D.O.(2016) Globalna konkurencija v naukovno-osvitnjomu prostori [monographia] / D.O.Ilnitski. – K.: KNEU, 2016. – 445 s

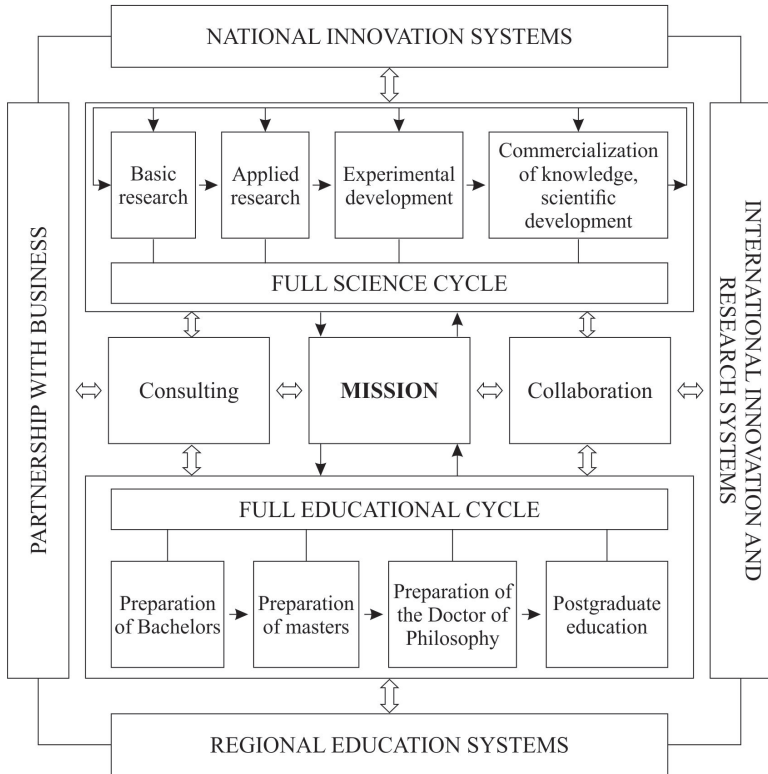


Figure 2.3.1. Research University Innovation System

Source: Compiled by the authors

post-industrial paradigm of global economic development, it is the world-class research universities (Table 2.3.1) that play a decisive role in generating resources such as knowledge, innovation and information, as they fulfill a global socio-intellectual mission, which is in first and foremost training the science, political, and business elites, as well as ensuring the intellectualization of all spheres of human life.

However, it should be emphasized that, for example, in the “triple helix” of innovation progress (universities

- industry - government regulation), Henry Itzkovitz, an American researcher, has put the universities in the first place not accidentally⁷⁸. The idea of the “knowledge triangle” that is popular in Europe consisted of the public and private sectors, and the knowledge sector⁷⁹, with education, research and innovation were named key current drivers of competitive development in the European Union’s innovation.

TABLE 2.3.1 Top 10 most competitive universities in the world in 2016⁸⁰

Rank	Academic Ranking of World Universities 2016		Rank	QS World University Rankings 2016/2017	
	Institution	Country		Institution	Country
1	Harvard University	USA	1	Massachusetts Institute of Technology	USA
2	Stanford University	USA	2	Stanford University	USA
3	University of California, Berkeley	USA	3	Harvard University	USA
4	University of Cambridge	United Kingdom	4	University of Cambridge	United Kingdom
5	Massachusetts Institute of Technology	USA	5	California Institute of Technology	USA

78 Etzkowitz, H. (2008) *The Triple Helix / H. Etzkowitz // University-Industry-Government. Innovation in Action.* – N.Y., 2008

79 Lansu, A., Boon, J., Sloep, P.B. Rietje van Dam-Mieras (2013) *Changing professional demands in sustainable regional development: a curriculum design process to meet transboundary competence // Journal of Cleaner Production.* – 2013. – №49. – P. 123-133

80 2016 Academic Ranking of World Universities (ARWU). — URL: <http://www.shanghairanking.com/index.html>; *Converging Technologies for Improving Human Performance: Nanotechnology, Biototechnology? Informatuioni Technology and Cognitive Science / Ed. By M. Roco, W. Bainbridge. Arlington, 2004.* – URL: <http://www.transhumanism-russia.ru/content/view/621/47/>

6	Princeton University	USA	6	University of Oxford	United Kingdom
7	University of Oxford	United Kingdom	7	University College London	United Kingdom
8	California Institute of Technology	USA	8	Swiss Federal Institute of Technology	Switzerland
9	Columbia University	USA	9	Imperial College London	United Kingdom
10	University of Chicago	USA	10	University of Chicago	USA

In our opinion, from a methodological point of view, it is important that due to accessible and high-quality online communication the “open innovation” model, which proved

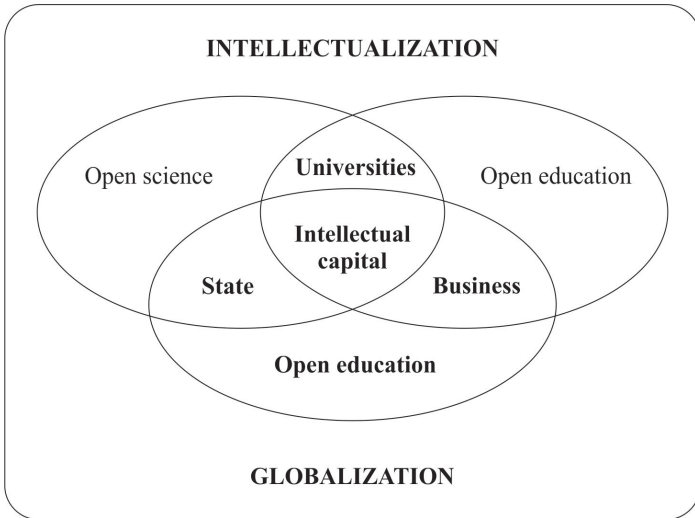


Figure 2.3.2. An eclectic model of global economic development intellectualization

Source: Compiled by the authors

its efficiency in the 2000s, is complemented by new important components, namely “open science” and “open education.” In other words, a qualitatively new model of global intellectualization is being formed not only by nature but also by an organization that clearly reflected in our eclectic model (Figure 2.3.2).

An important, and in some countries, decisive role in the constant innovation progress is played by the government-business relationship, the most effective form of which is a public-private partnership in the modern market economy (Table 2.3.2).

TABLE 2.3.2. Knowledge resources in public-private projects⁸¹

From state projects	From private business
<p><i>Macroeconomic knowledge</i></p> <ul style="list-style-type: none"> • Integral indicators of socio-economic policy and its priorities • Integral business conditions: tax, financial, antimonopoly policy, tariffs of natural monopolies 	<p><i>Competitive knowledge on the market institutions functioning</i></p> <ul style="list-style-type: none"> • Exercise and protection of property rights • Development of contractual (agreement) system
<p><i>Specialized knowledge</i></p> <ul style="list-style-type: none"> • Conditions for import of new technologies and support of high-tech production • Specific strategic decisions on particular actual problems of development 	<p><i>Specialized knowledge on business environment</i></p> <ul style="list-style-type: none"> • Conditions and obstacles for effective growth • Potential conditions and opportunities for participation in state project tasks implementation

As an important competitiveness factor for the universities is their close interaction with business in the knowledge economy, which we believe can be considered as a key global trend in the education system development. Specifically, the

81 Misin N.M. Organizatsionnije osobennosti upravlenija znanijami v uslovijah sotrudnichestva gosudarstva I biznesa v cfere innovatsij. Voprosi ekonomicheskikh nauk. 2016. №1(77). S. 49-52

business is capable to secure the proper financing for intellectual products release and their large-scale commercialization. It is necessary to note that there are now obvious dilemmas in the relationship between business and universities: as for business, the following factors have crucial significance such as profit priority, pragmatic urgency, obligatory positive result, and professional communication; then for universities there are such factors of crucial significance as knowledge value, career priority, urgent uncertainty, negative result usefulness, and broad communication.

In turn, the above mentioned dilemmas generate a dichotomy in university education between its academic and professional components⁸²:

- academic or professional composition of knowledge within educational programs;
- academic emphasis on understanding the logic of knowledge or emphasis on the transfer of knowledge in the direction of practical problem solving;
- academic orientation to search for knowledge for the sake of knowledge itself or to learn understanding of the differences between theory and practice;
- preparing students for an academic career or using learning outcomes for practical activities outside the university;
- priority for understanding and ability to use well-known knowledge or critical approach in performing fuzzy tasks in the innovation process;
- transfer of all necessary knowledge or

82 South East Asia Investment Opportunities – Tax & Other Incentives. URL: <http://www.pwc.com/la/en/publications/sea.html>

- professional knowledge bases to the students;
- emphasis on general knowledge and competences against specific academic or professional knowledge and competences;
- disciplinary or interdisciplinary approaches;
- improving the professional essence or awareness about the impact of practical professional actions.

At the same time, the unified universal long-term trends in the intellectual economy are also evident. As for business, such trends as innovation, corporatization, transnationalization, socialization are pertinent, whereas for the universities respectively are pertinent such trends as intellectualization, professionalization, international mobility, and humanization. As the successful practice of cooperation proves, these trends are the fundamental basis for the strategic partnership of universities with business.

It is significant that the cooperation between the universities and business is distinguished, and then it is evaluated in the respective countries' competitiveness ratings (Table 2.3.3).

TABLE 2.3.3. The indicators of cooperation between universities and business⁸³

Catching-up development countries	Rating (position)	Score (scale 1-7)
Finland	2	5,8
Singapore	4	5,6
Israel	8	5,4

83 The Global Competitiveness Report 2013–2014. World Economic Forum. - 2013 - 553 p.
URL: http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2013-14.pdf

Taiwan, China	11	5,3
Ireland	13	5,2
Republic of Korea	26	4,7
<i>Central and Eastern European countries</i>		
Lithuania	28	4,6
Czech Republic	35	4,4
Estonia	36	4,4
Hungary	41	4,3
Slovenia	56	3,8
Russia	64	3,6
Latvia	67	3,6
Poland	72	3,5
Ukraine	77	3,4
Slovakia	93	3,3
Romania	88	3,3
Bulgaria	117	3,0

In a qualitative aspect, it is important that the strategic science-business-education partnership, implemented through joint projects, programs, platforms, etc., also allows receiving unique results, such as common intellectual property rights, significantly intensifying the process of commercialization and transfer of innovation. This, in turn, contributes to the formation of local, national, regional, global teams, partnerships, associations, communities as the basis of networked human capital.

The problems of the inadequacy of public funding, on the one hand, and the expansion of fields of activity, on the other hand, lead to the emergence of the phenomenon of business universities, such as in the United States, which take the place of research universities. At the same time, the university now becomes not only a participant of scientific and technological

parks, but their organizational subject and center, since it combines scientific research, R&D, commercial realization of their results with the training of specialists in the latest scientific and technological spheres⁸⁴. This is usually accompanied by an incubation effect, which qualitatively alters the structure of traditional innovation processes.

The defining features of universities of such status are capitalization of scientific discoveries, close interaction with business structures and the government, independence in defining development strategy, hybridization of organizational structure, and introspection as a continuous process of renewal⁸⁵. First of all, this requires diversifying constantly the spheres of university activity and resource base; second, cooperation with business and government; third, the formation of an integrated entrepreneurial culture based on the effective stimulation of innovation, etc.

In our view, such a transformation of the university as a public institute can have both positive consequences, first and foremost for the universities themselves, in terms of intensifying their market-oriented scientific and applied activities, and thus greater financial autonomy, and negative ones, as excessive commercialization will discredit fundamental research that requires long-term investments with unobvious commercial results. At the same time, fundamental science not only generates fundamentally new knowledge that is the basis of breakthrough innovations, but also ensures the proper quality of prospective university-oriented education. In this context, it is significant that in the United States, the government remains financially supportive to basic research, while business is

84 Ivanov N.P. Socialnij context innovatsionnogo razvitiia. Mirovaia economica I mejdunarodnije otnoshenija. 2013. № 5. S. 17–30

85 Ibid

simultaneously focusing on applied research and technological development. A European Research Council has been set up in the EU to prioritize fundamental science funding. The share of public funding for basic research in South Korea, Malaysia, South America, and Russia is constantly increasing. Instead, in countries with insufficient funding for the basic sciences, it is likely to result in decline of many science schools, intellectual outflows to other, more profitable fields and abroad. In general, systemic destructions in the direction of intellectual degradation of society and technological recourse are also possible.

In the end, we think that the global problem of functional illiteracy (inability to heuristic activity), which was actualized in the 1980s, is constantly exacerbated. Its reasons are rightly seen by experts in a comprehensive and unprecedentedly dynamic informatization through television and the Internet without forming an appropriate information culture. At the same time, the global struggle for the consumer is practically primitive, but high-tech means, leads to social disadaptation, and political technology - to apoliticalization. Intellectual asymmetry is emerging, that is, the gap between intellectual professionals and the functionally illiterate majority of the population is widening. It is quite representative that these asymmetries are becoming typical in leading information societies.

In 1985, the United States presented analytical statistics according to which, from 23 to 30 million Americans are completely illiterate, from 35 to 54 million - semi-literate, that is, their reading and writing skills are too low to cope with the responsibilities of daily life. In 2003, the proportion of US citizens whose writing and reading skills were below the minimum was 43%, or 121 million. In Germany, according to

Education Senator Sandra Scheeres, 7.5 million people (14% of the adult population) can be considered illiterate. 320,000 such people live in Berlin alone. In 2006, the UK Department of Education reported that 47% of schoolchildren dropped out of school at the age of 16, having failed to reach a basic level in mathematics, and 42% were unable to complete a basic level of English. Every year, almost 100,000 functionally illiterate boys and girls are graduated from British secondary schools. In 2003, a similar study was held for Russian schools (among 15-year-old students). It turned out that only 36% of students had sufficient reading skills. Of them, 25% of students could only perform medium-level tasks, such as generalizing information contained in different parts of the text, correlating the text with their life experiences, and understanding the information provided implicitly. A high level of reading skills (the ability to understand complex texts, give critical evaluations of the information provided, formulate hypotheses and conclusions) was demonstrated by only 2% of students⁸⁶.

The leading trend in the development of university education in recent decades can be considered its internationalization and globalization (Figure 2.3.3).

At the beginning of the 21st century, the international market for educational services (the system of relations between producers, providers and consumers of educational services provided to citizens outside their countries, as well as national providers in foreign markets, including the use of information and network technologies⁸⁷, is transformed into a global one,

86 Sokologorskaia Darija. Funkcionalnaja ngramotnost / Darija Sokologorskaia. – URL: <http://syg.ma/@daria-sokologhorskaya/funktsionalnaia-nieghramotnost>

87 Galichin V.A. Mejdunarodnij rinok obrazovatelnih uslug: osnovnije harakteristiki i tendencii razvitija / V. A. Galichin. – M.: Izdat. dom «Delo» RANHiGC, 2015. – 60 s

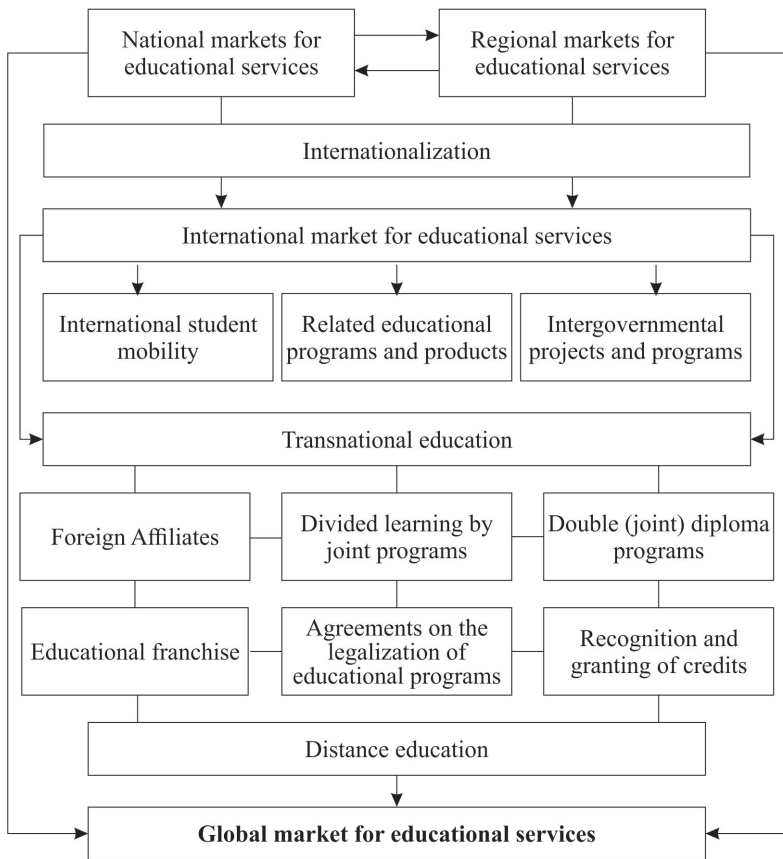


Figure 2.3.3. Formation of a global market for educational services

Source: Compiled by the authors

due to the continuous spread of three interconnected trends: the formation of global consumer demand for educational services driven by global information; formation of the global labor market, and cross-cultural unification in all fields.

Propositions in the global market for educational services

are determined by such key factor as the unprecedented increase in international mobility of students, graduate students, doctoral students, teachers, educational programs, which is confirmed by the relevant statistics.

Thus, in a study conducted by the UNESCO Institute of Statistics, a tendency of long-term and dynamic growth of the number of foreign students of higher educational institutions was recorded⁸⁸.

There is also a noticeable increase in mobility at the doctoral level, which in turn contributes to higher mobility of scientists. This is evaluated by experts as one of the most noticeable trends of recent times. It is also emphasized that students from Arab countries, Central Asian countries, Sub-Saharan Africa and Western Europe are more likely to study abroad than students from other regions of the world. By a share of doctoral students studying abroad, Central Asia has overtaken Africa.

Almost all Asian countries are actively promoting doctoral studies abroad. The Government of Vietnam, for example, is sponsoring the training of its citizens in doctoral studies abroad, with the aim of increasing the number of doctoral students in Vietnamese universities who have received doctoral degrees to 20,000 by 2020. Saudi Arabia also uses a similar approach, and Malaysia plans to become the sixth largest center for international students by 2020 (their number in Malaysia has doubled and exceeded 56,000 from 2007 to 2012). About 61,000 international students enrolled in South Africa in 2009, two-thirds of which came from other countries in the Southern African Development Community (SADC).

⁸⁸ UNESCO science report, towards 2030.: executive summary. // UNESCO. – 47 p. – URL: <http://unesdoc.unesco.org/images/0023/002354/235407r.pdf>

Cuba is very popular among Latin American students⁸⁹.

Researchers focus on increasing the effectiveness of international university activities, which is a consequence of its benefits. At the same time, the global leader in this field - United Kingdom - self-identifies the distribution of the effects of international higher education activities, as follows: economic effects (additional exports, side (indirect) economic benefits, professional networks, personal consumer behavior, skilled migration), influence and perception in the world (informal ambassadors of the UK, building confidence, strengthening influence through national institutes and development programs, etc.)⁹⁰.

One more trend that should be taken into account is the significant increase in the number of researchers. Currently, there are 7.8 million researchers worldwide, 21% more than in 2007. This has contributed to a significant increase in scientific publications under growing competition for publishing materials in a limited list of rating journals.

Of course, such trends reflect not only demographic trends, the dynamics of science and education funding, migration policies and processes, but also increasingly competitive conditions in the global market for highly qualified personnel.

The key factors of international competitiveness of universities were combined into a single system are shown in Figure 2.3.4.

At the same time, the science and education dilemmas are becoming relevant for all countries, and they have global features:

89 Ibid

90 Spartak A., Kostokova A. Mejdunarodnij rinoK obrazovatelnih uslug: istochnik dohodov I instrumenti "mjagkoj" sili / A. Spartak, A. Kostikova // Mejdunarodnaja economica. – 2016. - №6. – S. 46-59

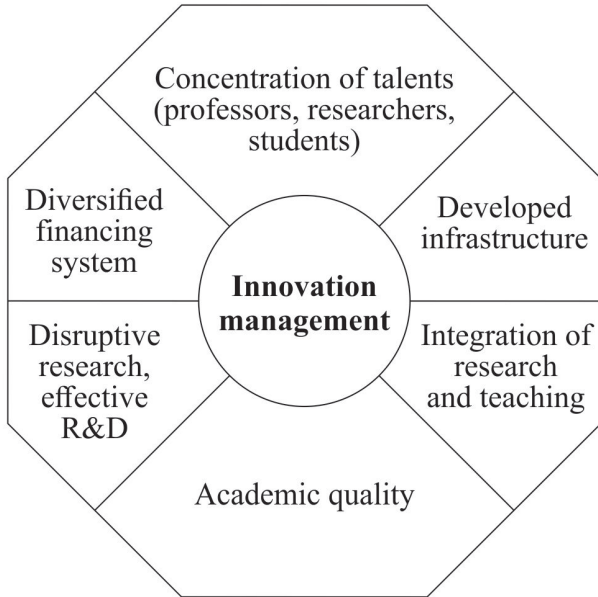


Figure 2.3.4. Factors of international competitiveness for the universities

Source: Compiled by the authors

- between basic and applied research;
- between research individualism and scientific collectivism;
- between science to provide social progress and science to increase business profitability;
- between the increasingly globalized science and education and the predominantly national nature of their funding and organization;
- between unprecedented global academic mobility and national protectionism in this field (Table 2.3.4).

TABLE 2.3.4. Modern dilemmas of science development

Criteria	Dilemmas	
Motivation and targeting	Generation of new knowledge	Generation of knowledge for the market
Spacing	Local (regional, national) arrangement of research	Participation in international networks
Prioritizing of the innovation cycle phases	Fundamental research	Applied research
Subjectivity of intellectualization	Research individualism	Scientific team spirit
Statusness	Academic image	Formalization and commercialization
Stimulation	Mostly moral	Mainly material
Value and benefits	Science for social progress	Science as a factor in high-yield business

Resolving successfully these dilemmas and other more local problems of the science and education development by globally institutionalized instruments is very important, when it is necessary to hold interdisciplinary basic and applied research that is problematic for the latest sustainable development tasks implementation.

2.4. The global economy's intellectual ecosystem

The global innovation space is being formed and developed in the conditions of intensifying transformational trends in development of the world economy, globalization, and ever-growing use of networks and higher technologies. In the present context of globalization and sharpening international

competition, the increasing intellectualization of social development favors to raising the value of spheres of business related to knowledge generation and spread of knowledge.

Knowledge and information are the key and most valuable resource in the new format of social development. The competitive advantages of the country and its subjects are provided not so much by the basic industries' power as by the intellectual factors.

A global intellectual environment is being formed, in which both traditional institutions and education / science institutions, and new ones are involved (such as business, international, governmental and non-governmental organizations, universities, and other institutions); the range of the international exchange objects is expanding (not limiting to goods and services, but also the realized results of intellectual activity in the form of patents, know-how, licenses, etc.), new financial flows, and new systems of economic relations between different sub-levels are formed.

In such a global intellectual ecosystem there are developing complex multi-level relationships between different actors relevant to the creation, dissemination, and use of new knowledge. These relationships are characterized by high competitiveness, innovation, active search for fundamentally new ideas, resources, and opportunities.

The processes of innovative development in the global economy have become an actual subject of scientific research a long time ago: their factors, frameworks, tools, dynamics, and so on. At the same time, the dynamism of the innovative development processes leads to qualitatively new phenomena and trends arising, especially such as the global intellectual

ecosystem (GIE) formation. These issues became the object of research in the works of a considerable number of both national and foreign scientists, including: D. Lederman, L. Sayens, B. Klinger, Y. Gorodnichenko, J. Svejnar, K. Terrell, L. Petkova, D. Palamarchuk, O. Dovgal, Y. Chentukov and others. The modern dynamic development of the global environment is constantly filled with new processes, trends, and features, which in turn require detailed study and generalization.

At the current stage of global economic development, a key feature is the reorientation to innovative development, which forms the basis of the Fourth Industrial Revolution. The fourth industrial revolution determines the further orientation of the production development basing on the use of robotics, and wider uses of networking and ICT technologies, and so on. The labor market moving into “tax haven” is one of the key features of the modern market, while the structure of production is changing, the opportunities through technologization and network technologies are developing, and export of services is becoming more active.

In these circumstances, the role of the education and science system as a major generator of intellectualization trends is growing dramatically. Thus, education is becoming an important bridgehead for ensuring the international competitiveness of each country, serving as an important institution for the skilled human resources development⁹¹. However, in today’s context, the importance of education and science has greatly enhanced: both directly and through the influence on other factors and drivers of social development.

91 What role will education play in the Fourth Industrial Revolution? // WEF. – 2016. – URL: <https://www.weforum.org/agenda/2016/01/what-role-will-education-play-in-the-fourth-industrial-revolution/>

Overall, all these changes form the basis for the global intellectual ecosystem that acquires the common market features, the rules on which are determined by key innovators.

The global intellectual ecosystem formation is a dynamic process, which is accompanied by changing in the countries' position in the world economy ranking, including the ranking of most innovative countries. Innovation is gaining more weight for all countries as it forms the basis for some competitive advantage in the leading industries. In order to achieve high ranking positions, both resources and results matter: as input resources, there are involved institutes, human capital, researches, infrastructure, and the market complexity; as the results, there are involved patents, scientific articles, and creative (innovative) results⁹².

Top 20 most innovative countries are high-income countries. These countries have been in this position for several years in a row. However, some Asian countries are gradually starting to fit into the circle of leaders, including China, which from 25th position in 2016 moved to 22nd in 2017. These countries consistently show broad innovative features: powerful scientific and engineering systems, and active cooperation between education, science, and business. Over the last ten years, the map of innovative economies has changed significantly (Table 2.4.1).

For the seventh consecutive year, Switzerland has been a global leader in innovation, having improved its position by 5 points over the past 10 years. Ireland had achieved the biggest improvement in its position, which in 2017 was ranked among the ten most innovative economies in the world, and

92 Kulkarni A. Index shows the global innovation gap is growing / Anand Kulkarni. – 2017.
– URL: <http://www.universityworldnews.com/article.php?story=2017080106484882>

TABLE 2.4.1. Dynamics of economies according to the Global Innovation Index, 2007-2017⁹³

Countries	GII, 2007	GII, 2017	Change of position
Ireland	21	10	+11
Sweden	12	2	+10
Republic of Korea	19	11	+8
Iceland	20	13	+7
Nederland	9	3	+6
Norway	25	19	+6
Switzerland	6	1	+5
Denmark	11	6	+5
Finland	13	8	+5
Austria	22	20	+2
Israel	18	17	+1
Singapore	7	7	0
Luxemburg	10	12	-2
United Kingdom	3	5	-2
USA	1	4	-3
Hong Kong	10	16	-6
Germany	2	9	-7
Canada	8	18	-10
France	5	15	-10
Japan	4	14	-10
Belgium	15	27	-12
UAE	14	35	-21

⁹³ Global Innovation Index 2007 <https://www.globalinnovationindex.org/userfiles/file/GII-2007-Report.pdf>; Global Innovation Index 2017- URL: <https://www.globalinnovationindex.org/gii-2017-report#>

moved up by 11 positions. Sweden has also entered in the Top 10 ranking, climbing by 10 steps, and taking 2nd position in 2017. Overall, almost all countries that had shown some positive growth (except for Norway and Austria) were in the top 20 in 2007. The highest rate of decline in the ranking was demonstrated by the United Arab Emirates, which have lost 21 positions since 2007, and Belgium with a loss of 12 positions, thus losing their place in the TOP-20 ranking. During this time, the US lost its leadership position while still kept in high positions. However, the indicators included in this index are quite different (Table 2.4.2).

TABLE 2.4.2. Ranking of TOP-10 countries by components, position in the ranking, 2017⁹⁴

Ranking	Economy	Institutions	Human capital	Infrastructure	Market sophistication	Business sophistication	Knowledge and technology outputs	Creative outputs
1	Switzerland	8	7	6	7	3	1	3
2	Sweden	10	4	3	10	4	3	11
3	Nederland	11	19	14	17	1	2	5
4	USA	17	13	21	1	8	7	10
5	United Kingdom	9	6	5	5	13	13	4
6	Denmark	6	3	15	6	12	16	9
7	Singapore	1	5	2	4	2	11	32
8	Finland	4	1	8	13	6	10	18
9	Germany	18	10	20	16	15	8	7
10	Ireland	12	18	17	25	10	5	13

94 Global Innovation Index 2017.- URL: <https://www.globalinnovationindex.org/gii-2017-report#>

For example, Singapore has shown the largest gap in its indicators, ranking first in activity of institutions and institutional support as such, and as much as 32nd position in creative activity results. Generally speaking, the global leaders in terms of innovation have showed the highest positions both in terms of knowledge-intensive and high-technological products, and in terms of performance. These results include the following: knowledge generation, number of patents by origin, patent applications, utility models by origin, scientific and technical articles, citation index, impact of knowledge, growth rate of personnel, new enterprises, costs for computer software, quality certificates ISO 9001, high-tech production (high and medium technologies), knowledge dissemination, intellectual property rights, export of high-tech goods, export of ICT services, net outflow of foreign direct investments. The significant gap in individual indicators explains the focus of individual countries on certain types of economic activity.

Generally speaking, in the modern world, open innovation networks are being formed, the main task of which is to form incoming innovation flows or the key factors that can contribute to the innovation development. As a rule, in the developed countries, which have the highest rates of innovation, the individual strategies for the innovation development are in the works aimed at enhancing both internal development and raising external resources. Such strategies have been successfully implemented in Switzerland, Sweden, the Netherlands, Ireland, Finland, and other developed countries. For example, Switzerland has directed its development towards maintaining all levels of innovation, including enhancing competitiveness through a balanced state

policy in coordination with the business sector. Much attention is paid to the level and quality of education, to the provision of a high level of support and funding for science, and to the promotion of international networks.

Arrangement of such an environment requires available human resources that are capable to produce and work with information in the new system of relationships. Thus, the first indispensable condition for the effective inclusion of each country in the global intellectual ecosystem is to form a strong base for education and science, which is capable to act in the global environment and meet all its challenges. These new conditions inevitably transform the educational and scientific sphere, its organizational and financial frameworks, also targets and the methods to achieve them.

The global trends in the development of education in the modern world are reflected in the following: increasing the size of the education sector, increasing the access to higher education, increasing life expectancy in education (life expectancy), implementation of the lifelong education concept, diversifying the forms of organization and financing for educational activities. There are different dynamics in different countries across the world, but the general trends are precisely made by the above indicators growth.

In modern world, the number of students of higher education has sharply increased both in individual countries and in the world as a whole. In 1999, there were 93 million students enrolled in the higher education institutions all across the world, then in 2017 there were enrolled nearly

223 million⁹⁵. Table 3 provides the data on the countries where student enrollment reached more than 1 million people (for 2016). The overall increase in the number of students, however, is accompanied by quite different trends in different countries. After some period of rapid growth in Europe and North America, there was observed a decrease in the number of students enrolled. At the same time, the number of students enrolled in such countries as China, India, Brazil, Indonesia, Mexico, Turkey and others is growing rapidly (Table 2.4.3).

TABLE 2.4.3. Number of students in the world and some countries, 2012 – 2016⁹⁶

Country	2012	2013	2014	2015	2016	2017
China	32585961	34091290	41924198	43367394	43886104	44127509
India	28568409	28175135	30305849	32107419	32391800	
USA	20994113	19972623	19700221	19531727	19288424	
Brazil	7241405	7541112	8072146	8285475	8319089	
Indonesia	6233984	6423455	6463297	-	-	7983633
Turkey	4353542	4975690	5472521	6062886	6689185	
RF	7983111	7528163	6995732	6592416	6182300	
Iran	4404614	4367901	4685386	-	4348383	
Mexico	3161195	3300348	3419391	3515404	4244401	
Japan	3884638	3862749	3862460	3845395	3846927	
Philippine	3044218	3317265	3563396	-	-	3589484
Republic of Korea	3356630	3342264	3318307	3268099	3204348	
Argentina	2726557	2768211	2869450	2966125	3061139	
Germany		2780013	2912203	2977781	3043084	
Egypt	2301182	2477581	2544107	2868912	2789278	
France	2296306	2338135	2388808	2424158	2480186	
Thailand	2430471	2405109	2433140	-	2410713	

95 Enrollment in tertiary education, all programs, both sexes (number). – URL: <http://data.uis.unesco.org>

96 Ibid

Columbia	1958429	2109224	2220652	2293550	2394434	2446314
United Kingdom	2495779	2386189	2352933	2330334	2387280	
Vietnam	2261204	2250030	2692124	2466643	2307361	
Spain	1965829	1969413	1982162	1963924	1968702	
Australia				1903454	1918625	
Pakistan	1816949	1915419	1931875	1871575	1856156	1941478
Italy	1925930	1872693	1854360	1826477	1815950	
Ukraine	2390989	2 205 595	2146028	1776190	1689724	1667288
Saudi Arabia	1206007	1356602	1496730	1527769	1622441	
Poland	2007212	1902718	1762666	1665305	1600208	
Canada	1505424	1555449	1577766	1564125	1593383	
Alger	1210272	1252579	1245478	1289474	1439594	1545523
Malaysia	1076675	1116733	1128027	1302091	1336550	1248927
Chili	1118773	1174011	1205182	1221774	1236701	
South Africa	1005721	1035594	1018543	1050860	1053607	
World	198196882	200488986	212931484	217458978	220005861	220704240

The increase in the number of students is characterized not only by absolute figures, but also by relative ones. Gross enrollment ratio is one of the most important and illustrative indicators. The gross enrollment ratio for higher education is calculated as the total number of students / graduates in higher education (ISCED 5 and 6), regardless of age, as a percentage of the five-year age group in total population after graduation. According to Table 4, we can see that most countries across the world are close to 100% enrollment in higher education, and even have exceeded this indicator: Australia (121.86%), Greece (126.86%), Turkey (103.75%). Overall, all leading countries are performing well: USA (88.84%), Finland 86.99%), South Korea (93.78%), etc. On the other hand, many countries in the world are witnessing high growth rates:

China increased its gross enrollment in higher education from 28.04% to 48.44% in just 4 years from 2012 to 2016. Ukraine is also in the leading position among the countries in the world in this indicator (Table 2.4.4):

TABLE 2.4.4. Gross enrollment in higher education, %⁹⁷

№	Country	2012	2016
1	Australia	-	121.86
2	Austria	78.88	83.46
3	Canada	64.17	67.04
4	Chili	78.78	90.32
5	China	28.04	48.44
6	Finland	92.89	86.99
7	France	57.91	64.44
8	Greece	110.31	126.38
9	Iceland	81.97	73.60
10	Latvia	66.64	80.60
11	Nederland	76.61	80.36
12	New Zealand	78.96	81.75
13	Norway	73.58	80.55
14	Republic of Korea	96.64	93.78
15	RF	76.14	81.82
16	Turkey	69.78	103.75
17	Ukraine	81.94	83.42 (2014)
18	United Kingdom	59.84	59.41
19	USA	88.73 (2013)	88.84
	World	32.48	37.46

In international education statistics, funding per student is also important, which can be expressed in both constant

97 Ibid

units and purchasing power parity. Table 2.4.5 provides the data on funding per student in different countries, based on purchasing power parity.

TABLE 2.4.5. Public funding for 1 student in countries (2012-2016 pp.), PPP USD⁹⁸

Country	2012	2015	2016
Australia	8 165.56	9 954.44	
Austria	17 219.31	17 938.14	
Belarus	2 540.18	2 926.75	3 083.1
Canada	12 510.172013	16 858.71	16 362.12
Denmark	18 772.69	20 658.292014	
Estonia	4 521.43	9 641.55	
Finland	14 628.20	14 535.67	
France	12 836.11	13 372.87	
Germany	17 222.46	16 262.81	
Iceland	10 371.17	12 052.89	
Israel	6688.79	6 940.73	
Japan	8 762.24	9 496.692014	8 705.11
Latvia	4 820.02	5 863.85	
New Zealand	9 282.522013	10 035.52	10 068.17
Norway	27 181.732013	23 036.56	
Poland	5 358.12	7 476.46	
Republic of Korea	4 183.40	5 127.95	
RF	3 931.64	4 629.29	
Spain	7 629.16	7 988.03	
Sweden	18 978.71	20 658.35	
Turkey	8 806.09	7 990.87	
Ukraine	3 505.76	3 222.012014	3 189.67

98 Ibid

United Kingdom	15 243.162013	14 446.92	15 353.81
USA	10 920.89	11 240.532014	

A notable trend of modern times is not only the increase in the number of students, but also an increase in the number of foreign students. In modern conditions, countries across the world are increasingly involved in the processes of globalization of the educational space. The number of international students increased from 0.8 million in 1975 to 1.7 million in 1995. With the beginning of the 21st century, a new wave of development of the global market for educational services came. From 2000 to 2017, the number of international students worldwide increased from 2.1 million (in 2005 - 3.0 million, in 2010 - 4.2 million, in 2011 - 4.4 million, in 2014 - 4.6), to 5.3 million. Competition for human and intellectual resources is intensifying between countries to increase their presence in the global educational services market. Table 2.4.6 presents the total and regional numbers of international students in the world.

TABLE 2.4.6. Dynamics of the number of foreign students in the world⁹⁹

	2000	2005	2010	2011	2017
Worldwide	2,1	3,0	4,1	4,3	5,3
OECD	1,6	2,4	3,2	3,3	3,7
Non-OECD	0,5	0,6	0,9	1,0	1,6

At the present stage, the global education market is characterized by new turbulence, changes in the balance of power between major players, the emergence of new processes, and outsiders. The share of OECD countries is shrinking, from a

⁹⁹ OECD. Education at glance 2019. Paris: OECD. URL: [http://: www.oecd.org/](http://www.oecd.org/)

total of 76.2% to 70.0% in 2000-2016. The positions of the main players (Australia, Austria, Germany, France, United Kingdom, USA and others) are declining or remaining at the same level, although the total number of foreign students is increasing.

The most attractive educational systems are in the USA, Great Britain, Australia, the Russian Federation, France, Canada, Germany, and Japan. In these countries, the number of foreign students exceeds the number of those who go abroad to study by more than 100 thousand. Table 2.4.7 presents data on the number of foreign students in the countries with the highest dynamics during 2012-2016. These countries have the largest share of the world market for educational services, more than 1%.

TABLE 2.4.6. Dynamics of the number of foreign students in the world¹⁰⁰

Country	Number of foreign students, 2012	Number of foreign students, 2016	Part of global market	
			2012	2016
Australia	249 588	335 512	6,2	6,6
Austria	58 056	70 484	1,4	1,4
Belgium	42 914	61 102	1,1	1,2
Canada	135 187	189 478	3,3	3,7
France	271 399	245 349	6,7	4,8
Germany	196 619	244 575	4,9	4,8
Italy	77 732	92 655	1,9	1,8
Japan	150 617	143 457	3,7	2,8
Korea	59 472	61 888	1,5	1,2
Netherlands	57 506	89 920	1,4	2,2
New Zealand	40 995	53 854	1,0	1,1

¹⁰⁰ Inbound internationally mobile students by continent of origin.- URL: <http://www.data.uis.unesco.org>

Poland	23 525	54 734	0,6	1,1
Spain	55 759	53 409	1,4	1,1
Switzerland	44 468	51 911	1,1	1,0
United Kingdom	427 686	432 001	10,5	8,5
USA	740 482	971 417	18,3	19,1
China	88 979	137 527	2,2	2,7
Malaysia	56 203	124 133	1,4	3,1
RF	173 627	243 752	4,3	4,8
Saudi Arabia	46 566	79 854	1,2	1,6
Singapore	48 938	53 122	1,2	1,0
South Africa	42 180	82 553	1,0	1,6
Turkey	38 590	87 903	1,0	1,7
Ukraine	43 609	54 144	1,1	1,1
UAE	54 162	77 463	1,3	1,5
World	4 058 385	5 085 893	100	100

At the same time, countries show different growth trends, which in turn changes the balance of power between them. Australia, Canada, the United States, the Russian Federation and the Netherlands have the highest growth rates, which are 68%, 375%, 56% and 233%, respectively. The increase in the number of foreign students in the Russian Federation is due to the attraction of students from Asia, while European countries generally have a wider geography of students. The main attraction for foreign students is the United States due to its active involvement in attracting young people for education. However, President Trump's policies are creating new constraints, and this will inevitably reduce the influx of new students from abroad.

In this situation, Canada and European countries are improving their positions. The main trend of 2007-2016 was

the emergence of new aggressive players: China (increased its market share from 1.4 to 2.7%, the total number of foreign students increased 2.5 times - from 42.1 thousand to 137.5 thousand), Saudi Arabia (from 0.6% to 1.6%, the number of foreign students increased 4 times - from 17.7 thousand to 79.9 thousand), the Russian Federation (from 2% to 4.8%, the number of foreign students increased 3.5 times - from 60.3 thousand to 243.8 thousand) and others. In general, in the global education market, the USA, UK, Australia, Germany and others remain the leaders.

Internationalization of education is represented not only by the growth of the number of foreign students. Academic mobility as an effect of the internationalization of higher education is extremely diversified and takes the following forms: scientists leaving abroad for work, internships, teaching (for a certain period of time), participation in conferences; joint scientific studies (writing articles, monographs, performing research on grants); participation of students, graduate students and teachers in various short-term programs (courses, certification programs, summer schools, etc.).

An important indicator of the export orientation of the country's economy is the share of foreign students in the total number of students. Among OECD countries, the ratio of foreign students to the total student population is highest in Luxembourg (44%). Among the leaders, there are New Zealand - 19%, Australia and the United Kingdom - 18%, Switzerland - 17%, Austria - 15%. The OECD countries average is 6% and the EU22 countries - 8%¹⁰¹.

101 Outbound internationally mobile students by host of region.- URL: data.uis.unesco.org

The hallmark of today's global education market is the increase in the percentage of international students with the increase in education levels. This share is the lowest for short-term and bachelor's programs, while much higher for master's and doctoral programs, as shown with the data in Table 2.4.8.

TABLE 2.4.8. International student mobility in OECD countries, %¹⁰²

Country	The share of foreign students at different levels of higher education					%, 2014/2013
	All higher education	Short programs	Bachelors programs	Masters programs	Doctors programs	
Australia	18	13.3	13.1	40	34	6
Austria	15	1.0	18.6	18	25	8
Belgium	11	4.9	8.2	20	37	24
Canada	10	9.0	8.1	14	27	12
Denmark	10	13.1	5.5	17	30	2
Finland	7	-	5.2	12	19	4
France	10	4.4	7.3	13	40	3
Germany	7	0	4.4	12	7	7
Ireland	7	1,1	5,8	14	23	11
Japan	3	3,4	2,5	8	19	2
Luxemburg	44	11,3	25,3	68	85	3
New Zealand	19	27,4	14,3	23	45	18
Sweden	6	0,2	2,4	9	33	0
Switzerland	17	0	9,9	28	53	5
United Kingdom	18	5,5	13,7	37	42	3
USA	4	2,0	3,5	9	35	7
OECD	6	3,0	4,9	12	27	5
EU22	8	4,5	6,1	13	22	4

Of course, for each country, not only the attraction of foreign students is important, but also the dynamics of their

¹⁰² OECD. Education at glance 2017. Paris: OECD.- URL: www.oecd.org/

own youth going abroad. It is important to note that this indicator is influenced by many factors. Leaving of young people to study abroad can be far not only because of the unfavorable economic situation in the country. Globalization encourages young people to be active in their searching. As a result, we can observe not only developing countries, but also developed countries among importing countries.

