

7.2 Development of innovative diffusions of the socio-economic systems in the conditions of the knowledge economy

The spread of innovation diffusion are key factors in the development and functioning of the socio-economic systems in the knowledge economy. Therefore, research on the development of innovative diffusions requires constant analysis and observation for a rapid response of the socio-economic system to global change. The main issue explored in the section is to identify the possibility of leveling the unpreparedness of the socio-economic system for the development and implementation of innovations based on modern knowledge and the effective implementation of innovative diffusions in various sectors of the national economy. The impetus for the study of innovation diffusion processes of social and economic systems serve the work of such scientists as E. Rogers [528] who developed the theoretical and methodological basis of research processes of innovation diffusion and R. Nelson, S. Uinter [529] examining the impact of organizational changes on socio-economic systems in general. Domestic scientists, such as L. Fedulova [530], V. Heyets [531], also paid considerable attention to the processes of development of innovative diffusions of socio-economic systems in the conditions of knowledge economy. Despite the great attention paid to this study, there are no agreed conceptual indicators and methodological framework that would clearly characterize the development of innovative diffusions of socio-economic systems.

The sphere of industrial production during the long period of Ukraine's development as a powerful economically developed state was a system-forming branch of the economy, and all other sectors of its economy either directly depended on the industrial complex or served it. This state of affairs persists in many respects, despite the sharp decline in industrial production and catastrophic depreciation of fixed assets. Further movement in the field of industrial production by inertia, given by the vector of industrial development of the administrative-command economy, is impossible due to increasing technological backwardness and obsolescence of most industries, which produce industrial products with high value added. The low competitiveness of such products and the loss of the domestic market have deprived many industrial enterprises

of opportunities for innovative development. The absence of a single state body responsible for the production of individual products throughout the chain of redistribution of raw materials, makes it impossible to resuscitate large industrial plants and their further modernization. That is why the expediency of studying the processes of initiation and dissemination of innovative diffusions must be developed and stimulated to enable socio-economic systems to respond quickly to global challenges in a permanent rhythm of changing knowledge.

7.2.1 Development of Economy of Knowledge and its Influence on Innovation of the Socio-Economic Systems

In the constant pace of development of socio-economic systems in the knowledge economy, the factors of innovative development always come to the fore. Therefore, the selection of factors that lead to the innovation of socio-economic systems will always be important. The most important factor is the development of innovative product, works and services with a high content of innovation and intellectual component and the key to this product is reproduction and formation of knowledge society in the socio-economic system.

Changes in the dominant factors of socio-economic systems determine the evolution of scientific and technological systems (Table 1) which clearly reflects the transition from industrial - a characteristic feature of which was the increase in technological capacity to the post-industrial stage - in which innovation and intellectual development of the system comes to the fore. A characteristic indicator of this stage can be considered a new form of interaction between socio-economic systems where one system dominates over another, which scientists have called - "intellectual imperialism".

Table 1

Evolution of technological orders

Technological orders	Leader Countries	Leading industries	Output phase, of the year	Descending phase, of the year
First	Great Britain	Textile industry, iron smelting	1740-1763	1763-1792
Second	Great Britain	Steam engine, railways, heavy engineering, chemical industry, electrical engineering	1792-1815	1815-1850
Third	USA	Metallurgy, power engineering, inorganic chemistry	1850-1873	1873-1914
Fourth	USA	Aviation and automotive industry, organic chemistry	1914-1945	1945-1973
Fifth	USA, EU, East Asia	Information processing, electronics, telecommunications, robotics	1973-2000	2000-2026
Sixth*	USA and others	Nano and biotechnology	2026-2050	2050-2080

Source [532]

According to these technological systems, a new stage inherent in the fifth and sixth systems began with the introduction of the term "knowledge economy" for a particular sector of the economy into scientific circulation by scientist Fritz Machlup [533] in 1962. Since the 70s of the XX century, the term has been used to define not a sector but a type of economy where knowledge plays a major role and knowledge production is a source of development. An important difference between the knowledge economy and the previous types is that it is not the economics of production, but rather the universities and fundamental-applied science, communication and patent system. Therefore, a new type of economy brings to the fore the socio-economic development of the system where knowledge occupies the highest place. In order to reliably assess the development of the knowledge economy and its impact on socio-economic systems, it is necessary to clearly define a set of functional elements that lead to the growth of knowledge, where they act as a catalyst for innovation. To determine the most common elements, we turn to the interpretations of domestic and foreign authors (Table 2).

Table 2

Defining elements of the knowledge economy

Elements of the knowledge economy	Authors					
	Fritz Machlup [533]	M. Porat [534]	V. Tyshchenko, [535]	World Bank experts [536]	Yu. Ivanov [537]	O. Shevchenko [538]
Uninterrupted education					✓	
State				✓		
Education and training	✓		✓	✓		✓
Innovative systems			✓	✓		
Information and communication sector	✓				✓	
Production of innovations		✓				
Intellectual services				✓		
Research and innovation	✓					✓
Intellectual capital					✓	
Primary sector of information production		✓				
Secondary sector of the product of information for personal use		✓				

Source: developed by the author based on [533,534,535,536,537,538]

Based on the above elements, we see that there is no single approach to innovation social and economic systems during the development of the knowledge economy. All the outlined elements are grouped into clearly consistent processes of influence, launching the mechanisms of system innovation:

1) the process of knowledge generation - reproduction, generation and functional network of knowledge dissemination;

2) the process of profitability of knowledge - intellectual property (patents, licenses and certificates for inventions, goods or services);

3) innovative diffusion of knowledge - the release of innovative products to support the competitive position of the socio-economic system.