Table 2.4.9 provides data on the number of international students by country of origin. The leaders of the importing countries are quite different countries: China, USA, Saudi Arabia, Turkey, Japan, Vietnam, Russia, etc. It is also noteworthy that the dynamics of young people leaving for study abroad is also quite different across countries. In countries, such as Greece, Turkey, Japan and the United Kingdom, the number of students leaving is decreasing. At the same time, countries like Saudi Arabia, Vietnam, Brazil, the Russian Federation, Mexico, Ukraine, the USA, Georgia, Tajikistan and others are showing a clear upward trend:

TABLE 2.4.9. The number of students studying abroad - immigrants from the country of origin¹⁰³

Country	1998	2000	2010	2015	2017	%, 2017/1998
China	151 055	165 348	570 449	818 803	847 259	561
USA	38 208	43 482	57 506	67 356	68 580	180
Saudi Arabia	9 941	10 626	42 651	86 223	85 277	858
Vietnam	7 858	9 148	47 268	68 038	70 328	895
RF	26 096	28 634	50 403	57 332	56 915	218

¹⁰³ Inbound internationally mobile students by country of origin.- URL: <http://data.uis.unesco.org/>

Turkey	51 067	51 604	51 885	45 921	45 331	89
Ukraine	13 064	20 891	36 203	68 279	76 181	583
Greece	62 059	63 676	29 226	37 092	37 484	60
Latvia	2 875	3 005	5 064	5 804	5 737	200
Japan	57 088	59 302	40 330	30 491	30 850	54
Brazil	15 596	17 274	27 753	42 645	43 438	279
United Kingdom	28 142	22 328	24 600	31 433	33 109	118
Mexico	13 149	14 230	26 072	30 194	30 646	233
Thailand	21 553	21 007	28 304	28 672	29 768	138
Sweden	12 819	12 601	15 540	17 378	17 567	137
Azerbaijan	4 882	4 862	14 302	39 970	41 762	855
Georgia	3 857	4 367	8 736	8 888	9 084	236
Tajikistan	1 292	1 396	8 342	15 677	20 623	1596

Ukraine is quite active at the international level and has the potential to increase its presence. The number of foreign students in Ukraine has more than tripled: from 17 thousand in 2001 to about 60 thousand people (approximately 1.5% of the world market) in 2015. After the 2014 events, the import processes (Ukrainians leaving for study abroad) accelerated significantly.

Among foreign students, there are 1.3 thousand from China, 3.7 thousand from Turkmenistan, 7.7 thousand from India, 6.7 thousand from Azerbaijan. Unfortunately, there is a clear tendency for Ukrainian youth to leave abroad. While earlier, their number was lower than the number of foreign students, then after 2014, it is much higher. At the beginning of the 2017/18 academic year, 76 181 Ukrainians (more than one and a half times the number of foreign students) studied abroad. According to UNESCO, 54,144 Ukrainians studied abroad in 2016, with over 30,000 studying in Poland:

TABLE 2.4.10. Dynamics of foreign students in Ukraine, 2000 – 2017¹⁰⁴

	2000	2005	2010	2015	2016	2017
The number of foreign students in the country, total	17 210	29 614	38166	53493	52147	48991
in% of the total number of students in the country	0,8	1,0	1,3	3.33	3.3	3.2
The number of Ukrainian students studying abroad, total	20 891	26 698	36 203	68 279	76 185	76 181
in% of the total number of students in the country	1.0	0.9	1.2	4.3	4.8	5.0

It is a well-known fact that only those countries that pay close attention to the science and education system are achieving rapid development. And while education can still boast of some positive trends, then in science, the situation becomes threatening. Ukraine is losing its positions very quickly, as evidenced by the tendency of most indicators to deteriorate. The data in the following table demonstrates the contradictory trends in the development of the scientific potential of Ukrainian higher education. First of all, in spite of the sharp decrease in the number of candidates and PhDs in 2014, after that, the country manages to recover their upward trends. Overall, the performance of research activities (number of publications, international conferences, international grants, etc.) has a positive trend (Table 2.4.11).

Transforming strong positions into real competitive advantages requires focused efforts. In the modern world, the

¹⁰⁴ Inbound internationally mobile students by country of origin; Outbound internationally mobile students by host of region.- URL: <http://www.data.uis.unesco.org>

TABLE 2.4.11. Dynamics of certain indicators of higher education system in Ukraine¹⁰⁵

Year	Financing of higher education, % of GDP	Number of PhD	Number of Doctors of Science	Number of international students	Number of international conferences	Number of publications	Number of grants received from international funds
2000	1,3	39 030	6 681	17 210	1 031	-	1 138
2005	1,8	61 150	11 309	29 614	1 768	241 942	1 464
2010	2,3	74 637	13 678	38 166	2 201	345 338	1 723
2014	1,8	86 230	16 090	56 933	2 023	327 919	1 885
2015	1,6	62 777	12 538	53 493	2 321	313 021	1 882
2016	1,5	63 603	13 233	52 147	-	-	-
2017		62 178	13 652	48 991	-	-	-

scientific recognition of each country's potential is determined by the number of publications in science publications. The authors summarize the dynamics of such publications, which have been compiled by the SCIMAGO international network since 1996¹⁰⁶. Table 2.4.12 presents data that allows to see the overall trends and dynamics of publications in the most advanced countries. Some countries show extremely high rates of increase in cited publications (China - 1531.1% growth, Malaysia - 2747.2%, Brazil - 678.6%, Iran - 5116.5%, etc.), which is certainly a realization of dedicated public policy of these countries. In 2017, the top ten in terms of publications in science journals were the USA (1st position), China (2nd), United Kingdom (3rd), Germany (4th), India (5th), Japan (6th), France (7th), Italy (8th), Canada (9th), Australia (10th). Unfortunately, Ukraine ranks 46th with a total of 11,111 publications and a Hirsch index of 225. However, the analysis shows that there is a great potential for

¹⁰⁵ State Statistic Service of Ukraine.- URL: <http://www.ukrstat.gov.ua/>

¹⁰⁶ SCIMAGO Journal&Country Rank. – URL: <https://www.scimagojr.com/countryrank.php>

higher education to increase the number of publications, which is confirmed by their rapid growth in recent years:

TABLE 2.4.12. Total number of publications in science publications in selected countries of the world, 1997-2017¹⁰⁷

Country	1997		2017		H Index	%, 2017 until 1997
	Number of publications	Rank	Number of publications	Rank		
USA	347 079	1	626 403	1	2 077	180,5
China	33 222	8	508 654	2	712	1 531,1
United Kingdom	93 103	3	191 830	3	1 281	206,0
Germany	82 769	4	170 114	4	1 131	205,5
India	21 939	13	147 537	5	521	672,5
Japan	93 779	2	123 043	6	920	131,2
France	59 918	5	115 747	7	1 023	193,2
Italy	40 571	7	110 402	8	898	272,1
Canada	42 453	6	100 810	9	1 033	237,5
Australia	25 644	11	94 065	10	848	366,8
RF	32 035	9	83 358	12	503	260,2
Korea	12 951	16	80 743	13	576	623,5
Brazil	10 860	21	73 697	14	489	678,6
Iran	1 063	51	54 388	16	257	5 116,5
Poland	11 964	18	44 692	18	479	373,6
Turkey	6 107	27	42 405	19	368	694,4
Sweden	17 953	14	39 976	20	778	222,7
Thai van	11 573	19	32 181	22	702	278,1
Malaysia	1 130	49	31 043	23	249	2 747,2
Ukraine	6 112	26	11 119	46	225	181,9
Estonia	604	60	3 118	68	234	516,2
Latvia	507	65	2 188	75	142	431,6

¹⁰⁷ Ibid

Military aggression and occupation cannot be an excuse to reduce the focus on science in the country. Ukraine's strategic future depends on whether the government will prioritize strengthening the country's scientific potential and creating the conditions for its effective use in line with global trends. The key issues are how to increase the funding for education and science; to increase inflow of financial resources from business, non-profit and foreign sources; support of scientists, and to make the conditions to realize their potential; to found powerful research centers and universities as generators of innovative development.

In the global intellectual ecosystem, key players are the world's leading universities, which are making huge investments in research, as evidenced by strong funding indicators. As an example, we provide data on the volume and structure of financial inflows to the Top 10 US universities in terms of research funding volume. Interestingly, the federal government's expenditures account for the highest share of all funding (more than 60 percent), universities (19.8%), non-profit organizations (9.1%), and business (6.9%) and local government (1.5%) are much lower.

In general, in Ukraine, the share of total expenditure on science in GDP was 0.48% in 2016 and 0.45% in 2017. For comparison, in 2016, the share of R&D expenditure in the GDP of EU-28 countries averaged 2.03%. The average share of R&D expenditure for Sweden was 3.25%, Austria - 3.09%, Germany - 2.94%, Denmark - 2.87%, Finland - 2.75%, Belgium - 2.49%, France - 2.25%. The world leaders in terms of the share of spending on research are Israel - 4.25%, Korea - 4.23%, Japan - 3.14%, the United States - 2.74% of GDP.

TABLE 2.4.13. Volume and structure of research funding in the Top 10 American Research Universities, mln. doll. (2017)¹⁰⁸

Ranking	University	R&D expenditures, all	Federal expenditures	State and local expenditures	University expenditures	Business expenditures	Non-profit organizations expenditures	Other
1	Johns Hopkins University	2 562,3	2 178,6	5,3	138,0	84,0	149,0	7,4
2	University of Michigan, Ann Arbor	1 530,1	829,7	2,7	537,2	82,9	64,7	13,0
3	University of California, San-Francisco	1 409,4	606,8	32,9	334,0	96,9	221,4	117,4
4	University of Pennsylvania	1 374,3	669,9	16,7	445,5	140,2	99,2	2,8
5	University of Washington, Seattle	1 348,2	952,7	28,0	128,0	53,8	153,1	32,7
6	University of Wisconsin-Madison	1 193,4	570,8	57,5	394,4	25,7	104,0	41,1
7	University of California, San-Diego	1 133,5	641,5	34,6	186,5	80,8	84,0	106,1
8	Duke University	1 126,9	623,6	0,12	151,2	234,8	98,2	19,0
9	Harvard University	1 123,2	573,2	2,3	334,0	47,0	150,0	16,7
10	Stanford University	1 109,7	710,7	30,4	106,5	114,8	142,6	4,8
	Whole Top-10	13 911,0	8 357,4	210,6	2 755,3	960,8	1 266,1	361,0
	%	100	60,1	1,5	19,8	6,9	9,1	2,6

Such a critically low level of funding for science in Ukraine cannot but be reflected in the overall performance and presence of Ukrainian universities in the global educational environment. So, in the famous Shanghai ranking of world universities (called the world ranking of research universities),

¹⁰⁸ National Science Foundation. URL: <https://ncesdata.nsf.gov/profiles/site?method=rankingBySource&ds=herd>

Ukrainian universities are absent in the top 500, as well as in the 501-1000 group of candidates for world leaders.

The well-known QS World University Ranking annually carries out both the overall ranking of the universities across the world and the specific rankings of the universities: by individual disciplines, employment prospects, by the assessment of the best MBA programs, regional rankings, rankings by location in the best cities, universities opened within 50 previous years, etc. The following Ukrainian universities were present in the overall QS World University Ranking 2018: in the group 401-410 – Karazin Kharkiv National University, 411-420 - Taras Shevchenko National University in Kyiv, 501-550 - National Technical University “Igor Sikorsky Kyiv Polytechnic Institute”, 701-750 - Kharkiv Polytechnic Institute, 801-1000 - Vasyl Stus Donetsk National University and Sumy State University.

The Webometrics rating evaluates the university’s presence in the global space, considering the relevance and importance of its performance. In the latest issue in January 2019, the following two institutions are present in the first two thousand: the Taras Shevchenko National University of Kyiv (1195th position) and the National Technical University “Igor Sikorsky Kyiv Polytechnic Institute” (1628th position).

One more famous rating is Universities21, which is the only ranking in the world for not by individual universities, but by national higher education systems. It is noteworthy that this rating has recently grown beyond just rating and is being transformed into a global network. The main areas of activity of this network are educational innovations, student experience and involvement of researchers. In the latest

edition of 2018, Ukraine ranked 38th out of 50. Since the emergence of this rating, our country's positions have changed significantly: in 2012 and 2013 - 25th place, in 2014 – 42nd, in 2015 – 41st, in 2016 – 42nd, in 2017 – 35th. If we look at sub-indices (constituent), then the strongest values for Ukraine are in the category “Resources”, the average - in the categories “Environment” and “Communications”, and the worst in the category “Results”. This again demonstrates that our country has considerable potential and resources, but powerful impulses are needed to activate and support it in order to bring the national higher education system to a competitive position in the global educational environment.

A common feature of all successful governments (which strategies were very diverse) was the fundamental recognition of the priority of intellectual factors of breakthrough social development, which was manifested not only in the significant attention and funding of education and science, but also in the involvement of the intellectual elite and the development of state policy. It seems that the present on state-level recognition of the priority of education and science and the real elevation of their role in the country's development can be a sign of a real reform. The transformation of research universities into an important factor in the innovative development of the country should be done through frameworks of programmatic management, enhanced financing, expansion of autonomy and entrepreneurial functions combined with the real economy and business.

The Ukrainian higher education system has great potential and traditions that have been built up over a long history. In today's context, it is important to improve the economic framework of higher education system functioning: the search

for the optimal model of state funding aimed at ensuring the quality of education and overcoming the differences in access to high-quality education. This requires a clear understanding of the desired outcomes, goals and frameworks for achieving them. A pressing issue for modern educational practice in Ukraine is the further elaboration of funding frameworks based on performance, the development of simple and clear goals that can be identified and defined as outcomes and benchmarks for financing educational institutions.

Not only new incentives and frameworks are needed to preserve the potential of our higher education and to stimulate new development. First of all, we need a state position to preserve and support our intellectual elite, and educational potential accumulated over many years. The experience of the advanced countries across the world shows that the creation of a circle of powerful research universities can be an effective factor in the development of higher education and increasing the country's competitiveness. To this end, it is necessary to create special conditions for national education leaders and to support all other sectoral or regional institutions, which in their place will contribute to the strengthening of the Ukrainian economy.

In a global environment, a single landscape of innovation is emerging, which sets out standard approaches to assessing its performance. Highly developed countries show naturally high performance. At the same time, some developing countries, such as Malaysia, Thailand, Vietnam, the Philippines, Indonesia and Cambodia, are significantly improving their results. Performance assessment takes into account the ability to make significant investments in education and research to produce social and commercial impact; number of engineering

graduates and employees in science and technology; opportunities for realization of talents in business structures; high share of export of creative goods, expenses of world companies, cooperation of business and science, number of patent applications (Table 2.4.14).

TABLE 2.4.14. Key Innovation Indicators of Global Key Innovators¹⁰⁹

Country	Global R&D companies, average expenditure top 3, 2016		University/industry research collaboration, 2016		Knowledge-intensive employment, %, 2015		Patents by origin/bn, PPP\$ GDP, 2015	
	Score/Value mil.dol	Rank	Score/Value, (0-7)	Rank	Score/Value	Rank	Score/Value	Rank
Switzerland	6880,31	0,98	5,80	1.00	46,16	0,65	17,74	0,97
Sweden	2177,94	0,92	5,16	0,91	68,56	0,94	12,34	0,93
Nederland	2382,3	0,93	5,50	0,97	59,08	0,86	11,06	0,93
USA	11774,73	1.00	5,57	0,98	71,01	0,96	15,99	0,96
United Kingdom	3826,19	0,95	5,47	0,96	38,16	0,58	7,37	0,88
Denmark	880,30	0,87	4,84	0,89	58,02	0,83	13,09	0,94
Singapore	403,62	0,83	5,47	0,95	50,51	0,74	3,11	0,74
Finland	980,14	0,89	5,72	0,99	56,77	0,82	14,63	0,95
Germany	8986,88	0,99	5,35	0,94	56,51	0,81	18,71	0,98
Ireland	1999,59	0,91	5,11	0,90	53,82	0,79	2,74	0,71

At the same time, the gaps in these indicators are also quite significant, so, Switzerland ranks first by the level of cooperation between universities and business, but far behind the number of researchers in business. The United States is the leader in R&D spending by three major companies, ahead of nearly 30% of its successor, Germany. In general, the United States is among the

¹⁰⁹ Global Innovation Index 2017.- URL: <https://www.globalinnovationindex.org/gii-2017-report#>

top 10 most innovative economies in the world by almost all indicators. The analysis shows that all key innovators have a high level of performance in scientific activities.

The analysis of the results of innovative activity allows to state that the intellectual leadership of the countries, which are in the TOP-10 most innovative countries, is supported and provided by a very active position and policy of the state. In particular, according to some indicators, only some of the selected are not in the TOP-10, but this may be due to their focus on other types of innovation. However, some of the countries that are not among the ten most innovative economies are leading by some indicators. For example, Israel is ranked number one in the world by the number of researchers per thousand people, which is the result of the government's policy on setting an innovation and technology hub, with simplified taxation for the companies opening their research centers in Israel. China is leading by the number of patent applications as a result of a long-term national strategy focused on very clear, specific indicators and goals. The strategy from imitation to innovation is primarily manifested at the level of certain indicators and in the long term, can provide world leadership by the level of innovation.

CHAPTER 3

Intellectualization of the regional economic space

3.1. Localization of the global entrepreneurship

Major changes in the organization of production that have taken place at the turn of the millennium brought about significant adjustments to the understanding of the terms of global regionalism, which were considered quite obvious and permanent for centuries. Basically, we are talking about the regional taxonomy in the EU, which, since the 1980s, has made it possible to clearly identify the inner EU sub-national regions on the level of NUTS-1, NUTS-2, NUTS-3, NUTS-4, NUTS-5¹. However, as early as 2000, only three statistical levels remained actively applied in the EU: NUTS-1, NUTS-2, NUTS-3, the use of the rest being the option for each Member State. Similar shifts, often referred to as regional reforms along with financial instruments, have become widespread in some other countries, having been undoubtedly underpinned

1 NUTS – Nomenclature of Territorial Units for Statistics

by the post-Keynesian paradigm. Instead, other states adopted neoliberal approaches, and over time have begun to adhere to the post-liberal principles of organizing their regional models (USA, Canada, and Australia). This grew into a convincing argument for the so-called “non-interference” with regional development, which in some countries (we mean subsidies, subventions, regional grants, etc.) was considered unconstitutional. As a result, the economic hyperactivity of the former “regional locomotives” gradually turned into a depressed zone with atypical forms of social and economic decline (Michigan in the USA; Alsace and Lorraine in France).

Changes in principles of production organization have also been noticed. The traditional orientation of many industries to sources of raw materials has gradually been replaced by the availability of convenient communication routes, especially seaports (Dunkirk, France). In this case, the cost of imported raw materials became important. As a rule, it was much lower, than what domestic producers could offer. Radical modernization of the transport sector, characterized by the emergence of heavy-duty tankers, container vessels, light trucks, as well as the formation of international logistics, covering various modes of transport, communication and infrastructure, finalized the destruction of this textbook principle of spatial production organization.

Significant shifts in the intellectual production spheres and their sectoral, horizontal and spatial localization, according to K. Schwab, are quite clear reflected in those fundamental global changes that will concentrate on certain sections of the land. As the author points out, by 2025, smart cities, as the most modern form of localization, will have experienced a number

of positive changes, in particular: growing resource efficiency, increasing density, improving quality of life, decreasing environmental impact, improving access to resources for the majority of the population, reduced cost of services, higher transparency on the use and condition of resources, reduced crime rates, increased mobility, decentralized and climate-friendly energy production and consumption, decentralized manufacturing of goods and provision of services, increased resistance, reduction of emissions, increased access to education, easy access to markets, rising education levels and “smart e-government”².

However, the modern world does not seem so “cloudless”, and the set of the abovementioned undoubted advantages should be balanced with a wide range of negative consequences, among which the experts, including K. Schwab, often mention the growing risks of collapse, especially in the energy sector, privacy breaches, personal vulnerability, cyber-attacks, cybercrime etc. There will be some ambiguous consequences for the creative sphere and individual living space, because in principle, the culture and its perception by Z-generation, the way of life in hyperlocalised areas of production of goods and services will change.

Of course, the above changes will naturally affect all existing regional taxonomies, since they will cause, on the one hand, complications in the perception of the concepts of “region” and “locality”, on the other - the awareness of its new, multi-structural characteristics, whose subindex significance will be constantly causing lively discussions in society. As a ready-made example, we can cite the rather flamboyant, in

2 Shvab K. (2019) Chetverta promislova revolucija, formujuchi chetvertu promislovu revoluciju. – Kharkiv:Klub simejnogo dozvillja. – S. 119

our opinion, work of M. Fujita, P. Krugman, A. Venables “The spatial economy”, in which the authors link into a single whole cities, regions, and international trade, and with the help of mathematical apparatus substantiate the so-called dynamic multiplication model of multilevel localities’ development (the authors do not use this term in this work, but it is quite widespread in the modern regional studies)³.

Swedish researcher T. Herrschel⁴ approached this research sphere from the point of view of creation of global networks, their scaling and development of a new territorial taxonomy model, as well as rather negative phenomena of peripheralisation and marginalization of individual metropolitan areas. The abovementioned author raised an extremely important issue not only for the future of the regions, but also for the rapid modernization of the structure of production processes in the world in general. Assuming that in the near future a global network of production of goods and services will be created, it is quite possible to raise the question of the existence of so-called “black holes”, because the advanced new centers of reproduction will be principally interested in reinvesting the profits into the highly localized clusters, technopoles or similar formations covering smart cities, creative quarters and others. It should be noted that the number of those who are interested in migrating to the hyperactive territories will be steadily growing, instead, these innovation-investment units will agree only to the “infusion of fresh intelligence” and will not be interested in attracting

3 Fujita M., Krugman P., Venables A. (2001) *The Spatial Economy. Cities, Regions and International Trade.* – London: The MIT Press, 2001. – P. 11

4 Herrschel T. (2011) *Regional Development, Peripheralisation and marginalization – and the Role of Governance/In The Role of regions, Network, Scale, territory/Ed. By Tassilo Herrschel, Pontus Tallberg.* – Kristianstands, Boktryckery, 2011. – P. 103-124

unskilled labour force at all via the introduction of special legal and economic filters. Therefore, the position of confrontation will become inevitable. Well-known American researcher M. Storper foresaw the so-called “rebellion” of rich regions against the poor in the 1990s⁵. A vivid confirmation for what was extensively discussed in academia at the end of the 20th century is active controversy over the growing flow of migrants to EU Member States, tensions on the US-Mexico border, and the introduction of stricter migration control measures in the laws of Canada, the United Kingdom, Australia, Japan and other countries. Many of the valuable ideas that have emerged at the turn of the millennium will be substantially corrected in the near future. Among them, the idea of M. Keating’s new regionalism⁶, as well as rather significant monograph “Political Economy of Regionalism”⁷ co-authored by J. Loughlin.

McGinnis’s idea of bioregionalism⁸, recognizing the establishment of harmonized boundaries of regions (considering natural borders) has not lost its popularity. Other valuable theoretical elaborations include the brilliant M. Porter’s concept of localization, clustering and competitiveness of the new economy⁹, a comprehensive J. Simme’s proposal to create innovative cities¹⁰, as well as H. Siebert’s bold rationalization for the concept of local competitiveness¹¹, identified by the

5 Storper M. *The Regional World. Territorial Development in a Global Economy.* – New York – London: The Guilford Press, 1997. – 338 p

6 Keating M. (1998) *The New regionalism in Western Europe. Territorial Restructuring and Political Change.* – Cheltenham: Edward Elgar Publishers, 1998 – 242 p

7 Keating M., Loughlin J. (1997) *Political Economy of Regionalism.* – Portland: Frank Cass, 1997. – 491 p

8 McGinnis M. *Bioregionalism.* – London: Routledge, 1999. – 525 p

9 Porter M. (1998) *The Adam Smith Address: Location, Clusters and the «New» Microeconomics of Competition // Business Economics.* – 1998. – № 33 (1). – P. 7-13

10 Simme J. (2011) *Innovative Cities.* – London: Spoon Press, 2011. – 254 p

11 Siebert H. (2006) *Location Competition: A neglected Paradigm in the International*

author at the level of the regions of the world and the structure of their foreign trade.

New trends in identifying the nature of localization processes emerged in early 2010s. These include a rather bold idea of R. Florida concerning the creative class and creative economy, that has taken place at the level of identification of those employees, who create an unusual but extremely important innovative product¹². Thus, according to the author, the dominant research economic paradigm of the XXI century should be called “Homo Creativus”. It should be noted that at the turn of the millennium, the theory of neoliberal cities¹³ has become extremely popular. Its generalized thematic interpretation was given by G. Pinson and Ch. M. Journal. However, research focus was placed on urban policy and the dominant neo-liberalization model. It is this approach in global regionalism that has become extremely important and significant, though not often accepted by the scientific community. For example, the above-mentioned M. Keating compared it to plutocracy¹⁴.

Despite all the dominant approaches to identifying the main trends of localization, the latter is constantly compared to those processes of urbanization which are actively occurring in different regions. In view of this, important categories that have been analysed, in particular by Ph. McCann, include: localization of business, agglomeration and clustering, spatial distribution of

Division of Labor / Horst Siebert // *The World Economy*. – 2006. – № 29 (2). – P. 137-159

12 Florida R. (2018) *Homo creatives. Jak novij klas zavojue svit / Per. z angl. M. Jakovlev. – K.: Nash format, 2018. – 431 s*

13 Pinson G., Journal Ch.M. (2016) *The neoliberal City-Theory, Evidence, Debates / Gilles Pinson and Christelle Morel Journal // Territory, Politics, Governance. – 2016. – Vol. 4 (№ 2). – P. 137-153*

14 Storper M. (2016) *The Neo-Liberal City as idea and reality / Michael Storper // Territory, Politics, Governance. – 2016. – Vol. 4 (№ 2). – P. 254*

activities, regional specialization and, quite naturally, the regional labour market¹⁵. We should also mention two fundamental works in world regionalism. The first one was written by H. Armstrong and J. Taylor with rather interesting approaches to assessing the cumulative growth of the region and related EU regional policy¹⁶. The second one is the work by Cl. Hagne, E. Hagne and C. Breitbach, who view the process of regional and local economic development as the only globalization trend, the content of which, as with R. Florida, includes creative class, territorial capital, agglomerations and clusters¹⁷.

The analysis of important sectoral, horizontal and spatial changes in terms of localization and regionalization (internal and external) allows to introduce adjustments into the understanding of localization processes, the essence and significance of which, over time, has undergone constant changes, because intellectual and investment capital in the conditions of globalization is an important mobilization factor, the dynamics of which depend substantially on clear and hidden business interests. The desire of many states to maximize the institutionalization of the process of managing regions and localities in the conditions of proliferation of integration blocks can reduce the distance between grassroots taxa, but it should be understood that this process of convergence may not always be permanent, as, for example, in the European Union the spill over effect is quite a common phenomenon. That is why localization should be understood as an objective process of

15 McCann Ph. (2013) *Modern urban and regional Economics*. Second edition. – Oxford: University Press, 2013. – 408 p

16 Armstrong H., Taylor J. (2007) *Regional Economics and Policy*. Third edition. – London: Blackwell Publishing, 2007. – 437 p

17 Hagne Cl., Hagne E., Breitbach C. (2011) *Regional and Local Economic Development*. – London: Palgrave Macmillan, 2011. – 344 p

concentration of financial, innovative and intellectual capital within a specific territory, which together with high quality of local infrastructure gives a significant effect of creating highly competitive goods, services, technologies.

An important prerequisite for modern localization is the presence of a number of circumstances, to which the management systems may not be ready. Among them, from our point of view, the following are important:

- possible blurring (incomplete definition) of the boundaries of the administrative-territorial units, which creates certain differences for a certain region, or for two or three at a time;
- lack of clear definition, including the legal one, of terms, like “locality”, “localization” and “local formation”;
- uncertainty in the taxonomy of production localization. In the EU there is a contradiction in the affiliation of localities to the existing hierarchy of regions - NUTS -2 or NUTS-3. This allows for a certain ambiguity of approaches in terms of the size, economic importance and technological completeness of a new territorial formation and its “incorporation” into the system of existing administrative structures of a country or even into the structural models of country coalitions;
- it is of utmost importance to identify the boundaries of localities and their saturation by models of rapid economic growth (clusters, smart cities, technopoles, etc.);
- rather problematic is the possible institutionalization

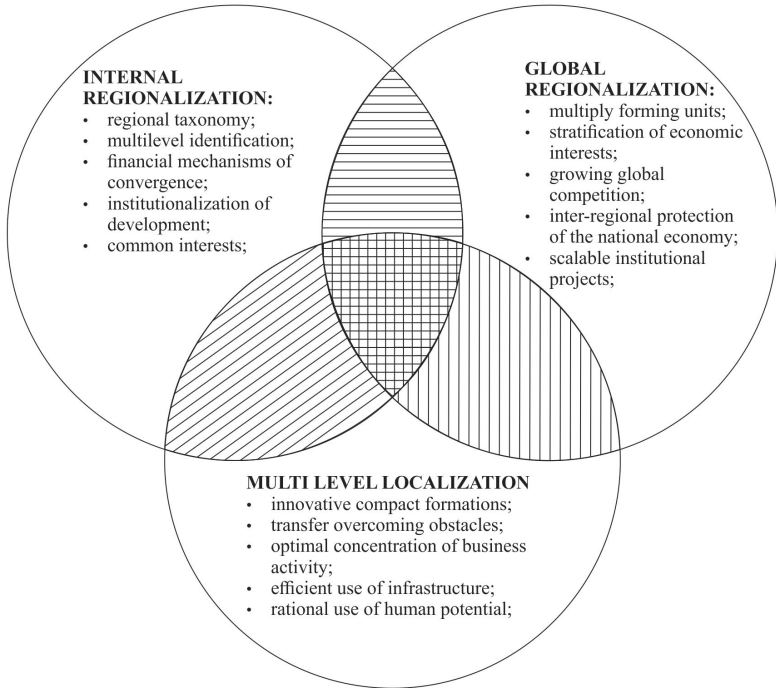
of processes of hyper concentration of production systems and their harmonization with agglomeration models' systems.

Overcoming the abovementioned obstacles will allow in the near future determining the nature and prediction of the future of a new spatial model of global society development, wherein the existing models of mutual influence will embrace internal regionalization, global (international) regionalization and multi-level localization, whose hybrid interaction will tackle the multi-structural process of multi-level diffusion (Figure 3.1.1).

Concluding from the figure 3.1.1, the process of regional reformatting in the present-day context can take quite a long time, but constant renewal of a region may become an important lever of its transformation. However, with certain miscalculations (such as under-utilization of infrastructure, rapid changes in the environment, insufficient investment, etc.), a certain locality, together with the surrounding area, can quickly become a depressed area, turning into a piece of the global periphery.

It should also be noted that inland regions are largely influenced by the financial mechanisms and instruments of existing regional policies, which in today's context should be seen as a complex influence on a given territory through a complementary mix of national activities, supranational financial resources, local and global funds, that are directly related to the dynamic movement of innovation and investment.

A natural consequence of global regionalism is its growing dynamic activity, which, over time, results not only in the formation of economic blocs whose main purpose is







-  – joined regionalization (regional unification taxonomy of the common field competition, joint global projects);
-  – global outsourcing (hyper concentration of global capital, global localities identification, development and institutionalization of their collaboration);
-  – taxonomic harmonization of national regional models – (forming a joint regional / local policy, standardization of mechanisms and instruments);
-  – convergent-divergent trend of regional singularity (network – expansion alpha – cities multi-structural regional space, forming new joint structures smart - cities).

Figure 3.1.1. Spherical interaction model of local - regional trends of the XXI century. Author's vision

Source: Compiled by the authors

the mutual trade benefits of states in a particular mega-region, but also the “penetration of influences” at the local level. The outcomes of such processes are both rapidly escalating conflicts of the participating countries or a clear stratification of economic interests and maintaining the specialization of the internal regions, upholding their own interests, as well as pursuing the large-scale institutional interests.

The third block of multilevel localization will be harmonized with the measures implemented by the two previous blocks. Its important trends should become the following ones: concentration of local benefits directly derived from the activity of previous institutions, saving on infrastructure costs, multi-level optimization, hyper-concentration of intellectual and entrepreneurial capital.

As a result of the mutual penetration of the three spheres, indicated in the figure 1, the so-called hybrid forms of interaction will emerge. In our opinion, there will be at least four of them:

- unified regionalization that provides for the global unification of regional taxa, their clear comparison and the development of common principles, mechanisms and instruments of common regional policy. Here, although conditional but still existing historical boundaries and the growing importance of territorial competition may become the most problematic issues;
- further spread of global outsourcing, which in many cases will serve as the “de-concentrator” of economic and intellectual activities. At the same time, collaboration as a new form of

cooperation within existing and future localities may well be possible. It will imply some interaction between individual companies in the early stages of creating a unified product and, at the same time, maintaining each company's competitive advantages at all the successive stages of economic relations. Important, however, quite contradictory may be the possible institutionalization of business projects at this level of global interaction;

- taxonomic harmonization of national regional models. Naturally, a particular country can make significant efforts for regional development, and may perceive new localities in the regions as creating a diverse structure of the territorial economy. In this case, an open question will always arise about the two contradictory, in general, approaches – the post-Keynesian approach and the post-liberal one. Each of the above approaches interprets differently the application of selective mechanisms and instruments of economic development;
- convergence-divergence trend, in modern conditions should be considered as a manifestation of local singularity, which implies a rapid increase of multi-structural interaction, emergence of a global network of α -cities, β -cities, γ -cities, as well as the global periphery.

It is possible to predict with great confidence that over the next ten to fifteen years a variety of forms of innovative

localization will occur with the simultaneous delocalization of existing models of concentration of entrepreneurship. Their intensive emergence will make significant changes to the regulation of the size of the cities around which this process will extend. Therefore, we will have, on the one hand, a linear expansion of the city itself, as well as the satellite cities formed around it, urban agglomerations, and on other hand - many new forms of local entrepreneurial activity with significant sectoral, horizontal non-linear differentiation. The traditional horizontal model may become the major trend in the extension of this type of spatial formations. However, it has its limits, due to the rising cost of land, geographical complications (seas, rivers, mountains and other landforms). In view of this, an important direction of expansion may be growing number of storeys in the office buildings and possible virtualization of certain types of services. It can be predicted that significant changes will take place in the area of accelerated urbanization and that African cities will become the new millionaire megalopolises. However, a “miracles” will not happen, and their non-industrial function will be preserved. Also urban lifestyle will not become their basis. Therefore, it is not difficult to predict that “fake” urbanization will fully determine the processes of linear expansion of cities with catastrophic infrastructure backlogs.

In view of the above, the general model of local and regional evolution of territories in the period 2025-2035 will take the form of sunflower, not honeycomb, as the German explorer Kristaller was convinced in his time (Figure 3.1.2).

The so-called “geometric approach” to modelling regional systems has always been desirable in the system of international spatial studies. However, it did not manage

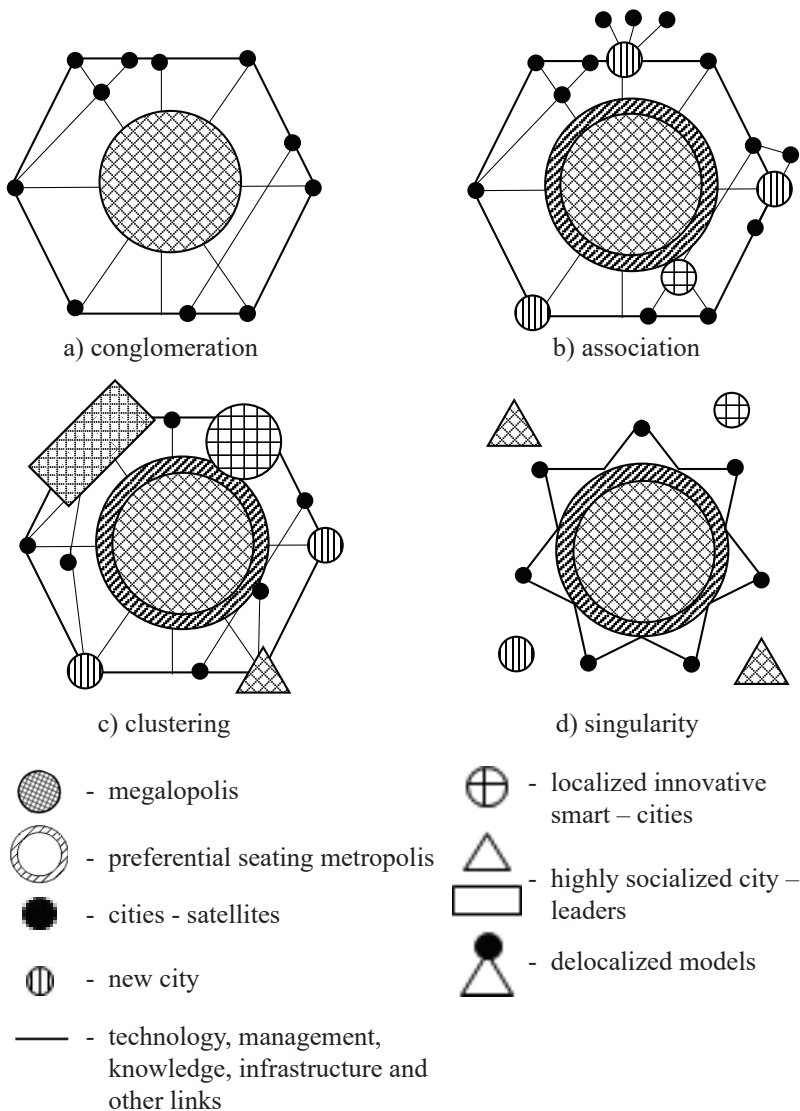


Figure 3.1.2. “Sunflower” model of evolution of regions

to become a system of concentric circles, and often it was hampered by the features of the topography, political structures, business interests or environmental protection. However, it should be noted that the ostensible attraction to other forms of diversification (hexagons, octagons) persists, which explains why the four phases are clearly distinguished in the immediate trends of the evolution of the regions:

- **conglomeration**, within which industrial agglomerations, consisting of satellite cities and a metropolis, emerge. In the later stages, the previously mentioned spill over effect becomes available, which provides not only the transfer of resources and technologies, but also the growth of the local infrastructure quality, which has been successfully justified by Italian researchers M. Ferraresi, G. Migali, L. Rizzo¹⁸;
- **association**, that envisages a gradual formation of a more complex multi-structural framework, with the emergence of highly specialized small towns, new satellite cities, and the development of infrastructure;
- **clustering**, which is a process of further complication of sectoral and horizontal technological links and diversification of forms of innovative growth. At this interval, according to K. Nowotny and D. Pennerstorfer¹⁹, the network

18 Ferraresi M., Migali G., Rizzo L. (2018) Spillover effects in Local Public Spending / Massimiliano Ferraresi, Giuseppe Migali, Leonzio Rizzo // Regional Studies. – 2018. – Vol. 52 (№11). – P. 1570-1584

19 Nowotny K., Pennerstorfer D. (2019) Network migration: do neighbouring region matter? / Klaus Nowotny and Dieter Pennerstorfer // Regional Studies. – 2019. – Vol. 53

- migration of factors of production becomes an extremely important indicator of changes;
- **singularization**, the main feature of which is the large-scale convergence of optimization and formation of both localized and delocalized forms of technological development, which will resemble the “sunflower” at different stages of its development.

Thus, localization of global entrepreneurship is a complex multi-structural process of hyper-concentration of major production factors, coupled with the delocalization of activities of those, who develop and implement individual technological projects at the final stages of which, already at the end of 2020, the global singularity will be clearly visible.

3.2. Innovation trends of European regions' development

The intensification of global competition based on intellectually innovative factors causes further deepening of the international division of labour and the spread of its new forms. Thus, the strengthening of economic specialization becomes noticeable not only at national, but also at regional and local levels. In order to identify trends of regional concentration of innovation activity and its factors in the EU, new methods of monitoring regional innovation development have been introduced.

One of the most common approaches is the European Regional Innovation Scoreboard, whose data analysis shows that there are constant asymmetries in levels of regional

innovation development that persist for a long time between the North and West of Europe on the one hand and the EU's South and East on the other. At the same time, competitive advantages at the level of the Member States are decisive for the development of innovative capacities at regional level: almost all EU regions, positioned as innovation leaders, as well as regions with strong innovation positions represent the most competitive Member States of the integration bloc. Moderate and modest regional innovators (with lower, then average levels of the complex regional innovation index – RII) are mainly concentrated in the EU Member States with generally low levels of country innovation indexes. Only a few regional “poles of excellence” were identified in the group of Moderate Innovator countries. They are Prague in Czech Republic, Crete in Greece, and Friuli-Venezia Giulia in Italy.

Of the 238 NUTS-2 regions surveyed by the European Commission in 2019, 38 regions were identified as Regional Innovation Leaders in 31 European countries, with RII at least at the level of 120% of the EU average. The group of regions with strong innovative economy (Regional Strong Innovators), whose RII is in the range of 90% to 120% of the EU average, includes 73 sub-national administrative units. The group of Regional Moderate Innovators includes 97 participants (their innovation index varies between 50% and 90% of the EU average), and the category of Regional Modest Innovators, which are apparently outsiders of the innovation process with RII less than 50% of the EU level, includes 30 NUTS-2 European regions (Table 1)²⁰.

20 Hollanders H. (2019) Regional Innovation Scoreboard 2019 / H. Hollanders, N. Es-Sadki, I. Merkelbach. – Luxemburg: Publications Office of the European Union, 2019. – 94 p. – P.14

The level of concentration of high-performance innovation regions is quite impressive, as most of them were identified in only nine of the 31 European countries, namely: Switzerland, Sweden, Finland, Denmark, the Netherlands, Belgium, the United Kingdom, Norway and Germany. Most of the regions with strong innovation position also belong to the countries, leading in innovation performance, or their close followers – strong innovators. As we can see from table 3.2.1, most of the countries in the survey contained regions, which belong to one or two innovation performance groups. For example, in Austria, Ireland, Spain, Lithuania, Slovenia and Switzerland, all sub-national taxa belong to only one performance group, whereas in the other 15 countries all regions belong to two groups, and in only five countries their inland regions were scattered across three performance groups²¹.

TABLE 3.2.1. Country distribution of regions by innovation performance, 2019²²

Countries	Innovation performance group of European countries	Regional Innovation Leaders	Regional Strong Innovators	Regional Moderate Innovators	Regional Modest Innovators
Switzerland	Innovation Leader	7	0	0	0
Sweden	Innovation Leader	4	3	1	0
Finland	Innovation Leader	3	1	1	0
Denmark	Innovation Leader	2	3	0	0
Netherlands	Innovation Leader	4	6	2	0
Luxemburg	Strong Innovator	-	-	-	-
Belgium	Strong Innovator	1	2	0	0

²¹ Ibid. – P. 15

²² Ibid. – P. 17

United Kingdom	Strong Innovator	3	9	0	0
Norway	Strong Innovator	2	5	0	0
Germany	Strong Innovator	12	22	4	0
Austria	Strong Innovator	0	3	0	0
Ireland	Strong Innovator	0	3	0	0
France	Strong Innovator	0	10	4	0
Estonia	Strong Innovator	-	-	-	-
Portugal	Moderate Innovator	0	3	4	0
Czechia	Moderate Innovator	0	1	7	0
Slovenia	Moderate Innovator	0	0	2	0
Cyprus	Moderate Innovator	-	-	-	-
Malta	Moderate Innovator	-	-	-	-
Italy	Moderate Innovator	0	1	20	0
Spain	Moderate Innovator	0	0	14	5
Greece	Moderate Innovator	0	1	11	1
Lithuania	Moderate Innovator	0	0	2	0
Slovakia	Moderate Innovator	0	0	4	0
Hungary	Moderate Innovator	0	0	7	1
Latvia	Moderate Innovator	-	-	-	-
Serbia	Moderate Innovator	0	0	3	1
Poland	Moderate Innovator	0	0	8	9
Croatia	Moderate Innovator	0	0	1	1
Bulgaria	Modest Innovator	0	0	1	5
Romania	Modest Innovator	0	0	1	7
TOTAL		38	73	97	30

Another dimension of innovative business-activity concentration is the influence of urban agglomeration factors of economic development. Figure 3.2.1 represents the corridor of fluctuation in the values of the RII for those EU Member States where there are at least three NUTS-2 regions, and identifies the position of the capital-city regions. Obviously,

the metropolitan regions occupy leading positions in most of the countries analysed. Exceptions to the general trend are only relatively small countries (in terms of territory and population) like Austria, Belgium, the Netherlands and Finland, wherein metropolitan regions show generally low values of RII compared to other (non-metropolitan) regions.