Thus, the process of knowledge generation will occupy the most important place in the development of the knowledge economy and the driving force is the knowledge society that launches the innovation of the socio-economic system. The knowledge society is a cohesive layer of the system, which with the help of intellectual abilities, accumulated knowledge, professional skills and abilities, spreads the ideas that are

embodied in the innovation of the socio-economic system. The accumulation of knowledge by society is achieved through education, its accessibility, quality and content.

Along with the functional elements, there are factors that ensure the full impact of the knowledge economy on all structures of the socio-economic system (Figure 1).

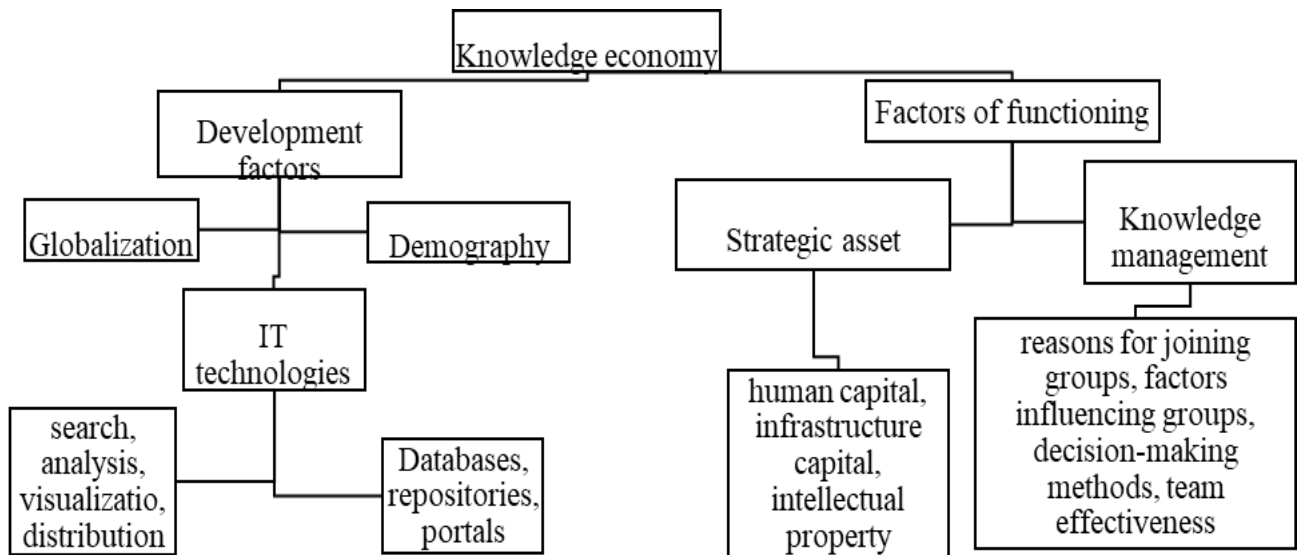


Figure 1. Infrastructure map of development and functioning of knowledge economy.

Source: developed by the author

All the above elements and factors can be grouped into logical and sequential stages of achieving the impact of the knowledge economy on the innovation of socio-economic systems (Figure 2).

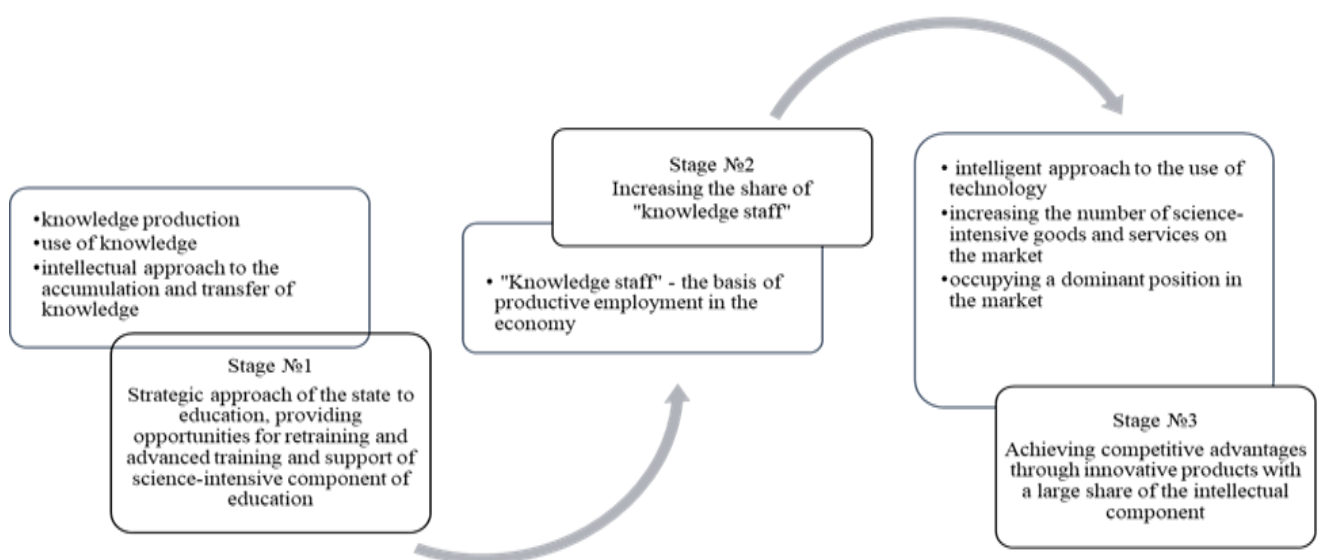


Figure 2. Stages of achieving innovation of socio-economic systems in the knowledge economy

Source: developed by the author

Hence, the development of the knowledge economy is based on the principles of knowledge society, which produces new knowledge and disseminates it through its intellectual and professional activities, thereby influencing the processes of innovation of socio-economic systems. The efficiency of coordination of industrial enterprises at the level of production complexes (large-scale socio-economic systems) increases when joining integrated structures for the following reasons:

- by participating in the implementation of socio-economic programs and priority investment projects of regional importance, they are able to significantly increase their manageability and reduce the corresponding risks for regional and municipal budgets;
- integrated structures are able to more efficiently and guaranteedly fulfill state and municipal orders;
- integration processes can seriously reduce transport costs of enterprises, increase the level of their profitability;
- integration of enterprises and organizations at the regional level will improve the situation with the production of goods for the needs of the local market.

Thus, the extensive system of knowledge economy directly affects the innovation of socio-economic systems, as the creation of the above conditions, along with stimulating the formation of socio-economic clusters increases the innovation activity of all economic entities. The reason is that within the unified production structure of a group of business entities, the efficiency of the use of intellectual resources and knowledge increases due to the expansion of access to them through the development of cooperation and integration relationships.

7.2.2 Measuring of Scales, the Innovative Diffusions of the Socio-Economic Systems in the Conditions of Changeable Knowledge

In 1962, in parallel with the theory of the KE, the theory of "Diffusion of Innovations" (hereinafter DI) was developed by E. Rogers [528], in which he explored communication processes to explain how an idea embodied in the development of a product or service spreads among a particular socio-economic system. In terms of theory, spread innovation diffusion is achieved when the system receives innovation

through the introduction of the use of new products or services. The key to success is that the adoption and use of the new is innovative diffusion.

Rogers identified five types of social and economic systems for the degree of dissemination of innovation diffusion:

- system-innovator - the first produces new ideas and perceives innovative diffusions;
- system-follower - creates opportunities for change and implementing innovative diffusion;
- system of the majority - at first proofs of functioning of innovative diffusion before the system accepts it are necessary;
- system - late perception - innovative diffusion is perceived after testing its system - the majority;
- conservative system - low level of perception of innovative diffusions.

Due to the fact that the theories developed in parallel with each other, and each of the theories fought for the right of "exclusivity" and not similar to the other, in today's reality we can understand that they are - inseparable from each other. The process of knowledge transfer is based on one practical and effective rule that helps to develop the KE - communication. Based on the DI system - innovations spread through the adoption, dissemination and communication in the socio-economic system.

Thus, innovative diffusion and knowledge transfer are interrelated and it can be stated that one triggers the other. Therefore, in order to study the processes of innovative diffusions of a socio-economic system in the constant conditions of changing knowledge, international banks and leading companies have developed methodological principles for measuring the scale of such processes.

1. The Knowledge Assessment Methodology (KAM)

The World Bank has developed the Knowledge Assessment Methodology (KAM) [539], which is an online tool. KAM is a handy interactive diagnostic and benchmarking tool designed to help socio-economic systems identify their strengths and weaknesses. Thus, KAM is useful in choosing ways to measure the scale of innovative diffusions of the socio-economic system, which will help identify problems

and opportunities for system development in a changing knowledge. The unique strength of KAM lies in its intersectoral approach, which allows us to holistically see a wide range of factors that help identify the positive or negative dynamics of the spread of innovative diffusions in the socio-economic system. Comparisons of socio-economic systems on the scale of innovative diffusions are calculated on the basis of 80 structural and qualitative variables. The variables are presented in the form of various diagrams and figures, which clearly emphasize the similarities and differences of the methods chosen by socio-economic systems to measure the scale of innovative diffusion. All data on which KAM is based are published by authoritative organizations involved in the collection and preparation of statistical data on the systems.

Currently, the methodological method of KAM, makes it possible to measure the scale of innovation diffusion as a whole or in a particular region of the socio-economic system in terms of constant change of knowledge by the following criteria:

- Global scale - comparison with all systems available in the KAM database;
- Regional scale - comparing the region of the system with other regions of the system;
- Intellectual scale - intellectual capital in comparison with other systems in the same categories that determine the development of intellectual capital;
- Financial scale - the main levels of income compared to other systems with the same category of income.