In addition, in some countries, capital regions and taxa containing large megalopolises have been awarded even higher than the national innovation categories. For example, in the UK, such regions include London, the South East, East Midlands and South West; in France, the capital city of Ile-de-France; in Italy – Piedmont and Friuli-Venezia Giulia; in Spain – Basque Country; in Slovakia it is the metropolitan Bratislava region. In general, our analysis of the EU Member States' metropolitan regions positioning has proved to be quite stable over the last 4-5 years, as evidenced by the comparison of the results obtained with the calculations of European Commission experts in 2012²³.

In general, high level of localization of regional innovation potential remains quite constant, as innovation performance group membership of 70% of the studied regions has never changed during the nine-year period of European Commission's statistical observations, and for 36 regions their performance group has changed only once²⁴. In addition, according to experts of European Regional Development Fund, the global financial crisis has not significantly affected the relative positioning of the EU's internal sub-national

23 Hollanders H. Regional Innovation Scoreboard 2012 / H. Hollanders, L. Rivera, R. Laura. – Brussels: Publications Office of the European Union, 2012. – 74 p. – c.16

24 Hollanders H. Regional Innovation Scoreboard 2016 / H. Hollanders, N. Es-Sadki, M. Kanerva. – Brussels: Publications Office of the European Union, 2016.– 63 p. – c. 18

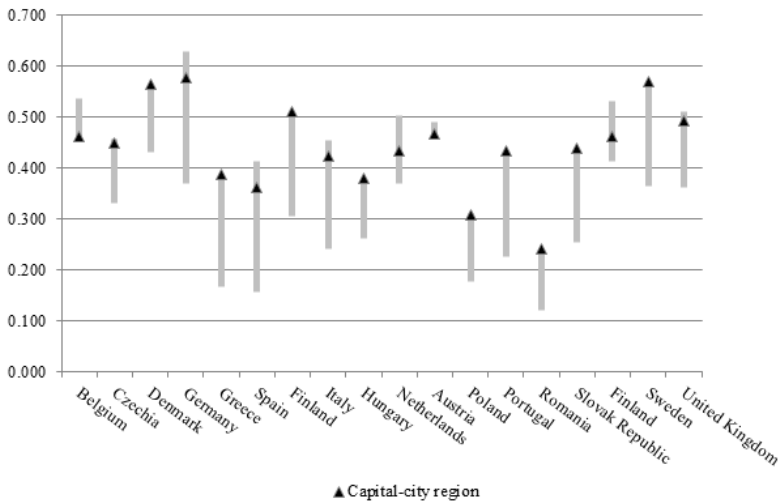


Figure 3.2.1. Comparative analysis of Regional Innovation Index 2016 for capital-city regions and other EU Member States' regions

Source: compiled by the author, based on²⁵

administrative territories. Regions with high innovation capacity have managed to maintain their strengths both during the crisis and after the end of its active phase (this applies to the regions of Germany, Denmark, Sweden and Finland). At the same time, regions with lower than EU average innovation performance (such as the new EU member states and Southern-European countries) experienced significant complications in the development of innovation activity due to the deterioration of their economic situation²⁶.

Decomposition of regional innovation index (RII)

25 Hollanders H. Regional Innovation Scoreboard 2016 / H. Hollanders, N. Es-Sadki, M. Kanerva. – Brussels: Publications Office of the European Union, 2016.– 63 p. – c.53-62

26 Ex post evaluation of Cohesion Policy programmes 2007-2013, focusing on the European Regional Development Fund (ERDF) and the Cohesion Fund (CF). – Luxembourg: Publications Office of the European Union, 2016. – 116 p

into components made it possible to uncover even greater imbalances of regional R&D and innovation development in more detail (table 3.2.2). For example, 89 NUTS-2 European regions performed better by 20% in comparison with the EU average in non-R&D innovation expenditures. Moreover, in almost 80 regions, SMEs performed 20% better, than the EU average in terms of in-house innovation and marketing/organizational innovation. At the same time, for 95 regions, the rate of PCT patent applications to the European Patent Office (EPO) per 1 EUR of GDP of region did not exceed 50% of the EU average²⁷. Only about 2 dozen of the leading European regions (representing Denmark, Finland, Germany, the Netherlands, Switzerland and Sweden) account for 50% of the total number of patent applications submitted to the EPO by the EU representatives²⁸.

A key feature of high-tech business activity is its concentration in a limited number of spaces. This is borne out by the fact that in the EU, about half of R&D expenditure is spent in thirty NUTS-2 regions²⁹, which explains the concentration of the vast majority of ESFRI Roadmap initiatives within 10 EU Member States. The highest level of public R&D investment (per 1 euro of GDP of region) was found in the most innovative EU member states (Austria, Denmark, Germany, the Netherlands, Finland, France and Sweden).

Public funding of innovation activities was also high in the

27 Hollanders H. Regional Innovation Scoreboard 2019 / H. Hollanders, N. Es-Sadki, I. Merkelbach. – Luxembourg: Publications Office of the European Union, 2019. – 94 p. – P. 35

28 Hollanders H. Regional Innovation Scoreboard 2019 / H. Hollanders, N. Es-Sadki, I. Merkelbach. – Luxembourg: Publications Office of the European Union, 2019. – 94 p. – P. 35

29 EU Structural Funds // European Commission : Web-site. – Text data. – Brussels, 2019. – URL: http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=structural_funds [accessed: 12.09.2019]

capital regions of Eastern-European states, among which Prague and the Southeastern region (Czechia), the Warsaw metropolitan area and Masovian Voivodeship (Poland), as well as Belgrade (Serbia). At the same time, European leaders in this category were the German regions (Trier, Braunschweig, Dresden, Berlin, Bremen, and Cologne) and Upper Norrland (Sweden)³⁰.

TABLE 3.2.2. Distribution of the EU regions by relevant levels of R&D and innovation activity indicators, 2019³¹

Indicators	Number of regions, performing at 120 % of the EU average	Number of regions, performing between 90 % and 120 % of the EU average	Number of regions, performing between 50 % and 90 % of the EU average	Number of regions, performing below 50 % of the EU average
Population having completed tertiary education	58	62	74	42
Lifelong learning	70	26	86	56
International scientific co-publications	50	55	88	45
Most-cited scientific publications	26	83	74	55
R&D expenditures in the public sector	42	59	96	41
R&D expenditures in the business sector	31	51	90	66
Non-R&D innovation expenditures	89	68	61	13

30 Hollanders H. Regional Innovation Scoreboard 2019 / H. Hollanders, N. Es-Sadki, I. Merkelbach. – Luxemburg: Publications Office of the European Union, 2019. – 94 p. – P. 45

31 Hollanders H. Regional Innovation Scoreboard 2019 / H. Hollanders, N. Es-Sadki, I. Merkelbach. – Luxemburg: Publications Office of the European Union, 2019. – 94 p. – P. 35

SMEs with product or process innovations	71	88	36	43
SMEs with marketing or organisational innovations	78	65	55	40
SMEs innovating in-house	79	82	27	50
Innovative SMEs collaborating with others	65	39	59	75
Public-private co-publications	52	38	62	86
PCT patent applications	50	34	52	95
Trademark applications	48	42	63	82
Design applications	45	45	80	62
Employment in medium/high tech manufacturing and knowledge intensive services	55	59	74	33
Sales of new-to-market/new-to-firm innovations (SMEs)	24	77	110	27
Regional Innovation Index 2019	38	73	97	30

Business R&D expenditures are not as much localized within a limited number of countries. At the same time, leadership, again, belongs to the regions of the Nordic EU countries (Denmark, Sweden, and Norway). In addition, some NUTS-2 regions of Austria, Belgium, Germany and Switzerland have competitive advantages in this respect. However Eastern and Southern European regions are less likely to be found in the cohort of leaders by this criterion. A similar continental dispersion is also observed in terms of non-R&D innovation expenditures: at least one region in the 15 countries belongs to the group of regional innovation leaders. However, this criterion is generally not considered to be decisive in the

overall assessment of the region's level of innovation³².

The structure of European regions in terms of SMEs' level of innovation activity is mainly determined by the innovative potential of the respective country. The cohort of the leading regions in Europe includes the regions of Norway, Portugal, Sweden, Belgium and Germany. As for SMEs' marketing and organizational innovations regional leaders are located in Austria, Belgium, Croatia, Finland, France, Germany, Greece, Ireland, Italy, Norway, Portugal and Switzerland³³. At the same time, outsiders are concentrated mainly in the Eastern Europe and the Netherlands.

In terms of technological innovations, there is little variation in regional performance by the share of SMEs that introduced a product or process innovation. However, the most outstanding performance has been found in Belgium, Norway, Portugal and Sweden in comparison to other European states, as most of the regions of these countries are top high level performers. Regional leaders and strong innovators in terms of marketing innovations are concentrated in Austria, Belgium, Croatia, Finland, France, Germany, Greece, Ireland, Italy, Norway, Portugal and Switzerland. Whereas moderate and low performing regions are for the most part dislocated in Eastern Europe, the Netherlands and Spain³⁴.

At the same time, the positioning of regions by the criterion of their collaboration in the field of innovation has its own specifics. Regional performance in terms of SMEs with innovation collaboration is spread across all European countries and different regions. British SMEs, however, are

32 Ibid. – P. 47

33 Ibid. – P. 53

34 Ibid. – P. 53

more, than companies of any other European country, inclined to cooperate in the process of innovation creation: among the 20 top-performing regions 12 British regions can be found. Among other countries where innovation collaboration is widespread at regional level are Austria, Belgium, Finland, Greece, Lithuania and Norway³⁵.

The study of the spatial regional structure of technological innovation (creation of new goods, services and production processes) has established its close relationship with national levels of entrepreneurial innovation. As well as in business R&D funding, the leading positions in terms of the share of SMEs that have introduced technological innovations, the leadership belongs to the regions of Austria, Belgium, Denmark, Finland, Germany, the Netherlands, Sweden, as well as two southern European countries - Italy and Portugal. Outsiders in this ranking were the regions of Eastern European countries (Bulgaria, Romania, Slovakia, Poland, Hungary, Croatia) and Spain. At the same time, as in the case of positioning regions by the overall level of innovation activity, the highest places belong to the German regions.

The analysis of indicators reflecting the efficiency of regional innovation activities does not confirm the unambiguous conclusion about the concentration of high technological achievements in a limited number of localities. Employment in high and medium-high-technology manufacturing and services is quite high across Europe. However, in a number of EU Member States, including the Moderate Innovators group, there are regions performing 20% and more above the EU average. This is most likely due to the

35 Ibid. – P. 57

effects of homogenization of the economic environment in the EU, due to the freedom of movement of results and factors of production, especially labour migration.

The share of high-tech manufacturing exports is high predominantly for the regions in Germany, the Czech Republic, Hungary and some other EU regions. At the same time, above EU average high-tech exports are also observed in seven countries, five of which belong to the group of Moderate Innovators, namely: the Czech Republic (four regions), Hungary (seven regions), Poland (three regions), Romania (two regions) and Slovakia (two regions). At the same time, this indicator is critically low in the regions of Bulgaria, Greece and Portugal³⁶. The strong positions of some Eastern European countries in the field of high-tech exports, in our opinion, can be explained by international investment decisions of leading Western European industrial corporations, whose production units have been actively expanding since the early 1990s in Eastern European countries (Poland, Czech Republic, Hungary). At the same time, German industrial companies proved to be more far-sighted, keeping their jobs in the country, along with the active expansion of manufacturing capacities in the CEE countries.

Innovative products commercialization trends differ much from the structure of high-tech employment. Twenty-four regions belong to the high performing group. They represent both strong innovators (Belgium and the UK) and less innovative countries (Italy and Greece)³⁷. However, whereas

36 Hollanders H. Regional Innovation Scoreboard 2016 / H. Hollanders, N. Es-Sadki, M. Kanerva. – Brussels: Publications Office of the European Union, 2016.– 63 p. – c. 40

37 Hollanders H. Regional Innovation Scoreboard 2019 / H. Hollanders, N. Es-Sadki, I. Merkelbach. – Luxemburg: Publications Office of the European Union, 2019. – 94 p. – P. 69

there is very little variance in performance amongst Italian regions, regional performance in Greece is widely spread with Kriti being the overall top performing region on this indicator and Notio Aigaiο demonstrating one of the lowest levels.

Summing up the analysis of the European regions' innovation development, it can be argued that the innovation-leading regions occupy leading positions across all indicators characterizing the results, factors and nature of local innovation, with the exception of the share of innovative products in the total sales of SMEs. Particularly high (above 30% of the EU level) are their results in the field of public R&D expenditures, in-house and collaborative SME innovations, patent activity, as well as employment in the high-tech manufacturing and services.

Overall highest performance of regional innovation leaders is found in 15 indicators, except for non-R&D innovation expenditures and innovative SMEs collaborating with others. In the last two criteria strong regional innovators showed a much higher level. Europe's innovative regional leaders perform more than 40% above the EU average in terms of lifelong learning (191%), public-private co-publications (172%) and PCT patent applications (149%).

Strong innovators show average values (20% lower or 20% higher than the EU average) on almost all indicators, with the exception of lifelong learning (127%), collaborative innovation in the SME sector (126%) and the number of trade mark applications (76%). The activity of SMEs in technological (117%) and marketing (116%) innovations as well as autonomous innovation activity of SMEs (117%) is also quite effective in this group of regions.

The moderate regional innovators perform below the EU

average on almost all indicators, except for Non-R&D innovation expenditures (108%), whereas modest regional innovators perform well below the EU average on all indicators, especially on patent applications (17%), co-publications (18%), lifelong learning (26%) and SMEs innovative collaboration (26%)³⁸.

Trends in the concentration of innovation and investment activity in the regions of technologically developed EU countries are also confirmed by the analysis of the clustering processes of the European economic space (table 3).

According to a study by the Stockholm School of Economics³⁹ among the EU regions with the highest level of cluster localization, the administrative territories of Southern Germany, led by Stuttgart, are dominant. Table 3.2.3 presents the 39 leading NUTS-2 regions in Europe with a star count greater than 15 (each star reflects a statistically significant concentration of innovative economic activity by different criteria in the existing sectors of the economy).

As noted above in the analysis of regional levels of EU innovation performance, most clustering centres are concentrated in the neighbourhood of capital regions, highly urbanized metropolitan areas, as well as traditional industrial centres. This is due to the nature of the sectors that dominate the value-added structure of the local economy. So, service-oriented creative and ICT clusters are most prevalent in capital regions and metropolitan areas of Europe. At the same time, industries whose performance is determined by their accumulated level of production experience are usually concentrated in territories traditionally possessed by a developed technological base,

38 Ibid. – P. 14

39 Ketels C. European Cluster Panorama 2016 / C. Ketels, S. Protsiv. – Stockholm: Center for Strategy and Competitiveness Stockholm School of Economics, 2016. – 68 p. – c. 24

stretching from Cologne (Germany) to Milan (Italy), as well as in some regions of Eastern Europe.

TABLE 3.2.3. Rating of European regions by clustering level, number of stars⁴⁰

Rank	Region	Largest city	Size stars	Specialization stars	Productivity stars	Dynamism stars	Total stars
1	Oslo og Akershus	Oslo	5	5	10	5	25
2	Stuttgart	Stuttgart	10	6	7	1	24
3	Darmstadt	Frankfurt am Main	10	6	7	0	23
4	Oberbayern	Munich	10	5	7	0	22
4	Düsseldorf	Düsseldorf	10	5	4	3	22
4	Köln	Köln	10	3	9	0	22
7	Karlsruhe	Karlsruhe	10	7	3	1	21
7	Tübingen	Tübingen	5	5	8	3	21
9	Île de France	Paris	10	3	7	0	20
9	Istanbul	Istanbul	10	0	0	10	20
11	Freiburg	Freiburg	7	7	4	1	19
11	Mittelfranken	Nürnberg	6	6	7	0	19
11	Arnsberg	Dortmund	9	5	5	0	19
11	Southern and Eastern Ireland	Dublin	7	5	4	3	19
15	Zentralschweiz	Luzern	0	4	10	4	18
15	Hamburg	Hamburg	8	6	4	0	18
15	Rhein Hessen-Pfalz	Mainz	10	8	0	0	18
15	Hovedstaden	Copenhagen	5	4	8	1	18
15	Lombardia	Milan	10	8	0	0	18
21	Stockholm	Stockholm	6	4	5	3	18

⁴⁰ Ibid. – p. 25-26

21	Antwerpen	Antwerpen	2	4	5	3	18
21	Yugozapaden of Bulgaria	Sofia	7	1	0	9	17
21	Oberpfalz	Regensburg	3		5	4	17
24	Wien	Wien	4	4	3	5	16
24	Schwaben	Augsburg	5	6	5	0	16
24	Agder og Rogaland	Kristiansand	2	3	9	2	16
24	Manisa	Manisa	3	6	0	7	16
24	Kocaeli	Izmit	1	7	0	8	16
24	Outer London - West and North West	London	4	3	8	1	16
30	Zürich	Zürich	3	2	10	0	15
30	Rhône-Alpes	Lyon	18	2	3	0	15
30	Piemonte	Turin	10		0	1	15
30	Veneto	Venice	9	5	0	1	15
30	Emilia-Romagna	Bologna	9	5	0	1	15
30	Noord-Holland	Amsterdam	7	2	6	0	15
30	Zuid-Holland	Rotterdam	7	2	5	1	15
30	Vestlandet	Bergen	1	4	9	1	15
30	Outer London - South	London	1	2	8	4	15
30	Berks, Bucks and Oxon	Oxford	5	3	7	0	15

However, the set of competitive advantages of highly clustered regions is quite diversified. The regions of Norway (Oslo), Belgium (Antwerp) and Switzerland are characterized by the highest levels of incomes and productivity in clusters. The regions of Eastern Europe (Bulgaria, Hungary and Romania) are unsurpassed in terms of the dynamics of entrepreneurial development. A number of regions in Europe have accumulated considerable critical mass in many sectors, but specialization in many sectors is not an easy task. In this

context, the in-depth specialization of the Italian Lombardy on eight inter-branch cluster groups at the same time is a remarkable economic achievement.

Most regions benefit from only two or three clustering criteria, significantly inferior to the rest of the criteria. In this light, the metropolitan regions of Sweden (Stockholm) and Ireland (South and East of Ireland) have the most balanced local clusters, with at least three stars assigned to each criterion. On the whole, the presence in the list of the most clustered territories of a large number of European capital regions (especially the Northern part of the continent) testifies to the dynamic development of creative and innovative sectors, which traditionally tend to be located within large metropolitan areas. Most powerful industrial clusters are concentrated in the stripe between Amsterdam (Netherlands) and Munich (Germany), forming the basis of the traditional European economic power pentagon. Identified clusters often rely on the modernization of existing manufacturing technologies, a behaviour traditionally inherent to the southern and western regions of Germany⁴¹.

Overall, 75% of EU regions and some other European countries have between 5 and 15 powerful clusters defined by the statistical methodology of the Stockholm School of Economics. The largest geographical localization of sectoral clusters was observed in the regions of Germany, France, Italy and Poland. So, for example in Upper Bavaria (Germany), 48.3% of the region's employment is concentrated within powerful clusters. At the same time, the most powerful are the clusters of the aerospace, defence, biopharmaceutical and video production industries. In Stuttgart (Germany), clusters in

41 Ibid. – p.13- 24

the manufacturing of heavy machinery, automobiles, and steel industry play a leading role, and in the Cologne (Germany) traditionally powerful industrial clusters in the steel industry are intertwined with modern service clusters in the fields of insurance and video production and distribution. German region of Darmstadt is known for its high-tech clusters in the fields of pharmacy, biotechnology, financial and insurance services, whereas the capital region of France (Ile-de-France) is characterized by powerful creative clusters in the field of performing arts, video production and distribution, marketing, design and publishing. Similar is the creative specialization of Lombardy, where world-class clusters of fashion, textile industry, as well as in the field of financial and insurance services, are located in Milan. Powerful European-level clusters have been identified in Poland in Silesian Voivodeship in coal, furniture, electrical and lighting industries, as well as in the Greater Poland Voivodeship in the production of household appliances, furniture and livestock processing⁴².

Summarizing the analysis of regional clustering processes, we note that they are based on the following principles:

- concentration within traditional centres of economic activity in a narrow stripe from the South of Germany through the Benelux countries to the South of the United Kingdom;
- localization of cluster activities in the most innovative regions of Northern Europe, extending from Denmark through the West of Sweden and Stockholm to the South of Finland and the capital city of Helsinki;

42 Ibid. – c. 17

- sticking to the leading urban centres of Europe with high population density and developed business infrastructure.

3.3. Media clustering of EU regional systems

Rapid development of basic industries in the second half of the twentieth century provoked a significant increase in competition between different companies, the advantages of which were often reduced to the location of production facilities, the use of advanced, at the time, technology, the achievement of a high level of technology and the corresponding development of infrastructure. It is no wonder, therefore, that the problem of optimizing the latest enterprise placement models has come to the forefront of much research.

In the Soviet Union, under the conditions of the planned economy's dominance, territorial - manufacturing complexes and energy - production cycles became the new forms of concentration of public investments, the departmental subordination of which and the lack of entrepreneurship have nullified all optimization efforts. In the West, modern "innovation breakthrough" has taken on more competitive innovative forms: technoparks, technopoles, innotechs, and clusters. The most recent in the new economic conditions have proven to be extremely effective and efficient, but not always perfect, because the practical experience of individual entrepreneurs is often significantly ahead of scientific developments.

In the current scientific literature, in the process of analysing the evolution of clusters, numerous researchers often recall Marshall's ideas and link his work to the justification

of new models of focusing innovation and entrepreneurial hyperactivity. Of course, there were many ideas expressed by this author, but it should be remembered that they did not find practical implementation in the 1920s and 1940s. Therefore, from our point of view, it would be advisable to recall the work of V. Harrison⁴³⁴⁴, who was also devoted to industrial areas, in which the author questions the new names of what was known before and offered his vision of localization. The topic of industrial districts and localization of the enterprises located in them, as well as the restoration of old - industrial districts, is continued by S. Sabel, who saw the possibility of creating new forms of organization and renewal of business activity in these regions, which could undoubtedly have a real impact on their regeneration. It should also be noted that in his later work, V. Harrison⁴⁵, mentioned above, on the example of the Silicon Valley in the USA, tries to explain the influence of the processes of concentration of the newest factors of production on the economic growth of certain territories.

In the late 1990s, the fundamental works of M. Porter⁴⁶ became particularly popular, including *Competition and International Competition*, which summarized the experience of clustering the global economy. However, not only these textbooks deserve attention. In 1998, a rather flamboyant article by M. Porter was devoted to the clear identification of

43 Harrison B. (1992) *Industrial Districts: old Wine in New Bottles?* //Regional Studies. – 1992. – №26(5). – P. 469-483

44 Sabel C. (1992) *Studied Trust: Building New Form of Co-operation in a Volatile Economy* /In: F. Ryke & W. Sengenberger eds /*Industrial Districts and Local Economic Regeneration*. – Geneva: ILO, 1992. – P. 50 – 85

45 Harrison B. (1997) *Concentrated Economic Power and Silicon Valley* //Environment and Planning. –1997. – №26. – P. 307-328

46 Porter M. (1998) *The Adam Smith Address: Location, Clusters and «The New Microeconomics of Competition»* //Business Economics. – 1998. –№33(1). – P. 7-13

several extremely important definitions - localization, clusters, competition, the new macroeconomics, and Adam Smith. In this work, the author tried to clearly justify the corresponding hierarchy of interpretations and terms of clustering as innovative (and not only) localized production formations and to evaluate the changes that took place in a highly competitive global economy. It should also be noted that an important trend towards the end of the last century - the beginning of the new one is getting a great deal of interest in specific manifestations of localization and evaluation of its consequences, in particular the local competition N. Siebert⁴⁷, M. Storpers⁴⁸ regional world, M. Ginni's⁴⁹ bioregionalism, new regionalism M Keating⁵⁰. However, at first glance, the development of cultural (art) clusters and other non-productive structures has often been linked to the presence of so-called agglomerated externalities, which G. van der Panne⁵¹ analysed quite clearly in a condensed retrospective of events. Of course, new production models could be formed in different regions, which usually stimulated their development and it is hard to disagree with the author, but such a thin sphere as media, culture, high technology, and tourism usually focused on big cities - metropolitan cities and their agglomerations. Leading universities in the world, which have often largely filled the budget of small cities in which they are located, with all their great potential for academic mobility,

47 Siebert H. (2006) Location Competition: A Neglected Paradigm in the International Division of labour / *The World Economy*. – 2006. – №2(29). – P. 137- 159

48 Storper M. (1997) *The Regional World. Territorial Development in a Global Economy*. – N. – Y. – London: The Gualford Press, 1997. – 338 p

49 Mc Ginnis M. (1999) *Bioregionalism*. – London: Routledge, 1999. – 525 p

50 Keating M. (1998) *The New Regionalism in Western Europe. Territorial Restructuring and Political Change*. – Cheltenham: Edward Elgar publishers, 1998. – 242 p

51 Panne van der G. (2004) *Agglomeration Externalities: Marshall versus Jacobs / Gerben van der Panne // Journal of Evolutionary Economics*. – 2004. – №14(5). – P. 593-604

remained immobile because to move buildings, laboratories, and equipment to another region was either extremely difficult or impossible at all. Instead, in the context of industrial agglomeration, the concentration of production and cultural clusters was quite possible. The experience of Greater London, a clusterization of which, according to M. Kennedy⁵², has led to significant progress in the growth of sectors such as technology, media, and telecommunications can be quite illustrative. Extremely important for understanding the significance of what is happening is the author's citing statistics, which also speak eloquently of the significant agglomeration effect of clusters. In particular, the study conducted by M. Kennedy shows the following indicator: in 2013, 60% of city firms bought goods and services from those sellers whose offices are located in the same agglomeration, ie the effect of localization was quite significant.

The first decade of the XXI century. it became quite indicative of the development of media clusters, because, for example, if biotechnology or aviation clusters were developing quite actively, enlarging and gradually turning into international ones, the media sphere had no such extensive experience, since the high level of competition significantly hindered the collaboration of production structures. That is why R. Riccard's⁵³ work, in our opinion, proved to be quite breakthrough, which was devoted to the study of the nature of media clusters, their typology, as well as characteristics, features of development, trend shifts, and possible variations of location when creating and operating. The author repeatedly

52 Kennedy M. Clusters in the City and the Growth of the Technology, Media and Telecommunications Sector. - URL: <https://colresearch.typepad.com/colresearch/2016/08/clusters-in-the-city-and-the-growth>

53 Picard R. G. (2008) Media Clusters: Local Agglomeration in in an Industry Developing Networked Virtual Clusters /WPJIBS, Working Paper Series. – 2008. – №13 –16 p

emphasizes the importance, innovative nature and receipt of the so-called spill over effect, as well as the possible composition of sectoral content: TV, radio, DVD, games, websites, magazines, advertising, books and more. Attention is also drawn to small and medium-sized companies that may be part of clusters and large international specialized enterprises in the fields of: publishing (Leipzig, London, New York), film production (Hollywood, London, Babelsberg, Bombay), duplication Newspapers and Magazines (Fleet Street in New York City) (p. 4).

Of course, interest in media clusters proved to be extremely large and encompassed a rather large palette of different trends, shapes, models and numerous hybrid entities. A number of researchers of the time, including J. Britton⁵⁴ (2003), believed that the media industry, whose model was successfully implemented in Canada, had good prospects. It should also be noted that somewhat earlier, the above author linked clustering with Digital Economy (J. Britton and G. Legare, 2005)⁵⁵. It should be added that the idea of creating media cities was quite substantiated by W. Goldstein, T. O'Rogan⁵⁶, the transformation of the local film cluster (Munich, Germany) into the world by R. Kaiser, M. Liecke⁵⁷, and I. Turok⁵⁸ instead. Scotland's example, for the first time,

54 Britton J. N. H. (2007) Path dependence and cluster adaptation: a case study of Toronto's new media industry //International Journal of Entrepreneurship and Innovation Management. – 2007. – №7(2-5). – P. 272-297

55 Britton J. N. H., Legare G. (2005) Clustering and the Digital Economy: New Media in Toronto//Canadian Journal of Regional Science. – 2005. – №28(2). – P. 329-349

56 Goldstein B., O'Rogan T. (2003) Cinema cities, media Cities: The contemporary international studio complex/ Report. Screen Industry, Culture, and Policy Research Series, Australian Film Commission. – 2003

57 Kaiser R., Liecke M. (2007) The Munich Feature film cluster: The degree of global integration and explanations for its relative success //Industry and Innovation. – 2007. – №14(4). – P. 385-399

58 Turok I. (2003) Cities, Clusters and Creative Industries: The Case of Film and Television

made an attempt to bring cities, clusters and creative industries together. J. Vang, C. Chaminade's⁵⁹ attempt to link the existence of cultural clusters with the development of WANs proved to be extremely productive.

Of great importance for the development of clustering ideas in the European Economic Area was its institutionalization, which included systematic financial support for the latest entities, the legal framework, consulting and monitoring. Considerable support for the creation and operation of clusters was provided by the European Cluster Observatory⁶⁰, created in 2018, whose organizational model has been rapidly transformed into a polystructural system covering at least six structural units:

- bi-annual “European Cluster Panorama” (cluster mapping);
- a European Cluster Trends report;
- a Regional Ecosystem Scoreboard;
- a European Stress Test for Cluster Policy;
- showcase a modern cluster policy practice through advisory support services to six selected model demonstrator regions;
- Europe’s cluster policymakers and stakeholders at the European Cluster Conferences.

The proposed model has made it possible to clearly identify the increasing level of EU clustering already in the

in Scotland //European Planning Studies. –2003. – №11(3). – P. 549-565

59 Vang J., Chaminade C. (2007) Cultural clusters, global – local Linkage and spillovers: Theoretical and empirical insights from an exploratory study of Toronto’s film cluster // Industry and Innovation. – 2007. – №14(4). – P. 401

60 European Cluster Observatory. - URL: <http://ec.europa.eu/growth/smes/cluster/observatory/>

dynamics, to formulate cluster policy directions, to evaluate its sectoral progress and to take advantage of mapping within the European Cluster Panorama programs.

At the same time, numerous studies of various sectors of the modern economy began to be conducted in the European Union in the early 2010s and the particularities of the nature of their clustering were determined. However, it is worth noting that the analytics that would be devoted to media clusters is not enough. However, some studies covering not only the cultural sphere but also the media have started to appear. A striking example of one of the avant-garde studies, no doubt, was M. Komorowski's⁶¹ article, in which the author used an interactive approach to analyse local media clusters. At the same time, this researcher substantiated seven parameters of identification of the development of the newest forms of entrepreneurship, though not all of them seemed indisputable.

It should be noted that interest in media clusters and cluster policy increased tremendously in the 2010s when this type of innovative systems began to be seen as an integral part of information and communication technologies, as Ch. Karrisson⁶² and the previously mentioned R. Picard. In their rather the fundamental study, scientists insist on cluster urban location based on the motivation of the media industries and the numerous effects that their location has on both large and small cities.

The history of media entrepreneurship in the EU is, in many cases, quite instructive, since focusing media in one hand (Italy) can always be a danger to democracy. That is why

61 Komorowski M. (2016) The seven parameters of media clusters: An integrated approach for local clusters analysis //International Journal of Media and Cultural Politics. – 2016. – №12(2). – P. 171-191

62 Karrisson Ch., Picard R. (2011) Media cluster and Media Clusters Politics //Working Paper Series in Economics and institutions of innovation. – 2011. – 246 p

monitoring the so-called media pluralism, which regularly conducts Eurobarometer⁶³, is a constant in the European Union.

The post-2010 period in the EU can be called with certainty the stage of diversification of media clusters, the selective implementation of a number of projects in this field and the first failures in their creation. It should be noted that the special role of the European Cluster Observatory and its individual structures has been discussed earlier. As of the beginning. October 2012 to Famous Researchers Ch. Ketels, G. Lindaqist, Ö. Solvell⁶⁴ has been able to establish that the Observatory can provide free information in more than 600 industries in more than 400 regions. It is also noted that the 3 million data at its disposal were able to move 1, 3 million indicators that became available on the Observatory's web platform. It was also noted that cluster organizations are indeed examples of public - private partnerships with 60% of public funding. However, both in this and in many other studies, there has been increasing competition between media and related clusters (telecommunication, cultural, high-tech). It is also of the utmost importance that some of the three-star (Cluster Observatory) clusters began to compete successfully with similar structures in the US, Canada, Switzerland, Norway, and other leading countries. Recognized the expansion and sectoral structure of the media cluster, a typical example of which is the media park in Brussels⁶⁵, which provided a rather high growth rate of production in such fields as media, information technology and communications, advertising, marketing,

63 Media pluralism and democracy //Special Eurobarometer. – 2016. – №452. – 80 p

64 Ketels Ch, Lindaqist G., Ö. Solvell Ö. (2012) The Role Cluster Organisation. – Brussels: The Cluster Observatory, October 2012. – 56 p

65 Media park Brussels - URL: www.mediapark.Brussels/en/strategic-areas/media-cluster

graphic design agencies, news agencies, publishing, research and new technologies, music, broadcasting, virtual reality.

The city of Hamburg, where a number of economic clusters have been established, including health, life sciences, logistics, marine, and renewable energy clusters, is an exceptionally successful model of localization of media initiatives. At the same time, this city is often called the German capital of the media, as according to Media & IT Cluster⁶⁶, about 110,000 employees and 23,000 companies are involved in this field, including such world-renowned companies as Gruner + Jahr, Axel Springer, Spiegel, Die Zeit. It is also worth noting that Hamburg has always been considered the “hub” of digital media, for which it was called “Gamecity”. Also involved in this cluster are the so-called Hamburg @ work private initiative, which hosts a platform for sharing ideas, knowledge, telecommunications contacts and the next Media Finance Association. Hamburg, which finances startups in the digital media industry.

The creation of the Barcelona Media Alliance (Catalonia, Spain) on the basis of the European Cluster Collaboration Platform⁶⁷ at the end of 2015 should be considered as indicative. Unlike many others, he has been able to combine several areas (education, knowledge, music and sound recording, E-publishing, digital content, visualization, virtual reality, creative industries). However, this kind of activity coincided with the new EU policy under Smart Specialization (RIS3), as well as with the H2020 program in the S3 Priority Area “Development of regional cultural and creative industries.

66 Media & IT Cluster. URL: <http://hamburg.com/business/clusters/11704176/media-it/>

67 European Clustercollaboration platform URL: www.clustercollaboration.eu

Production of films, videos and television programs, sound recordings, publications, music.

The experience of the Norwegian media cluster in Bergen⁶⁸, which has quickly become a world leader in the technology of “augmented” reality, such as graphics, visualization, digitization, radio, and television, is an interesting and in many cases instructive. It has combined the interests of more than 100 companies, six universities and research centers, with total revenue exceeding \$ 1 billion annually. It should be noted that during the development process within this cluster there have been quite significant changes, which is quite possible due to the overall success of the joint activity of the companies. The Media Cluster has its own NCE Media Cluster, which in 2015 was reorganized into the Norwegian Center of Expertise, as well as the MCB Media Lab, a laboratory that houses digital platforms, a showroom, tools for innovation and business development, and more.

Some successful projects for the launch of new media clusters have been presented in Central and Eastern European countries, for example in Poland, which has succeeded in creating a creative media cluster⁶⁹ by joining the efforts of Warsaw University, National Science Center of Poland, London University of the South Bank, European Association of the European Association other interested institutions, as well as individuals. The project of the cultural and creative industry cluster in Pécs (Hungary)⁷⁰, which combines 12

68 Media City Bergen URL: <http://mediacitybergen.no/members>

69 Organizational culture of public service media in digital media scapes. - URL: <http://www.creativemediaclusters.com>

70 Cultural creative industry cluster - URL: www.clasterobservatory.ek/index.html#view=documents;mode=one;sort=name;uid=4d04623-ffod-4fed-a111-750bb6d3eaac;id=

creative industries, including art, cultural trade, media, publishing, audio-visual industries, advertising, computer programming and services, museums, is quite powerful. and exhibitions, architecture, design, music industry, cultural heritage. However, such a large list of sectors is, in our opinion, a very difficult burden on the media component of the creative industry and makes it difficult to manage.

Another relatively successful example of clustering new media is the Interactive Cluster of New Media Industry City of IASI⁷¹, which was formed in Romania. It is based on a few new ideas about the cluster that underpin the so-called Internet of Things and Digital Products. On the one hand, it provides enhanced connectivity for devices, systems, and services, on the other - it provokes the enhancement of digital multimedia, additional music downloads, Internet TV, streaming media, online channels, Internet tickets, cloud applications and online games. The founders of this rather pragmatic cluster were 27 companies based in Iasi, including two local universities, as well as the technopolis of this city.

The above examples of successful cluster cooperation in the field of media allow us to establish important features of their modern activities:

- first, production of media clusters is an objective process of development of modern information systems in the conditions of intensification and aggravation of competition of both the manufactured products and the companies that produce it;

71 Iconic, Interactive cluster of New - media industry, city of Iasi - URL: <http://www.iconiccluster.net>

- secondly, the collaboration of companies, corporations, and small firms is a complementary complement to technological processes, hyperconcentration of production factors creates all conditions for optimizing cluster models and mastering the production of modern products with new set qualities.
- thirdly, a rather successful model of multistructural support for media clusters has been formed in the EU, covering information, financial, monitoring, scientific and social levels. Clusters existing in the European Union really make it possible to attest to the priority of existence in this integration grouping of an effective model of public-private partnership;
- fourth, media clusters can be extremely dynamic in changing their sectoral and corporate composition. A real alternative to localization is the development and production of new products on the conditions of delocalization of economic activity, the process when a significant part of productive functions is transferred to the virtual level;
- Fifth, due to the fact that many, for example, biotechnology clusters in the EU have already reached the global level, and entered the first stages of global competitiveness, it should be noted that media clusters do not yet have such “conditional success”, unlike American analogues;
- sixth, quite often the organization of clusters does not take into account the possibility of their

cooperation with other similar formations, the common local concentration of which can serve as an additional condition for the efficiency of creative projects;

- Seventh, the problem of optimal and maximum clustering boundaries seems to be quite debatable, since the transformation of NUTS - 3 regions and sometimes NUTS - 2 into a solid multisectoral cluster is unlikely to contribute to the development of the advantages that existed in a similar model where such a model existed. before.

Given the above, it may be extremely important to develop a comprehensive theoretical model of the European media cluster, which embodied a system of polystructural approaches to creating global clusters (Figure 3.3.1).

In the process of development, the author proceeded from the idea that in our time there is a European creative environment and a number of clusters similar to the media (art - information, technological), which are tangentially to the researched, complementing the functions.

However, the media cluster, which, like many other sectoral models, is a variety of creative clusters that constantly need creative workers, who will usually come from recruitment agencies, or even universities. The level of development of local infrastructures, which may not necessarily be ideal for this type of clusters in the first stage, can be a very clear addition to this scheme. However, over time, they can undergo significant upgrades and transformations due to the growing demands of the display cluster. However, it is important to remember that not all local, national or international infrastructure development

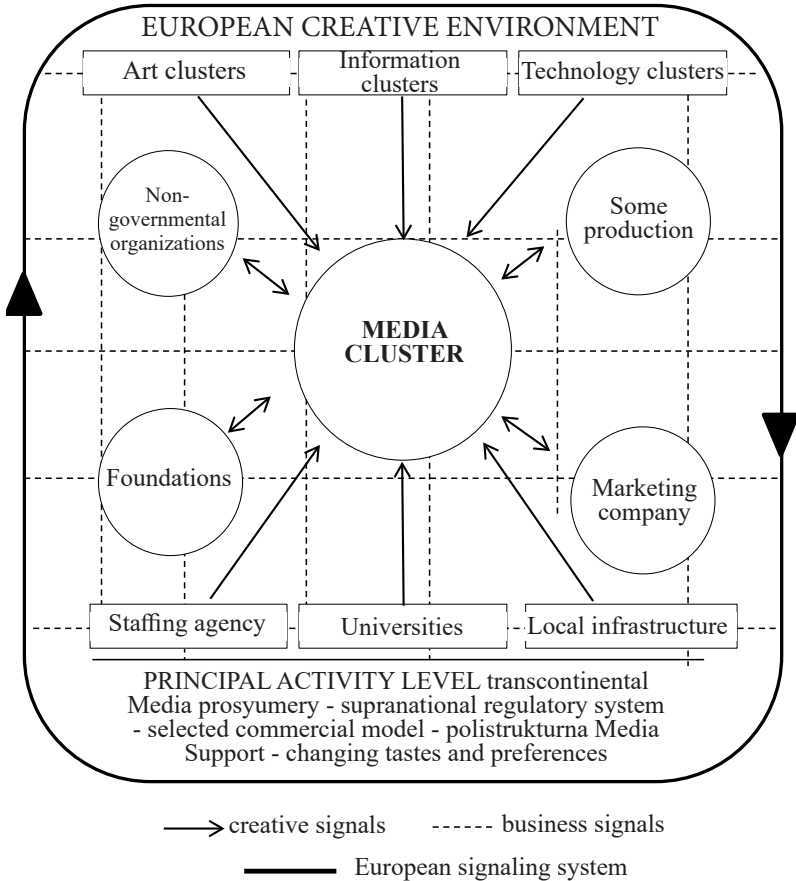


Figure 3.3.1. The theoretical model of the European media megacluster

Source: compiled by the author

costs can be effective. It is unfortunate, but for some reason nowhere in modern scientific and practical literature are described the unsuccessful projects of media clusters. This kind of information would help to avoid those mistakes that were made in the past by the sponsors of the first clusters.

Naturally, any European cluster can be contained within a European creative environment, where a proper signaling system is dominant, which includes a continental system of signals coming from both the internal market and the external, as well as a number of creative and business signals, common the impact of which provides appropriate behavioral motivation. It is the satisfaction of the interests of consumers / consumers, the influence of the supranational regular system, the active use of the chosen commercial model, the selection of polystructural support for the media and will form the so-called framework of transcontinental activity, at the heart of which are the changing tastes and preferences of the acquired customers.

3.4. Intellectualization of economic development in East Asia

In the modern paradigm of global economic development, the driving force of economic growth of countries and their leadership in the XXI century is the effective implementation of human, scientific, technological resources that ensure the development of the knowledge economy and technology of Industry 4.0. Intellectualization is inextricably connected with the development of new knowledge and its rapid commercialization. This is evidenced by the experience of the key innovators of East Asia: China, Japan, and South Korea, which create 24% of world GDP.

Over the past forty years, the countries of East Asia, in particular, Japan, South Korea, and China have demonstrated dynamic economic development, and have become internationally recognized as technological leaders. This is confirmed by the assessments of experts of the World

Intellectual Property Organization and the Indian business school INSEAD, which are reflected in the study “The Global Innovation Index”. The dynamics of the twelve-year period indicate a constant increase in the innovative competitiveness of the top three countries in East Asia. According to the report “The Global Innovation Index”, in 2019 South Korea ranks 11th, China – 14th, and Japan – 15th among 129 countries in the world⁷². One of the key prerequisites for the building of innovative competitiveness of East Asian countries is the funding of research and development. The leaders in this are China, whose research and development spending amounts to \$519.2 bn, Japan – \$193.2 bn, and South Korea –\$93.5 bn.

An integral element of ensuring innovative development is the formation and effective implementation of intellectual capital, which is carried out through the development of education, science, and healthcare. According to the report “The Global Talent Competitiveness Index”, these countries are among the top 50 leaders during the last five years⁷³. Successful implementation of intellectual capital is facilitated by effective national innovation systems, which are formed in the countries being studied. Thus, in terms of the strength of higher education systems (QS Higher Education System Strength Rankings 2018), China ranks 8th in the world, South Korea – 9th, and Japan – 10th. The top ten global innovation clusters include Tokyo-Yokohama, Shenzhen-Hong Kong,

72 Dutta, S., Lanvin, B., & Wunsch-Vincent, S. (2019). *The Global Innovation Index (GII) 2019: Creating Healthy Lives—The Future of Medical Innovation*. Geneva: World Intellectual Property Organization. – URL: <https://www.globalinnovationindex.org/gii-2019-report>

73 Lanvin, B., & Monteiro, F. (2019). *The Global Talent Competitiveness Index*. Fontainebleau, France: INSEAD. – URL: <https://gtcistudy.com/wp-content/uploads/2019/01/GTCI-2019-Report.pdf>

Seoul, Beijing, Osaka-Kobe-Kyoto⁷⁴.