According to the methodology of the method of measuring the scale of innovative diffusions, KAM [539] developed a formula for a normalized indicator on a scale from 0 to 10 - the normalization indicator uses raw data - "u" to rank socio-economic systems on the scale of innovative diffusions, then calculates the number of systems with the lowest rating - "N_w" and uses the following formula to normalize estimates for each system for each variable according to their rating and in relation to the total number of socio-economic systems in the sample - "N_c".

$$u = 10 * (N_w / N_c)$$

According to the calculation carried out according to the methodological method, the scale values are obtained and the rating is compared (Figure 3), where:

- 10 - the best score according to the scale of innovative diffusions of the socio-economic system in changing conditions;
- 0 - the worst score for the socio-economic system.

In the context of the study, socio-economic systems are the leading countries with their scale of development of innovative diffusions in comparison with identical processes in the socio-economic system of Ukraine.

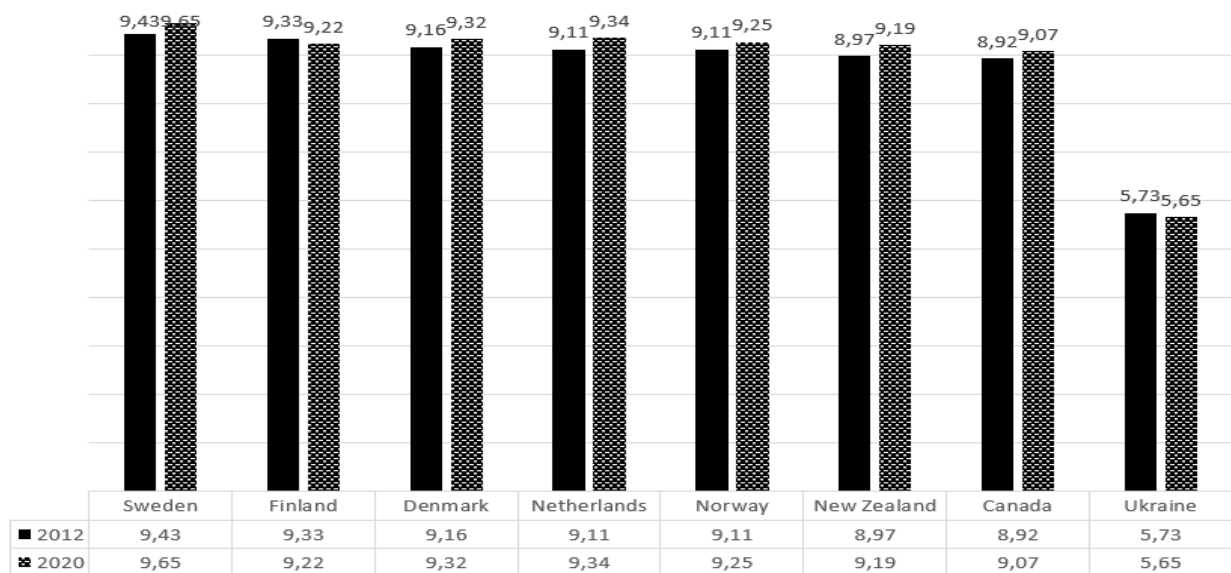


Figure 3. Leading countries in scaling innovative diffusions in KMA and Ukraine's place in the ranking

Source: compiled by the author based on statistical data [536]

Sweden has been the constant leader for 8 years, followed by the neighboring countries of the European Union, and New Zealand and Canada are joining them improving their performance. Unfortunately, Ukraine ranks 55th in the ranking and the indicators are deteriorating. The ranking is compared using indices (Figure 4): the Knowledge Index (KI) and the Knowledge Economy Index (KEI), based on the four pillars of the KE.

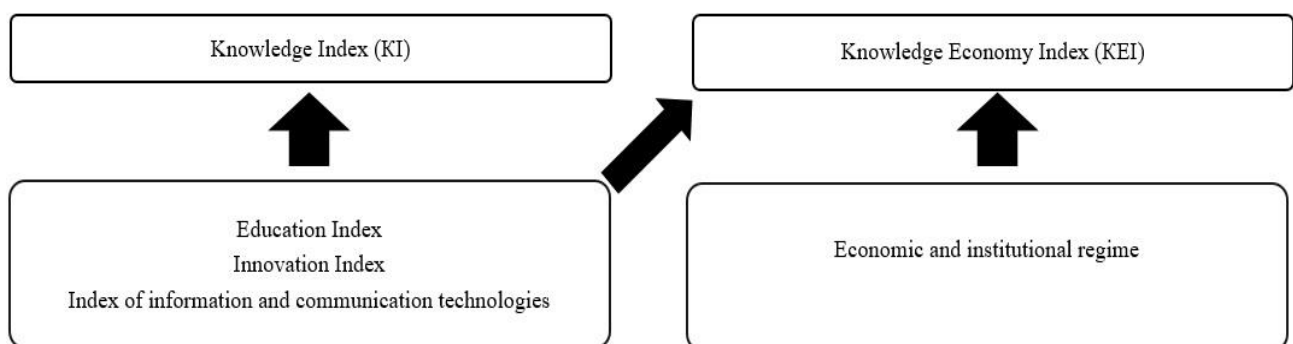


Figure 4. Relationship between knowledge indices and the knowledge economy

Source: developed by the author

Currently, 148 indicators (quantitative and qualitative indicators) are included in the index functionality, which form calculations. Because the set of indicators is very large, the World Bank has simplified the functionality and developed a "Baseline Scorecard" [536], which includes 14 basic ways to measure the scale of innovative diffusions of socio-economic systems.

One such method is the Index for the Development of Information and Communication Technologies (ICT) [540]. The presented methodology attaches great importance to this index, because the index itself highlights the full set of information and communication links of scaling the innovative diffusions of the socio-economic system. Since 2007, research has been conducted every year, the leaders in ICT development are Iceland, South Korea, Switzerland, Denmark and the United Kingdom. Ukraine ranks 79th in the ranking, behind most European Union countries and all CIS countries.

2. KE Index from EBRD

The European Bank for Reconstruction and Development (hereinafter EBRD) [541] has developed a methodological method [542] that fully meets the conditions of ever-changing knowledge - strategic assistance to the development and dissemination of innovative diffusions of socio-economic systems. The bank positions itself as a financial investor who offers specific ways to scale innovative diffusions for a particular socio-economic system.

The calculation methodology from the EBRD is based on four components and ten parameters (Figure 5) with which the bank develops recommendations for accelerating the processes of innovative diffusion of socio-economic systems. The Bank emphasizes that after calculating the indicators, methods for measuring the scale of innovative diffusions, in the face of constantly changing knowledge, are developed and applied individually for each socio-economic system.

Using the method, the EBRD divides socio-economic systems into three groups of readiness and ability to scale innovative diffusions:

- The first group - early implementation (unprepared innovation institutes and as a consequence lack of innovative skills and ICT);

- The second group is intermediate (development of innovation institutions and building ICT ties, but weak development of KE implementation skills);
- The third group is progressive (strong institutions, well-established ICT network and rooting of innovative skills).

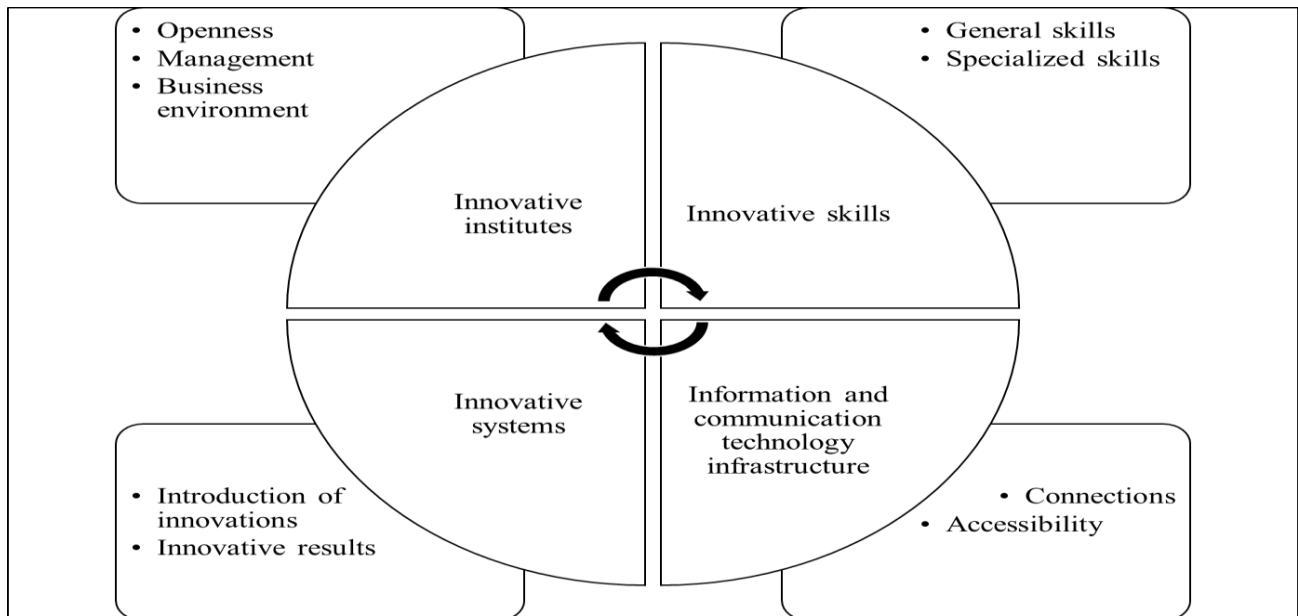


Figure 5. Structure of the EBRD Innovation Diffusion Scaling Index

Source: formed by the author on the basis of [542]

During 2011 – 2019 the EBRD studied the socio-economic systems of the partner countries and divided them into three groups, with the leading representatives of the progressive group being Estonia, Hungary, Croatia, Cyprus and Poland, and the representatives of the early group being Ukraine (Figures 6, 7), Bosnia and Herzegovina, Egypt, Turkmenistan and Uzbekistan.