An important aspect of ensuring the effectiveness of the national innovation system and facilitating the intellectualization of the economy is the protection of intellectual property rights. According to the International IP Index, which is calculated by the Global Innovation Policy Center, Japan ranks 8th, South Korea 13th, and China 25th among 50 countries⁷⁵. The development of the system for the protection of intellectual property rights has enabled countries to become leaders in patenting activity.

Such successes of the leading countries of East Asia are due to systemic government policies that are based on the intellectualization of economic development, the driver of which is innovation. Experts of the UN Economic and Social Commission for Asia and the Pacific (UNESCAP) identify three phases of state policy development that are related to the level of industrialization in the report “Evolution of Science, Technology and Innovation Policies for Sustainable Development: The Experiences of China, Japan, the Republic of Korea and Singapore”: pre-industrialization, catch up (the level of industrialization converges with that of advanced economies), post catch-up⁷⁶. Each of the countries being studied had these phases over different time frames, however, there are common features: government intervention and the support of

74 7 key findings from the world’s biggest study on innovation. (2019). - URL: <https://www.globalinnovationindex.org/gii-blog/7-key-findings-from-the-world%e2%80%99s-biggest-study-on-innovation--b173>

75 Global Innovation Policy Centre. – URL: <https://www.theglobalipcenter.com/ipindex2019-chart/>

76 UNESCAP. (2019). Evolution of Science, Technology and Innovation Policies for Sustainable Development: The Experiences of China, Japan, the Republic of Korea and Singapore. URL: https://www.unescap.org/sites/default/files/publications/UN_STI_Policy_Report_2018.pdf

foreign partners (Japan, South Korea – the US; China – the USSR and later the US); industrialization based on imported or borrowed technology; the liberalization of tax legislation for private business development; attraction of foreign direct investment through the ensuring of favorable investment climate (special economic zones, industrial parks); stimulation of the creation of own innovations through the development of education and science, as well as the formation of a national innovation system; considerable funding for research and development; confronting the United States of America in technological competition; solving economic, social and environmental problems through innovation, development of new technologies. These features are characteristic of the Akamatsu's "flying geese paradigm"⁷⁷, according to which the governments of the countries of East Asia adhered to the strategy of transition from import dependence to export-led economy – increasing imports (in particular, technological one to ensure the industrial development), increasing production and output and the transition to exports.

At the present stage of development, the key priority for Japan, South Korea, and China is inclusive economic growth driven by innovation. Therefore, to ensure a strong competitive position, governments have adopted a number of strategic medium- and long-term plans. In particular, the current policy of the Chinese government is aimed at the transition to an economic model based on knowledge and innovation, where the key resources are intellectual capital and the continuous exchange of knowledge and technology, and is characterized by the effectiveness of the implementation

77 Akamatsu, K. (1962). A historical pattern of economic growth in developing countries" March–August. *Journal of Developing Economies*, 3–25

of innovative potential in high-, medium- and low-tech industries in order to achieve global competitiveness. The strategic priority of the government is the development of an innovative nation, a harmonious, creative and balanced society that creates breakthrough ideas and innovative solutions (table 3.4.1). In particular, the “Made in China 2025” strategy, the main priority of which is the development of entrepreneurship and innovations in order to increase employment, contribution to technological innovation, as well as stimulation of the growth of the industry. Activities within the framework of the strategy allowed increasing the number of small businesses, and according to Hurun Greater China Unicorn Index, in 2018 almost every 4 days a new “unicorn”-startup was being created in China. In general, 97 such startups were created within the year. In total, there are 233 “unicorn”-startups in China.

TABLE 3.4.1. Medium- and long-term plans and strategies for innovative development of China

Years	Name of plan/strategy	Description of goals
2016 – 2020	13 th Five-Year Plan for Economic and Social Development	Comprehensive development of middle-class society; maintaining high rates of economic growth; optimization of the modern industrial system through the strategic development of new sectors of the economy, improving the quality of goods and services; innovative development (spending 2.5% of GDP on research and development).
2016 – 2020	National Plan for Science and Technology Innovation	The rapid development of space and aerospace industry, energy industry, marine research, increasing market share in these areas, conducting reforms in the field of education, the introduction of creative learning.

2016 – 2020	Development Plan for Industrial Robotics	Building and improving standardized automated industry system, accelerating research and development of technical standards required by industry, providing support for research and verification of robot evaluation standards.
2015 – 2030	New Generation of Artificial Intelligence Development Plan	Becoming the global leader in the field of artificial intelligence by 2020; by 2025 – artificial intelligence is the driving force in industrial upgrading and economic restructuring; by 2030 – China is the global innovation center in terms of artificial intelligence; the development of the country on the principles of the knowledge economy.
2017–2027	Automobile Mid and Long-Term Development Plan	Having a strong competitive position in the automotive industry and becoming a national leader in the field of spare parts and automotive brands connected with technology in this industry in 10 years, support drivers and vehicles with self-steering.
2018–2025	National Agricultural Science Park Development Plan	Development of agricultural technology parks to ensure national food safety, accelerate the modernization of agriculture and develop innovative enterprises.
2015–2025	Strategy “Made in China 2025”	The transition from the production of low-tech products to the production of high-tech ones; targeted financing of technological innovations, stimulation of small and medium-sized enterprises, as well as improving the quality standards of consumer products.
2015–2025	Strategy “Internet plus”	Stimulating social and economic transformation with the use of digital technologies, the interconnection of all industries via the Internet, as well as the development of the digital economy

2012–2030	Strategy “China 2030”	Strengthening the industrial base by using innovation and technology, the transition to the production of high-tech products and the predominance of the service sector (scientific research, development, consulting, knowledge sharing, etc.) through involvement in global research networks.
2050	Science & Technology in China: A Roadmap to 2050	Creation of clusters, agglomerations, business incubators, smart cities, cooperation with leading countries in innovation.

One of the priorities of the Japanese government is the digitalization of all sectors of the economy and the creation of a smart society, as well as ensuring national security and sustainable growth. The important part of the government program is the stimulation of the development of technologies of the Fourth Industrial Revolution, in particular, artificial intelligence, robotics, smart technologies in order to improve the living standards and well-being of the population (Table 3.4.2).

TABLE 3.4.2. Medium- and long-term plans and strategies for innovative development of Japan

Years	Name of plan/strategy	Description of goals
2016 – 2021	The 5 th Science and Technology Basic Plan	Sustainable growth and regional development; ensuring the security of the country, its citizens, improving the living standards and well-being of the nation; overcoming global challenges and promoting global development.

2018	Strategy “Society 5.0”	Creation of an ultra-intelligent society where technologies are integrated in everyday life – everything is connected by the Internet of things, which will contribute to improvement of the living standards; manufacturing of industrial robots to increase productivity; expansion of communication infrastructure; stimulating businesses to integrate advanced cloud technologies; digitalization of agriculture; the development of regenerative medicine based on artificial intelligence and cybernetic treatment; the introduction of "smart" services and fingerprint authentication.
2016	Japan Revitalization Strategy	Creating an environment for the use of big data; developing and protecting human capital, as well as increasing flexibility in the employment system; accelerating innovation and technology development; strengthening the financial system; promoting the gradual transformation of production and working structures; spreading the results of the revolution among small and medium-sized enterprises.
2016 – 2030	Future Vision towards the 2030s	Stimulation of technological innovations, in particular, the Internet of things, big data, artificial intelligence, and robotics; directing scientific and technological achievements on social and economic development, improving the living standards and well-being of the population.

In recent years, the Korean government has focused on

the development of small and medium-sized businesses using a variety of enabling mechanisms, in particular, financial and fiscal, as well as the creation of accelerators and incubators with a focus on developments and creative solutions. The priorities for the Korean government are the development of digital infrastructure, which will help enterprises to create own innovative technologies and take a leading position in the world market; adaptation of education to the intellectual information society; ensuring long-term investments in fundamental research of artificial intelligence technologies; improving the living standards with the help of science and technology, contributing to the growth of research and development productivity (table 3.4.3).

TABLE 3.4.3. Medium- and long-term plans and strategies for innovative development of South Korea

Years	Name of plan/strategy	Description of goals
2017-2021	2 nd Basic Plan of National Intellectual Property	Provides for the expansion of commercialization opportunities through the creation and networking of technology owners.
2017	Mid- to Long-term Master Plan in Preparation for the Intelligent Information Society	Development of digital infrastructure that will enable Korean enterprises to create own innovative technologies and take leading positions in the global market; promote effective public-private partnership in the development of digital technologies; reform and adapt education to the intelligent information society; ensure long-term investment in fundamental research of artificial intelligence technologies; launch 5G to accelerate the Fourth Industrial Revolution.

2018-2022	The 5 th Regional Science and Technology Promotion Comprehensive Plan	Facilitate regional development of science and technology, development of local innovation system and empowerment of local economic entities.
2018-2022	The 4 th Science and Technology Basic Plan	Improving people's living standards with the help of science and technology, contributing to the growth of research and development productivity.
2018	I-Korea 4.0	Creating an intelligent network using modern digital technologies (artificial intelligence, big data, supernets, etc.); reforming the research and development system to stimulate breakthrough innovations; stimulating the development of innovative businesses.

Common features of the current innovation policies of China, Japan and South Korea are digital transformation of economies, stimulation of technological development through the introduction of financial and fiscal mechanisms to promote innovative small and medium enterprises, adaptation of education systems to the challenges of the Fourth Industrial Revolution, enhancing living standards and well-being of population.

Inclusive development and reorientation on domestic resources are relevant for the countries being studied. This derives from the impact of rapid economic growth on the deterioration of the environment and growing social inequalities. The process of transition from external sources of economic development to internal ones requires significant resources, so in these countries, there is a slowdown in economic growth. Over 18 years, the growth rate of real GDP

TABLE 3.4.4. Economic profile of East Asian countries

Indicators	Japan		South Korea		Mongolia		China		China, Macao SAR		China, Hong Kong SAR		China, Taiwan	
	2000	2018	2000	2018	2000	2018	2000	2018	2000	2018	2000	2018	2000	2018
GDP (current billion USD)	4888	4971	561.6	1619	1.14	13	1211	13608	6.7	54.6	171.7	363	331.5	590
GDP growth (annual %)	2.8	0.79	8.9	2.7	1.2	6.95	8.5	6.6	5.8	4.7	7.7	3.02	6.4	2.63
GDP per capital, PPP (current thousand international dollars)	26.8	43.4	18.1	40.5	3.7	13.7	2.9	18.2	33.6	122.4	21.7	64.5	21.6	53
Inflation, consumer prices (annual %)	-0.68	0.98	2.26	1.48	11.6	6.8	0.35	2.1	-1.61	3.0	-3.67	2.4	1.26	1.35
International reserves (billion USD)	361.6	1270	96.3	403	0.2	3.6	171.8	3168	3.3	20.3	107.6	424.6	122.2	461.8
Foreign direct investment (inflow, billion USD)	10.7	25.9	11.5	14.5	0.05	2.2	42.1	203.5	-0.001	0.43	70.5	86.5	5.2	8.3
Export (billion USD)	479.3	738.4	172.3	604.9	0.54	7.01	249.2	2487	2.54	1.5	202.7	569.2	148.3	336.3
<i>share of high-tech export, %</i>	37.6	26.7	44.6	44.6	0.7	0.2	26.6	36.4	3.4	49.5	38.8	64.2	49.4	60.9
Import (billion USD)	379.7	748.2	160.5	535.2	0.6	5.9	225.1	2135.9	2.6	11.2	214.1	627.3	140.0	286.7

<i>share of high-tech import, %</i>	28.5	27.3	35.5	29.8	13.1	13.9	38.1	37.2	10.2	34.7	40.7	63.4	47.3	43.0
Population (million)	126.8	126.5	47	51.6	2.4	3.2	1263	1393	0.43	0.63	6.7	7.5	22.2	23.6
Unemployment, total (% of total labour force)	4.7	2.5	4.4	3.7	6.1	6.3	3.3	4.4	6.8	2.02	4.9	2.8	3.2	3.8
Research and development expenditure (% of GDP)	2.91	3.2 (2017)	2.18	4.55 (2017)	0.19	0.13 (2017)	0.89	2.18	0.06 (2001)	0.17 (2017)	0.47	0.8 (2017)	2.02 (2001)	3.30 (2017)
Researchers in R&D, 1 000 per million people	5.1	5.3 (2017)	2.3	7.5 (2017)	N/A	N/A	0.54	1.2 (2017)	0.26 (2001)	3.2 (2017)	1.2	3.4 (2017)	3.3 (2001)	7.9 (2016)
Total patent applications, residents and abroad (thousand units)	490.8	460.4	85.8	232	0.106 (2001)	0.083	26.5	1460.2	0.014 (2003)	0.136	0.097	2.2	31.2 (1996)	39.3
Number of cited scientific publications (thousand units)	102.8	118.4	181.7	79.6	0.06	0.46	51.7	569.2	0.035	1.6	6.9	19.6	13.5	33.5
Hirsch-Index	967		624		91		794		95		517		475	

Source: drafted by authors on the basis of the statistical data World Bank, UNCTAD, WIPO, Scimago, National Statistics Taiwan

in Japan decreased from 2.8% to 0.79%; China – from 8.5% to 6.6%; South Korea – from 8.9% to 2.7% (Table 3.4.4).

Despite the slowdown in the economic growth of China and Japan, they remain to be among the top three largest economies in the world, and South Korea occupies the 12th position in terms of GDP. In 2018, the total contribution of these countries to global GDP is 23.5% or \$20.2 tn. In 2010, China surpassed Japan in terms of GDP, taking second place after the United States with a gap of \$387 bn (in 2018 –\$8.6 tn). Therefore, the Chinese economy shows the highest growth in nominal GDP in the period from 2000 to 2018 (by 11 times). This is due to the policy of reform and opening up of the Chinese government that is aimed at attracting foreign investment (foreign direct investment increased by almost 5 times over the last 18 years), export growth (in particular, the share of high-tech exports grew by 9.8 p.p., and the export volume – by 10 times), and innovation intensity of GDP (the share of research and development spending increased from 0,89% to 2.18% of GDP) and intellectualization of the economy (in 2000 – 542 patent applications per \$100 bn (PPP), and in 2017 – 5869).

According to estimates of the World Intellectual Property Organization, that are presented in the report “Global Innovation Index 2019” the most innovative economies in East Asia include South Korea, Hong Kong, China, Japan⁷⁸. One of the key prerequisites for the innovation competitiveness of East Asian countries is government policy aimed at supporting and developing education, science, and technology. An important objective of this policy is to create a supportive environment for the generation of new knowledge, development of advanced

78 GII Report 2019. (2019). - URL: <https://www.globalinnovationindex.org/gii-2019-report>

technologies and successful commercialization of innovation and intellectual property. Research and development (R&D) spending is powerful leverage for innovation. According to the OECD, the share of research and development spending in South Korea's GDP is the highest in the world – 4.55% in 2017 (Israel – 4.54%)⁷⁹. In Japan, this figure was 3.2% of GDP, China – 2.15% of GDP, Hong Kong – 0.8% of GDP, Mongolia – 0.2% of GDP (Figure 3.4.1).

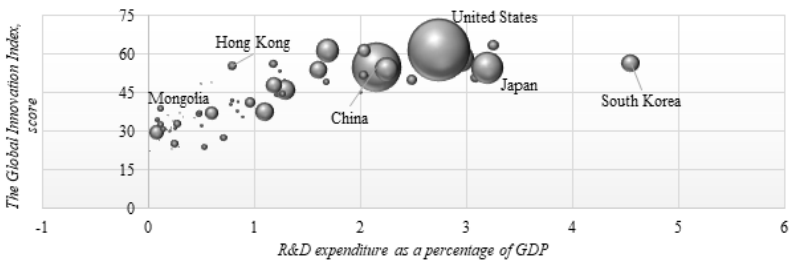


Figure 3.4.1. Distribution of East Asian countries according to the Global Innovation Index and research and development spending

Source: compiled by authors on the basis of the statistical data of the Global Innovation Index and World Bank

The innovative competitiveness of the country is influenced not only by the funding of research and development but also by the available intellectual capital, human resources, the up-to-date infrastructure, an effective national innovation system, which is integrated into the global and state innovation policy. Considering these indicators and trends of the Fourth Industrial Revolution, experts of the European Commission have developed the International Digital Economy and Society Index, which is based on five dimensions: connectivity (broadband infrastructure); human capital (the ability to use

⁷⁹ OECD. (2019). Main Science and Technology Indicators. - URL: <http://www.oecd.org/sti/msti.htm>

digital technologies); the use of Internet services by the population; the integration of digital technologies by businesses; digital public services (e-government and healthcare system)⁸⁰. The key objective of this index is to assess the effectiveness of digital technologies in the economic development of countries.

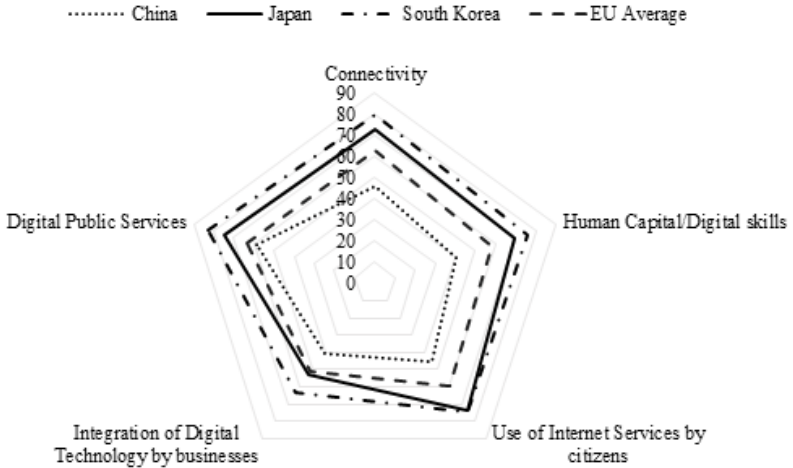


Figure 3.4.2. Benchmarking of the dimensions of the International Digital Economy and Society Index 2019
Source: compiled by authors on the basis of the International Digital Economy and Society Index

According to the International Digital Economy and Society Index, South Korea and Japan have higher scores than the European average in all dimensions (Figure 3.4.2). In terms of the development of digital public services, China is approaching the EU average. Thus, there is a process of digitalization of all sectors of the economy with widespread broadband communication, active use of Internet services by

⁸⁰ European Commission. (2018). I-DESI 2018: How digital is Europe compared to other major world economies? -URL: <https://ec.europa.eu/digital-single-market/en/news/how-digital-europe-compared-other-major-world-economies>

the population and the introduction of digital technologies in public administration and business processes.

A key indicator of the effectiveness of innovation is the patent activity of the subjects of the national innovation system. In 2018, South Korea, China and Japan were the leaders in the intellectualization of GDP – the number of patent applications per \$100 bn (PPP): 8561, 6183 and 5264 respectively. Together with the United States (289 thousand patents) and Germany (102 thousand), China, Japan and Korea are among the top five countries in terms of the number of patents received in 2018. Their share in the total amount is 79% (three East Asian countries – 53%). The United States has the largest number of patents in force – 2.6 million, China ranks second – 1.8 million, Japan is third with 1.2 million and Korea – fourth with 1.1 million patents.

At the initial stage in order to facilitate industrial development and to accelerate industrialization, Japan actively bought intellectual property rights. Then, since the 80-s, it began to actively stimulate basic research in order to ensure competitiveness. In 1980, more than 38 thousand patents were obtained, and in 2018 – 284 thousand. This figure grew, on average, by 31% annually between 2000 and 2018 (Figure 3.4.3).

During the first twenty years of reform and opening-up policy, China's economy was built on borrowed technology, but since the early 2000s, the government's key focus has been on developing its own innovations and technologies. Already in 2005, the number of patents has tripled, and in 2018, it increased by 60 times compared to 2000. In 2018, 377.3 thousand patents were obtained (the average annual growth rate during 34 years is 71%).

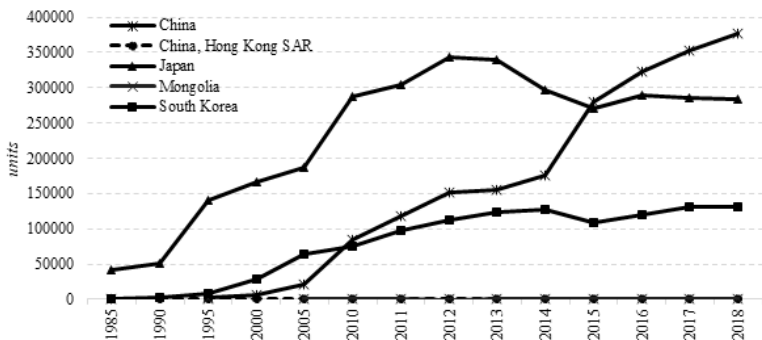


Figure 3.4.3. The number of granted patents by the residents of East Asian countries, 1980-2018 yrs.

Source: compiled by authors on the basis of the statistical data of the World Intellectual Property Organization⁸¹

While in China the period of activity falls in the mid-2000s and 2010s, in South Korea the revival of patent activity falls in the mid-90s and the number of patents grew annually by an average of 21%. This is due to the state science and technology policy aimed at building innovation potential via funding research projects and institutions.

The largest share of China's patents is connected with computer technologies (9.0%), Japan's and South Korea's – with electric machines (10.1% and 8.7%, respectively) (Table 3.4.5).

In 2018, the share of China's patents for computer technology is 29.6% from the total number of patents of all countries, Japan's and Korea's patents for Electrical machinery, apparatus, energy – 27.3% and 11%, respectively.

According to patent applications in the PCT system, China specializes in digital communication (18.4% of applications in 2018), computer technology (13.2%), and electrical machinery, apparatus, energy (6.5%). Most of Japan's applications are

81 WIPO. (2019). WIPO IP Statistics Data Center. - URL: <https://www3.wipo.int/ipstats/index.htm?tab=patent>

connected with such technologies: electric machines (10.8%), transport (5.7%) and computer technology (5.4%). Applications of Korean companies pertain to digital technology (11.9%), electric machines (9.3%), and computer technology (7.3%)⁸².

TABLE 3.4.5. Distribution of granted patents of East Asian leading countries by technology in 2018

Country	Top 5 technologies	Number of patents, thousand units	Share in a total amount of patents of country, %
China	Computer technology	33.99	9.0
	Electrical machinery, apparatus, energy	28.68	7.6
	Measurement	28.61	7.6
	Digital communication	25.41	6.7
	Machine tools	18.97	5.0
Japan	Electrical machinery, apparatus, energy	28.62	10.1
	Optics	17.15	6.0
	Transport	17.04	6.0
	Computer technology	16.47	5.8
	Semiconductors	15.95	5.6
South Korea	Electrical machinery, apparatus, energy	11.49	8.7
	Computer technology	10.27	7.8
	Semiconductors	8.29	6.3
	Digital communication	8.00	6.1
	Audio-visual technology	6.87	5.2

Source: compiled by authors on the basis of the statistical data of the World Intellectual Property Organization

⁸² WIPO. (2018). PCT top tech fields. URL: <https://www.wipo.int/edocs/infogdocs/en/ipfactsandfigures2018/>

In among the leaders in PCT: Chinese companies – Huawei Technologies Co. Ltd., ZTE Corporation, BOE Technology Group Co., Ltd; Japanese companies – Mitsubishi Electric Corporation, Sony Corporation, Panasonic Intellectual Property Management Co., Ltd.; Korean companies – LG Electronics Inc., Samsung Electronics Co., Ltd.

According to the World Intellectual Property Organization, Huawei's patent applications pertain to digital (57.4%), computer (17.9%) and telecommunications technologies (11.5%). Distribution of Mitsubishi's patent applications: electric machines (19.6%), thermal processes and apparatus (13.2%). Applications for patents of LG Electronics Inc. pertain to digital technologies (40.6%), telecommunications (14.5%), and computer technologies (8%)⁸³. Thus, the leading companies focus on the development of digital technologies in order to maintain a strong competitive position in the market.

Revenues and expenditures from the use of intellectual property rights affect the payments position of countries and, accordingly, the economic growth of countries. Among the countries studied, Japan receives the highest revenues from the use of intellectual property rights (\$45.5 bn or 0.92% of GDP). Revenues from royalties to the balance of payments of South Korea and China are \$7.6 bn (0.5% of GDP) and \$5.6 bn (0.04% of GDP), respectively (Figure 3.4.4).

With due regard to the accelerated economic development of the East Asian countries in different years, which was ensured by the technological efficiency of production, and therefore by the import of intellectual property rights, countries pay royalties. In 2018, China made the largest payments for the

83 WIPO. (2019). World Intellectual Property Indicators 2019. - URL: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2019.pdf

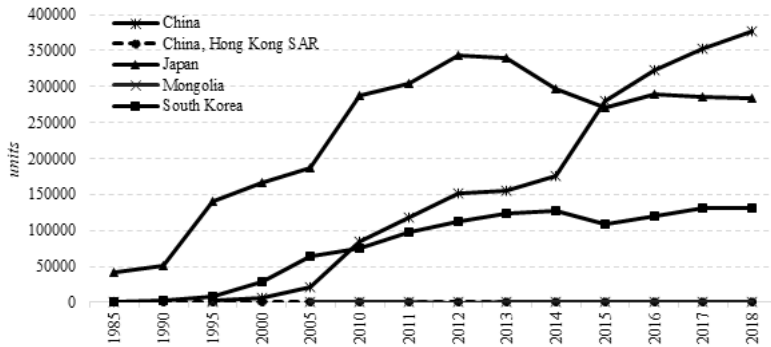


Figure 3.4.4. Revenues received from the use of intellectual property rights, million USD

Source: compiled by authors on the basis of the statistical data of the World Bank⁸⁴

use of intellectual property rights – \$35.8 bn (0.26% of GDP). Royalty payments by Japan and Korea amounted to \$21.7 bn (0.44% of GDP) and \$9.9 bn (0.61% of GDP) (Figure 3.4.5).

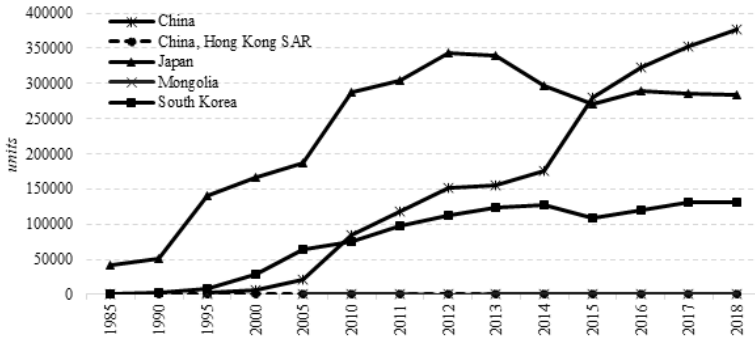


Figure 3.4.5. Charges for the use of intellectual property rights, million USD

Source: compiled by authors on the basis of the statistical data of the World Bank⁸⁵

84 World Bank. (2019). Charges for the use of intellectual property, receipts (BoP, current US\$). - URL: <https://data.worldbank.org/indicator/BX.GSR.ROYL.CD?locations=JP-CN-MN-HK-KR&view=chart>

85 World Bank. (2019). Charges for the use of intellectual property, payments (BoP, current

Thus, Japan has a balance of payments surplus for the use of intellectual property rights (\$9.7 bn), while there is the balance-of-payments deficit in China (-\$14.1 bn) and Korea (-\$4.3 bn). This is due to close industrial cooperation with other countries of the world and participation in global value-added chains, as well as the opening of foreign branch offices of TNCs.

Modern economic development strategies of China, South Korea and Japan are responsive to the trends of globalization and the Fourth Industrial Revolution and entail in-depth cooperation with other countries, integration into the innovative forms of international specialization of labour characterized by cooperation of economic entities in the continuous exchange of knowledge and technology through participation in global research networks and work based on the principle of the “open innovation” model. The active participation of South Korea, China and Japan in the processes of research and development, transfer of knowledge and technology enables the country to be an integral part of global innovation networks. Global innovation networks facilitate cooperation with academic organizations and cooperation in the field of innovation with other firms. The key characteristic of the global innovation network is the interaction of actors of different levels with the aim to achieve high innovation performance. According to the data of Global Innovation Index 2019, Japan ranks 12th, South Korea – 18th, China – 58th based on the sub-index – the Innovation linkages. In particular, the closest innovative ties in the countries being studied are intrinsic to cooperation between universities and industries and the development of clusters. Therefore, the effective

US\$). - URL: <https://data.worldbank.org/indicator/BM.GSR.ROYL.CD?locations=JP-CN-MN-HK-KR>

interaction of the subjects of the innovation network translates into highly innovative performance. Thus, according to the Innovation Output Index (sub-index of the Global innovation index), China ranks 5th, South Korea – 13th, Japan – 17th.

Countries that are actively involved in global innovation networks and bear high costs associated with research and development are ranked high on the Global Innovation Index and the Higher Education and Training Index. Among such countries, there are Singapore, South Korea, Japan. While China, Malaysia, Slovakia, Bulgaria, Poland, Hungary, Kazakhstan, Indonesia are the countries with a moderate level of spending on research and development. Countries with a low-level of spending – Thailand, Ukraine, Egypt, Vietnam, Albania, Pakistan, Nepal, Tajikistan, Georgia, Moldova, South Africa⁸⁶. This can be demonstrated by graphing the dependence of the Global Innovation Index and the Networked Readiness Index (Figure 3.4.6).

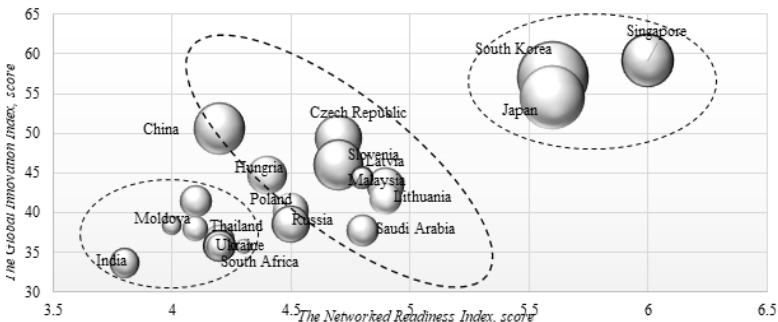


Figure 3.4.6. Distribution of East Asian countries according to the Networked Readiness Index and research and the Global Innovation Index

Source: compiled by authors on the basis of the data of World Economic Forum, INSEAD, WIPO

86 Antonyuk, L. L., Drobotyuk, O. V., Khlystova, O. S. (2018). Stratehiyi innovatsiynoho rozvytku KNR: 1978-2018. Ukrayina-Kytay (14), 38-47

Thus, the dynamic economic and innovative development of East Asian countries, in particular, China, Japan and South Korea, derives from the effective innovation policy of the governments, which has systemic, strategic nature and ensures the building of global competitiveness of countries. The process of intellectualization of economic development of the countries being studied results in the developed system of science and higher education, which ensures the formation and implementation of intellectual capital; an effective entrepreneurial ecosystem where innovative and creative business projects that turn into global “unicorns” are formed; a shaped innovative network, that enables the acceleration of the process of commercialization of new knowledge. These countries are world leaders in terms of investment in research and development, the number of patents, research staff and have highly competitive professionals and high level of human capital.

The strategic goal of achieving global competitive leadership in East Asia is reflected in the government’s long- and medium-term plans and strategies, the implementation of which entails a constant increase in research and development spending, stimulation and growth of innovative activity of national businesses, the development of scientific and technological cooperation and the development of technologies of the Fourth Industrial Revolution.

CHAPTER 4

Information component of the global space of the knowledge economy

4.1. Formation of global information space

At the turn of XX–XXI centuries, a new phase of development of information space globalization (ISG) commenced¹. This process is based on the global informatization, enhanced information exchange, unimpeded dissemination of information in all spheres of vital activities and interaction. Despite of the world asymmetry, the global informatization creates conditions for formation of knowledge economy on a global scale. The evolutions of the world economy were directly influenced by the so-called information revolutions. The next wave of structural and functional changes to the world economic system commenced with the emergence of Internet, which implements the idea of universality and creates global infosphere².

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- 1 Polyakov M.V. (2017) Specific features of formation of the global information space of the knowledge economy and methodological aspects of its study. *Economic space*. 2017. No.123. 13-26 p
 - 2 Polyakov M.V. (2018) *Economy of Knowledge: essence, determinants, global landscape: monograph*. Dnipro: New ideology, 2018. - 688 p

The space is organized with the use of institutes, infrastructure and communication tools (tools for information exchange). Information infrastructure of the global information space (GIS) includes computer hardware, networks (network equipment), data centers, information transmission protocols and standards. The space means a sphere of human opportunities and activity, which, in this case, consists in information exchange (communications) on a global scale that have impact on all other types of human activity. GIS is understood as a communication environment, which allows disseminating knowledge, establishes and maintains social contacts and networks. GIS becomes an attribute of the contemporary word order, encompassing all forms of international economic relations and manifestations of metanational, world and planetary scale.

Within the framework of the modern information revolution, the Internet triggered the wave of informatization on a global scale. Internet was firstly represented as a way of maximization of freedom in communication sphere, including control and management. Free access to spatially remote information reSource through overcoming not only physical, but also institutional and cultural barriers. The expansion of Internet use became a mechanism of globalization development, which encompassed almost all spheres of human life and ensures penetration of globality in it. Overcoming of spatial fragmentation and localization in the information, institutional and cultural aspects is a basis of global society (civilization) built on openness. In this aspect, DIS will be considered as a basis for integration of economy or society on the global level³.

3 Polyakov M.V. (2017) Special features of formation of global information space of knowledge economy and methodological issues of its study. Economic space. 2017. No.123. p.13-26

The Internet had impact on all other manifestations of globalization as a multidimensional process, including economic, political, social, technological, scientific and migration aspects. This network became a basis for convergence and integration of various national systems, harmonization of institutes and different processes. The Internet encompassed all levels of social and economic relations in the countries almost everywhere. It has multiplied human capabilities in the sphere of information exchange and knowledge gaining, communication with any spatial centers and elements of higher level of institutional hierarchy. Today, the Internet starts uniting not only people, but also things. All this leads to increasing complexity of the world economy and ensures free interaction between all participants of international relations.

The extraordinary opportunities of the Internet trigger significant changes in the economy and economic relations. Firstly, the Internet became a new basis and gave impetus to the world integration of national markets, facilitated acceleration of economic processes on a global scale as well as intensification of international flows and economic convergence, namely – equalization of prices for the goods and factors of production. Within GIS framework, national economies become more closely linked into a single organism.

Secondly, the Internet minimizes information expenses, reduces transaction costs, and, at the same time, often increases the costs on supervision. This enhanced the Internet use in business and daily life. The Internet became a basis for change in the functioning mechanisms of modern markets, where the information asymmetry is decreasing and communicativeness is enhancing; the interactions become constant, unplanned,

easily renewable, with feedback, openness, transparency and hyperconnectivity. In this environment, there are new ways of commercialization, which became global, having expanded the markets even for small producers and individuals.

The Internet led to emergence of new channels of interaction with suppliers and consumers. The forms of clients' servicing have changed, for instance, delivery, technical maintenance and education as well as form of consuming, for instance, with continuous switching. The Internet contributed to more comfortable daily life, increased convenience of obtaining services, and provided opportunities for savings in communications, purchases, education, administration, management, etc.

In general, owing to the Internet, the market approached its perfect type (in respect of consumer goods) in terms of: absolute information (market of comprehensive information), minimization of transaction and temporary costs, assessment of the goods and intermediaries, expanded opportunities for buyers and sellers (that does not include monopoly on the market of technology and information services). The consumer has an opportunity of obtaining maximum data on the goods, making assessment on a global scale, and producer – accessing the needs.

Thirdly, such communicative environment as the Internet contributed to emergence of so-called network economy, based on the respective forms of organization. An increase in the number of market actors and reduction of spatial limits partially favors to demonopolization of economy. The Internet enabled international production systems, value chains and global innovative networks. The global network economy is understood as an environment, where any economic units, for instance, companies, which are in any point of the word space,

can contact with each other or other structures at minimum costs within the framework of their economic activity.

In the modern economy, the Internet has acquired the infrastructural role, corresponding to the attributes of systematic use, the role of “framework”, fostering the development of new processes and phenomena, performing the functions to ensure certain types of activities and their intensification (optimization). The peculiar features of the Internet as an infrastructure became its “non-physicality”, socialization, free or cheap access.

Fourthly, the Internet ensures satisfaction of information needs of the society, and also creates conditions for more efficient provision of a wide range of services. Information dissemination in the internet is widely accessible, and commercialization is based on the principles of increasing output. In this regard, the Internet becomes a basis for provision of global social benefits, which are related to, for example, educational activities, training and education that become particularly important knowledge economy⁴.

Fifthly, migration of multiple branches to the Internet and the magnitude of changes have contributed to emergence of so-called digital economy (Internet economy). Since the very beginning, this new economic model is built on the involvement in global processes and closely correlates with the concepts of network economy and information society. Moreover, the Internet provides opportunities to collect data on human behavior, various processes, reference to reSource and organizations, use of things, etc. Processing of this data enables obtaining new useful knowledge.

4 Stiglitz J.E. (1999) Public policy for a knowledge economy. Department for Trade and Industry and Center for Economic Policy Research, 1999. URL: <http://akgul.bilkent.edu.tr/BT-BE/knowledge-economy.pdf> [Accessed: 11.01.16]

The basis for a concept of digital economy was laid in the papers of M. Castells⁵, D. Barney⁶, M. Gumah, Z. Jamaluddin⁷, Y. Masuda⁸, J. Unold⁹, S. Choi¹⁰ and others. Digital economy is understood as a new format to represent the structure of economy, based on formation of the integral information space (based on the Internet and modern ICT), virtual environment of economic activity, which creates a new reality with a high level of freedom of information exchange. The existing economic mechanisms, systems and business models undergo fundamental transformation. These changes are escalated to the national level, developing qualitatively new form of economic order, displacing hierarchical forms and disseminating network forms of organization and interaction. This is supplemented with changes in public management (for example, electronic government) and social services (for example, medicine). In the branches of economy, the whole world within the framework of GIS becomes the field of communications.

Digitization compliments economy with a large number of new elements: information systems, computer networks, web applications, services, infrastructure, operations, etc. This integral ecosystem as the all-encompassing electronic

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- 5 Castells M. *The Rise of the Network Society*. Wiley-Blackwell, 2010. URL: https://detritorialinvestigations.files.wordpress.com/2015/03/manuel_castells_the_rise_of_the_network_societybookfi-org.pdf [Accessed: 08.10.16]
 - 6 Barney D. *The Network Society*. Polity, 2013. 208 p
 - 7 Gumah M.E., Jamaluddin Z. (2006) What is the Digital Economy, and How to Measure it. Knowledge Management International Conference and Exhibition 2006 (KMICE 2006). Kuala Lumpur, 2006. P. 378-382
 - 8 Masuda Y. (1983) *The Information Society as Postindustrial Society*. Wash.: World Future Soc., 1983. 45 p
 - 9 Unold J. (2003) Basic Aspects of the Digital Economy. *Acta Universitatis Lodzianens. Folia Oeconomica*. 167. 2003. P. 41-49
 - 10 Choi S.Y., Whinston A.B. (2000) *The Internet Economy: Technology and Practice*. SmartEcon Publishing: 2000. 376 p

environment unites sellers, consumers, intermediaries, infrastructure companies and providers of various services. A new structure of economy emerges as well as configuration of processes, models of cooperation and competition.

Digital economy encompasses a wide range of spheres of activities in their new format. Their typology includes: e-Shops, e-Malls, e-Procurement, e-Auctions, e-Infrastructures, e-Logistics, e-Agriculture, e-Health (e-Medicine), e-Education, e-Banking, etc. We can also observe migration in Internet labor market, financial sector (crediting, insurance, and payments), emergence of crowdsourcing, crowdfunding, wide penetration of the Internet into the sphere of energetics. This network also becomes a basis for service providing, for example, legal, tourist, brokerage and other services. The Internet of things is actively developing, wireless networks are being formed in such segments as b2c (wearable devices, “smart house”, “smart clothing”, etc.) and b2b (“smart transport”, “smart city”, insurance telematics, “smart workplaces”, “smart grid”, “smart factory”, precision agriculture, “smart warehouse”, etc.). The Internet of things becomes the sphere of knowledge obtaining through study of the processes and processing of data accumulated. The Internet offers a plenty of opportunities for innovations and creates new management problems.

The rules of digital economy start to differ a lot from the industrial structure. The key distinctions of the digital economy are: the activity and competitiveness are based on social and information capital, because of the increased significance of confidence and information; predominance of network organization, removal of spatial barriers; increased degree of socialization, the emerged phenomenon of “crowd”; new

understanding of leadership; development of social communities, development of platforms for cooperation and exchange, including on a global scale; change of cooperation standards in entrepreneurial environment: emergence of new format of intermediary link; promotion of the principle “on demand”.

There is a new landscape of economy at the global level, which is characterized by institutional, social and structural changes. These structural changes, despite their asymmetry, reach the level of the world economy. ICT becomes the driver of its development in the field of economy and international relations.

Besides the additional opportunities for multiple types of activities, the new types of entrepreneurship (virtual, network, Internet-entrepreneurship) emerge within the framework of digital economy. The Internet industry also becomes a sphere of specific innovations (services, information products, software tool, marketing and management changes) with their vectors and trends of development. These are the innovations of Schumpeter’s type which imply destruction of the old and shift to the new (creative destruction), as well as the innovations which imply creation without destruction (creative accumulation), without combating the old¹¹.

The transformation processes, brought about by the Internet, are considered today as an imperative of the economic growth and increased productivity, and are supported by the governments, including the aspects of enhancing the international competitiveness. The effects of digital transformation are contradictory and often lead to collapse of industries. The effects considerably differ by countries depending on the structure of economy and the level

11 Corrocher N., Malerba F., Montobbio F.(2007) Schumpeterian patterns of innovative activity in the ICT field. Research policy. Amsterdam, 2007. Vol. 36, No.3. P. 418-432

of development. The national and supernational strategies for building of digital economy emerge.

The formation of digital economy is accompanied with transformation of the state and its role in terms of institutionalization and regulation. Along with maximization of the individuals' activity, the country does not narrow the functions and changes the format and method of operations. In the state policy, new directions and priorities appear due to use of ICT (training of specialists, development of infrastructure, innovations).

The concept of electronic government, consisting in creation of new nation-level system of public management based on ICT, becomes widely spread and used. This allows, in a new way, providing a wide range of state services, building a system of electronic document flow, automating various management processes and, in general, reducing the costs. Thus, for example, the international development index of electronic government assess: the scope and quality of online services, development of telecommunication infrastructure, quality of human capital, level of electronic participation (electronic information, electronic consultation) as well as electronic decision-making¹². There are all preconditions for the e-government systems to encompass more and more issues of international cooperation, in particular, in the sphere of ICT, security and monitoring. A special task is to ensure electronic sovereignty.

As a part of state social and economic policy, a new trend was distinguished. It is related to building of information (digital, network) society as a new model of social structure and integration, aiming also to improve the quality of human life¹³.

12 UN E-Government Survey 2016. E-Government in Support of Sustainable Development. New York: United Nations, 2016. 237 p. URL: <https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey->[Accessed: 05.02.17]

13 Barney D. (2013) The Network Society. Polity, 2013. 208 p

14. Such society building has shown conceptual distinctions, which gave rise to diverse models of information society building, as reflected by national (supernational) strategies: “Digital Europe” (EU)^{15, 16}, “Society 5.0”, Super Smart Society (Japan)^{17, 18, 19}, “Digital China” (Chinese People’s Republic)²⁰, “Digital Singapore”, “Digital Malaysia”, “Digital India”²¹. This proves that building of knowledge economy could have certain tactical features, but, in general, it includes basic conceptual aspects: informatization, digitalization, high-quality education, innovative business.