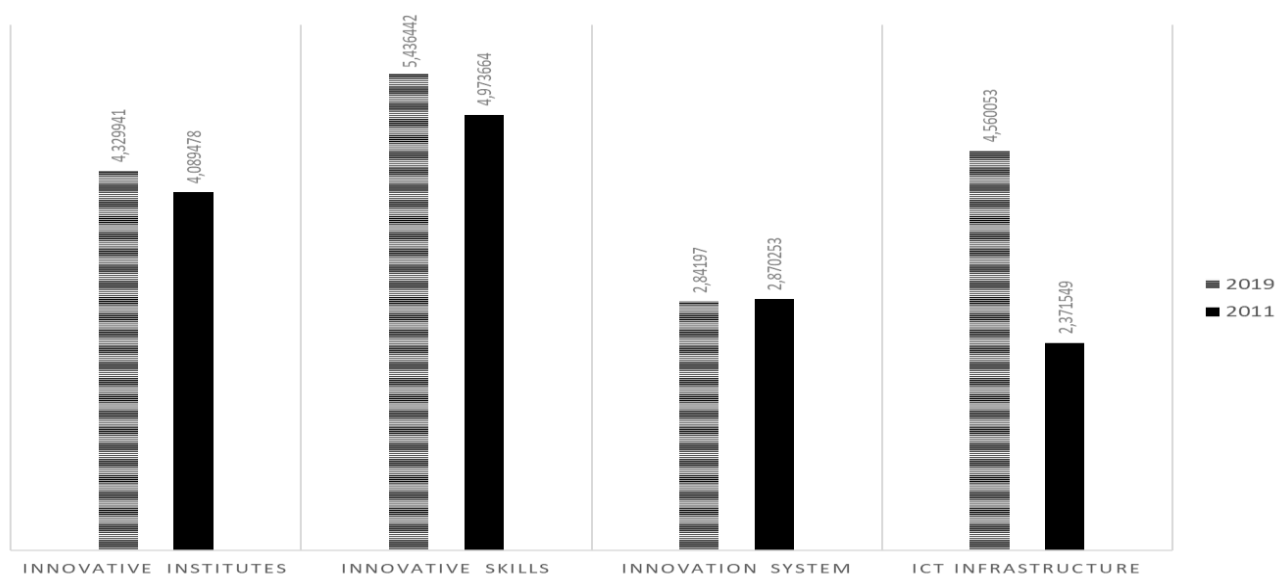


Figure 6. Dynamics of development of innovative diffusions in the conditions of the KE in Ukraine

Source: formed by the author on the basis of statistical data [542]

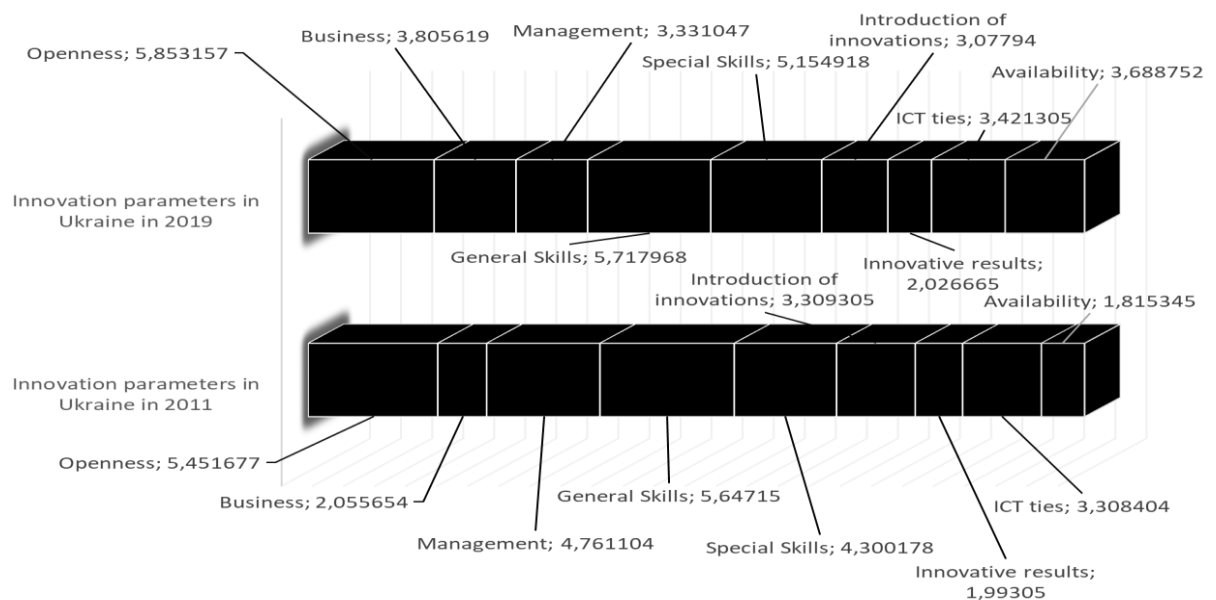


Figure 7. Dynamics of innovative development parameters in the KE in Ukraine

Source: formed by the author on the basis of statistical data [542]

Summing up the methods of measuring the scale of innovative diffusions of the socio-economic system in a constantly changing knowledge, it is necessary to adjust the strategy to eliminate negative factors that inhibit the development of special skills of perception, dissemination and rooting of innovative diffusions in all parameters.

Therefore, the choice of the direction of measuring the scale of innovative diffusions of socio-economic systems in the context of changing knowledge should include the following tasks and measures:

- improving business conditions that ensure the economic efficiency of market participants and improving the quality of their products, works, services, production of innovative products;
- intensification of innovative development of enterprises, introduction of innovations in all processes of economic activity;
- achievement of economic and social goals - economic growth of regions, transition to an innovative way of development, increase of well-being of the population;
- development by enterprises of a long-term strategy of credit borrowing, aimed at reducing business risks and taking into account the innovative way of development;

- attraction of significant budgetary and private resources, including within the framework of public-private partnership, for realization of technological updating, introduction of resource-saving innovations at the enterprises;
- active support and application of international norms and rules of production of innovative products (works, services) established by generally recognized international organizations.

Based on this, the question of measuring the scale of innovative diffusions of socio-economic systems in the context of changing knowledge will become relevant every day. At the same time, the issues in assessing the level and capacity of innovative diffusions of both organizations and regions still remain segmented and do not have a comprehensive view due to the selectivity and vastness of research on innovative diffusions.

7.2.3 Diffusion of Innovative Knowledge in the Context of Modern Development of the Socio-Economic Systems

The current course of development of socio-economic systems is impossible without the diffusion of innovative knowledge. In the context of the study, the authors proved that the development of socio-economic systems is achieved through the formation of a knowledge society, where the factor of formation of such a society is education and acquisition of competence through which the diffusion of innovative knowledge is achieved.

The role and scale of the educational sector in the socio-economic system is constantly growing and needs innovative renewal and improvement. According to the World Bank study "Globalization, Growth and Poverty: The Formation of the Global Economy" [536], which examined the experience of 24 socio-economic systems, there is a link between increasing the percentage of society with higher education and reducing the percentage of society on the brink of poverty points to the increasing pace of development. Knowledge, education, information and communication channels are currently indicators of the diffusion of innovative knowledge of the development of socio-economic systems.

Against the background of global socio-economic trends, Ukraine pays significant attention to the issue of education and ensures its accessibility, meaningful quality and comprehensiveness. Within the framework of the development of the socio-economic system of Ukraine, the “National Strategy for the Development of Education in Ukraine until 2021” [543] and the “National Doctrine for the Development of Education in Ukraine” [544] were approved diffusion of innovative knowledge and development of the socio-economic system. In Ukraine, there is always a high level of public demand for education at all levels, so the cost of providing a high level of education is constantly growing (Figure 8).