The above-stated list of countries is far from exhaustive that demonstrates an inevitable idea of building a global information society. The Internet evolvement sets this task within the framework of international policy (for example, Okinawa Charter on Global Information Society) and at the research level²², taking into account a huge majority of implementation

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- 14 Castells M. T(2010) *he Rise of the Network Society*. Wiley-Blackwell, 2010. URL: https://deterritorialinvestigations.files.wordpress.com/2015/03/manuel_castells_the_rise_of_the_network_societybookfi-org.pdf [Accessed: 08.10.16]
- 15 Digital Economy & Society. Official website of the European Union. URL: https://europa.eu/european-union/topics/digital-economy-society_en [Accessed: 08.02.17]
- 16 Digital Europe 2.0 – Moving Towards a Digital Society. EPP, 2015. URL: <http://www.epp.eu/files/uploads/2015/11/Digital-Europe-2.01.pdf> [Accessed: 08.02.17]
- 17 From Industry 4.0 to Society 5.0: the big societal transformation plan of Japan. i-SCOOP. URL: <https://www.i-scoop.eu/industry-4-0-society-5-0> [Accessed: 26.11.17]
- 18 Granrath L.(2017) *Japan’s Society 5.0: Going Beyond Industry 4.0*. Bonuterra Inc., 2017. URL: <https://www.japanin.dustrynews.com/2017/08/japans-society-5-0-going-beyond-industry-4-0> [Accessed: 20.05.17]
- 19 *i-Japan Strategy 2015. Striving to Create a Citizen-Driven, Reassuring & Vibrant Digital Society. Towards Digital Inclusion & Innovation*. IT Strategic Headquarters, 2009. URL: http://japan.kantei.go.jp/policy/it/i-JapanStrategy2015_full.pdf [Accessed: 09.03.16]
- 20 Sun M. (2009) *Information Society in China: A Prospective*. Bangkok: EGM-ESCAP, 2009. URL: [http://www.unescap.org/sites/default/files/China_ESCAP-IS%20Presentation\(Sun-China071809\).pdf](http://www.unescap.org/sites/default/files/China_ESCAP-IS%20Presentation(Sun-China071809).pdf) [Accessed: 06.03.2016]
- 21 Okeleke K., Stryjak J. (2015) *Building Digital Societies in Asia*. GSM Association, 2015. URL: <https://www.gsmaintelligence.com/research/?file=bd5b3cf1d0533f9c9641039ba6966864&download> [Accessed: 02.07.16]
- 22 Martin W.J. (1996) *The global information society*. Aslib Gower, 1996. 233 p

models, new features, advantages and risks. The global information society takes on different aspects of development, including the sphere of knowledge²³ (Figure 4.1.1).

Information infrastructure (networks, data centers, cloud computations, protocols).
Dissemination of mobile devices, terminals, sensors, etc.
Dissemination of the concept of electronic government, development of international cooperation.
Information web environment: content, data processing, access standards.
New legal institutes, standards in the sphere of information.
Being aware of social institutes: education, science, medicine, labor market, management.
New form of global industries (tourism, logistics, payments, etc.).
New requirements and trends in social development (education, skills, rights and opportunities).
Formation of new culture of communications, network interaction, change in the culture of professional partnership.

Figure 4.1.1. Key aspects of building a global information society

Source: compiled by the authors

Realizing the magnitude and strategic importance of digital transformation, the countries-leaders of the world economy implement special strategies to build digital economy, basic directions of which are represented in Figure 4.1.2^{24,25,26,27}.

23 Global Information Society Watch 2016: Economic, social and cultural rights and the internet. APC and IDRC, 2016. 271 p.; Martin W.J. (1996) The global information society. Aslib Gower, 1996. 233 p

24 A Stronger and More Secure Digital Denmark. Digital Strategy 2016-2020. Danish Ministry of Finance, Local Government Denmark and Danish Regions, 2016. 60 p

25 Ambition numérique. Pour une politique française et européenne de la transition numérique. Rapport remis au Premier Ministre. CNNum, 2015. URL: <https://contribuez.cnumerique.fr/sites/default/files/media/CNNum--rapport-ambition-numerique.pdf> [Accessed: 05.03.16]

26 Digital Strategy 2025. Berlin: Federal Ministry for Economic Affairs and Energy, 2016. 60 p

27 National Digital Economy Strategy. Leveraging the National Broadband Network to Drive Australia's Digital Productivity. DBCDE, 2011. 68 p. URL: <http://rdanwq.org.au/>

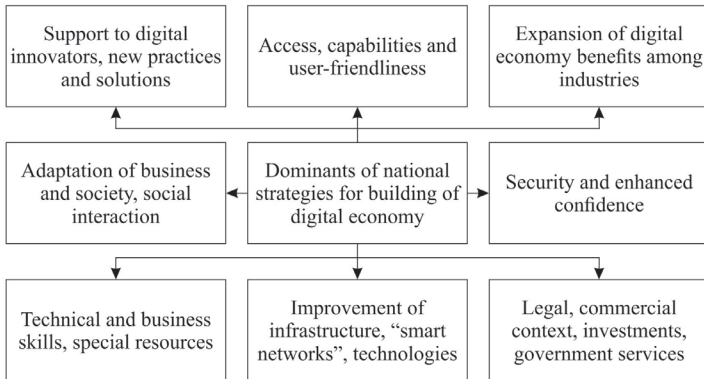


Figure 4.1.2. Basic directions of national strategies on building the digital economy of countries-leaders of the world economy

Source: compiled by the authors

The policy of the countries, being EU members, is coordinated and supported at the level of association, covering such sectors as: 1) formation of a single digital market; 2) expansion of the European digital industry; 3) building of the European data-driven economy; 4) increasing the opportunities and expanding the access; 5) increase in the investments to networks and technologies; 6) development of digital science and infrastructure; 7) development of digital culture; 8) enhancing the credibility and safety. The vector of digital transformation at the level of EU has a boundary nature^{28, 29}.

For the last two decades, the digital economy has been the most rapidly growing sector of the world economy, and acquired a new form of economic structure. The large-scale use of ICT and Internet have increased steadily (Table 4.1.1)^{30, 31}.

files/ National_Digital_Economy_Strategy.pdf [Accessed: 04.02.16]

28 European Commission. URL: <https://ec.europa.eu> [Accessed: 28.12.16]

29 International Telecommunication Union. URL: <http://www.itu.int> [Accessed: 15.11.17]

30 European Commission. URL: <https://ec.europa.eu> [Accessed: 28.12.16]

31 International Telecommunication Union. URL: <http://www.itu.int> [Accessed: 15.11.17]

TABLE 4.1.1. Indicators of access to ICT by countries and their use in 2010 and 2015³²

Countries			Sweden	Luxemburg	South Korea	Denmark	Norther lands
Indicators of ICT use	<i>Users of mobile Internet per 100 dwellers</i>	2015	122.1	83.3	109.7	116.8	70.5
		2010	82.9	61.4	98.2	63.9	38.0
	<i>Fixed broadband Internet per 100 dwellers</i>	2015	36.1	36.5	40.2	42.5	41.7
		2010	31.8	33.2	35.7	37.7	38.1
	<i>Internet users per 100 dwellers, %</i>	2015	90.6	97.3	89.9	96.3	93.1
		2010	90.0	90.6	83.7	88.7	90.7
	<i>% of households with Internet</i>	2015	91.0	96.8	98.8	91.7	96.0
		2010	88.3	90.3	96.8	86.1	90.9
<i>Share of households with computers</i>	2015	88.3	95.3	77.1	92.3	96.2	
	2010	89.5	90.2	81.8	88.0	92.0	
<i>International Internet (Bit per user)</i>	2015	421237	7186378	46764	328018	242326	
	2010	236919	86985	11878	142158	154333	
<i>Users of mobile communications per 100 dwellers</i>	2015	130.4	148.5	118.5	128.3	123.5	
	2010	116.1	143.3	105.4	125.8	115.4	
<i>Fixed telephone lines per 100 dwellers</i>	2015	36.7	51.0	58.1	29.9	41.3	
	2010	52.5	53.7	59.2	47.1	43.5	
Index of ICT development (place)	2015	8.47 (6)	8.34 (10)	8.78 (1)	8.77 (2)	8.36 (8)	
	2010	8.21 (2)	7.64 (6)	8.45 (1)	8.01 (3)	7.60 (7)	

32 Measuring the Information Society Report, International Telecommunication Union. – URL: <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017.aspx>

Iceland	Switzer land	Japan	Norway	Great Britain	Hong Kong	Finland	USA	China
93.4	97.6	126.4	92.8	87.8	107.0	144.1	109.2	56.0
45.3	30.7	88.2	19.4	43.2	38.9	84.3	52.7	3.5
37.0	44.8	30.5	38.9	37.7	31.9	31.7	31.5	18.6
33.4	38.0	26.9	35.3	30.8	29.9	29.3	27.6	9.4
98.2	88.0	93.3	96.8	92.0	84.9	92.7	74.6	50.3
95.0	83.9	78.2	93.4	78.0	72.0	86.9	74.0	34.3
96.5	84.7	96.5	96.6	91.3	79.0	89.9	82.2	54.2
92.0	85.0	81.3	89.8	79.6	76.4	80.5	71.6	23.7
98.5	88.4	80.0	96.5	89.9	80.4	89.3	87.3	49.6
93.0	86.9	83.4	90.9	82.6	77.9	82.0	75.5	35.4
725806	275957	62618	220937	374554	4155651	208526	99017	6530
290995	155512	15831	109641	144665	776625	107267	39184	2389
114.0	142.0	125.1	113.6	125.8	228.8	135.5	117.6	93.2
106.5	125.8	97.4	115.7	130.8	195.6	156.4	89.9	64.0
49.9	50.3	50.2	20.0	52.6	59.2	9.8	37.5	16.5
60.5	64.0	51.9	45.4	53.9	61.8	23.3	48.7	21.9
8.66 (3)	8.50 (5)	8.28 (11)	8.35 (9)	8.54 (4)	8.40 (7)	8.11 (14)	8.06 (15)	4.80 (84)
7.96 (4)	7.48 (9)	7.57 (8)	7.39 (11)	7.35 (14)	7.39 (12)	7.89 (5)	7.11 (16)	3.58 (79)

Before 2016, the total bandwidth of international Internet reached 185.000 Gbyte/s, as compared to 30.000 Gbyte/s in 2008. The global Internet traffic has increased from 30 exabyte/year in 2005 to 966 exabyte/year in 2015. At the same time, the number of users in the G-20 developing countries has been increasing more dynamically³³: G-20 developed countries (Australia, Canada, France, Germany, Italy, Japan, South Korea, Great Britain and USA): 2005 – 508 million people, 2015 – 672 million people; G-20 developing countries (Argentina, China, India, Indonesia, Mexico, Russia, Brazil, Saudi Arabia, South Africa and Turkey): 2005 – 238 million people, 2015 – 1.390 million people.

In 2016, 95% of the world's population lived on the territories, covered with mobile network. The mobile broadband networks (3G or higher) covered 84% of the world's population (rural population – 67%). LTE networks (networks of the fourth generation) have become widespread for the last three years and, for today, they have covered 53% of the world's population.

Although, still, over the half of the world's population do not use the Internet (2016): the South and North America – 35 %, Europe – 20.9 %, CIS – 33.4 %, Arab countries – 58.4 %, Asia and Pacific Region – 58.1 %, Africa – 74.9%. It can be presented as “digital distribution” (table 4.1.2), that is also related to the Internet speed (2015 - the developed countries – 93Kbyte/s per dweller, the developing countries – 13 Kbyte/s per dweller, the countries with low level of economic growth – 1Kbyte/s per dweller)³⁴.

33 The Boston Consulting Group. URL: <https://www.bcg.com> [Accessed: 15.10.16]

34 International Telecommunication Union. URL: <http://www.itu.int> [Accessed: 15.11.17]

TABLE 4.1.2 “Digital distribution” by regions of the world and groups of countries³⁵

Region/ Countries	Interest			
	People who use Internet	Households with access to the Internet	Subscribers of broadband mobile network	Subscribers of fixed broadband communication
By regions of the world				
Europe	79.1	84.0	76.6	30.0
South and North America	65.0	64.4	78.2	18.9
CIS	66.6	67.8	53.0	15.4
Arab countries	41.6	45.7	47.6	4.8
Asia and Pacific Region	41.9	46.4	42.6	10.5
Africa	25.1	15.4	29.3	0.7
By groups of countries				
World	47.1	52.3	49.4	11.9
Developed countries	81.0	83.8	90.3	30.1
Developing countries	40.1	41.1	40.9	8.2
Countries with low level of economic development	15.2	11.1	19.4	0.8

In recent years, an increase in social movement and political activities has been marked, aimed at bridging the digital divide and expanding the access of the world’s population to ICT. There is a new measure of international competitiveness of a country, which consists in strengthening the network readiness and increasing the speed of digital transformation. For example, it is measured by the Index of network readiness of the

³⁵ Ibid

countries, which includes assessment of conditions (political and regulating environment, innovative and business environment, readiness (infrastructure, accessibility, professional skills), level of use (individuals, business, government), and impact of ICT (economic and social). This Index (Table 4.1.3), in fact, reflects the development of ICT and adaptation of countries to the conditions of modern information economy, and the importance for ensuring the competitiveness³⁶.

TABLE 4.1.3. Index of network readiness of the countries-leaders of the world economy in 2010-2011, 2015 and 2016³⁷

Country	2010-2011 (138 countries)		2015 (143 countries)		2016 (139 countries)	
	Value	Position	Value	Position	Value	Position
Sweden	5,60	1	5,8	3	5,8	3
Luxemburg	5,14	14	5,6	9	5,7	9
South Korea	5,19	10	5,5	12	5,6	13
Denmark	5,29	7	5,5	15	5,6	11
Netherlands	5,19	11	5,8	4	5,8	6
Iceland	5,07	16	5,4	19	5,5	16
Switzerland	5,33	4	5,7	6	5,8	7
Japan	4,95	19	5,6	10	10	5,6
Norway	5,21	9	5,8	5	5,8	4
Great Britain	5,12	15	5,6	8	5,7	8
Hong Kong	5,19	12	5,5	14	5,6	12
Finland	5,43	3	6,0	2	6,0	2
USA	5,33	5	5,6	7	5,8	5
China	4,35	36	4,2	62	4,2	59

In general, we can tell about the “digital globalization”,

³⁶ World Economic Forum. URL: <http://www.weforum.org> [Accessed: 21.12.17]

³⁷ Ibid

when the digital economy is already producing 10% of the world's GDP and has 50% of potential growth. The flow of data forms 2.8 trillion USD of the world's GDP that can be compared with the global market of high-tech products³⁸. Digital globalization³⁹ leads to enhancement of the global flows of data in the sphere of: online media; information search; online entertainment; transactions of e-commerce and financial operations; messages in cross-border social networks; interactions, related to Internet education and online employees.

The digital globalization is accompanied with activation of the world market of information goods and services, forming a new sphere of absolute and comparative advantages of countries in international trade. This is evidenced by dynamics of export of ICT services, information services and ICT goods to the countries-leaders and throughout the world in general (Table 4.1.4, 4.1.5)^{40, 41}.

TABLE 4.1.4. Dynamics of the export of ICT services and information services by countries-leaders of the world economy⁴²

	Years						
	2005	2010	2012	2013	2014	2015	2016
Export of ICT services¹, million USD (current prices)							
World	645,043	992,720	1,272,000	1,421,000	1,546,000	1,740,000	-
USA	73,816	126,065	152,892	155,946	163,861	170,543	177,877
Germany	52,441	83,187	96,860	105,445	116,949	108,337	114,434
France	55,586	69,410	83,255	94,305	108,614	98,133	96,136

38 McKinsey & Company. URL: <https://www.mckinsey.com> [Accessed: 08.02.17]

39 The New Era of Digital Globalization. Trends Magazine. 2016. No.158. URL: <http://audiotech.com/trends-magazine/new-era-digital-globalization> [Accessed: 23.01.17]

40 The World Bank Group. URL: <http://data.worldbank.org> [Accessed: 15.11.17]

41 UNCTADSTAT Statistics. United Nations Conference on Trade and Development (UNCTAD). URL: <http://unctadstat.unctad.org> [Accessed: 14.12.17]

42 The World Bank Group. URL: <http://data.worldbank.org> [Accessed: 15.11.17]

Denmark	-	-	-	12,013	12,579	10,985	11,047
Finland	-	-	11,379	11,420	13,334	13,094	12,436
Sweden	14,670	25,082	30,810	34,782	35,525	33,179	33,464
Poland	3,159	11,689	12,696	13,239	14,974	14,485	16,314
Great Britain	71,469	92,809	103,765	113,133	126,959	125,271	124,809
Japan	20,238	33,493	27,795	31,208	40,712	37,341	42,457
China	16,362	-7,165	67,269	74,333	89,068	82,952	83,389
South Korea	9,688	12,686	17,813	19,818	23,962	22,561	24,217
India	35,074	75,037	98,562	100,456	102,996	105,143	-
Export of information services², million dollars (current prices)							
World	9,500	16,300	17,440	20,940	23,970	24,790	26,150
USA	4,133	5,137	6,207	6,770	7,156	7,299	7,043*
Germany	-	-	-	605	1,031	918	-
France	-	508*	757	1,056	914	856	-
Denmark	-	248	253	215	134	117	-
Sweden	-	394	184	156	602	329	-
Poland	-	144	181	222	302	319	-
Japan	-	-	-	-	151	162	196
South Korea	-	85	166	324	560	504	544
India	164	592	183	177	242	196	3233
Hong Kong	58	73	99	98	94	90	-

¹ICT services according to ISIC include: various types of telecommunication activity, computer programming and advising; data processing; web portals; repair of computers and communication tools, etc. ²Information services include services of information agencies (providing news, photos and artistic works in mass media, database services, direct subscriptions for newspapers and periodicals, other services related to online content as well as library services and backup services; ³assessment.

In the context of digital globalization, there are new global challenges, first of all, related to safety, monopolization of data, contradictions in global management of social processes.

Digital economy creates (or is closely related with) a number of modern technological trends, such as: mobile Internet, cloud technology and computation, robotization, and Internet of things. The intensive development of the Internet of things is observed in highly developed countries⁴³, ⁴⁴. The nature of ICT use is changing; they are widely used for intellectual support to address the challenges of analysis and management.

TABLE 4.1.5. Export-import of ICT goods* by countries, million USD (current prices)⁴⁵

	Years						
	2000	2005	2010	2012	2013	2014	2015
Export of ICT goods							
World	999908	1375579	1723070	1860147	1954564	2016965	1947707
USA	156670	128943	134905	139532	140037	145225	141752
Germany	46169	77168	64652	62514	62327	67718	61799
France	31916	27327	22584	22719	22481	21864	19877
Denmark	3539	4067	3514	3483	3570	3971	3467
Finland	10711	13238	4463	2903	1719	1946	1470
Sweden	15414	14613	15403	12405	11272	11384	9733
Poland	1268	3558	15119	12639	13733	16595	15782
Great Britain	51529	52922	24400	20386	20949	21272	19122
Japan	108807	100814	82187	73048	61813	57763	53236
China	44135	234086	459522	554310	605756	607581	607559
South Korea	59426	85314	99813	94036	107127	113410	114422
India	714	1113	4404	5734	5358	3092	2351
Import of ICT goods by countries							
World	1033480	1453413	1891186	2045990	2137212	2183324	2111422

43 Manyika J. Digital Economy: Trends, Opportunities and Challenges. McKinsey Global Institute, 2016. URL: https://www.ntia.doc.gov/files/ntia/publications/james_manyika_digital_economy_deba_may_16_v4.pdf [Accessed: 04.02.17]

44 Organisation for Economic Co-operation and Development (OECD). URL: <http://www.oecd.org> [Accessed: 21.12.17]

45 The World Bank Group. URL: <http://data.worldbank.org> [Accessed: 15.11.17]

USA	218859	236788	279978	299149	301547	310137	318419
Germany	58283	89709	97728	88587	85943	94065	89259
France	35988	40662	43940	41689	42231	40974	37598
Denmark	5532	7483	6583	7374	7152	7190	6552
Finland	5635	8357	5658	5257	4476	4790	4148
Sweden	10471	12408	16878	16401	15530	16045	14048
Poland	4499	8041	17082	15689	17569	19238	18572
Great Britain	69970	67935	59573	50313	51668	54272	52247
Japan	61485	69497	83163	90731	90742	91486	80014
China	45454	166849	284783	355563	400669	386184	394496
South Korea	34644	39836	50514	50874	53846	59996	64019
India	2886	10757	22081	25970	26915	28995	33463

**According to the Harmonized system of 2012 (HS12), the list of ICT goods consists of 93 goods, including computers and peripheral equipment, communicative equipment, consumer electronics, electronic components, etc.*

The intellectualization is also related to functioning of the Internet, intensity of which requires more comprehensive solutions in management of web services and their targeting, which requires knowledge about users and processes, occurring in the environment. Over the last two decades, we can see a development of technologies, means and approaches, providing intellectualization of Internet environment, namely: emergence of Semantic Web technology stack, intellectual agents, multiagent information systems, semantic electronic libraries, collective and personal repositories of Wiki knowledge, Web Ontology Languages (OWL), knowledge grid architecture, semantic link networks (SLN), etc.⁴⁶. In this context, the technologies of collecting, processing and analyzing data (Data Mining/Big Data) are being developed,

46 Glybovets M.M., Polyakov M.V. (2014) Intellectual networks: teaching manual. Dnipropetrovsk: New ideology, 2014. 464 p

and there is also an automation of the work with knowledge in the Internet environment. In the nearest future, an evolvement of the so-called intellectual technologies and systems in all spheres of ICT use can be expected.

In the context of intellectualization of the Internet environment and the entire GIP, an enhancement of the level of information security becomes an imperative. Security requirements involve all areas of the work with information resource in all spheres. In the view of formation of knowledge economy, firstly, it is related to transfer, storage and processing of data, including in science and education. Information security is a precondition for maintaining the control over knowledge and preservation of its value for an owner, taking into consideration the special rights to intellectual property. Ensuring the preservation of knowledge does not require special software tools, infrastructure and institutes.

Today, the information security is one of the most critical, general and all-encompassing priorities of global policy. Ensuring the information security becomes a matter of international legal institutions and the leading international organizations, which produce special global mechanisms including the Internet. For example, they are represented by the international industrial and professional associations, which carry out direct international coordination of the activities in the sphere of information security, for example: International Electrotechnical Commission, International Telecommunication Union; Association for Computing Machinery; W3 Consortium; Information Systems Security Association; Center for Internet Security; International

Computer Security Association; Information Systems Audit and Control Association; Internet Security Alliance; Information System Audit and Control Association, etc. The international standards become to act as global mechanisms. In this sphere, the significant work is carried out by ISO (a family of ISO/IEC 27000 standards – Information security management systems).

The exponential developments of digital economy and Internet industry as well as intensification of the global data flow are expected in the next few years. Thus, the experts of Cisco in the calculation of Visual Networking Index predict steady increase in the monthly IP-traffic (the scope of the transferred/obtained information under IP protocol, exabyte per month) in the nearest years: 2016 – 96, 2017 – 122, 2018 – 151, 2019 – 186, 2020 – 228, 2021 – 278. In retrospective, the forecast of Visual Networking Index of the global Internet traffic looks like: 1992 – 100 Gbyte/day, 1997 – 100 Gbyte/hour, 2002 – 100 Gbyte/s, 2007 – 2,000 Gbyte/s, 2016 – 26,600 Gbyte/s, 2021 – 105,800 Gbyte/s⁴⁷. The high growth of traffic in all regions of the world is expected (Table 4.1.6), which makes it possible to speak of strengthening of CIS.

On a global scale the number of devices and connections per capita has increased by 2.3 in 2016 and will rise by 3.5 until 2021 (Table 4.1.7)⁴⁸. The lion's share of Internet users is concentrated in the South-East Asia.

47 The Zettabyte Era: Trends and Analysis. Cisco, 2017. 32 p. URL: <https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni-hyperconnectivity-wp.html> (date of application: 20.12.17)

48 Ibid

TABLE 4.1.6. Global IP-traffic by type, segments and regions (2017-2021)⁴⁹

	Years (since 2017 - forecast)						Yearly average growth rate
	2016	2017	2018	2019	2020	2021	
IP-traffic by type (Petabyte per month)							
Fixed Internet	65,942	83,371	102,960	127,008	155,121	187,386	23 %
Controlled IP-address	22,911	27,140	31,304	35,226	38,908	42,452	13 %
Mobile data	7,201	11,183	16,646	24,220	34,382	48,270	46 %
By segment (Petabyte per month)							
Consumer	78,250	99,777	124,689	154,935	190,474	232,655	24 %
Business	17,804	21,917	26,220	31,518	37,937	45,452	21 %
By regions (Petabyte per month)							
Asian and Pacific region	33,505	43,169	54,402	68,764	86,068	107,655	26 %
North America	33,648	42,267	51,722	62,330	73,741	85,047	20 %
Western Europe	14,014	17,396	21,167	25,710	30,971	37,393	22 %
Central and Eastern Europe	6,210	7,451	8,940	11,016	13,781	17,059	22 %
Latin America	5,999	7,502	9,141	10,861	12,909	15,464	21 %
Middle East and Africa	2,679	3,910	5,538	7,773	10,941	15,490	42 %
Total (Petabyte (PB) per month)							
General IP-traffic	96,054	121,694	150,910	186,453	228,411	278,108	24 %

⁴⁹ Ibid

TABLE 4.1.7. The average number of devices and connections per capita (2021 – forecast)⁵⁰

	2016	2021 (forecast)	Yearly average growth rate	Number of Internet users (% Of regional population)
Asian-Pacific region	1.9	2.9	8.3%	2.6 billion (62 %)
Central and Eastern Europe	2.5	3.8	9.1%	356 million (72 %)
Latin America	2.1	2.9	7.0%	446 million (66 %)
Middle East and Africa	1.1	1.4	5.4%	477 million (28 %)
South America	7.7	12.9	11.0%	334 million (89 %)
Western Europe	5.3	8.9	10.9%	365 million (87 %)
World in general	2.3	3.5	8.5%	4.6 million (58 %)

The global informatization of the world economy takes place asymmetrically. At the same time, improving the speed of access, which is predicted in the nearest years, will even more consolidate the global Internet space (Table 4.1.8).

TABLE 4.1.8. Speed of the fixed broadband access to the Internet, Mbit/s⁵¹

Region	Years (since 2017 - forecast)						Yearly average growth rate
	2016	2017	2018	2019	2020	2021	
Worldwide	27.5	39.0	42.3	47.9	50.4	53.,0	14 %
Asian-Pacific region	33.9	46.2	49.8	56.4	59.4	63.7	13 %

⁵⁰ Ibid

⁵¹ Ibid

Latin America	9.3	11.7	13.6	15.0	17.6	20.5	17 %
North America	32.9	43.2	51.0	57.5	65.0	74.2	18 %
Western Europe	30.2	37.9	40.7	46.9	49.3	53.6	12 %
Central and Eastern Europe	29.2	32.8	36.0	39.0	41.6	45.5	9 %
Middle East and Africa	29.3	39.0	46.0	51.6	59.2	67.4	18 %

Therefore, in general, the Internet environment and digital economy at the national and global level will continue their dynamic development in the nearest years, being accompanied by the structural transformations. The potential of digital economy development, besides dynamics at the national level, and structural and institutional harmonization at the world level, will depend on solving the ICT problems. In general, the activation of innovations in the sphere of ICT and Internet (so-called digital innovations) became a stand-alone trend of modern digital economy. It is related, first of all, to a wide range of software, information services or web services, infrastructure of data storage and processing⁵². By the type, such innovations should be related to global, as they can be used almost in all countries and at the global level. Moreover, such innovations can be focused on business, sphere of state government, scientific researches, industry and agriculture, financial sector as well as diverse social groups and individuals. At present, the number of digital innovations in energetics, logistics, ecology, medicine, education and social sphere is increasing.

By the subject of changes, the digital innovations encompass: 1) R&D (software for data processing); 2) information products (databases and repositories, knowledge bases, expert systems, ready-for-use array of information);

⁵² World Economic Forum. URL: <http://www.weforum.org> [Accessed: 21.12.17]

3) software for organization of activities (management), marketing, communications; 4) web services for various spheres; 5) data processing tools (computational programs, programs of parallel computations; 6) mechanism for cooperation and exchange.

Digital innovations differ from traditional concepts of innovations (product and technological), primarily, by the following criteria: “non-materialness”; special social focus; taking into account psychological and behavioral aspects; closeness to various human practices, accumulation, addition and change of human experience; predominance of empirics over heuristics (absence of fundamental scientific base); dynamism and continuity, high degree of integration with other technologies, etc.); transparency in development and accessibility of use.

However, along with the key drivers (entrepreneurship, talents, capacity of computer hardware and information infrastructure, skills and social needs), we would like to emphasize the importance of development of new scientific theories in ICT sphere. It can be grounded on the methodology of vertical integration of knowledge and the model of paradigm innovative development. The problems of modern ICT are the unstructured data, their variety, taking into account interests of the user, problem of costs and losses, engineering problems of ICT, logical and theoretic problems, etc.

The formation of GIS is accompanied by the development of the system of international economic relations (IER), which became evident in, as follows:

- 1) additions and improvements of the international legal institutions, formation of new sectoral

- institutional regime, which ensures digital economy, which, more or less, encompasses all industries, and maintains cooperation and flows. The development of international legal institution is related to regulation of competitiveness, establishment of new rules of trade and customs control, protection of intellectual property and data, security, consumer rights protection, investment regulation, taxation;
- 2) emergence of new areas of activity of the universal international organizations. Evolvement of the systems of international legal and organizational institutes demonstrates a genesis of the new system of CIS regulation and, at the same time, of knowledge economy;
 - 3) emergence of the new segments of new market of goods and services, for example, data, information products, software tools, etc.;
 - 4) formation of the new elements of economic infrastructure at the global level;
 - 5) emergence of the effects of establishing the new communications between national economies; demonstration of the effects, which create flows in the sphere of information, goods, finances and services.

Informatization of IER by means of Internet triggered a change of the nature of global economic relations within GIS. A new form of IER – the international relations in the information sphere, is developing. Such relations ensure all the basic forms of IER (cooperation, international scientific

and technical cooperation; currency and financial relations) and form a special sphere of relations – the infosphere. The Internet contributed to informatization of IER at the new level, assuming, in its turn, an infrastructural role in the system of relations and making an internationalization of economic life to become of global nature, and, at the same time, complicating the existing phenomena and accelerating the processes. The Internet and the related components of information support become one of the cornerstones of the global market of goods and services, a new framework for its functioning, in particular, such as: network forms of cooperation, systems of payments and bidding (including the global ones), system of business communications. Data movement becomes primary in the international trade and cooperation.

The web-services, represented in diverse spheres of IER, give rise to international trade and finances and jointly create the mechanisms for cooperation of the subjects at the global level, i.e. of the entire global economic mechanism. This global mechanism is characterized by an acceleration of interactions and flows, intensification of information exchange, low level of information and transaction costs; ample opportunities for coordination and control; emergence of new services; extra opportunities for automation of operations in the infosphere.

The uncertainty and information asymmetry decrease within the framework of such mechanism. This as well as minimization of costs, elimination of intermediary agents, increase in the level of control, transparency and cost-effectiveness form the new advantages of working via the Internet. The disadvantages of the Internet as an economic mechanism can include: extra opportunities for manipulations; availability of surplus revenue

on account of unequal access to information; strengthening of the power of Internet companies, monopolization of data; problems related to confidentiality; problem of sufficiency, completeness and authenticity of information; problem associated with the rights for protection of the intellectual property in the Internet; problem of human control in condition of the information pressure; chaotization of markets, particularly the innovative ones, etc. These problems are hard to overcome and it will require a long-term evolution of digital economy.

Therefore, as a part of the existing practice of Internet regulation, it is expedient to single out the sector, related to overall management of network development in the sphere of operations with knowledge, which contributes to elimination of the above-listed disadvantages. This is also related to the standards for presenting knowledge and information, development of global control institutions. Besides, the Internet is more and more considered as one of the elements to address the global problems of mankind, including the problem of global warming, counterterrorism, anticorruption efforts, etc.⁵³. As a part of multilateral cooperation and international institutions, a new strategic vision of Internet development should be developed, transforming it into institutionalized basis for knowledge economy and intellectualization of all spheres of life.

In general, GIS changes the landscape of the global economy. In terms of knowledge economy, it is critical that Internet unites and links all individuals, communities, enterprises (including small and medium sized), organizations (universities), centers (agglomerations), cities, national regions and other participants into a single system, connected by IER. At

53 Atkinson R.D. (2009) ICT & Innovation: Facing the Global Challenges. KISDI, 2009. 80 p

the same time, there are features of virtuality and exterritoriality.

Based on GIS, the following aspects emerge: global causality – new factors, which have impact on economic activity (knowledge, communications, relations, etc.); transmitting power, dissemination of signals and information reSource (with certain velocity performance), dissemination of information, continued growth in the volume of information; eigen vectors of development; inertia, relativeness, monotony, topology; global centers of concentration of the information reSource (knowledge); communication networks and information gravitation (according to data centers, centers of information generation, economic centers); process organization function, networking of labor and cooperation; mass communication culture, network culture, which encompasses different professions and social groups.

It is necessary to consider the specific aspects of globalization in the sphere of knowledge separately and in relation to knowledge economy. Due to the specific features of science and education, the rapid globalization is natural for the sphere of knowledge and it is reaching a higher level (which can be compared with financial globalization), irrespectively of any problems of knowledge accessibility, security and intensification of technological competition among the countries. Proceeding from the uneven scientific and technological development, the aspirations to gain knowledge prevail over restrictions, which transform globalization into a powerful impetus in science, education, technologies and innovations.

The globalization and, in particular, informatization considerably change the conditions of scientific, technical and innovative activity and education, forming for this purpose a

qualitatively new environment within the framework of GIS. That is why there is a huge majority of new trends, related to intensification of flows, internationalization processes, activation of cooperation, and convergence of national systems of science, education and innovations. Despite the counteraction, the globalization processes predominantly do not lose their speed. There are all preconditions for globalization and informatization to overcome the contradictions of the modern paradigm based on the principles of rejection of monopoly and hegemony, refusal from total unification, solidarity, combining the efforts for advancement of knowledge in the interests of humanity.

The increasing volume of knowledge is disseminated over the whole world and disorganized. The globalization helps generating knowledge by means of their diffusion, free exchange of ideas, research findings and various kinds of cooperation. Formation of GIS makes the turnover of knowledge more freely, creating new external effects. Therefore, the planetary thinking, which appears today, makes it possible to gain knowledge from different Source, to compare it, to sum up and adopt; it also enables to develop collective creativity. This requires new methodologies and information tools, understanding of new forms of scientific communication.

The Internet is full of special systems, which directly or indirectly facilitate the information exchange and cooperation, connect local centers events and reSource. In this regard, GIS takes on a new functional aspect, and Internet becomes a driver of progress in a number of industries related to knowledge.

Formation of GIS in the sphere of knowledge has critical social aspects. In general, globalization activates a majority of the world population in terms of gaining and using knowledge.

The role of the Internet in obtaining the access to educational reSource and communications, in improving the cognitive and creative human capabilities is increasing. The targeted networks (entrepreneurial, innovative, expert, research, etc.) and professional communities, including the informal ones, are created owing to the Internet. Thereby, the Internet enables involving the large numbers of people in the processes of gaining and using knowledge, education, creativity as well as in diverse communities. Formation of GIS has an impact not only on mass culture, but also on professional culture of scientists, enhancing the interactive focus of their activities. These social aspects are also largely related to the entrepreneurial sphere, which is closely related to the Internet. This is also critical for the developing countries, when the Internet enables overcoming the physical barriers and establishing cooperation or workplaces where required, irrespectively of the external conditions.

A globalization of the knowledge sphere facilitates consolidation of the global labor market for high-skilled professionals, including by means of virtual remote employment. The new opportunities for mobility, skill upgrading and implementation of one's own knowledge arise. In this sphere, the Internet facilitates development of migration networks, informing the migrants and their contacts with employers. In the educational sphere, the virtual mobility of instructors and students becomes possible.

It should be emphasized that the Internet has a substantial impact on diffusion of knowledge and innovations. The diffusion of knowledge is considerably intensified in the infosphere (networks, communities, cooperation processes, trade of goods and services). Dissemination of innovations is

also considerably intensified and commences from the stage of discussing the ideas. In many aspects, it determines the dissemination of the model of open innovations. The more intensive joint development of innovations becomes a common trend. The Internet also plays a huge role in establishment and development of partnership relations, creation of a new basis for the respective mechanisms. New mechanisms of knowledge commercialization and innovations emerge as well as dissemination of information about them.

In general, we can tell about an emergence of information infrastructure, built based on the Internet and focused on providing a new quality of GIS. Traditionally, the information infrastructure is considered in three categories: 1 – computer hardware, 2 – networks and network equipment, 3 – information reSource (content). In the framework of this research, the attention is focused on various types of scientific and technical information and reSource, which belong to the sphere of science, education and technology. Thus, for example, the third category – information reSource – begins to include special information systems – various websites, portals, social networks in the Internet. They are the information software infrastructure, which ensures the applicable nature of this environment (hardware and information reSource) and the process of information service providing.

The relevance of information systems in the knowledge sphere is increasing owing to the enhanced array of scientific and technical information, involved community of scientists and organizations, volume of communications. Along with it, the problems of search and analysis are mainstreamed, thereby creating the need for special tools and services

(search of people, patents, articles, etc.; data processing). The combination of special information systems, which are used in the sphere of knowledge, creates Internet-infrastructure of the knowledge economy, being characterized by a significant degree of diversification of services in the sphere of science, education and innovations. The objective process of scientific development and increase in the complexity of GIS causes the growth in requirements to information structure of knowledge economy and its components (Figure 4.1.3).

We should emphasize the emergence in its composition of the international scientometric databases, electronic editions, various social media (Facebook, Twitter, Google+ etc.). The academic, entrepreneurial and innovative networks as well as the accessible educational reSource are actively developed. Scientific communication becomes more varied and, at the same time, chaotic.

It should be noted that the modern science is characterized by: mediatization, advancement of news block, activation of scientometrics and emergence of its new types (webometrics), “competition for attention”, the problem of promoting the scientists and publications. An increase in the volumes of information reSource mainstreams the problems of understanding, assessment of achievements and prospects, manipulations, and fashion.

There are new emerging needs and development prospects. In particular, there is a need in development of information mechanisms for international cooperation, namely, for organization of joint activities. As a part of GIS, it is also necessary to enhance the quality of services for search and assessment of the objects of intellectual property, expertise,

search for scientific and technical information and scientists (experts) as well as data processing by areas of activity. It defines the level of their global integration.

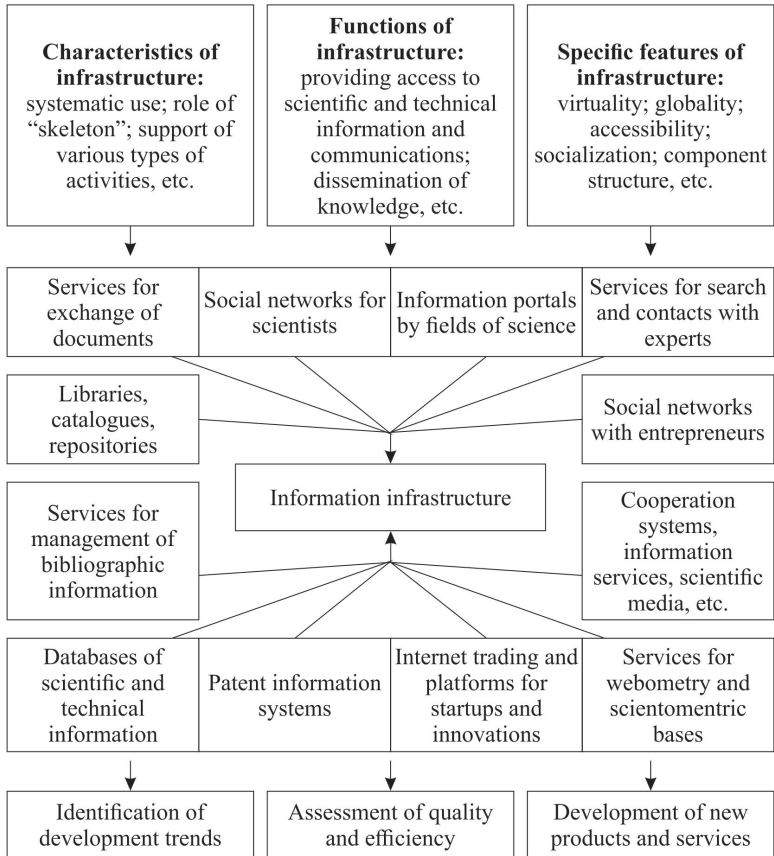


Figure 4.1.3. Key elements of information infrastructure of knowledge economy in the Internet

Source: compiled by the authors

Among the positive effects of the development of information infrastructure in the sphere of knowledge, we

can distinguish: expansion of the Source of scientific and technical information and information reSource; provision of the extended access to knowledge in package; establishment of contacts between scientists and entrepreneurs; ensuring virtual presence of people and organizations in the information space; emergence of new forms of communications, practices and models of organization of work, alternative verticals and chains, mechanisms of transfer; reduced relevance of physical barriers and advancement of remote labor; increase in the level of social awareness of the activities of universities, business and trends in development of science; promotion of transparency in science and cooperation with business that creates new opportunities for monitoring.

The key problems of using ICT in the sphere of knowledge are related to: 1) integration of data, obtained from different Source and having different structure and semantics (unification); 2) integration of information systems by structure of data, legal institutes, languages, etc.; 3) ensuring the completeness and authenticity of the outgoing information; 4) ensuring the motivation of information Source to provide timely and high-quality information; 5) creation of efficient assessment system, comparison and classification of scientific and technical information and scientists as knowledge holders. All this requires continuous and timely elimination of the arising inconsistencies of information systems. One of the crucial conditions of quality is flexibility of information systems in case of an increase in their level of complexity.

Thus, in the Internet there is a separate segment, focused on the sphere of science, education and innovations. A development of the processes of convergence and integration

continuously leads to acquisition of systematicity by the innovative infrastructure, at least, in terms of integration of the Source of scientific and technical information and functions of interaction with them. System boundaries are linked with the boundaries of internet expansion and configurations, and economic parameters of access by countries. There is an additional measurement – Internet geography of knowledge.

The contemporary level of development of information infrastructure and globalization processes in the sphere of knowledge allows us to speak of formation of the global knowledge economy (GKE). In the modern studies, we can find such concept (for example, J. Roberts⁵⁴, S. Cozzens, E. Kallerud, L. Akwrs, B. Hill, T. Santos Pereira⁵⁵, A. Di Minin⁵⁶, J. Johannssen, B. Olsen⁵⁷, D. Archibugi, B.-A. Lundvall⁵⁸), although, it is still insufficiently substantiated.

In our view, study of the processes and phenomena, related to formation of knowledge economy at a global scale, and conceptualization of GKE are the critical tasks of the economic science in the context of limitedness of the existing theoretical base in the explanation of international aspects of knowledge economy.

54 Roberts J. (2009) The global knowledge economy in questions. *Critical Perspectives on International Business*. 2009. Vol. 5, No.4. P. 285-303

55 Science, Technology, and Inequalities in the Global Knowledge Economy: Policy Dimensions. Preliminary Position Paper / S. Cozzens, E. Kallerud, etc. James Martin Institute, 2006. URL: http://www.ces.uc.pt/myces/UserFiles/livros/127_WP1-Preliminary_position_paper_Del%231_Final.pdf [Accessed: 26.01.16]

56 Di Minin A. (2003) Regions in the global knowledge economy. IN-SAT Laboratory, 2003. 26 p

57 Johannssen J., Olsen B. (2010) The Future of Value Creation and Innovations: Aspects of Theory of Value Creation and Innovation a Global Knowledge Economy. *International Journal of Information Management*. 2010. No.30. P. 502-511

58 Archibugi D., Lundvall B.-A. (2001) *The Globalizing Learning Economy*. Oxford: Oxford University Press, 2001. 328 p

It will considerably improve the concept of knowledge economy inasmuch in view of the decisive role of the impact of globalization. GKE allows us in a new way to explore international flows and cooperation, global markets, international policy, i.e. the fundamental components of the world economic system⁵⁹.

GKE should be considered in several aspects: general economic, information, social, service and technological. Moreover, GKE, as a concept, can be used for identification of diverse entities in the world economy, in particular, such as: digital space which often prevails over “physical” space; multilevel, multi-element and multifunctional system of interaction to gain knowledge and develop innovations; generalized bank of scientific and technical information with global access; meta equal environment, where the processes of gaining, disseminating and using knowledge take place, as well as information exchange, networks are created and global market of knowledge operates; global intersystem which integrates national systems of knowledge and innovations; global ecosystem of activities in the sphere of generating and using knowledge, which integrates and creates new operating conditions for local centers; market system which integrates and consolidates global markets of knowledge, skilled personnel, ICT, information services, etc.

Within the framework of GKE, there is not only communication and scientific and technical exchange, but also organization of scientific and technical, educational and innovative activities and cooperation. GKE has especially

⁵⁹ Polyakov M.V. (2016) Foundations of the concept and components of global economy of knowledge. Scientific Bulletin of International Humanitarian University. Series: “Economy and Management”. 2016. Iss. 21. P. 32-36

strong impact on the number of world markets of equipment, labor, science-intensive services, capital, intellectual property, software products. As a result, GNE can be represented as a mechanism, which facilitates the search, generation/gaining and circulation of knowledge on a global scale.

The most important thing in GKE is a more extended access to knowledge and, respectively, manifold increase in information flows, related to diffusion of knowledge. The idea of GES is based on the ideas of internationality and openness of science as an “intellectual universe” – a single transparent mechanism without artificial limitations for exchange of knowledge aiming at overall progress. Breaking up the monopoly on knowledge is one of the most critical components of human development.

The need to consider GKE stems not only from the aspiration to gain new knowledge, but also from the demand for management of intellectual potential on a global scale. This concept will enable improving the institutes and infrastructure, provided by GKE, thereby enhancing positive effects of globalization in science, education and innovations. GKE develops new information field of knowledge development, and, as a result, the new patterns of knowledge diffusion and concentration are created, new positions and roles of actors are developed. GKE, as a system, acquires its own potential and becomes a driver of information and innovative processes.

GKE has the same features as GIS: integrity, common availability, hierarchy, “horizontal nature”, polycentricism, interactivity, intensity, simultaneousness, asymmetry, predominance of self-organization and self-regulation. The attractors in GKE can be represented by the global scientific and

technical, and innovative centers, universities and corporations. They accumulate the basic reSource of knowledge, identify their geography and organization.

The emergence of GKE has an impact on the world economy, which is demonstrated by: consolidation of knowledge sector on a global scale; intertwining and merging of national innovative systems with creation of international structures; combining the scientific and technical potentials of countries and intellectual reSource; transformation of the markets functioning mechanisms of the number of science-intensive services; increased international scientific and technical exchange and cooperation.

GKE, despite the inconsistency and asymmetry, gives impetus to overall progress owing to exchange and cooperation. This is demonstrated in the following: reduced centralization and hierarchy of the systems of science, which facilitates demonopolization; integration of national systems of science, education and innovations; development and consolidation of the world market of knowledge; formation of the new system of cooperation in the sphere of science and innovations as well as the new system of regulation; leveraging of new reSource in the processes of knowledge generation; development of international chains of knowledge organization and global innovative networks; mainstreaming the internal scientific research and innovative activities; increased self-organization and self-regulation; intensified diffusion of scientific knowledge, technology and best practices; emergence of new capabilities of search, identification, knowledge gaining and commercialization.

GKE enables optimizing the national systems of

scientific and technical information by means of integration and education, for instance, of global banks of scientific and technical information. In fact, in the framework of GKE, there is formed a holistic intellectual stratum, accumulating the knowledge resource and represented by the intellectual potential (scientists, entrepreneurs, professional communities), where the clusters of knowledge generation are formed, and a synergy and integration of various knowledge takes place. Information systems become critical for formation of such layer.

GKE covers a huge majority of the types of economic activity and transactions, creates a new environment, where the immediate dissemination of market signals and response to them takes place on a global scale. Everywhere we can observe a shift transition from individual to collective (network) structures and methods of production and adaptation of new knowledge that the new economic forms are created around. GKE provides the additional opportunities for scientists and entrepreneurs in terms of knowledge gaining and cooperation. At the same time, the new information needs arise.

The adverse effects of globalization in the sphere of knowledge should be taken into consideration. Firstly, globalization facilitates homogenization of scientific approaches, eliminates distinctions, synchronizes development trends of scientific, educational and innovative systems. Science starts moving within the frameworks of single paradigms and theories, the risks of false viewpoint dissemination (including disinformation). Moreover, globalization acquires additional volatility and chaotic nature. All this is contrary to the productivity of science and, in the long run, will have a negative impact on its efficiency. Secondly, an increase in the volumes

of information reSource, which requires new tools, can lead to “superficial” manner of scientific search. In case of change in the quality of search, the content of scientific search undergoes negative alterations. Thirdly, the new forms of monopolization of reSource as well as space emerge in GKE. The inclusion in GKE mechanisms expands the opportunities of strong players – countries and corporations – dealing with knowledge mining and search for intellectual potential. Therefore, we can recall so-called digital hegemony (accumulation of data in hands of a few huge Internet companies). The large states take control of reSource, enhance formal and informal control and pursue their interest at a new level. Fourthly, an “inequality” of freedom is created in GKE as well as an access to knowledge for different countries. Providing access to various knowledge Source, GKE can create new dependence on global environment.

In the context of individual countries, inclusion in GKE is determined by the vision of openness in economy and science. The high level of inclusion in GKE triggers change in national systems that can be represented as modernization. In modern conditions, the openness and the opportunities, provided by it, are objectively needed for development in keeping with global trends and rates, which require new openness policy with the appropriate attention to the sphere of knowledge. An integration of a country into the global space should be accompanied by the activities to prevent the outflow of scholars and loss of knowledge, including those related to provision of information security. It is also required to develop new approaches to retain and build scientific and technical potential, to create mechanisms to increase intellectual reSource, which will take into account the expanded opportunities of knowledge obtaining from the global environment.

In conditions of GKE, a consideration at the national level is required, as globalization does not diminish a dependence of scientific and technical activity on the local conditions. This dependence remains, but becomes different and is related to the local factors of productivity of knowledge generation and use. This creates additional requirements to national scientific and innovative policy. The degree of individual countries' participation in GKE is suggested to be evaluated using a number of indicators, which are able to create an integral system in line with the objectives of a specific study (Table 4.1.9).

TABLE 4.1.9. Key indicators of the countries' participation in GKE

Areas	Indicators
Accumulated internal reSource of the country	<ul style="list-style-type: none"> • Relative share of the country in the global indicators of the number of researchers and the whole number of people engaged in R&D sphere; • Relative share of the country in the global indicators of R&D funding; • Number of valid patents, including by residents and non-residents;
Efficiency of scientific and educational activities	<ul style="list-style-type: none"> • Relative share of the country in the global indicators of R&D performance; • Number of scientific and technical publications; • Number of patents, issued in the countries, in particular to residents and non-residents; • Number of patents, issued by international and foreign organizations; • Number of graduates by the level of education and fields of study.
Amount of the external knowledge diffusion	<ul style="list-style-type: none"> • Indicators of using by the country's population of scientific information and education reSource in the Internet; • Indicators of purchase-sale of the intellectual property on the global market and payment/receipt of the respective fees;

	<ul style="list-style-type: none"> • Indicators of export-import of technologies (in materialized form) and purchase/rendering of the related engineering services; • Export-import of science-intensive services; • Indicators of migration of the high-skilled staff, in particular, mobility of students and academic staff; • Number of publications in the editions, included into international scientometric databases; • Number of grants received and the amount of grant funding.
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Source: compiled by the authors

At the global level, the study of GKE should assume evaluation of dispersion, asymmetry and generalization of the indicators of scientific and technical activity of the countries by the areas. The following activities are suggested for improvement of information infrastructure and development of GKE:

- development and introduction of new standards and tools for formalization of knowledge (for example, diversification of the categories of scientific and technical information);
- creation of general education systems of scientific and technical information, integration of individual components of national systems and the ones, which facilitate formation of a new type of international structures with global access;
- institutionalization of the mechanisms of control over compliance with the principles of cooperation, protection of social rights on knowledge and intellectual property, mechanisms for coordination of state policy, etc.;
- conducting the international education (training)

- programs for the development of ICT in science and education with involvement of entrepreneurs and youth;
- conducting the international programs for cooperation of science and business;
 - supporting the developing countries in overcoming the technological backwardness, use of Internet and inclusion in GKE;
 - building of new institutes and regulatory mechanisms in knowledge sphere, which are related to counteracting the monopolization and supporting the conditions of international competition.

The Internet security issues become critical, thereby requiring further development of international regulation, development of international rules, programs, procedures, standards of knowledge transfer and user rights protection in the process of international cooperation.

4.2. Information imperative of the human development

Global processes take place in the development of modern civilization starting from the second half of the twentieth century, which are unprecedented in their capabilities and significance in the development of human society. Significant changes determine the development of modern world, which are caused by the expansion of knowledge in all fields of science, transnationalization, digitization and multi-conceptualization of the world order. These processes are affected by the development of an information society based on new technologies, communications and innovations; they have

established Informationalism as a new technological paradigm. The creation of this civilization is the result of the interaction of three main processes - globalization, informatization and technological revolution, leading to the formation of a new technological structure, that will dramatically change the lifestyle of almost the entire Earth population. The history of mankind did not go through such changes yet.

Tectonic shifts occur in the information sphere, economy, science, culture and education, which are expected to form a new civilization - the global information society. Its main features will be the globality and widespread use of scientific knowledge and technology-intensive technologies. These global changes have occurred as a result of human activity and influenced the development of human society, productive forces, production relations, human resource, and values.

Significant changes in the world technological and human development prearranged the study urgency of the comprehensive study of the mentioned processes. The essence and the information society development perspectives have been explored by many scholars, in particular, D. Bell, G.M. McLuhan, M. Castells, P. Drucker and others. Such western sociologists as E. Masuda, A. Turen, and A. Bühl influenced significantly the formation of the information society theory. This term was introduced by the professor of the University of Tokyo Yu. Hayashi.

A futurologist and sociologist A. Toffler explored in the work "The Third Wave" the decisive influence that the information revolution has on society, where he presented the history of mankind in the form of three waves of civilization that successively change one another - the first leads to the

establishment of agricultural civilization, the second - of agricultural civilization, third – informational one⁶⁰. According to a well-known American sociologist, professor of Harvard University D. Bell, the revolution in the organization and processing of information and knowledge is developing under the post-industrial society, and the computer plays a central role here⁶¹.

The information society differs significantly from previous socio-economic formations. Researchers have shown that the fundamental difference between the information society and previous technological approaches is that key varieties of human activity are based on knowledge generation and information processing, and globally organized into the real time information networks functioning as a single unit by means of telecommunications infrastructure. According to experts, the revolution in information technology can only be compared, by its potential and influence on society, with the industrial revolution, which had a fundamental impact on human activity, its life, education, ways of communication, freedom of choice⁶².

Each method of production is determined by an element that is fundamental to improving productivity. So, if in the main productivity source under the industrial mode of development was the introduction of new energy Source in the production processes, such source is the technology of knowledge generation under the information mode. In this

60 Toffler A. (2000) *The Third Wave*. – Translation from English, Kyiv – 2000

61 D. Bell. (1999) *The Coming of Post-Industrial Society: A Venture in Social Forecasting* - Translation from English., M., 1999

62 Economic and social significance of information technologies. Science and engineering indicators. – P.8

regard, A. Toffler proved the statement that electromechanical-based branches of economy become a thing of the past, while using a lot of energy, producing high waste, having low requirements for skill, monotonous work, standardized products and centralized management. Their influence in developed countries is becoming noticeably weaker. Instead, industries that are based on the interplay of such disciplines as quantum electronics, information theory, mechanics, ecology, etc are gaining importance⁶³.

Each mode of development also has a structurally determined principle of functioning around which technological processes are organized. Yes, industrialism is focused on economic growth (namely, on output maximizing), and Informationalism is focused on technological development, which requires the accumulation of knowledge of a higher complexity level, although certain levels of knowledge and information are important in any mode of production. The main criteria of an information society are the quality and quantity of information, its effective transmission and processing, and the main activity is the creation and dissemination of information. It is now estimated, that information technologies constitute from one third to half of all capital expenditures of a modern firm⁶⁴.

The most important economic assets are becoming information and technology, and the intelligence and knowledge are becoming a direct productive force in the information society, that is the main difference of information society from its predecessors, where natural resource, physical labour and

63 Toffler A. (2000) *The Third Wave*. – Translation from English, Kyiv – 2000

64 N. Rozanova.(2010) *Information Technology: A Survival Tool or Competitive Advantage?* ME&MO, №7, 2010. – P. 74

goods were the source of wealth and the basic value.

The peculiarity of the information society is the increasing value of information and knowledge that have more power than natural or material resource, the value of knowledge generation is growing, increasing noticeably the value of knowledge and recognition. At the same time knowledge plays a dominant and decisive role in the national economy and becomes an important corporations' asset in competition on global markets. As T. Stewart points out, knowledge is more valuable and more powerful than natural resource, giant enterprises, or a considerable banking account⁶⁵.

Well-known specialist in the information society problems M. Castells emphasizes that the influence of knowledge on knowledge itself as the main source of productivity is specific to this mode of development⁶⁶. D. Bell adheres to the same opinion. He based himself on the scheme of building society around the “axis of production and the types of knowledge used» and consider a fundamental difference between the modes of production in the determining role of scientific knowledge. The ability to create, disseminate, and use knowledge becomes the key to the prosperity of nation under the information society development.

The development of information technologies has influenced the sectoral structure of the economy. Thus, according to the forecasts of American analysts, the transition to the information society will be completed by around 2020 in the USA, when 17% of the population only will be involved in

65 Stewart T.A. (1997) Intellectual capital. The New Wealth of Organizations. Nicholas Brealey Publishing, Business Digest, New York, 1997.- P. 11

66 Castells M. (2000) The Information Age: Economy, Society and Culture. Translation from English, M.: HSE, 2000.- P. 39

the material production sphere, and the rest be engaged in the sphere of information services, education and leisure⁶⁷.

In 1995 professor at the Massachusetts Institute of Technology (USA) Nicholas Negroponte introduced into the scientific circulation the term “digital economy”, which is understood as the stage of social development, in which the processes of production, distribution, exchange and consumption, including all related communications, are carried out on the digital technology base. As a result, real economic processes, objects, projects are replaced by their computer (digital) models during the communication; the main result of production is the creation of digital images of real goods and services, which are also objects of distribution, exchange and consumption. At the heart of the digital economy is the “technology of construction, analysis and application of digital models of economic, social, engineering and natural-environmental systems. Such models should concentrate the knowledge about man, nature, society”⁶⁸.

The use of advanced digital technologies will significantly improve the efficiency of decisions on the selection of reSource, technologies, production volumes, facilitate the conditions for optimizing the business scale; the development of obtaining, storing, completing and disseminating information technologies will allow to expand and streamline the economic activity, which is related to the “project” sector of the economy. There is an opportunity to automate the coordination processes within the distribution of material and cultural goods (innovations,

67 Kashlev Yu. B. (2005) et al. Information, mass communication and international relations. - M. 2005. -- P. 40

68 Davis E. (2008) Technognosis: Myth, Magic, and Mysticism in the Information Age. - Yekaterinburg: Ultra. Culture, 2008.- 408 p

educational technologies, logistics, etc.). At the same time, an industry of effective regulation of environment information permeability is emerging. The possibility of different countries to participate in the “global economic space” is increasing within the “investment climate”, “institutional landscape”, and “information networks”⁶⁹.

The swiftness of social development brings to life new concepts of Informationalism. Information technologies cannot be seen in isolation from the processes and transformations that occur in other industries under single digital environment. In this regard, M. Castells noted, that there is a “growing convergence of specific technologies in a highly integrated system, in which the old isolated technological paths become literally inseparable. Thus, microelectronics, telecommunications, optical electronics and computers are now integrated into information systems”⁷⁰. Today information systems are the basis of such technologies as: “Big data” (BigData), artificial intelligence, blockchain, quantum technologies, new and portable source of energy, additive technologies, digital simulation, sensorics and components of robotics, wireless communication technologies, technology of biological objects property management, neurotechnologies, virtual and augmented reality technologies.

The speed of development based on technological innovation, where the unifying factor is the information technology, changes the human environment, and prearranges its adaptation to the technological environment. Macroshift in

69 Kleiner G.B. (2018) Systemic foundations of the digital economy. *Philosophy of economy*. 2018. No. 1 (115). - S. 131-142

70 Castells M. (2000) *The Information Age: Economy, Society and Culture*. Translation from English, M.: HSE, 2000.– P. 39

social evolution (by E. Laszlo) became a bifurcation of the civilization development and entailed a revision of the human concept, and the search for new anthropological approaches and concepts⁷¹.

M. Castells believes that a network society is characterized by a simultaneous transformation of economy, labour and employment, culture, politics, government institutions and, finally, space and time. This is true. After all, with the development of the information society, in which the information space is growing rapidly, the mass media are dramatically changing the standards of human behaviour, dominates the cult of knowledge, skills and recognition, which determines the comprehensive development of a human. According to scientists, the fundamental difference of post-industrial from previous world civilizations lies in the exclusive place of the human in the reproduction processes and in society. Human factor was important for the development in any society, but in industrial society a man was mainly a part of his created huge mechanisms - industrial, market, political, but in humanistic, post-industrial societies, where he is the generator and carrier of knowledge, skills and ideas, human itself, its thorough development, free creativity become the highest aim of social development. Spiritual sphere - science, education and culture, ethics and religion gains the first place, which ensure the full development of man, rather than resource and market mechanisms as tools for growth of profit⁷².

E. Masuda stated 30 years ago, that computerization would

71 Laszlo E.(2004) *Macroshift: Navigating the Transformation to a Sustainable World* / Erwin Laszlo; From the foreword Arthur C. Clark; Per. from English Yu.A., Danilova. - M.: Tydex Co., 2004

72 B.N. Kuzyk, Yu.V. Yakovets.(2006) *Civilizations: theory, history, dialogue, future. T.2.* – M., Institute of Economic Strategies, 2006. P. 19

transform a person from *Homo sapiens* into *Homo Intelligens*. The person is not only the consumer of information, but also the creator of a giant information flow now⁷³. A distinctive feature of information civilization is precisely the decisive role of the person, since it will be the main resource and driving force for the development of society. This entails the fact that the main object of work will be the information and its highest form – the knowledge. Therefore, it is important to focus on humanitarian issues related to personality development. The changes have never been so radical and rapid in the history of mankind. This generates an acute and urgent modernity - the problem of the man in a changing world.

Well-known Ukrainian scientist A.S. Galchinsky notes that “today there is an increase in the socialization of the economic process, its humanization, extended reproduction of life, and wealth of the individual. The economy of production of material wealth is transformed into the economy of “production of social product - media of information, knowledge and communication”. In this sense, the economy of the “social environment” acts as the “economy of cognition”, communicative activity, the accumulation and exchange of knowledge, the realization of the creative mind potential”⁷⁴.

The new civilization needs a reorganization of production based on the introduction of the newest advances in science and technology. Telecommunications, biotechnology, programming, computer science and electronics are steadily changing the nature of work and the employees status, which

73 A new industrial wave in the West. Collection of works by Western authors. - M.: Science. - 1999

74 Galchinsky A.S. (2013) Political nooeconomics: the beginnings of the renewed paradigm of economic knowledge. K.: Lybid, 2013. - 472 p

leads to an overestimation of their abilities, capabilities and perspectives⁷⁵. It is becoming clear that the most important element is the production of high quality human capital in society in order to create competitive advantages in the information society.

Since the information is a major resource, capital and value in the information society, the human development involves the acquisition of high competencies to use life information the information environment, the ability to navigate under the growth of information flows, adapt to the new structure of information spaces.

Knowledge, information, education stand for system-forming values, without which the development of the information society is impossible. A global knowledge system formation opens fundamentally new opportunities for the humanity in the field of intellectual and cultural development, contributes to improving the millions of people life quality. The development of computer and telecommunication systems gives virtually every person access to the information resource of the world community, and an opportunity to develop cooperation in economy, science, education, and culture. Even people of moderate means have widespread use of mobile communication now, which is becoming an integral part of the culture of modern society.

Knowledge has a significant impact on all values of the information society, especially in the areas of economic, political and aesthetic values. Such economic values as property and wealth start to base on knowledge, while the knowledge and information production becoming the leading

75 Toffler A. (2000) *The Third Wave*. – Translation from English, Kyiv – 2000

economy sector in information society. Such political value as a power changes qualitatively under the influence of the knowledge. If in an industrial society power was based on the physical force and the power of money, then in the information society, knowledge-based power is emerging. Knowledge has a significant impact on the spheres of the aesthetic values in the information society and promotes the emergence of new arts.

The level and the quality of education are the main characteristic of the workforce in the information society, so the main investment is the investment in human resource and education in such a society. Information society is characterized by constant education and self-education at the same time. It becomes an integral form of being for all age clusters (life-long education). The information society potentially creates all the conditions for creative self-realization, as education becomes public, global and individual.

Since the mid-70's of the last century, the development of the information economy has led to increased demand for workers with advanced intelligence and good education. According to many scientists, the creation and use of knowledge are the basis for the emergence in the society of new social groups, which have the basic characteristics of classes⁷⁶. Moreover, in a post-industrial society intellectual worker constitute the dominant class of the new society. This class of intellectuals has its own distinctive features.

Firstly, the qualities that allow a person to enter the intellectual class are formed over a long period of time, starting from primary and secondary school, high school, and throughout their work in the process of self-improvement

⁷⁶ Inozemtsev V.L. (1997) The inevitability of a monopolar civilization. - Megatrends of world development – P. 30

and experience gaining. Since knowledge differs from most material goods by their rarity and non-reproducibility, their value is determined by the laws of the prices on monopoly goods, and their carriers have an exclusive position. Thus, D. Bell based the class society on the principle of knowledge and qualification, and identified 4 main classes: specialists (scientists, engineers economists), technicians, employees and manual workers. In the “post-industrial society” dominated a “meritocracy” (by J. Galbraith - “techno-structure”) – a new elite, consisting of the talented persons. It becomes dominant not only in production but also in politics.

Secondly, as employees improve their skills, there is a tendency to increase the well-being of their part, that has above-average abilities. Individuals, social groups and nations that benefit from the technological improvement handle the wealth they have created not through exploitation, but through their creative activity or through market exchange.

At the same time, not only the education of citizens but also the development of intellectual abilities is of a high value. Studies have shown profound shifts in socio-economic development within the information society, accompanied by the substitution of manual labour on intellectual one, and growth the role of intelligence. The main productive force in the society is gradually becoming not the fixed assets or even the managerial resource, but the human capital, and increasingly - creative capital – a critical number of creative individuals in the organization.

As the work began to be more intellectual, the traditional company, organized according to a strict hierarchy, was replaced firstly by an adaptive and then by a creative corporation, that

anticipate cooperation. In addition, in today's context, there is an increasing number of diverse media, small and micro venture enterprises, up to the individual-enterprise phenomenon. The multipurpose network model has become widespread, which introduced to the practice by small and medium-sized enterprises. New opportunities for autonomous human activity also emerged, the prospect of producing a finished information product and its realization on the market opened, as the high-tech sectors of the economy and the Internet develop, which does not fit into the classical organization of production.

The development of information technology has caused changes in the organization of work, which is associated with changing forms of production organization. Thus, there is now a shift from mass production based on productivity gains through economies of scale and conveying mechanized production process of standardized goods to the flexible manufacturing that can respond quickly on the market needs. At the same time, the crisis of a large corporation has shown the high viability of small and medium-sized firms as the agents of innovation and Source of job creation.

Information technologies have an influence on the employment relations. The inherent flexibility and mobility enhance the autonomy of decision making, which facilitates the simplification of hierarchical structure of the company, the creation of temporary groups of specialists for the implementation of interdisciplinary projects, outsourcing development, outstaffing and others. Economy of knowledge, digital markets, and digital business leads to development of new employment forms, destandardization of work, and its variability. The conceptions of working time and workplace

change, and the success of self-realization is transferred to the sphere of free time. Principles of organization of society are changing, the vertical hierarchies are replaced by horizontal connections. A developmental of informatics, and computerization, is changing the very nature of work, social relations, and even family structure.

The increasing demand for highly skilled labour has led to changes in the structure of the world labour market. For example, M. Castells concluded that a production in advanced economies is based on educated people aged 25-40 years. Highly qualified specialists and people with unique abilities are the most demanded in the labour market. A noticeable trend became the increased demand for specialists in natural, mathematical and technical specialties.

According to Microsoft CEO Satya Nadella, giants' companies will have to spend a lot of money to "retrain" old staff by 2020. Instead, the real fight for talent will continue, and therefore competition will be highest in the science, architecture, engineering, mathematics, and technology fields.

In the future, the professional subject area will be defined by the acronym STEM (Science, Technology, Engineering, Mathematics). New technologies will absorb more and more jobs. The digital revolution will cause a radical revolution in the labour market.

The knowledge economy requires working abilities that many do not have. International Labour Organization experts note that the greatest benefits of being part of the global economy have shareholders, managers and subcontractors, who are associated with successful multinational corporations and globally competitive domestic enterprises. Highly qualified

technicians, those who possess capital and other assets, can do business, have the education and professional qualifications have advantage in the emerging global labour market. At the same time, up to a third or more of human resource remain idle. At the same time, the consequence of this tendency will not be the widespread unemployment, but the flexibility of the labour regime, its individualization, and the highly segmented structure of the labour market⁷⁷.

A new attitude to work as such is formed under the development of the information society. Specialists of the International Labour Organization include in the concept of “decent work” the requirement that “work must be free chosen, guarantee sufficient income to meet economic and social needs, rights and representation must also be respected, and a basic level of stability must be ensured through any form of social protection, adequate working conditions must be guaranteed. These elements constitute what is called “decent work”⁷⁸.

The development of a knowledge society shapes the demand for highly skilled labour force and stimulates global mobility of talented scientists and specialists. The United States is the world centre for attracting foreign scientists and highly qualified specialists. Recently, however, foreign specialists have been intensively attracted by Hong Kong, the Republic of Korea, Singapore, China, Taiwan, Malaysia, and Japan. Migration of intellectual resource is caused not only by the higher salary in knowledge sphere, civil rights and democratic freedoms, but also by such not less important motivation as

77 Castells M. (2000) *The Information Age: Economy, Society and Culture*. Translation from English, M.: HSE, 2000–C. 39

78 *Fair globalization: creating opportunities for all.* - The World Commission on the Social Aspects of Globalization. - Geneva, International Labour Organization, 2004.– P. 69

opportunities for creativity and self-development, due to the availability of appropriate material and technical base in the country of immigration - perfect research equipment, the possibility of practical implementation of scientific results and more. The attention to the specialist, scientist, laboratory or centre is very often important for the decision of the intellectual reSource' migration.

It should be noted, that virtually all types of short-term effective contracts of scientists traveling abroad (conferences, scientific symposia, colloquiums, etc.), as well as joint development in scientific centres and laboratories of other countries, are useful. They allow scientists to improve their profession, improve research methods, contribute to the growth of the authority of the national scientific school, to confirm the research direction, and to enter the world scientific community. In this context, short immigration waves of professionals play a very positive role.

The development of information technologies can cause dramatic changes in all the life areas. Foreign researchers note their significant impact not only on migration processes, industrial and labour relations, but also on culture, society and even the state. Thus, well-known American economist P. Drucker spoke about overcoming of traditional capitalism and the transition to a new economic system, based on the knowledge and information, which is accompanied by the transformation of the national state under the influence of the processes of the economy and society globalization⁷⁹.

However, the main feature of the information society, according to experts in the field of social philosophy, is that

79 Drucker P. (1999) Post-capitalist society. - Per. from English - M. 1999

the information technologies are able to influence the very nature of human being - the lifestyle, consciousness, vision of the world, habits, moral standards, value system, emotions, behaviour. That is its revolutionary influence on society and on the spiritual world of people. The new civilization, according to A. Toffler, is so deeply revolutionary, that it challenges all established ideas and norms. The rapidly changing world requires completely new ideas and analogies, classifications and concepts, due to the collision of new values and technologies, and new geopolitical relations⁸⁰.

The German sociologist A. Bull emphasized very accurately the peculiarities of the information society, noting that the virtual world, which is an achievement of a civilizational scale and a mean of the information transmitting, revolutionized cultural values and their transfer between people and generations; this transformation is comparable in value and globality only to writing and typing invention. The emergence of new generations who have computer skills but are not accustomed to reading books and printed texts, can mark the entry of humanity into a new era⁸¹.

Ideal values dominate the material ones in the information society system of values; there is a tendency to replace the material values with the ideal ones. Such basic economic values, as property and capital take an ideal form. At the same time, the importance of post-material values, the expansion of the sphere of individual choice, moral-psychological, ethnic and religious assessments are increasing. Not only intangible factors, but even time prevail within the value priorities in the

80 Toffler A. (2000) *The Third Wave*. – Translation from English, Kyiv – 2000

81 Ivanov D.V. (2000) *The virtualization of society*. - St. Petersburg: Petersburg Oriental Studies. - 2000

information society. Thus, the Japanese sociologist and futurist E. Masuda believes that the basis of the new society will be a computer technology, and the leading sector of the economy be an intellectual production, which products will be accumulated and distributed through new telecommunication technologies. Society itself must become classless and conflict-free. Time is of a paramount importance here, unlike the consumption industrial society⁸².

French sociologist A. Touren stresses that the means of communication and interpenetration of cultures are blurring the boundaries of existing cultural communities over a long period of time⁸³. Indeed, the physical distance between the interlocutors does not play a significant role for communication in the Internet, because space and time are erased, there is a convergence of cultures, world outlook, traditions and values, preferences, standards of consumption, etc. In connection with this, Canadian philosopher and cultural scientist G. M. McLuhan notes, that this form of communication forms a new sociological structure within the existing culture context. He first introduced the concept of a “global village”, which is widely incorporated in the Western mentality and culture, in order to define the new communication, and therefore cultural, situation⁸⁴. M. Castells expresses the similar views, noting that the computer communication can be a powerful means of strengthening the social cohesion of the cosmopolitan elite and providing material support to the global culture.

Freedom of creativity and formation of a specific

82 Masuda E. I(1997) nformation Society as a Post-Industrial Society. - Transl. from English - M. - 1997

83 Fukuyama F. (2004) The Great Break. - Tranl. from English Ed. A.V. Alexandrov. - M.: AST Publishing House LLC: NPP Ermak CJSC, 2004. - P. 12

84 Rovinskaya T.(2010) Information Society: Theory and Practice. – ME&MO No. 9, 2010. - P. 81

intellectual atmosphere of creativity get a high importance in the information society. If, according to M. Weber, capitalism is impossible without a proper “work ethic”, then the formation of information society and information economy is impossible without a corresponding “spirit” - ethics, culture, a positive attitude to the world. Changes occurring in the information-technological and communication sphere of society and the corresponding spirit of freedom, which is not less important for the formation of a new type of society, mean a change in the paradigm of socio-economic development and the change in the socio-psychological people attitudes in the society⁸⁵.

Therefore, network society has already become a socio-political reality in most countries of the world and has enormous potential for development, as a new form of organizing of people provides new opportunities for creative expression, free information exchange, new models of government, etc. It may well be true, that this form of public organization helps to overcome the long-standing conflict between the human personality and the state apparatus, between individual and collective interests⁸⁶.

There is a transformation of information into a powerful social force already. As A. Toffler points out, fundamentally new working conditions are being created in the information society, the degree of freedom and awareness of a person’s capabilities is increasing, and political decisions become more calculated and substantiated. E. Masud is of the same opinion, who believes that such a society will lead to the formation of a fundamentally

85 Castells M., Himanen P. (2006) Information Society and Welfare State. The Finnish model. - K. Wackler, 2006. - S.HUP

86 Rovinskaya T. (2010) Information Society: Theory and Practice. – P. 90; Stewart T.A. (1997) Intellectual capital. – P. 12, 108

new type of person - “more humane” and environmentally oriented. The evolution of humanity will be replaced by the co-evolution - the mutual development of humanity and nature. Therefore, the information society has many advantages, first - it is an opportunity to grow intellectually, to access Source of information and knowledge. On the one hand, informatization of society is an absolute benefit.

Ways of communication change in the society, new principles of life are formed, and the culture is transformed, with the advent of forms and channels of communication created by global information processes. You can continue the list of changes in the life of people that occur in the modern information society. The main point here is that, the history has not yet known the pace and magnitude of changing such a pervasive power of digital and information technologies, under the influence of which a person may be helpless. Therefore, it should be understood, that the information society development is not deprived of conflicts and threats, which must be studied and considered, while forming the national and the global development strategy. Thus, there is a problem of global information inequality - not all the members of the society can take advantage of the new opportunities offered by the information society. This occurs due to differences in education, opportunities to access of information reSource, economic and technological factors of possible cognition and the development of intellectual abilities. An opportunity to manipulate the public consciousness and threaten the virtualization of the society exists. The threat of cyber illness arises; which carries out the form of a psychological dependence of people on the television of computers. At the international level, there is

a risk of information crime spreading - unauthorized access to databases of automated information systems of the state bodies, corporations, financial institutions; the spread of information terrorism - the organization of massive network attacks and information wars, which are an effective means of confrontation in the fields of politics, economy and culture. The factors of crime transnationalization are exacerbated influenced by the latest information and communication technologies, and the latest factors of economic instability are often linked to market virtualization. Significant influence of the latest technologies is also observed in the social sphere. There is a fear that computer communication will lead to the formation of cyber civilization, where the human personality becomes impersonal, detached from the familiar environment with its ideals and values, and therefore loses its creative potential. D. Lyon emphasizes this, noting that the society is becoming manipulative, where is increasing the level of manipulation of the person, and the information technologies themselves are becoming more widely used in politics, becoming political technologies. This leads to the fact that most of the population is not aware of the state of “a real distribution of power and control in this society”⁸⁷.

It is also important that there is a direct clash of different cultures and worldviews, ethical ideas and traditions under the globalization, which can destroy the originality, spiritual and cultural identity. Conflicts of cultural and ideological nature are exacerbated on this basis. In addition, many national and ethnic cultures are influenced by the changes and policies of neo-globalism pursued by the “golden billion” countries, and

87 Lyon D. (1989) *The Information Society: Issues and Illusions* / D. Lyon - M.: INION. - 1989

not only the traditional value system of the Eastern countries has been revised, and but also revised in Europe, and thus it may be destroyed.

In addition, the changes in the social structure of society and the nature of contradictions are noted. A. Turen believes that the information society is a class society with deep social conflicts, which declare themselves in the struggle between the ruling class, technocracy and trade unions, in the clash between professionals and non- professionals in organizations and in society.

Summarizing the above, we can distinguish the following main directions in which information technology have an impact on the society development. First, information technologies allow the effective creation and use of information reSource of society. In turn, the effective use of information reSource such as knowledge (discoveries, inventions, best practices, etc.) allow the rational use of material reSource (raw materials, energy, materials, equipment, human reSource). Information technologies allow to optimize and automate the information processes that are the objects of work (automated control systems, automated information support systems, automated design, expert evaluation, etc.).

Information technology play an important role in providing information interaction between people in the system of training and dissemination of mass information. Along with the traditional means of communication (telephone, telegraph, radio, television), electronic telecommunication systems are increasingly used in the information society, they contribute to the processes of globalization and integration of the world community, the expansion of international cultural

and economic ties.

Information technology plays a key role in the processes of knowledge acquisition and accumulation. Now, traditional support technologies of scientific research and education, which realizing the accumulation, systematization and dissemination of information, are replaced by the technologies of artificial intelligence, which allow find solutions to complex problems.

Information technologies can contribute to solving the global problems of humanity. Methods of information modelling of global processes can provide the possibility of many crises predicting in regions of high social and political tension, environmental disasters, natural disasters, and industrial disasters, which have an increased risk for the society.

Nowadays, you can see not only is the formation of global information systems, but also the formation of a new type of personality - the Information Man. Therefore, it is urgent to create a new system of spiritual values in order to solve global problems and to form a new information culture of the individual and society, which should be adequate to the needs of the information society. The advances in fundamental science, the development of information media, and global technologies create unprecedented opportunities to improve the quality of life for millions of people, receive quality education, develop intelligence and creativity. The person will be the main imperative of the information society, since its values, education, culture will determine not only the features of the new society, but also the existence of civilization.

Strengthening the information cohesion of the world community through information and communication systems, which is a factor in the sustainable development of civilization, leads to the development of partnerships, business, scientific,

educational ties between countries, the development of mutually beneficial trade, the formation and expansion of optimal production systems, reducing energy consumption.

All this is responsible for the regulation of many social and political problems globally. In the framework of the International Declaration of Human Rights, which forms the basis of information rights for the future society, UNESCO has adopted the Information for All Programme, which creates a platform for discussions on international policy in the field of information security and public access, on common participation in the global information society, as well as the ethical, legal and social implications of information and communication technology development. This Program should play a key role in the development of “education for all”, the “free exchange of information and knowledge” and the enhancement of communication between people. The program should help narrow the gap between informationally rich and informationally poor countries. The program identified five priority areas for the Information for All Strategic Plan:

- information for development purposes;
- information literacy;
- information retention;
- information ethics;
- availability of information⁸⁸.

Aurelio Peccei, the founder and first president of the Roman Club, in 1977 in the book “The human quality”⁸⁹ noted that “there is essentially nothing left for man now, as soon as possible to approach the next phase of his development - that

88 UNESCO’s Information for All Program.- URL: <http://profy.4uth.gov.ua/miznarodni-dokumenti/programauneskoinformaciadlavsih>

89 Aurelio Peccei. (1985) “The human quality”, “Progress”, 1985

one, where he, combining his power with worthy wisdom, will learn to maintain in harmony and balance all human affairs”.

Okinawa Charter of the Global Information Society was adopted by the leaders of the G8 countries in July 2000, emphasizing the key importance of the latest information and communication technologies in formation of such society. They are one of the most important factors influencing the formation of the society of the 21st century. Their revolutionary influence concerns people lifestyle, their education, the interaction of government and civil society. The sustainability of the global information society is based on the democratic values promoting human development, such as the free exchange of information and knowledge, mutual respect, and others⁹⁰. these conclusions must be considered when developing a strategy for socio-economic development, both at national and global level.

4.3. Formation of the global industry of data collecting and processing as a component of the global knowledge economy

In the content of the global information space, the world industry of data collecting and processing is formed as a component of GKE as well as a new element of the world economic system, introduced by the development of ICT. Our assumptions are based on the fact that data mining and exchange becomes a steady and independent subject of international economic relations (IER), and the above-stated industry – a new sector of the world economy and a separate

90 Rovinskaya T. (2010) Information Society: Theory and Practice. – P. 90

object of study^{91, 92}

The development of computer hardware provided an opportunity for collection, accumulation and processing of huge arrays of data, which is extremely important for scientific and analytical activities. This is especially the case of Internet, leading to formation of a huge amount of information and social data on a global scale. Besides the development of mathematical methods, we can see the emergence of new technical capabilities (computing speed and power, capacity of memory, etc.) and the ways of automatic receipt of various types of data from multiple Source (devices, Source, satellite images, digital photos and video materials, GPS-signals, transactions in the Internet, etc.). In the context of widespread use of computer hardware, the digitization of historically accumulated data commenced⁹³.

The development of data collecting and processing industry has intensified with the emergence of the Internet and Internet economy, where the new problems of decision making, audience segmentation (often depersonalized) and needs identification arise. In the modern economy, data becomes the factor of innovations, management (in terms of intellectualization, decision making, optimization of processes and structures), competition (and acquisition of additional

91 Polyakov M. V. (2017) Specific features of formation of the world industry of data collecting and processing as a component of global knowledge economy. Scientific Bulletin of Poltava University of Economics and Trade. Series: "Economic Sciences". 2017. No.4 (82). P. 116-120

92 Polyakov M.V., Belozubenko V.S. (2016) Data economy" as a new stage of using the information and communication technologies in national economy. Scientific Bulletin of Poltava University of Economics and Trade. Series: "Economic Sciences". 2016. No.2(74). P. 154-159

93 Polyakov M.V. (2018) Knowledge economy: essence, determinants, global landscape: monograph. Dnipro: New ideology, 2018. 688 p

competitive advantages), and integral part of value creation. Data determines the quality and dynamics of the processes thereby enhancing its social significance, importance of continuous collecting and analysis and, accordingly, efficiency of the required operations to collect, store and process it. All this causes the increased importance of data, even provided that not all of it is useful.

Prior to considering the international aspects of formation of data collecting and processing industry, let us briefly look at the meaning of the basic concepts. Data processing has got a widely known definition of Data Mining, understood as a connection of the varied and inhomogeneous data (including diverse types of Big Data), analysis and identification of its logical, hidden, non-trivial regularities or patterns (clusters, associations, sequences and distinctions between clusters) based on verification of preliminary formulated hypotheses. With the use of computer hardware, such analysis is carried out automatically, encompassing huge arrays of data.

Based on Data Mining, we can obtain available and practically useful data, required for decision making in various spheres of human activity. Therefore, Data Mining is represented as a basis of the process of data transformation into knowledge. For this purpose, various mathematical methods (logical and combinatory, Bayesian method, linear discrete function methods, Support Vector Mashine presented by Yurii Ivanovich Zhuravlev) are used for different types of analytics (predictive analytics, text mining, etc.). Data Mining is a multidisciplinary industry, methods of which can be used in diverse fields of social-economic, technical and scientific anaysis aiming at obtaining new knowledge and taking of

more rational decisions, thereby contributing to STP. With an evolvement of the Internet and an impact of some other changes related to large-scale involvement of users, the Data Mining is more and more used for analysis of social changes, and enables obtaining the objective (scientific) and socio-humanitarian knowledge, for example, about volumes and structure of needs, behavior of various social groups. Knowledge is converted into value (improved or innovate goods and services, enhanced security level, increased efficiency of logistics, energy saving, reduction of time, minimization of losses caused by fraud, etc.), and can be used in marketing, management and generation of innovations.

In data processing, a few levels of processing can be considered: “raw” data as a primary resource, which can contain knowledge; designed and verified data set; training data set, a number of hypotheses and decision rule; outcomes of processing which can be knowledge. It is essential for understanding of the data value and development of the idea of it as a resource, formulation of the requirement to quality of data and tools to work with it.

Along with the term “Data Mining”, the essence of the modern industry of data collecting and processing explains the notion “Big Data”, which describes a set of technologies, special software tools, methods and approaches to complex and automated collection, storage and processing of Big (exceeding the human capabilities) Data. The quantitative criteria of Big Data are still incomprehensible and relative. The main point is to produce a result, instead of meeting any high-volume criteria. The term “Big Data” is applied even in relation to relatively small amount of data.

The key qualitative characteristics of Big Data are: volume, speed (of gaining and processing), variety, relevance, significance, authenticity, value, primacy, sustainability (continuity). To ensure the above-stated characteristics, we need to perform certain tasks related to accumulation, storage, structuring and management of data. When dealing with Big Data, the principles of complexity, multidimensionality and fullness come to the forefront, which entails additional requirements. Big Data includes not only the extended analytics, but also management and storage of data, which requires the corresponding equipment and software tools (data repository, database management system, data management platform, costs on data integration and visualization). Its importance is increasing with the growth of volumes and the level of data variety.

The technologies of working with Big Data are focused on diverse spheres of science, management goals, economic branches, communities. Processing of big arrays of data becomes necessary, particularly due to market globalization processes. In practice, Big Data is related to a few types of analytics, for example: Business Analytics, Business Intelligence, Deep Analytics, Research Analytics, Quantitative Analytics, predictive analytics, data mining, distributed computing, etc.

Digitization of economy, which encompassed all spheres of life, requires development of methods to work with data. Due to the emerging demands and goals in respect of data collecting and processing, the best practices in the sphere of Data Mining and Big Data (mathematical algorithms and tools, software tools) are the special asset, required to gain

knowledge. Moreover, if we are talking about the respective services, i.e. new type of business. Owning and efficient use of data become a competitive factor, particularly in the Internet environment, which, in its turn, becomes a source of knowledge. The purpose of Data Mining and Big Data is to gain knowledge and, therefore, to win in the competition, which can also be related to the global market. Data Mining/Big Data can be considered in the context of ICT as a tool for competition in world markets.

Big Data is applied in various industries of economy: agriculture, energetics, industry, transport, financial sector (banks and insurance companies). It is natural that the significance of data in diverse industries varies, but, in general, it is growing. Data is more widely used in social sphere, in combating crimes, development of state policy and taking administrative decisions. Data Mining and Big Data become a part of scientific researches in all spheres. The advancements in work with data is one of the goals of building a new R&D infrastructure within the framework of eScience concept, which includes development of computing methods and power, knowledge management, building R&D networks at the level of academic organizations and scientists. University alliances and research networks are often created to work with data. The new models of cooperative researches conducting and scientists' work organizing (for example, "Science 2.0", Research Data Management, etc.) are being generated based on the new forms of scientific communication and multidisciplinary^{94, 95}.

94 Leibniz-Gemeinschaft. URL: <https://www.leibniz-gemeinschaft.de> [Accessed: 02.12.17]

95 FIZ Karlsruhe. URL: <https://www.fiz-karlsruhe.de> [Accessed: 02.12.17]

In the medium-term perspective, Big Data is related to the most critical technologies in the modern economy, especially as it pertains to scientific researches, innovations and technological development⁹⁶. Data Mining and Big Data create an area, which is rapidly developing and closely related to modern technological trends, including^{97, 98, 99}: artificial intelligence (data processing is required to obtain regularities and rules as a basis for machine learning, imitation and decision-making, which is necessary for creation of intellectual systems; on the other hand, artificial intelligence is used for collection, management and processing of data); the fourth industrial revolution (collection and processing of data are required for management of cyber-physical production systems, including formation of production orders); the Internet of things (data collection and processing are required for management of the physical item network and their interaction with the help of computer systems, in order to improve these things, networks and processes). These technological trends are related to all elements of economic system and heighten the needs for collection and processing of data. Being accompanied by changes in the sphere of production and consumption, these trends will form a significant amount of economic growth in

96 Global R&D Funding Forecast 2017. R&D Magazine. ABM, IRI, 2017. URL: https://edisciplinas.usp.br/pluginfile.php/3378934/mod_resource/content/1/RD%202016.pdf [Accessed: 09.11.17]

97 Brödner P. Industrie 4.0 und Big Data. Kritische Reflexion Forschungspolitischer Visionen. Universität Siegen, 2014. URL: https://www.uni-siegen.de/infme/start_ifm/veranstaltungen/vortrag_peter_broedner.pdf [Accessed: 12.11.16]

98 Gunning D. Explainable Artificial Intelligence. Defense Advanced Research Projects Agency. URL: <https://www.darpa.mil/program/explainable-artificial-intelligence> [Accessed: 15.06.17]

99 Meola A. (2016) What is the Internet of Things (IoT)? Business Insider Inc., 2016. URL: <http://www.businessinsider.com/what-is-the-internet-of-things-definition-2016-8> [Accessed: 25.02.17]

the nearest future. That is the reason for significance of data and its analysis (quality, scope and depth of processing).

The transformation of data processing into a source of knowledge and technologies makes Data Mining and Big Data to be a component of knowledge economy. Collection, storage and processing of data find their place in the new economic system¹⁰⁰, particularly for development of innovations¹⁰¹. Data is represented as a source of building the capital of knowledge and, respectively, growth factor¹⁰². In this regard, the notion “economy of data” has been introduced in recent years (in the context of this paper, we understand it as the sphere of knowledge economy)¹⁰³, which results from the new features of modern economy, related to digitization, transparency, turn towards the Internet and expanded use of information and communication technologies aimed at continuous accumulation and analysis of big data for better satisfaction of social needs, enhancement of production efficiency, management and marketing. Data becomes a connecting link and foundation of “neurosystem” of economy. The “economy of data” can also be considered as a separate discipline, the subject matter of which is the efficiency of data collection, storage and processing.

In terms of economy, it is important to take into account

100 Wang X., White L., Chen X. (2015) Big Data Research for the Knowledge Economy: Past, Present, and Future. *Industrial Management & Data Systems*. Vol. 115, No.9. URL: <http://www.emeraldinsight.com/doi/full/10.1108/IMDS-09-2015-0388> [Accessed: 12.04.16]

101 Organisation for Economic Co-operation and Development (OECD). URL: <http://www.oecd.org> [Accessed: 21.12.17]

102 Organisation for Economic Co-operation and Development (OECD). URL: <http://www.oecd.org> [Accessed: 21.12.17]

103 Polyakov M.V., Belozubenko V.S. (2016) “Economy of Data” as a new stage of information and communication technology use in national economy. *Scientific Bulletin of Poltava University of Economics and Trade*. Series: “Economic sciences”. 2016. No.2(74). P. 154-159

the emergence of new business models, where the analysis of data is viewed as an integral element included into a huge number of tasks of production and marketing, including stock planning, goods promotion, costs optimization, risks minimization, etc. Data becomes the factor of value creation and data-driven deals implementation¹⁰⁴. Business sphere faces a necessity of system management of data and its efficient processing. Generalized consideration of new business models makes it possible to speak of the new demands and features of the economic activity of business. On the other hand, at the level of enterprises, industries and economy in general there is the question of readiness to “revolutionary” data and harnessing new opportunities. Such readiness includes various aspects, for example, infrastructural, availability and qualification of personnel, mastery of methods, availability of regulatory institutions.

Taking into account the above-stated information, we can speak of the emergence of the whole industry of data collection and processing¹⁰⁵. The separation of such industry is based on singling out of: new types of economic activity, new types of services, new types of software tools; data market (of different processing level), new requirements to specialists (data scientist, data analytics); new segment of labor market; new branch of science (data science).

With the Internet expansion this branch becomes of global nature. The application of Data Mining/Big Data in science

104 McCallum Q.E., Gleason K. (2013) *Business Models for the Data Economy*. O'Reilly Media, 2013. URL: <http://www.oreilly.com/data/free/business-models-for-the-data-economy.csp>. [Accessed: 14.03.16]

105 Dirschl C. (2014) *Data economy – a new industry?!* Wolters Kluwer, 2014. URL: <http://solutions.wolterskluwer.com/blog/2014/02/data-economy-a-new-industry> [Accessed: 08.02.17]

activates international scientific and technical cooperation in the sphere of data processing. The international business is developing in the sphere of data collection in the Internet. The modern data processing industry has heightened requirements to automation and technological effectiveness, which requires advancement of technical infrastructure.

The issue of the integral industry of working with big data becomes a critical point of national strategies for development of countries. For example, in France, they set a goal to make the country a leader of digital revolution¹⁰⁶. Such countries as USA, Ausralia, China, South Korea, Great Britain, Japan, Taiwan, Netherlands, Canada, et., have special strategies in the sphere of development of big data collection and processing industry^{107, 108}. These strategies become a basis for formation of the respective focal point of state policy^{109, 110}. The examples of national strategies in the sphere of Big Data can be: “The Federal Big Data Research and Development Strategic Plan” (USA)¹¹¹, “Smart Japan ICT Strategy” (Japan)^{112, 113}, “Digital

106 Big data et objets connectés: Faire de la France un champion de la révolution numérique. P.: Institut Montaigne, 2015. 228 p

107 An international comparison of the development of research data infrastructures. Report and Suggestions. 2017. 54 p

108 Weng W.-H., Lin W.-T. (2014) Development Trends and Strategy Planning in Big Data Industry. Contemporary Management Research. 2014. Vol. 10, No.3. P. 203-214

109 Germany – Excellence in Big Data. Bitkom, 2016. URL: <https://www.bitkom.org/noindex/Publikationen/2016/Leitfaden/Germany-Excellence-in-Big-Data/Germany-Excellence-in-Big-Data.pdf> [Accessed: 18.10.17]

110 UK Digital Strategy 2017: Policy paper. Department for Digital, Culture, Media & Sport. 2017. URL: <https://www.gov.uk/government/publications/uk-digital-strategy/uk-digital-strategy> [Accessed: 10.01.18]

111 The federal big data research and development strategic plan, 2016 // URL: <https://bigdatawg.nist.gov/pdf/bigdatardstrategicplan.pdf>

112 Digital Economy in Japan and the EU. An Assessment of the Common Challenges and the Collaboration Potential. Tokyo: EU-Japan Centre for Industrial Cooperation, 2015. 51 p

113 Smart Japan ICT Strategy. Ministry of Internal Affairs and Communications, Japan, 2014. URL: http://www.soumu.go.jp/main_content/000301884.pdf [Accessed: 20.05.16]

Strategy 2025” (Germany)¹¹⁴.

The key elements of data collection and processing industry are^{115, 116}:

- 1) technological infrastructure, which ensures obtaining, accumulation, storage and processing of data; requires considerable investments and advancement of technologies;
- 2) software tools, which ensure data processing according to the addressed challenges and given algorithms;
- 3) sector of services for collection, storage and processing of data, ensured by business and science;
- 4) data Source;
- 5) special information platforms for management of data, including industrial and R&D;
- 6) computing centers, laboratories, cloud services;
- 7) labor market segment, where the data processing specialists are hired;
- 8) specialists training system, competence centers;
- 9) professional communities and networks;
- 10) Big Data innovative centers;
- 11) legal basis for obtaining, exchange, processing of data and application of the outcomes.

In addition, we can lay emphasize on the special

114 Digital Strategy 2025. Berlin: Federal Ministry for Economic Affairs and Energy, 2016. 60 p

115 Germany – Excellence in Big Data. Bitkom, 2016. URL: <https://www.bitkom.org/noindex/Publikationen/2016/Leitfaden/Germany-Excellence-in-Big-Data/Germany-Excellence-in-Big-Data.pdf> [Accessed: 18.10.17]

116 Weng W.-H., Lin W.-T. (2014) Development Trends and Strategy Planning in Big Data Industry. Contemporary Management Research. 2014.Vol. 10, No.3. P. 203-214

development programs and projects, mechanisms for financing of the industry, researches and innovations in the data processing sphere.

The emergence of the industry is confirmed by the active development of data market that has been created at the confluence of the markets of knowledge, information and various information services¹¹⁷. At the same time, the subject of this market can be represented not only by data in a “raw” form, but also knowledge, gained as a result of its processing at different stages.

Data market acquires its structure and form, the open and closed segments are created, and the latter prevails. Its features are: entry to the market of small enterprises, complex structure (segments: data, mathematical algorithms, processing services, software tools, specialists, etc.), relation to Internet services and technological progress. The samples of the organized online markets are the webservices “Jigsaw” and “Kaggle”. Continuous race for data, involving huge corporations, states, small business, scientific and non-governmental organizations, forms the respective market, which is being rapidly globalized.

The issue of formation of the industry of data collection and processing can be represented as creation of the ecosystem of work with data, which, in its turn, is related to technical infrastructure and software tools, but can include institutional aspects. More complete overview is provided by cluster approach, which enables encompassing not only infrastructure, but also: specialized business, education, consulting, professional communities.

117 Elbaz G. (2012) Data Markets: The Emerging Data Economy. Oath Tech Network, 2012.
URL: <http://techcrunch.com/2012/09/30/data-markets-the-emerging-data-economy>
[Accessed: 10.01.17]

When considering the whole industry, we can single out the drivers of its development: development of computer hardware, investments, change of legal principles, increased competition, globalization, advancement of processing technology and tools; migration of industries in the Internet and development of mobile Internet, expansion of client base, digitization of historical data, etc. On the other hand, we can also emphasise the development limits, for example: high cost of Big Data technology; difficulty in integration with the existing systems; lack of the skilled personnel; personal data use restrictions; insufficient amount of accumulated data to provide valuable solutions; absence of mechanisms for accumulation of data or scarcity of the accumulated array, etc.

The industry of data collection and processing should be considered at different levels: global; international; national; regional; industrial; sectoral; cluster; corporate, including within the framework of international business. Separately we can single out the so-called industry of open data, created as a result of certain initiatives in public and state sectors. The central element of such industry is open data portals. Creation of open data is a subject to the principles of openness and an intention to provide additional information reSource for development of business¹¹⁸. The industry of open data is expanding at the international level. The opening of data is considered as an individual focal point of international policy, which is confirmed, for example, by introduction of the respective global index¹¹⁹.

118 The Open Data Economy. Unlocking Economic Value by Opening Government and Public Data. Capgemini, 2013. 17 p

119 Tracking the state of open government data. Open Knowledge International. URL: <https://index.okfn.org> [Accessed: 02.09.17]

The rapid development of data collection and processing industry in recent years is marked with intensive infrastructure building, increased demand for skilled personnel, mathematical algorithms, software tools and technologies. At different levels of economy they started considering: digital transition, digital transformation and digital conversions. It means an integration of digital technologies in all spheres of human and business life. The industry of work with data became individually influential and, sometimes, gained critical importance. Among the key trends of its development, there are^{120, 121}: dissemination of Big Data tools and technologies; advancement of machine learning and artificial intelligence, enhancement of their precision; use of cloud technologies; inclusion of data to the Internet of things; aggregation of historically accumulated data; stringent requirements to security of data repository; real-time analytics development; acceleration of big data processing; diversification of data processing tools; use of diverse data repositories; stringent requirements to quality, speed and efficiency of data processing; industry specialization.

According to the experts of the International Data Corporation (IDC), within the period from 2015 to 2020¹²²: 1) the annual average growth rate of Big Data technologies and services will make 22.6% and will reach 58.9 billion US Dollars; 2) the annual average growth rate of income from Big Data infrastructure will make 20.3% and will reach 27.7 billion US

120 Shacklett M. (2016) 6 big data trends to watch in 2017. CBS Interactive, 2016. URL: <http://www.techrepublic.com/article/6-big-data-trends-to-watch-in-2017> [Accessed: 18.04.17]

121 Top 10 Big Data Trends 2017. Tableau Software, 2016. URL: <https://www.tableau.com/resource/top-10-big-data-trends-2017> [Accessed: 28.12.17]

122 Nadkarni A., Vesset D. (2016) Worldwide Big Data Technology and Services Forecast, 2016–2020. International Data Corporation, 2016. URL: <https://www.idc.com/getdoc.jsp?containerId=US40803116> [Accessed: 27.07.17]

Dollars; 3) the annual average growth rate of income from Big Data software Big Data will make 25.7% and will reach 15.9 billion US Dollars; 4) the annual average growth rate of earnings from Big Data services (professional and auxiliary services) will make 23.9% and will reach 15.2 billion US Dollars.

In general, the experts of IDC state that the world income from Big Data and Business Intelligence will increase from 130.1 billion US Dollars in 2016 to over 203 billion US Dollars in 2020 with total annual average growth rate of 11.7%¹²³. According to IDC, by the end of 2017 the growth of income from information products will double the product/service portfolio for one third of the companies from the Fortune 500 list. “Monetization” of data will become the key income source, as in 2025 there will be created 180 ZettaByte (80 trillion gigabyte) of data in the world, as compared with less than 10 ZettaByte in 2015. An evolvement of the industry of data collection and processing reflects an exponential growth of Big Data market size Big Data and provides forecast for the neares years (Figure 4.3.1.)¹²⁴.

A positive dynamics of Big Data is observed in all regions of the world and the key sectors of the economy: chemical industry, construction and mechanical engineering, consumery goods, education and social services, financial services, government, etc.¹²⁵. The key factor is the increased demand for knowledge from business as well as from state

123 Press G. (2017) 6 Predictions for the \$203 Billion Big Data Analytics Market. Forbes Media LLC, 2017. URL: <https://www.forbes.com/sites/gilpress/2017/01/20/6-predictions-for-the-203-billion-big-data-analytics-market/#b0ed00b20838> [Accessed: 26.12.2017]

124 The Statistics Portal. URL: <https://www.statista.com> [Accessed: 02.12.17]

125 Adams J. (2018) Forrester Data: Big Data Management Solutions Forecast 2016 To 2021. Forrester Research, Inc., 2018. URL: <https://www.forrester.com/report/Forrester+Data+Big+Data+Management+Solutions+Forecast+2016+To+2021+Global/-/E-RES135913> [Accessed: 08.10.16]

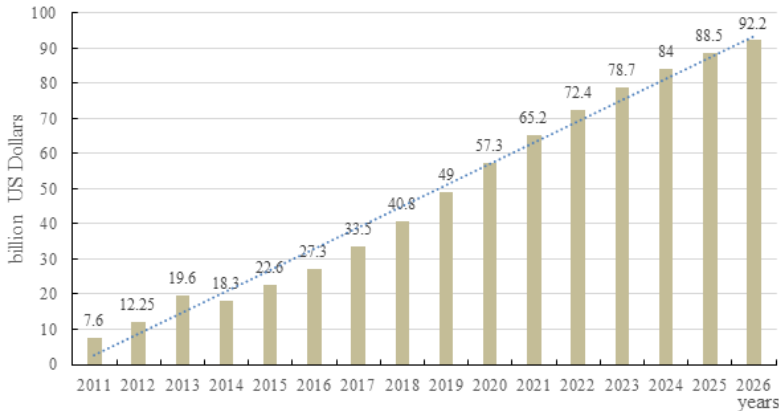


Figure 4.3.1. Dynamics of BigData market size in 2011-2016 and forecast (since 2017 –forecast), based on incomes, billion US Dollars¹²⁶

within the framework of the innovative policy.

The experts of Cisco has assessed the total amount of actual data, stored in the data processing centers. On a global scale, this amount will increase by 5.3 times up to 915 exabyte till 2020 with overall annual growth amounting to 40%. Big Data is the key driver for overall growth of the stored data. From 2015 to 2010, the amount of Big Data will increase almost by 10 times with an overall annual growth amounting to 58% (Figure 4.3.2)^{127, 128}.

Irrespectively from the rapid development of the industry dealing with data, it should be said about criticism of Big Data. For example, Morozov E. highlights the negative effects of Big Data in the economy, particularly in the sphere of healthcare and education¹²⁹. Most often, data processing does not provide

126 The Statistics Portal. URL: <https://www.statista.com> [Accessed: 02.12.17]

127 Cisco Global Cloud Index: Forecast and Methodology, 2016–2021. Cisco, 2018. 46 p

128 The Statistics Portal. URL: <https://www.statista.com> [Accessed: 02.12.17]

129 Morozov E. (2015) *Le mirage numérique. Pour une politique du Big Data*. Paris: Les

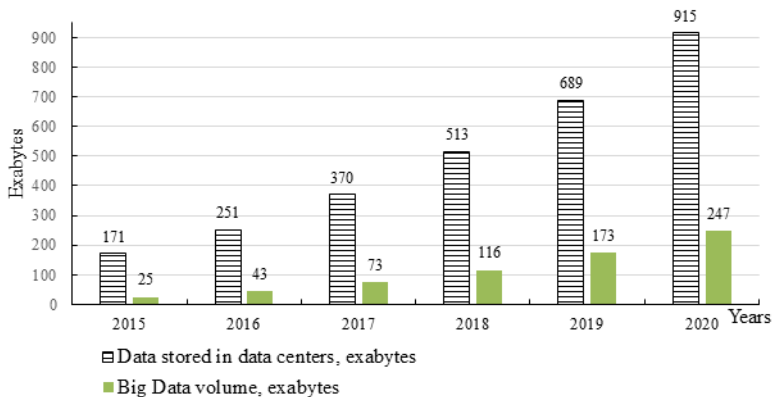


Figure 4.3.2. Dynamics of growth of Big Data amounts in the world (2017-2020 – forecast)¹³⁰

valuable knowledge or its outcomes cannot be interpreted. By data processing, the matter of which is often incomprehensible, they often try to replace the other ways and aspects of scientific researches and knowledge gaining. In the context of strengthening the popularity of Big Data, the inflated expectations and the groundless attempts to use it everywhere take place. The scepticism is often related to the economic aspects of Big Data application, namely the heavy expenditures in contrast to a relatively small effect.

The inefficient use of Big Data is caused by the number of problems, which ultimately have impact on building and development of data collection and processing industry¹³¹. Among the key groups of the reasons for the inefficiency of Big Data, it should be emphasized: 1st group – methodological (discreteness of subject area description; inaccuracy of setting

Prairies ordinaires, 2015. 129 p

130 Ibid

131 The Boston Consulting Group. URL: <https://www.bcg.com> [Accessed: 15.10.16]

the problems and hypotheses, absence of clear idea of the final results of processing; etc.); 2nd group – functional (fragmentarity or unstructured nature of data; insufficient accumulation of historical data; absence of verified or training data set; data corruption; insufficient/excessively huge size of data, low quality and coverage of data; difficulties to integrate data; negligence of data; low reliability and information capacity of data; continuous changes, etc.); 3rd group – economic (high costs on storage infrastructure and data processing tools, lack of investment; high time consumption; impossibility to assess economic value of data, etc.); 4th group – organizational (difficulties to obtain data; lack of skilled personnel; difficulties to integrate data Source; difficulties to ensure security of data, etc.); 5th group – ethical and legal (problem of access to personal data, maintaining confidentiality; restrictions due to protection of intellectual property; absence of clear rules; the problem of responsibility; data manipulations, etc.).

Design of data sets and selection of methods for processing are usually heuristic, the processing is carried out in several iterations. In practice, the data which can be found is collected instead of the data which is needed, thereby leading to inaccuracy. For today, most of the data is accumulated in vain. Thus, according to the International Data Corporation, only 5% of data is “valuable or multipurpose”¹³².

There are also the infrastructurally-technical and software-technological problems, which constrain the collection (including from different Source) and processing of big data. New threats and risks, related to big data, emerge. It is, for example, digital noise, “blindness” of data, information overloading, etc.

132 International Data Corporation. URL: <https://www.idc.com> [Accessed: 28.12.17]

In the sphere of Internet economy, there are often a problem of monopoly of large internet companies on data. However, the problems are universal. Still we have no vision how to develop this industry at the international level, although, certain legal basis for international policy arises in this sphere.

Due to numerous problems, the extensive measures to increase efficiency of Big Data is low-efficient. A huge number of restrictions, high costs, social, institutional and organizational difficulties, shortcomings of the used information systems, do not allow taking advantage of data potential. It is necessary to adopt the approaches that will enable real intensification and increased efficiency of work with data. Most of the above-stated problems will not be addressed through automation and building the capacity of computer hardware. At the current stage, the theoretical and methodological problems come to the forefront.

In order to enhance efficiency of Data Mining and Big Data, it is necessary to take the following measures: activation of experiments for practical verification by creation of special institutes, procedures, mechanisms, structures, etc.; institutionalization of data collection activities, creation and verification of training sets in different sectors; formation of preliminary collections (sets) of data according to various challenges; development of cooperation in the sphere of data collection and procesing, including activation of interaction between science and business; enhancement of the quality and authenticity of data; transformation of the unstructured data into the structured ones; organization of work on collection and verification of new types of data; development of the methodology to design attribute spaces, training sets; development of the theory and methodology for assessment

of data value, refocusing from “big” to “valuable” data in the researches; preparation of basic sectoral solutions using attribute spaces and mathematical algorithms; introduction of new data structures for full and multifaceted description of objects. The negative outcomes of introducing the intellectual and expert systems should also be taken into account and eliminated.

In order to address the problem of data integration at all levels, apart from the technical changes, we need a unification and standardization of structural data (for example, for database creation) based on the scientifically grounded approaches as well as international dissemination of such standards. Their development requires the theory of objects description (subject area), for example, based on system-semiotic paradigm, introducing it as a universal tool for cognition¹³³. Such theories will enable determining the key positions: elements, features, properties, functions of objects, events, and other essential characteristics. This will determine and rationalize data structures, enable creation of semantically enriched descriptions of objects, universal (for class of objects) attribute spaces, conceptual or analytical models. Such changes also have positive impact on software tools, quality of search and efficient performance of ICT. New data structures will enable generalizing the available data, creating larger repositories of data, adapting the databases to changes, enhancing the flexibility of databases and information infrastructure, forming the multilayer intrusive arrays of data on the basis of which diverse data sets can be formed.

In terms of international researches, the industry of data

133 Polyakov M.V., Khanin I.G., Bormatenko N.V. (2006) System-semiotic paradigm for information and intelligence technologies. The issues of the applied mathematics and mathematical simulation. Collected papers. Dnipropetrovsk, 2006. P. 208-231

collection and processing is represented as a new element of the world economy, related to formation of knowledge economy, and a component of the global knowledge economy. This element is closely linked to international Internet trade, development of the global Internet, advancement of international logistics, and it is a subject of international scientific and technical cooperation. While representing the Big Data industry as an element of the world economy, it is suggested focusing on the following facts.

Firstly, in the contest of development of the Internet and creation of the global information space, it is necessary to single out the global sphere of data. In terms of formation of the global knowledge economy, in particular, development of Internet and international business, and technological trends, the issue of formation of data collection and processing industry can be considered. This world industry is globalized due to Internet expansion, and it requires integration of national information system.

Secondly, a wide range of interactions is created in the industry of data collection and exchange, purchasing of the respective services and processing services, which should be considered the sphere of international economic relations. This sphere of relations in the information industry is related to trade in services and scientific and technical cooperation. The specifics of relations in data sphere is determined by the fact that it serves as a source of pure knowledge. Data exchange creates new information flows, chains and networks of interaction. An international trade in data, services for its storage and processing emerges as well as information service delivery. This requires an international legal support.

Within the framework of the global information and knowledge markets, the data market is formed, encompassing the data in different forms, results of processing, services, software tools, mathematical algorithms, experts. On the global data market there are special mechanisms of interaction between sellers and buyers, the market is often hidden and insufficiently institutionalized. A specific competition arises over access to data, and delivery of services in the sphere of data processing becomes the sphere of international division of labor.

Thirdly, an exchange of data requires integration of national information systems (Big Data industry), which becomes a separate sphere of international economic integration.

Forthly, in certain industries, a cooperation in the sphere of data collection and processing is objectively needed, for example, preventing natural disasters, combating crimes and terrorism, natural science researches, etc. Data exchange becomes an object of scientific cooperation in the sectors where the coordinated scientific activities are needed (for example, study of animal genome).

Fifthly, in the sphere of data collection, storage and processing, we can see the emergence and development of international business, which provides various services, including consulting. It is the international Internet business which owns the main bulk of data.

Fourthly, the issues of data accumulation and use become a separate focus area of international cooperation and international policy, which includes, first of all, the aspects of legal regulation, infrastructure development and security protection. The international policy in the sphere of data is focused on: coordination of using the data processing to address

global problems (for example, combating terrorism) including in the spheres of common interest (for example, prediction of emergencies); ensuring the integration of national information systems; protection of data and intellectual property; creation of efficient legal institutes to support the global data industry, etc.

In the sphere of data, apart from the intellectual property protection treaties, there are being developed the special international institutes, which are closely intertwined with trade and scientific and technical cooperation. First of all, such institutes are formed based on UN Commission on international trade law - UNCITRAL; UN Economic Commission for Europe and UN Center of Trade Facilitation and Electronic Business (Model interchange agreement for the international commercial use of electronic data interchange), Council of Europe (or example, the European Convention for the Protection of Individuals with regard to Automated Processing of Personal Data). The International Open Data Charter has been adopted¹³⁴.

The special international organizations are established within the framework of developing the international institutes, for example: Research Data Alliance and Trans-Eurasia Information Network. The EU has a goal to create a single system of data collection and processing, expansion of the European digital industry and economy of data, especially in the context of a single digital market for integration. As a part of activities of the European commission, there are a number of special doctrines and trends of common policy (for example, “Building a European Data Economy”)¹³⁵. These trends have gained strategical importance and scale, therefore we can

134 Open Data Charter. URL: <https://opendatacharter.net> [Accessed: 03.12.17]

135 European Commission. URL: <https://ec.europa.eu> [Accessed: 28.12.16]

speak of transition to a single development strategy of data industry (“A European strategy on the data value chain”). EU relies on the coordinated plan of actions and cooperation with member states in the context of transition to the knowledge economy, which creates a new sphere of integration.

At the level of EU, there is formed a legal basis for use of the Internet, which includes the issues of processing of personal data, protection of private life secret, protection of intellectual property, delivery of information society services, etc. EU actively supports the initiatives in the sphere of using and developing the Big Data technology. Horizont 2020 serves as one of the bases for this purpose. The specialized funds, for example, Data Pitch – the European Fund backing open data startups started providing financial support¹³⁶.

EU has adopted special program “European Big Data Value Strategic Research & Innovation Agenda”, created the European technological platform with the program for the functioning¹³⁷, developed the project “Road map” for European technologies in the sphere of Big Data tools and networks, and implemented activities for support and development of Big Data within the limits of scientific and technical policy¹³⁸. The organizational functions to provide support are performed by Data Value Association¹³⁹, Research Data Alliance¹⁴⁰,

136 Simperl E. Data Pitch: a new Europe-wide fund backing open data startups. Guardian News and Media Limited. URL: <https://www.theguardian.com/odine-partner-zone/2017/jul/28/data-pitch-a-new-europe-wide-fund-backing-open-data-startups> [Accessed: 12.09.17]

137 The Networked European Software and Services Initiative. NESSI. URL: <http://www.nessi-europe.com> [Accessed: 14.11.17]

138 RETHINK Big Project. URL: <http://www.rethinkbig-project.eu> [Accessed: 14.12.17]

139 Big Data Value Association. URL: <http://www.bdva.eu> [Accessed: 02.10.16]

140 Research Data Alliance. URL: <https://www.rd-alliance.org/node> [Accessed: 02.12.17]

Committee on Data of the International Council for Science¹⁴¹. Open Data Incubator¹⁴². All this speaks for building of the industry of data collection and processing within the framework of the integration.

With the support of EU, the European Data Portal has been created¹⁴³ as well as regional data management platform¹⁴⁴, projects in the sphere of infrastructure (for example, The European Cloud Initiative, European infrastructure network, etc.), Europe-wide forum¹⁴⁵. The European projects encompass a wide range of scientific spheres and economic sectors, thereby ensuring the accumulation of data.

Thus, the experience of EU and Europe in general demonstrates the new format of forming the international and organizational institutes in the field of data. This can be considered as a new aspect of economic integration and an example of building the international ecosystem of information economics. ASEAN, following the mainstreams of the world economy transformation, also starts implementing the policy to support Big Data¹⁴⁶. This is due to the development of digital economy in the region., taking into consideration its specifics and the progress of certain countries. The countries of ASEAN progressively form the market of data and services in this sphere.

It should be noted that the integration of national industries of work with data, as a part of economic integration, includes: formation of the mechanisms for coordination of

141 Committee on Data of the International Council for Science. URL: <http://www.codata.org> [Accessed: 15.12.17]

142 Open Data Incubator. URL: <https://opendataincubator.eu> [Accessed: 03.12.17]

143 European Data Portal. URL: <https://www.europeandataportal.eu> [Accessed: 18.10.17]

144 Big Data Europe. URL: <https://www.big-data-europe.eu> [Accessed: 02.10.16]

145 Big Data Public Private Forum. URL: <https://www.big-project.eu/> [Accessed: 02.10.16]

146 Association of SouthEast Asian Nations (ASEAN) URL: <http://asean.org> [Accessed: 05.02.17]

activities in the sphere of data studies; building of the favorable transnationally harmonized cooperative environment to exchange data; overcoming of the fragmentation of information structure at the technical and institutional level; combining the efforts to build such industry; interaction between science, education, ICT sector and labor markets; harmonization of national strategies; development of joint investment; support to development of international networks and communities; development of cooperation in the sphere of scientific studies. The infrastructural aspect is a pillar for development of the industry of work with data and international integration of national systems. The infrastructure ensures regular communication processes and can be considered in relation to individual projects.

The key elements of information infrastructure in the sphere of data processing are: 1) centers for data processing (data centers), centers for exchange of traffic; 2) cloud platforms; 3) digital libraries and directories; 4) networks which connect data processing centers, national archive centers, etc.; 5) systems of distributed computing; 6) networks which integrate scientific organizations, information centers, national archive services; 7) platforms and networks which bring together data researchers; 8) institutions and companies which create reSource to manage data; 9) tools for data storage, transfer and analysis.

The critical issue of spatial organization of the world economy is an optimal location of data centers. In terms of Big Data processing, this issue can be considered within the framework of economic geography, including the multivariate criterion evaluation of these centers location. Apart from the

set of traditional criteria (staff, political and legal framework, security level, energy availability, infrastructural productivity, cost of traffic, etc.), it is necessary to take into account the possibilities of resource consolidation and availability of parallel computing. It should be emphasized that it is necessary to develop technological capacity of the developing countries in the field of creation of their own reSource to work with data.

A new type of ICT capacities conglomeration emerges as well as a new type of clusterization. The effect of the “home infrastructure” is increasingly demonstrated, when it is concentrated in the countries being the leaders in development of Internet economy. The link between location of data centers and complex development of localization places is being established. In the context of informatization and formation of knowledge economy on a global scale, a new type of countries’ specialization emerges. Data centers are the clusters for their processing (technical infrastructure, training of personnel, development of software tools and algorithms). Figure 4.3.3. shows the structure of the world data collection and processing industry.

Several aspects of building such industry, connected in a single process, should be emphasized: 1) entrepreneurial – expanded use of Big Data technology by business; 2) infrastructural and technical – development of the required infrastructure at the national and global levels; 3) institutional – establishment of the required legal institutes and international organizations which regulate the activities in the sphere of data; 4) managerial – application of Data Mining/Big Data as a management tool; 5) intelligent – development of mathematical algorithms and tools; 6) social – adoption of innovative technologies, dissemination of skills; 7) investment – investment in Big Data industry.

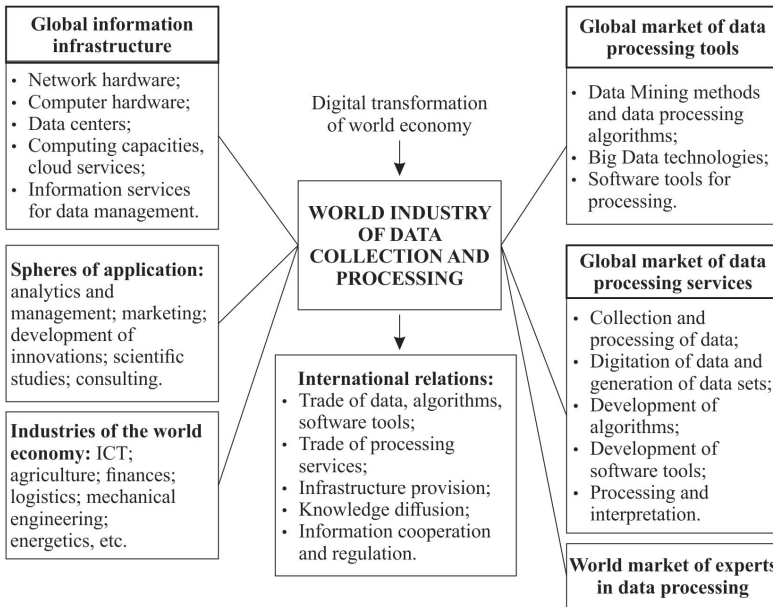


Figure 4.3.3. Structure of the global data collection and processing industry

Source: compiled by the authors

The functioning of the industry requires initiation of data Source and involvement of data in economic turnover. Within GIS, the industry of work with data becomes a “core” of all spheres of knowledge generation, expansion and use (Figure 4.3.4).

The specifics of computing capacities agglomeration while processing data is: use of alternative Source of energy; localization in the centers with high level of political stability and security; development of the huge and powerful data centers with the respective infrastructure as a demonstration of the economy on scale; focusing on control over data by states.

It is evident that, in conditions of knowledge economy

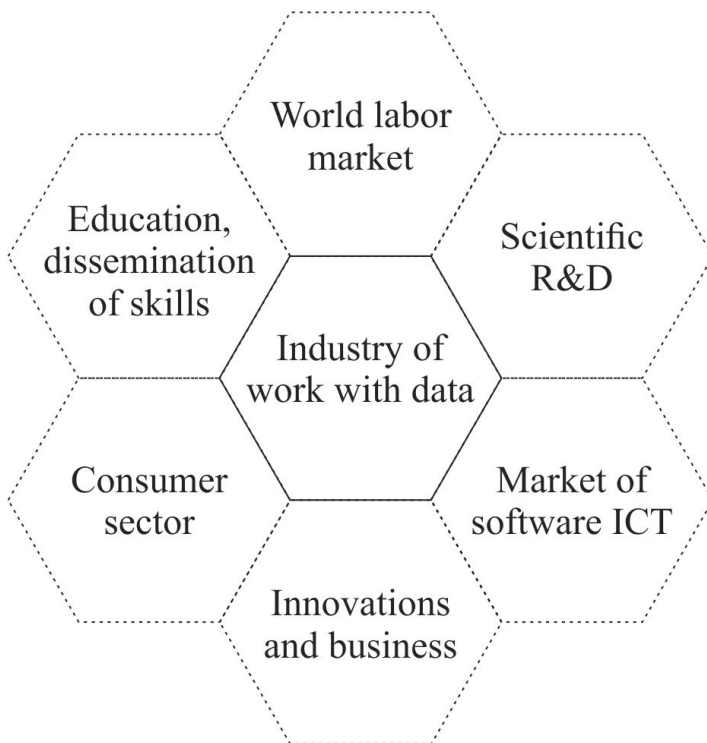


Figure 4.3.4. World industry of data collection and processing in GIS

Source: compiled by the authors

formation, data collection and processing industry becomes an integral element of the world economy. Satisfaction of the increasing demands for information requires further development of this industry as well as its infrastructural component. It appears that, in modern conditions, the actual trends for development of the world data collection and processing industry are: 1) harmonization of national initiatives in the sphere of development of data processing industry, particularly for scientific studies; 2) advancement

of international institutes which regulate activities in the sphere of data obtaining and processing, adoption of international code of conduct; 3) development of special international organizations dealing with the problems of data collection and processing industry; 4) enhancing the technical resource to create international data processing networks; 5) establishment of international competence centers in the sphere of data data analysis, which will provide services of technological or scientific consulting; 6) establishment of international industry expertise centers for data analysis which have the respective capacities to accumulate data; 7) creation of international platforms in the sphere of analysis of social data and open data; 8) development of the system to support the huge international R&D projects related to data collection and processing; 9) activation of cooperation in the sphere of processing the intelligent solutions for local communities and security sector; 10) creation of the mechanisms for promotion of initiatives in the sphere of Big Data at the national level (software, forums), promotion of national strategies for development of the industry of work with data; 11) enhanced cooperation in the sphere of development of information infrastructure and standardization; 12) facilitation of the development of international professional communities and promotion of crowdsourcing in the sphere of advancement of data processing technologies; 13) advancement of international informatization projects on science, education, logistics, social mobility, etc. in terms of data collection and processing; 14) formation of data security monitoring system.

At the national level, in the context of interests of an individual country, it is possible to speak of the need to form

a wide national innovative Big Data network, which is an organizing element of digital economy. It should meet the requirements and provide digital sovereignty of the country. There should be provided the efficient mechanisms for integration of this national network into the global industry.

4.4. Digital adaptability of the higher education

One of the main current trends of countries' socio-economic development is digitalization of economic processes, active implementation and rapid up-dating of information and communication technologies (ICT). In such conditions the special role in countries' economic growth and competitiveness is played by sectors capable of generating innovations and conducting high-quality research. In this context is increasing the scientific interest in issues of evaluation of the influence of research, innovation and educational component on dynamics of information economy. Technological innovations in production, speeding up the technology upgrade, active implementation of ICT, increase of the science-intensive products cause growth in the demand of economic actors for intellectual reSource. Under such conditions, knowledge and information are becoming one of the key factors in the socio-economic development of the country and an important strategic resource for companies. Accordingly, this leads to an increase in the role of higher education and universities in the development of the national economy - as the main producers of highly skilled personnel and generators of knowledge.

The XXI century is marked by the formation within the information society of the so-called information economy¹⁴⁷.

147 Bell, D.(1999) *The Coming Post-industrial Society*. N.-Y.: Basic Books. 507 p.; Masuda,

The information economy we understand as a type of economic system, within which information plays a key role in the development of the main spheres and sectors of national economy; as an integral part of the implementation of production, distribution, exchange and consumption processes. The further development of this type of economic system is directly related to the implementation of innovative information technologies in the economic actors' activities, and also related to the rapid digitalization of economic processes.

The digitalization of national economy puts new requirements for ensuring the competitiveness of economic entities. The experience of leading countries (the world's innovative leaders Switzerland, the Netherlands, Sweden, the United Kingdom, Singapore, and the United States) shows that balanced economic growth and global competitiveness growth are determined by the level of preconditions for the development of human capital of the country¹⁴⁸. The quality of human capital (professional competence, qualification level, innovative susceptibility, creative thinking) is determined by the efficiency of higher education institutions functioning. In addition, processes of the information economy formation correlate with the efficiency of universities research activity and the transfer of its results (inventions, scientific developments, advanced technologies, innovative products) into the real

Y. (1983) *The Information Society as Postindustrial Society*. Washington: Word Future Soc. P. 45; Porat, Mark U. (1977) *The Information Economy*. Nine volumes. Office of Telecommunication, US Department of Commerce. Washington

148 Andriessen, D.G. & Stam, C.D. (2004) *The intellectual capital of the European Union*. URL: www.intellectualcapital.nl/artikelen/ICofEU2004.pdf; Davenport Th.O. (1999). *Human Capital What It Is and Why People Invest It*. Jossey-Bass Publishers. San Francisc. P.186; Schuller, T. (2007) *Understanding the social outcomes of learning*. Second OECD World Forum on Statistics, Knowledge and Policy. Istanbul, Turkey. June 30. Pp. 8

sector of the economy¹⁴⁹.

Scientists recognize the significant contribution of higher education to the economy development. This is reflected in the inclusion of educational parameters in the methodology for determining a number of international ratings: the Global Competitiveness Index; the Human Development Index; the Innovation Development Index; the ICT Development Index (IDI), etc. In the context of our research, the IDI is of particular interest because it allows determining the level of development of information society and information economy in the country, as well as determining its position in the global economic space. The ranking of countries by IDI and the dynamics of their constituent sub-indices shows that it is expedient to formulate a comprehensive approach to evaluation the level of the information economy development. This is substantiated by: 1) the urgency of modernization of existing methodological approaches in order to bring them in line with current trends in socio-economic, scientific and technological, and innovative development; 2) the expansion of the spectrum of factors influencing the development of the information economy; 3) the need to form a specific system of indicators that have an impact on the information economy development.

The issues of development of the information economy are in the focus of scientific interest of foreign and domestic scientists. The theoretical and methodological basis for the study of information economics is formed by the works of D. Bell, Z. Brzezinski, M. Castells, Y. Masuda, F. Machlup, M. Porat, E. Toffler.

¹⁴⁹ Kwilinski, A. (2017). Development of industrial enterprise in the conditions of formation of information economics. *Thai Science Review*. Autumn 2017. Pp. 85 – 90. URL: <https://doi.org/10.5281/zenodo.1414236>

The essence and features of the information economy are considered in the research papers of scientists Grynkevych S., Iliash O., Krystynevych S., Malyk I., Nikolaiev Ye., Bazhal Yu., Tolstiaikov R., Fedulova L., Chukhno A., etc.

The growing scientific interest in the informational economy leads to an increase in the number of publications on this topic. The problem of evaluation the information economy development level is studied by foreign specialists, the United Nations experts: Genevieve Feraud, Susan Teltscher, Scarlett Fondeur Gil, Muriel Guigue, Sonia Boffa, Jose Luis Cervera Ferri, Sheridan Roberts, Torbjorn Fredriksson, Rémi Lang, Brahim Sanou, Cosmas Zavazava, etc.

Despite numerous advances in the field of peculiarities of the information economy development, the problem of evaluation of its development level remains poorly researched. In our opinion the deepening needs the identification of the impact on the processes of forming such a type of economy of the complex of parameters (particularly - educational, innovation, and research components).

The department of the International Telecommunication Union prepares annually “Measuring the Information Society Report”. According to the analytical characteristics of the development of national economies of 176 countries, this report presents their ranking according to the ICT Development Index (IDI). IDI is one of the most comprehensive global indices, compared to the rest of the existing ones; it reflects the countries progress towards the dissemination of the information society and within it - the information economy. The IDI methodology is cumulative, tested and reliable (Figure 4.4.1). The index is integrated and includes 11 indicators grouped into sub-indices:

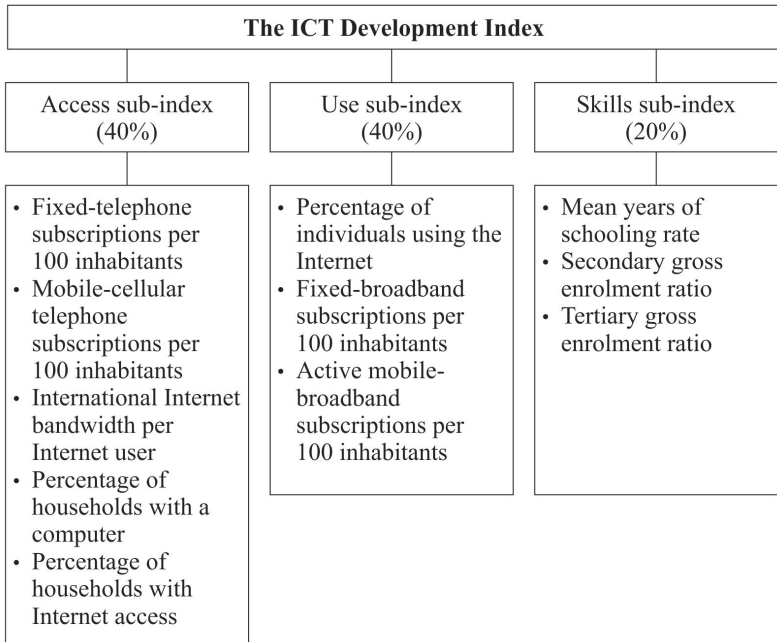


Figure 4.4.1. Scheme of IDI methodology

Source: compiled by the author on the basis of (The ICT Development Index (IDI): conceptual framework and methodology. URL: <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017/methodology.aspx>)

Access sub-index, Use sub-index and Skills sub-index.

The IDI structure includes skills sub-index (Figure 4.4.1). Structurally, this sub-index consists of the indicators of the mean years of schooling rate, secondary gross enrolment ratio, and tertiary gross enrolment ratio. In our opinion, the parameters of the educational system development and the efficiency of its subjects' activities (higher education institutions) should necessarily be taken into account when assessing the pace of information society. The education

has a decisive influence on the human capital development, and accordingly forms the basis of the country's scientific, technological, and innovative development¹⁵⁰.

The leaders of the IDI rating in 2017 were Iceland, South Korea, Switzerland, Denmark and the United Kingdom. The analysis of dynamics of the national economies demonstrated that the rating leaders are countries with strong and developed economies; countries capable to allocate significant financial resource in support of research, innovation activities and education system development; because the mentioned spheres form the basis for the stable and consecutive development of information and communication technologies, as well as create the preconditions for their introduction into the activities of business entities.

The prerequisites of proposed methodical approach to evaluation of the information economy development: orientation on modern social and economic, scientific and technical trends of development; selection, structuring and optimization of the system of relevant evaluation indicators available in official statistical databases; in-depth analysis of the influence of factors characterizing the educational, innovation and research components of the information economy development. The proposed methodical approach in its basis has the evaluation of a comprehensive integral indicator of the information economy development.

The stages of proposed methodical approach to the evaluation of the information economy development:

- 1) structuration of the comprehensive integral indicator: educational component, innovation

¹⁵⁰ Sullivan, P. (1999) Profiting from intellectual capital. *Journal of Knowledge Management*. Vol. 3. Issue 2. Pp. 132-143

- component, and research component (Table 4.4.1);
- 2) identification of the system of partial indicators - for the characteristics of comprehensive index' components (Table 4.4.1):

TABLE 4.4.1. Component structure of the comprehensive integral indicator of evaluation of the information economy development (I_{ie})

Symbol	Partial indicators	Indicator weight (by Saaty method)
I. The index of educational component (I_{edu})		
E_1	Number of higher education institution (III-IV levels of accreditation), pcs	0,06
E_2	Number of undergraduate students of higher education institution (III-IV levels of accreditation), thous. persons	0,10
E_3	Number of post-graduate students, person	0,15
E_4	Number of doctoral students, person	0,19
E_5	Amount of consolidated budget expenditures on higher education, UAH mln	0,19
E_6	Number of higher education institutions with doctoral students, pcs	0,09
E_7	Number of higher education institutions with post-graduate students, pcs	0,08
E_8	Number of undergraduate students per 10000, pcs	0,14
II. The index of innovation component (I_{inn})		
i_1	Share of enterprises introducing innovations, %	0,10
i_2	Number of introduced new technological processes, pcs	0,15
i_3	Number of introduced innovation products, pcs	0,15
i_4	Expenditures on innovation activity of industrial enterprises, UAH mln	0,14

i_5	Share of sold innovative products in the number of industrial ones, %	0,14
i_6	Number of agreements on intellectual property rights disposal, pcs	0,13
i_7	Share of enterprises engaged in innovations, %	0,10
i_8	Number of applications for patenting inventions from national applicants, pcs	0,09
III. The index of research component (Isc)		
S_1	Number of organizations conducting research and development (R&D), pcs	0,08
S_2	Number of scientists , person	0,10
S_3	Expenditure on R&D, UAH mln	0,15
S_4	Share of R&D in GDP, %	0,15
S_5	Share of higher education institutions among organizations conducting R&D, %	0,14
S_6	Share of higher education sector in R&D funding, %	0,12
S_7	Number of Doctors of Sciences engaged in economic activities, person	0,14
S_8	Number of PhD engaged in economic activities, person	0,12

Source: compiled by the authors

- educational component¹⁵¹ – indicators characterizing the staffing potential of the information economy development (number and structure of higher education institutions; number of undergraduate students,

151 Ionescu, D.D., Cuza, A. I., Ionescu, A.M., Cuza, A.I. & Jaba, E. (2013).The Investments in Education and Quality of Life. Journal of Knowledge Management, Economics and Information Technology. Special Issue.

Petrushenko, Yu. M., Vasylieva, T. A., Lyeonov, S. V. & Vorontsova, A. S. (2017). Investment in the development of a system of long life education as an effective factor of socioeconomic development. Financial and credit activity: problems of theory and practice: collection of scientific works. № 2(23). Pp. 426-436

- postgraduate students, doctoral students; funding of higher education);
- innovation component¹⁵² – indicators characterizing the innovative development of national economy as the basis for its informatization (introduction of innovative products and new technological processes; expenditures on innovation activity; applications for patenting inventions; agreements on intellectual property rights disposal; share of innovative active enterprises);
 - research component¹⁵³ – indicators characterizing personnel and financial maintenance of scientific and technological development as a basis of the information economy formation (number of research organizations; number of scientists; R&D expenditures; share of higher education institutions in processes of R&D implementation and financing);

3) choice of method for constructing a

152 Jetter, M., Satzger, G. & Neus, A. (2009). Technological Innovation and Its Impact on Business Model. Organization and Corporate Culture – IBM's Transformation into a Globally Integrated, Service-Oriented Enterprise. *Business & Information Systems Engineering*. №1. Pp. 37–45.

Roper, S. Du, J. & Love, J.H. (2008) Modelling the innovation value chain. *Research Policy*. № 37(6-7). Pp. 961-977

153 Franses, P.H. (2003) The diffusion of scientific publications. *The case of Econometrica* 1987. *Scientometrics*. Vol.56 (1). P. 29–42; Zhylynska, O.I. (2016) Komplementarni efekty v aktyvizatsiyi rozvytku naukovo-texnichnoyi diyalnosti v informatsionomu suspil'stvi [Complementary effects in enhancing the development of scientific and technological activities in the information society] *Bulletin of the Taras Shevchenko National Taras Shevchenko University*. № 9 (186). Pp. 54-60

- comprehensive indicator¹⁵⁴;
- 4) accumulation of statistical data array on identified partial indicators (in dynamics - to ensure the reliability of evaluation);
 - 5) determining the weight of each partial indicator within the components (educational, innovation, research) – on the analytic hierarchy process AHP of Thomas L. Saaty¹⁵⁵:
 - compiling a matrix of pairwise comparisons - for constructing a hierarchy of indicators according to the degree of influence on the components of comprehensive integral index;
 - compiling of calculation tables - for determining weight coefficients¹⁵⁶;
 - 6) formalization of components;
 - 7) normalization of analytical indicators - compiling of a matrix of standardized values by the formula¹⁵⁷
 - 8) calculation of partial indices of comprehensive indicator of the information economy development

154 Kozmenko, O. V. (2014). Ekonomiko-matematyčni metody ta modeli (ekonometryka) [Economic-mathematical methods and models (econometrics)]: a manual. Sumy: Universytetska knyga

155 Saaty, T. (1980) The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. McGraw-Hill. 345 p

156 Beshelev, S.D. & Gurvych, F.G. (1980) Matematy'ko-staty'sty'chesky'e metody ekspertnyx ocenok [Mathematical and statistical methods of expert assessments] 2nd issue. M.: Statistika. 263 p

157 Docenko, O.S. (2010) Prakty'kum z zagal'noyi teoriiy staty'sty'ky' [Practical handout on general theory of statistics] Sevastopol: SevNTU. 204 p.; Ovezgeldyev, A.O., Petrov, E.G. & Petrov, K.E. (2002). Sintez i identyfikatsya modelei mnohofaktornogo otsenivaniya i optimizatsii [Synthesis and identification of multivariate estimation and optimization models] Kyiv: Naukova dumka. 164 p

- in terms of dynamics of three components;
- 9) calculation of forecast values of partial indices of the comprehensive indicator;
- 10) development of a comprehensive integral index (on the described above algorithm)
 - as an average weighted cumulative index of educational, innovation, and research component, with weights identified on basis of the Saaty method¹⁵⁸.

The aim of the methodical approach is determining the level of the information economy development, while the existing approaches are aimed mainly at monitoring the state of the information society (and only partially include economic aspects). The proposed methodical approach allow: evaluating the level of information economy development; identifying the features of educational, innovation and research component of the information economy development; identifying problem points; developing the scientifically grounded recommendations for activating processes of national economy transition to functioning on the informational and innovational basis.

One of the main prerequisites for use of the proposed methodical approach is the open access to official statistics, in particular on the indicators included in the structural components of the comprehensive integral indicator. The results of calculations of the structural components of the proposed comprehensive integral indicator are presented on the Figure 4.4.2.

The component analysis as the first stage of the proposed methodology made it possible to come to the following

158 Saaty, T. (1980) *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*. McGraw-Hill. 345 p

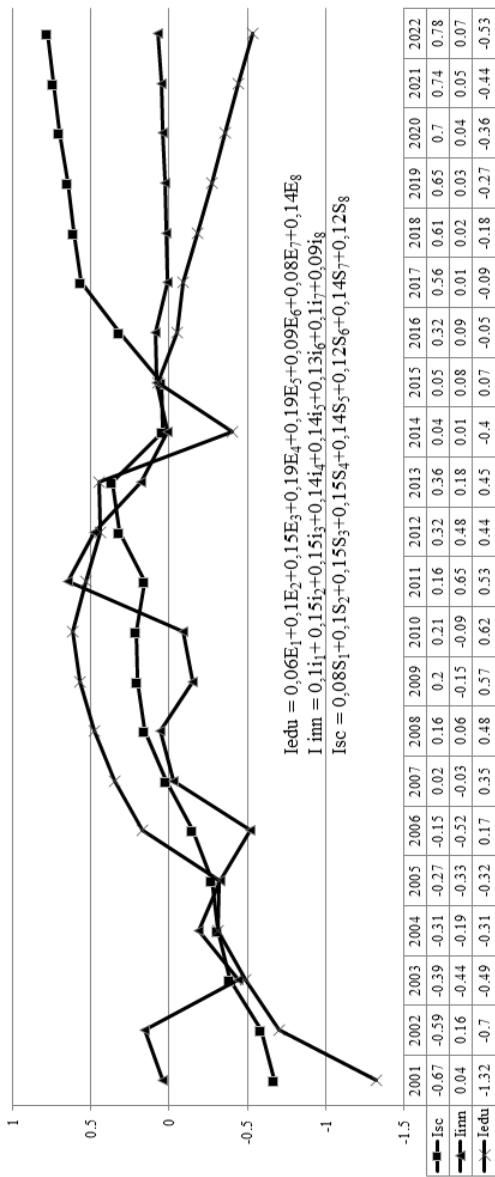


Figure 4.4.2. Results of approbation of methodical approach to evaluation the index of the information economy development: innovation (I_{inn}), research (I_{sc}), and educational (I_{edu}) components

Source: compiled by the author

conclusions. Dynamics of the Index of research component of the information economy development shows a decline in 2011, which is the result of the global financial and economic crisis of 2008-2009 (the crises led to total savings, including R&D expenditures). Complication of the geopolitical situation, beginning of hostilities in the East, led to a significant reduction of this Index in 2014-2015.

The Index of innovation component demonstrates the high fluctuation. The pace of innovation development correlates with the parameters of the effectiveness of research activities in the country. The problem points outlined above on the Index of research component negatively affect the dynamics of the innovation component. Additionally, it should be emphasized the Index of innovation component's high elasticity, high sensitivity to the change of exogenous factors.

The forecasting dynamics of educational component demonstrates a negative tendency to decline – in the context of its impact on processes of formation and development of the information economy in country. However we should put the attention on the considerable potential of the higher education in intensification of digitalization of national economy. The reasons for the forecasting downward dynamics of this Index are: reduction of higher education funding; low level of diversification of universities funding Source; reduction of the number of higher education institutions within the course of optimization of their structure; reduction of the number of students (as a result of impact of demographic and migration factors); insufficient level of practical value and commercial potential of universities' R&D, etc.

The system analysis as the second stage of the proposed methodology allowed making the following conclusions: in Ukraine the information economy is only at the stage of its formation; the highest correlation is observed between the comprehensive indicator and the partial Index of innovation component; the sphere of science demonstrates the significant prospects in information economy development; the significant reserves of information economy development are concentrated in the higher education system (modern universities consolidate a country's intellectual capital; generate innovations, make research discoveries and inventions, and also to commercialize them in the national economy; train a new generation of professionals and entrepreneurs, able both to think and act in an innovative way and to adapt to dynamic economic changes).

Thus the index analysis allowed identifying the some problem points: the information economy is only at the formation stage; unsatisfactory level of realization of educational, scientific, and innovation organizations' potential; undeveloped cooperation between business enterprise sector, higher education sector, government sector and private non-profit sector; inefficiency of public financing of higher education, scientific and technical, and innovation activities in the country; undeveloped innovation infrastructure; outdated material and technical base of higher education and research institutions; migration of perspective young people abroad ("brain drain"); low prestige of research activity in society; low commercial potential of universities' R&D results; reduction of global competitiveness of domestic universities;

high sensitivity of partial indices of information economy development to the influence the exogenous factors.

The results of index analysis we have completed with clustering regions of Ukraine by the development level of educational, innovation and research components of the information economy. Our research is based on the official data in open access at the website of the State Statistics Service of Ukraine. However, there are some limitations caused by: 1) absence of official statistical data in the Luhansk, Donetsk regions and the Autonomous Republic of Crimea (due to the inability to monitor statistical parameters due to the temporary occupation of these territories); 2) exclusion of statistical data in Kyiv (because of special administrative status of the city; the advantages of its social and economic development in comparison with other regions of Ukraine); 3) absence of official statistical data in some parameters by regions. The used K-means algorithm for clustering regions is visualized in Figure 4.4.3.

The clustering of regions of Ukraine by research component of the information economy identified three groups (Table 4.4.2). Kharkiv region is defined as the leader region;

Dnepropetrovsk and Lviv regions are considered as promising regions with average development level. The rest of Ukraine's regions (21 oblasts) are included in the cluster, which objects are characterized by a low development level of parameters of the research component.

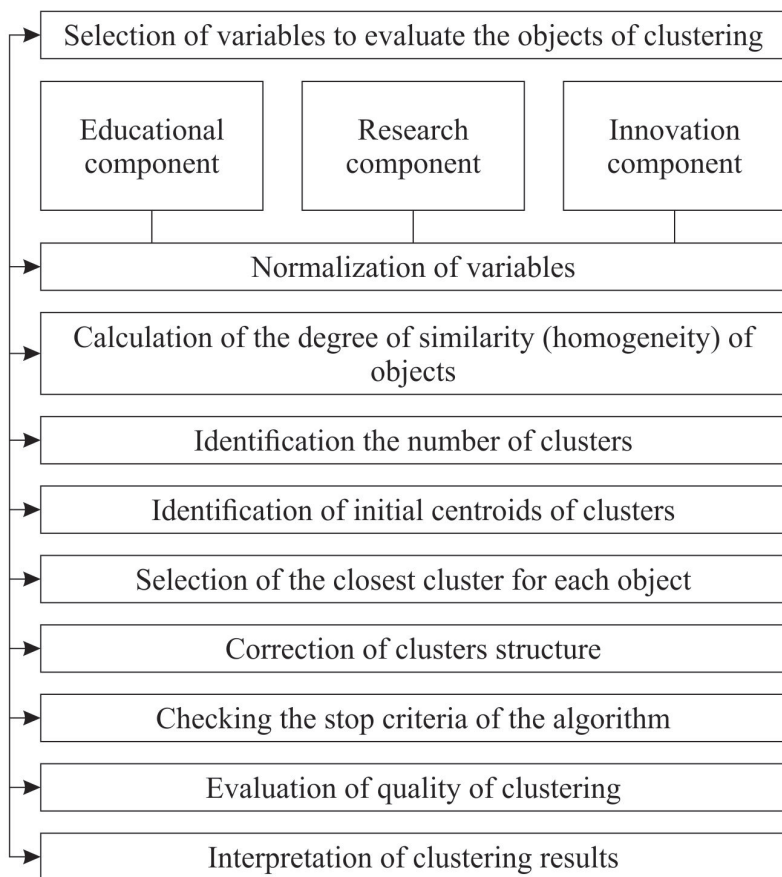


Figure 4.4.3. K-means algorithm for clustering regions of Ukraine according to development level of educational, innovation and research components of the information economy

Source: compiled by the authors

TABLE 4.4.2. Clustering results of Ukrainian regions by components of information economy development

Cluster	Number of regions	Regions	Type of cluster
Educational component			
1	6	Donetsk, Kiev, Kirovohrad, Lviv, Mykolaiv, Sumy	Promising regions of medium development level of educational component
2	15	Vinnitsia, Volyn, Dnipropetrovsk, Zhytomyr, Transcarpathian, Ivano-Frankivsk, Luhansk, Poltava, Rivne, Ternopil, Kherson, Khmelnytsky, Cherkasy, Chernivtsi, Chernihiv	Regions of low development level
3	3	Odessa, Zaporizhia, Kharkiv	Regions of intensive development
Research component			
1	21	Vinnitsia, Volyn, Donetsk, Zhytomyr, Transcarpathian, Zaporizhia, Ivano-Frankivsk, Kiev, Kirovograd, Luhansk, Mykolaiv, Odesa, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytsky, Cherkasy, Chernivtsi, Chernivtsi	Regions of low development level of research component
2	1	Kharkiv	Regions of intensive development
3	2	Dnipropetrovsk, Lviv	Promising regions of medium development level
Innovation component			
1	19	Vinnitsia, Volyn, Donetsk, Zhytomyr, Transcarpathian, Ivano-Frankivsk, Kiev, Kirovograd, Lugansk, Mykolaiv, Poltava, Rivne, Sumy, Ternopil, Kherson,	Regions of low development level of innovation component

		Khmelnysky, Cherkasy, Chernivtsi, Chernihiv	
2	1	Kharkiv	Regions of intensive development
3	4	Dnipropetrovsk, Zaporizhia, Lviv, Odesa	Promising regions of medium development level

Source: compiled by the authors

The largest cluster (88% of the analyzed regions) is the first one. It consists of regions with the heterogeneous development trends of the research component of information economy. Despite the existing opportunities and reserves (functioning of research institutes and higher education institutions conducting both teaching and research activities), the regions included in the first cluster are not currently able to ensure the successful realization of their potential. In our opinion it is caused by the following reasons: low level of commercial attractiveness of research activities; low level of applied value of universities' research results; mainly theoretically oriented research at higher education institutions.

The second cluster includes the Kharkiv region that demonstrates intensive development of research component of the information economy. Leadership of Kharkiv region is substantiated by the efficiency of functioning of both organizations conducting R&D projects (about 150 organizations), and scientists (about 10 thousand). There are powerful universities in the Kharkiv region (Kharkiv Polytechnic Institute, VN Karazin Kharkiv National University, Kharkiv National Medical University, etc.) that concentrate intellectual potential and conduct competitive research. The highest levels of financing research activities in Ukraine are in Kharkiv region (including financing of fundamental R&D,

applied R&D, experimental developments).

The third cluster is represented by two regions that demonstrate the average development level of research component. In our opinion, the intensification of scientific and technological development of Lviv and Dnipropetrovsk regions is possible by the synchronization of interests and coordination of activities of subjects of government sector, business enterprise sector, higher education sector and civil society. The Dnipropetrovsk region has greater prospects for migration from the third to the second cluster - according to dynamic of the statistical indicators (number of scientists; internal costs for applied R&D and experimental development). The development of mentioned above partnership could form stable preconditions for activating of digital economy through the increasing the R&D effectiveness, and commercialization of R&D results in the real sector of the national economy.

The research component of the information economy influences the dynamics of innovation component. It is reflected in the results of clustering of regions of Ukraine by innovation component – Table 4.4.2. Effective realizations of the existing potential and ability to attract talents have provided the leading positions of the Kharkiv region on the innovative component (cluster 2). The cluster of medium-term developmental regions (cluster 3) consists of Dnipropetrovsk, Lviv, by Zaporigia and Odesa regions. The leadership in the cluster 3 is held by the Zaporigia and Dnipropetrovsk regions. The majority of regions of the country (79%) are in cluster 1; the objects the cluster 1 demonstrate a low development level of indicators of innovative component of the information economy.

It is important to emphasis that innovation component of the information economy is the most problematic for all regions of Ukraine. Disruption of the communication between

the entities of government sector, business enterprise sector, higher education sector, and representatives of civil society led to following problems:

- state and local authorities make unsubstantiated decisions on investment of innovative activity (particularly – the priority spheres and industries);
- higher education institutions conduct research, which are often characterized with low levels of commercial value and investment attractiveness;
- enterprises spend financial resource on innovative projects, the implementation of which does not bring the foreseen level of profitability due to lack of technical, economic, scientific validity of some projects;
- the underdeveloped innovation culture in society; the underdeveloped innovative thinking of employees; the low development level of skills of using modern information and communication technologies in professional activities, etc.

We consider the educational component of the information economy development as a structure-making component (Table 4.4.2). This point of view is based on the fact that the majority of researchers, scientific and pedagogical workers of the country are employed in the higher education sector. The educational component integrates the elements of research and innovation component of the information economy.

The analysis of the research and innovation components demonstrated the increasing contribution of higher education institutions to the development of the information economy. In particular, the mentioned above contribution of HEIs is

concentrated in the following areas:

- a. training of research staff, as well as future specialists, capable of innovative thinking and acting; the development of a new generation of entrepreneurs, capable of doing business in the conditions of informatization, digitalization of the global economy;
- b. generation of innovative ideas; development of new technologies and modernization of existing ICTs.

Thus the higher education system, on the one hand, provides staffing for development of the information economy, and on the other hand, conducts R&D, and transfer the R&D results into the real economy.

So according to the results of the cluster analysis, Dnipropetrovsk, Zaporigia and Kharkiv regions are classified as regions with intensively developed educational component of the information economy (cluster 3); the cluster of prospective regions with medium development level (cluster 1) includes the Kyiv, Kirovograd, Donetsk, Lviv, Mykolaiv, Dnipropetrovsk, and Sumy regions; the rest regions of Ukraine (15 regions, 62% of the analyzed regions) are concentrated at the cluster of regions with low level of educational component development – Table 4.4.2.

The results of our research showed that the educational component has the greatest prospects in intensifying the development of the information economy. In the same time it is possible only in the conditions: of complex engagement of the potential of the higher education institutions; of including

the state support of modernization processes in higher education system according to the challenges of digitalization of national economy; of effective stimulation of development of educational, research and innovation activities of Ukrainian universities.

Current optimization processes in the national higher education system are accompanied by a decrease in the number of educational institutions. These processes are aimed at consolidating of universities' potentials, transforming them into regional centers of attraction of talents and investment. The described above processes faces the difficulties that require the consideration of the specific needs of regions of Ukraine. It applies both: 1) to the professional and qualification structure of professionals according to the demand in local labor markets, 2) as well as to the structure, profile orientation and quality of universities research. The inconsistency of the state policy of optimization in the higher education system with the meso-economic inquiries causes a deepening imbalance in the digitalization processes at the regional level.

The problem of financing education, research and innovation activities is common to all regions of Ukraine. This is due, first of all, to the low investment attractiveness of education and science; secondly, the low diversification of funding Source of the educational and scientific institutions; third, the non-synchronization of the government, universities, enterprises and civil society; fourth, insufficient level of innovation activity of local business in a number of regions of Ukraine. Thus, it becomes urgent the need to develop and implement a comprehensive strategy of state regulation of the processes of digitalization of national economy and its main sectors.

The conducted research showed that the higher education

system has considerable potential in intensification of digitalization processes at national and regional levels. At the same time, the current stage of development the national higher education system is characterized by a number of problems (Table 4.4.3). These problems could form the barriers for the digitalization of national economy.

TABLE 4.4.3. System problems of higher education development in the conditions of information economy development

Type of problem	The characteristic of the problem	Approaches to the problem's solution
Contextual problems	irrelevance or inconsistency of the educational and research processes to the real economy needs	A comprehensive approach to regulating the issues of synchronizing the activities and interests stakeholders
Legal problems	inconsistency of the current legislation regarding the commercialization of intellectual property; low level of protection of intellectual property rights	Scientific and practical approaches to transformation of the legal mechanism of transfer, commercialization of R&D results
Organizational and economic	underdevelopment of mechanisms for commercial transfer of R&D results	Synthesis of economic synergetics and institutionalism
Financial problems	low diversification of funding Source; low level of universities' financial autonomy	Development of an integrated model of higher education financing within the Quadruple Helix model
Logistical problems	outdated equipment of teaching and research laboratories; low development level of innovation and information infrastructure	System-synergetic approach

Problems of coherence	lack of effective motivational mechanisms for cooperation of economic entities in fields of higher education, science, innovation	Development of a model of achieving positive synergistic effects of modernization of the national higher education system; institutional approach to development of function and target consent of entities of the Quadruple Helix model
Problems of internationalization	weak competitive position of the national higher education institutions in the global area	Structural and functional approach

Source: compiled by the authors

The existing problems of development of the higher education system cannot be fully solved within the existing concept. In theory, it is important to understand the phenomenon of virtualization in the digital economy, as a result of unprecedented rapid progress in the latest materials, mathematical computing, and K. Schwab's cryptography¹⁵⁹. Today it covers virtually all areas of business and life and is the most dynamic and profitable sector of the global economy.

The digital economy¹⁶⁰ is, on the one hand, the latest phenomenon of informatization and virtualization, and on the other, the product of the evolution of economic systems in the post-industrial development paradigm.

The methodological format of the study and the likely trend of digital economy development are shown in Figure 4.4.4:

¹⁵⁹ Schweb, K. (2017) Chetvertaya promyshlennaya revolyuciya [The Fourth Industrial Revolution]. Moscow, Eksmo, 208 p.; Schweb, K., Devis, N. (2018). Tekhnologii chetvertoi promyshlennoi revoliutsii [Shaping the Fourth Industrial Revolution]. Moscow, LitRes, 410 p

¹⁶⁰ The concept of the digital economy was introduced in 1995 by American scientist Nicholas Negroponte (MA), and the concept of virtualization emerged in the second half of the 21st century

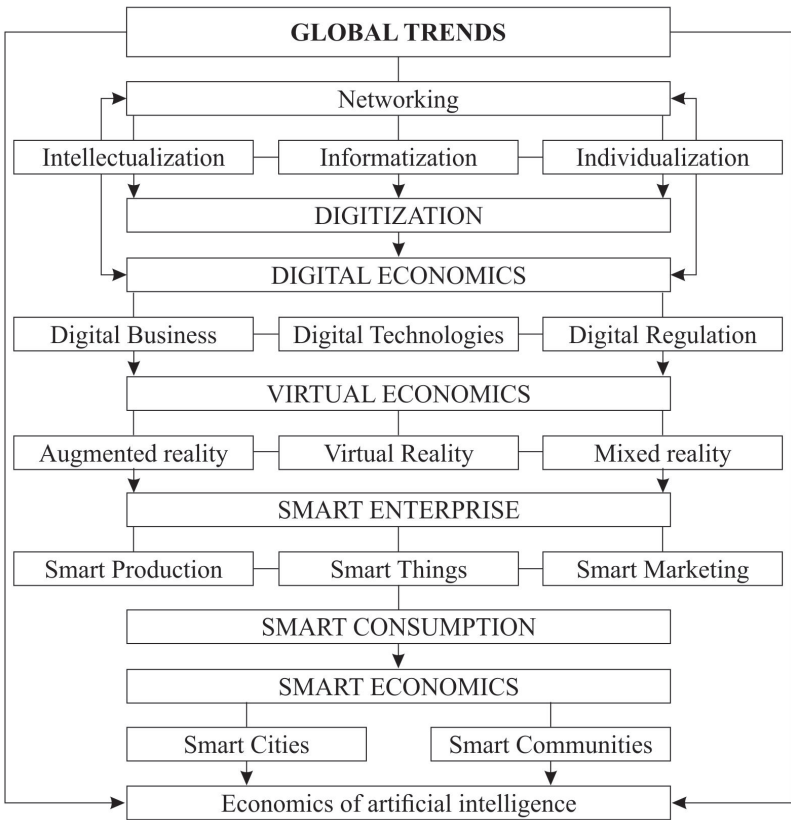


Figure 4.4.4. The phenomenon and evolution of the digital economy

Source: compiled by authors

At the macro level, we focus on the relevance of the digital adaptability of higher education. The problems of the higher education system development cannot be fully solved within the existing concept, because it does not take into account the dichotomous nature of the influence of the higher education and the information economy. In our research, we focus on the

relevance of development of the digital adaptability of higher education. The process of modernization of the higher education system should be structured; it will allow consistently solving the set tasks and achieving the set goals.

The development of the Concept of Digital Adaptability Strategy of the Higher Education System of Ukraine is caused by the following reasons: the need to modernize the national higher education system; updating of the integrated financing model within the Quadruple Helix concept (“government sector – higher education sector – business enterprise sector – private no-profit sector”); maximizing the positive synergistic effects of stakeholder interaction based on their function and target consent; ensuring the impulse response of the higher education system to the influence of exogenous and endogenous factors; raising the level of resilience, the system’s ability to withstand the external influences, and return to the desired trajectory of development after the impact of the challenges generated by digitalization of the national economy.

The study is based on the following methodological approaches:

- structural and functional approach – used in the analysis of the influence of the global educational area on the interactions between elements of the higher education system;
- systematic approach - in analyzing the essence of the higher education system and its modernization processes in order to ensure its digital adaptability to the challenges and perturbations brought by the information economy;
- synergistic approach - to develop the mechanisms

for effective interaction between the subjects of higher education sector, governance sector, business enterprise sector and civil society in order to minimize the effects of negative synergy and maximize the effects of positive synergy, which are able to ensure the resilient development of the higher education system in the conditions of national economy digitalization;

- Institutional approach - to develop a theoretical basis for building a dense business environment within the national economy, based on function and target consent of the Quadruple Helix model entities. Such a business environment should be able to adequately respond to the challenges of the information economy and to create the preconditions for ensuring the high resilience of economic agents.

The described conceptual approaches are used in developing the Concept of Digital Adaptability Strategy of the Higher Education System of Ukraine (Figure 4.4.5). The Concept structurally contains the following components:

- 1) systemic-synergistic (a set of connection between stakeholders that could generate synergetic effects);
- 2) institutional and regulatory (a set of institutions - state, public, international, etc. - in the fields of higher education and science);
- 3) structural and functional (a set of functions and tasks oriented towards the achievement of the

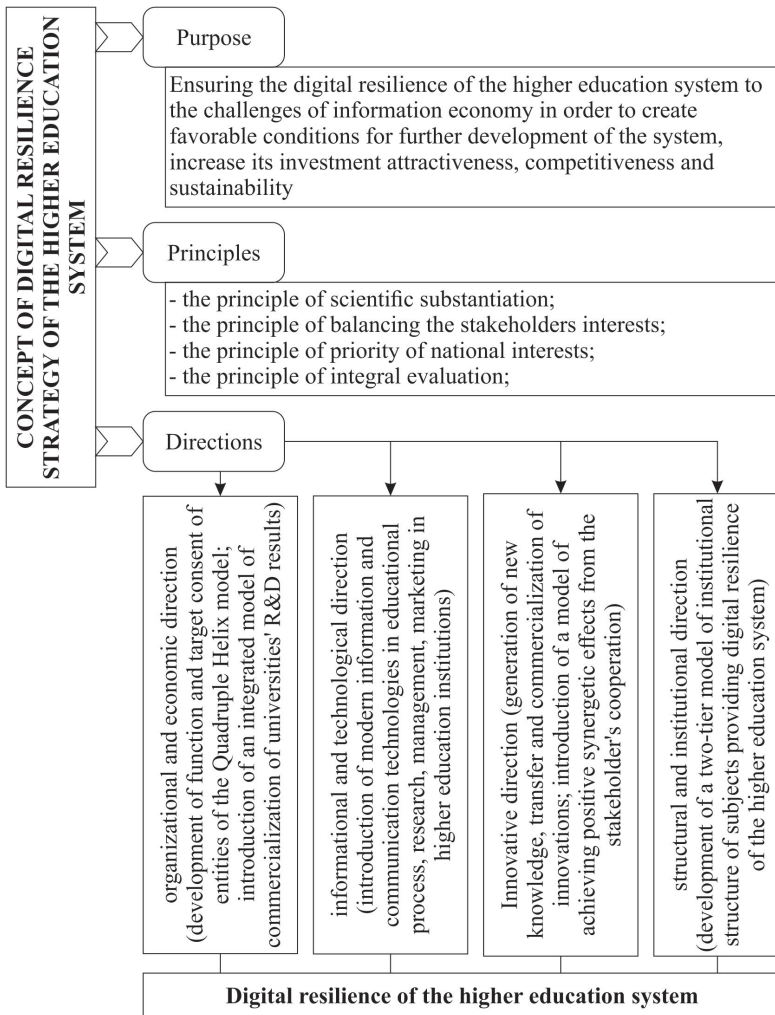


Figure 4.4.5. Conceptual Scheme of the Digital Adaptability Strategy of the Higher Education System

Source: compiled by the authors

- defined strategic goals);
- 4) informational and communicational (a set of technologies that allow to establish and develop communication channels between stakeholders).

The subjects of the proposed Strategy are: the state and its bodies; higher education institutions and their management (the manage subsystem). The objects are: universities, institutes, academies, their staff and activities (the managed subsystem). The priorities and expected results of the Strategy should be consistent with the strategic and tactical goals of the state policy in the fields of higher education, scientific, technical and innovative development of the national economy. The implementation of the proposed Strategy is based on the establishment of long-term interaction of its main stakeholders (Table 4.4.4).

TABLE 4.4.4. Quadruple Helix Entities Synchronization Matrix for the Implementation of the Digital Adaptability Strategy of the Higher Education System

	Governance sector	Business enterprise sector	Higher education sector	Private non-profit sector Civil society
Governance sector	National interests	Fiscal stimulation of stakeholders cooperation	State orders	Equal access to quality educational services
Business enterprise sector	Taxation	Competition	Investment	Meeting the needs for goods and services
Higher education sector	Transfer and commercialization of R&D results	Skilled personnel; R&D results	Quality educational services	Meeting the needs for quality educational services
Private non-profit sector Civil society	Taxation	Needs, interests	Public monitoring	Development of information society

Source: compiled by the authors

Presented in Table 4.4.4 matrix contains the results of systematization of perspective directions of synergetic partnership of subjects of the Quadruple Helix model. It is important to emphasize that the entities in the Table 4 in the rows are mentioned as subjects (it means they act and influence), and in the columns are listed as objects (it means they are influenced by the subjects). At the intersection in the matrix are identified the priority vectors of entities cooperation under the conditions of digitalization of the economy.

The basis for the development Strategy (Figure 4.4.5) is the system-synergetic paradigm and theoretical results of generalizing scientific approaches to the study of the phenomenon of digital adaptability. In addition, current trends in the development of the national higher education system and exogenous factors of influence have been taken into account. The exogenous factors are the factors caused by the transformations of the global educational area that change the very nature and scale of the interaction of subjects. Internationalization and globalization factors need to be taken into account in the Strategy because they create additional risks for domestic universities. Increasing demographic difficulties are leading to a decrease in the student population in EU countries. In such circumstances, foreign education institutions are constantly searching for new markets. The Ukrainian domestic educational services market is attractive for foreign universities. The openness of the Ukrainian market causes the new challenges to higher education institutions of the country. In addition to mentioned above, there is a steady upward trend in the demand of Ukrainian students for foreign universities' educational services.

Therefore, the purpose of the proposed Strategy is to ensure digital adaptability of the national higher education

system to the challenges generated by the processes of informatization of economy in order to create favorable conditions for further development of the system, increase its investment attractiveness, level of competitiveness and sustainability. The objectives of the Strategy in accordance with the defined purpose are the following:

- synchronization of interests by Quadruple Helix model entities;
- coordination of stakeholder activities;
- stimulating the private investment into the higher education system; activation of commercialization processes;
- promoting the effectiveness of international research and educational projects;
- ensuring the competitiveness of domestic higher education institutions;
- increasing the level of adequacy of educational and research activities of universities to the needs of the real sector of economy in the conditions of its digitalization;
- development of innovative infrastructure at higher education institutions, etc.

The key priorities of the Digital Adaptability Strategy of the Higher Education System by 2025 are the following:

- 1) harmonization with the priorities of the state innovation, scientific, educational policies, as well as harmonization with international programs in the fields of higher education and science;

- 2) encourage cooperation between the entities of the Quadruple Helix model in educational and research activities;
- 3) ensuring the effectiveness of the higher education financing model (with accent on diversification of financing Source, differentiation of universities services, expanding the universities financial autonomy);
- 4) activation of international scientific and educational cooperation of universities in response to the requirements of globalization and internationalization of the educational area;
- 5) increase of educational efficiency (indicator - level of competitiveness of graduates in the labor market), research (volumes of commercialization of patented inventions and developments), innovative (indicators of transfer of generated innovations to the real sector of economy) and international (number of joint research and educational projects) activities of universities;
- 6) accelerating the pace of implementation of modern information and communication technologies;
- 7) guaranteeing the effective functioning of the intellectual property protection system;
- 8) introduction of effective motivational mechanisms for the development of cooperation between higher education institutions and the business enterprise sector.

The implementation of Digital Adaptability Strategy of

the Higher Education System by 2025 involves strengthening the responsibility of stakeholders:

- at the national level - the Verkhovna Rada, the Cabinet of Ministers, the Ministry of Education and Science, the Ministry of Finance, the Ministry of Economic Development and Trade, the National Academy of Sciences;
- at the meso-level - public organizations in the fields of higher education and science; employers' associations; business associations, etc.;
- at the local level - management, administrative and scientific-pedagogical staff of higher education institutions (Table 4.4.5).

In modern and predictive analytical formats, most scholars and experts highlight the field of higher education as a necessary fundamental basis for ensuring a new quality of development and continuous scientific, technological, economic and social progress on the latest information bases and platforms.

Modern digital technologies are already providing new tools for the development of universities around the world, and digitization provides opportunities to share lessons learned and knowledge, enabling people to acquire new knowledge and make more informed decisions.

The general concept of “DIGITAL UNIVERSITY” takes into account the modern requirements and competitive advantages of digitization (Figure 4.4.6).

The joint effective activity of the subjects at the described above levels is possible on the basis of development of mutual trust. In the condition of digitalization of national economy such partnership requires the implementation of

effective communication channels, providing high flexibility of information networks, rapid replenishment of information bases, guaranteeing wide and free access of stakeholders to information reSource.

TABLE 4.4.5. Levels of implementation of the Digital Adaptability Strategy of the Higher Education System

Characteristics of regulation directions at different levels	Possible consequences of effective implementation of measures within the Strategy
Macro level – Organization, regulation of modernization processes and the order of their implementation; resource provision; monitoring efficiency of use of reSource	Formation at the national level of preconditions for the implementation of modernization changes in the higher education system; enhancing the competitiveness of the national higher education system; synchronization of development of subjects of the higher education system and business enterprise sector
Meso-level – Mobilization of reSource and potentials of stakeholders; attraction of external reSource for implementation of the Strategy	Reconciling the interests of stakeholders; ensuring the effective use of their potential
Micro level - Encouraging higher education institutions, scientific and pedagogical staff to support modernization changes in the system	Increasing the flexibility of higher education institutions and their management; development of their endogenous environment; increase of international competitiveness of domestic universities at the global educational services market

Source: compiled by the authors

Therefore, in our opinion, ensuring the digital adaptability of the higher education system in the medium and long term is impossible without establishing effective synergetic cooperation

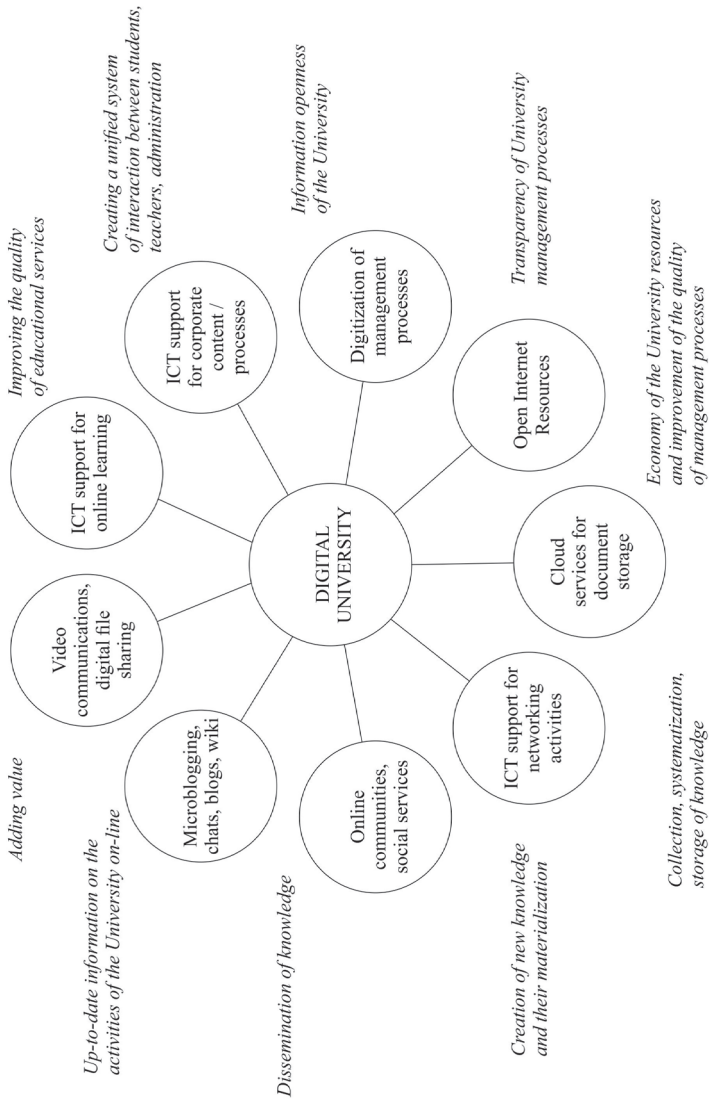


Figure 4.4.6. Digital University

of domestic universities with enterprises, state authorities, and public organizations. Taking into account the imbalance of activities of the subjects of different sectors of the national economy, their non-synchronization with the higher education sector, the attention of scientists is concentrated on issues of development and implementation of effective motivational mechanisms and appropriate tools for promoting partnership. Achieving synergies from the interaction of Quadruple Helix model entities requires reconciling their interests (coherence principles), pooling reSource and potentials (consolidation principle), and coordinating activities (based on trust and information capacity).

The implementation of Digital Adaptability Strategy of the Higher Education System contributes to the convergence of education, science and business; ensures diversification of funding Source for higher education institutions; enhances the investment attractiveness of education and science; provides for increased international competitiveness of the national higher education system. The digital adaptability of the higher education system will ensure its sustainability in dynamic exogenous conditions, the ability to restore the desired trajectory of development after shock perturbations, to reorganize or adapt to the conditions of informatization of the national economy.