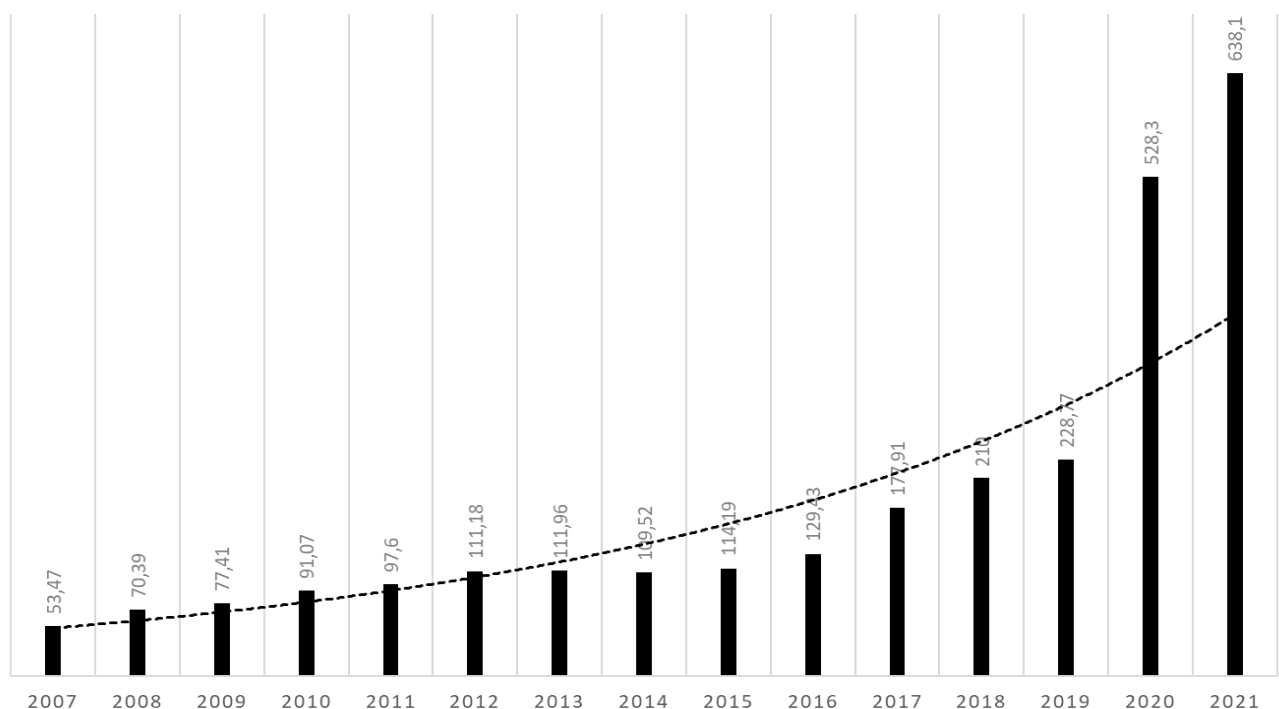


Figure 8. Expenditures of the budget of Ukraine for education in innovative conditions of socio-economic development

Source: formed by the author on the basis of statistical data [545]

In the context of all expenditures on education, higher education deserves special attention because it is the last link in the formation of the knowledge society of the socio-economic system. Current trends indicate a change in the choice of specialties and future professions by students, which reflects the transition from the industrial system with industrial and applied professions to the post-industrial one, where the predominant professions are humanities, law and information and communication (Figure 9).

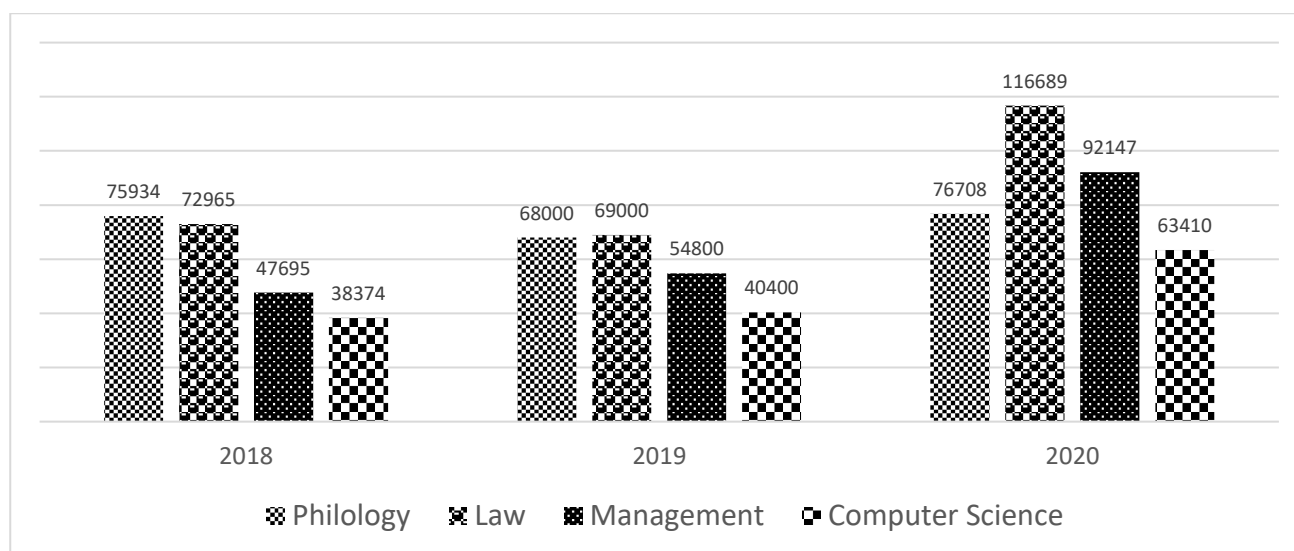


Figure 9. Conjunction of educational specialties in the context of socio-economic system development

Source: based on statistical data [546]

However, with the increased level of expenditures on education, including higher education, and the change in the choice of professions, there is an imbalance between the development of education and the development of the knowledge society of the socio-economic system. This imbalance is observed in the calculations of the education index [547] and the human development index [548].

Table 3
Imbalance of education and human development

Index	Place in the ranking for the studied years	
	2013	2020
Education index	28	47
Human Development Index	83	74

Source: formed by the author on the basis of [543, c. 17]

The imbalance is caused by the fact that there is a gap between the needs of sectors of the socio-economic system and the demand for specialties. This indicates that the diffusion of innovative knowledge requires a balance between the demand for specialties and the needs of the labor market of the socio-economic system.

Another imbalance is the outflow of intellectual power, which begins with Ukrainian students. In 2019, the Ukrainian Independent Analytical Center Cedoss (Center for Society Studies) [549] presented a report on the study from 2008 to 2019 on the number of Ukrainian students studying abroad. According to these data, most students are in Poland, Russia and Germany, and every year the percentage of students

studying abroad grows by 1-2%. Of the total number of entrants to Ukrainian universities, these percentages are not so significant, but the fact that the dynamics of migration of carriers of innovative knowledge requires the development of measures to stop this negative trend.

Therefore, to develop the socio-economic system and accelerate the diffusion of innovative knowledge, a developed educational paradigm is proposed (Figure 10) which will help to make good use of the intellectual resource of the system and lead to social cohesion in achieving economic benefits.

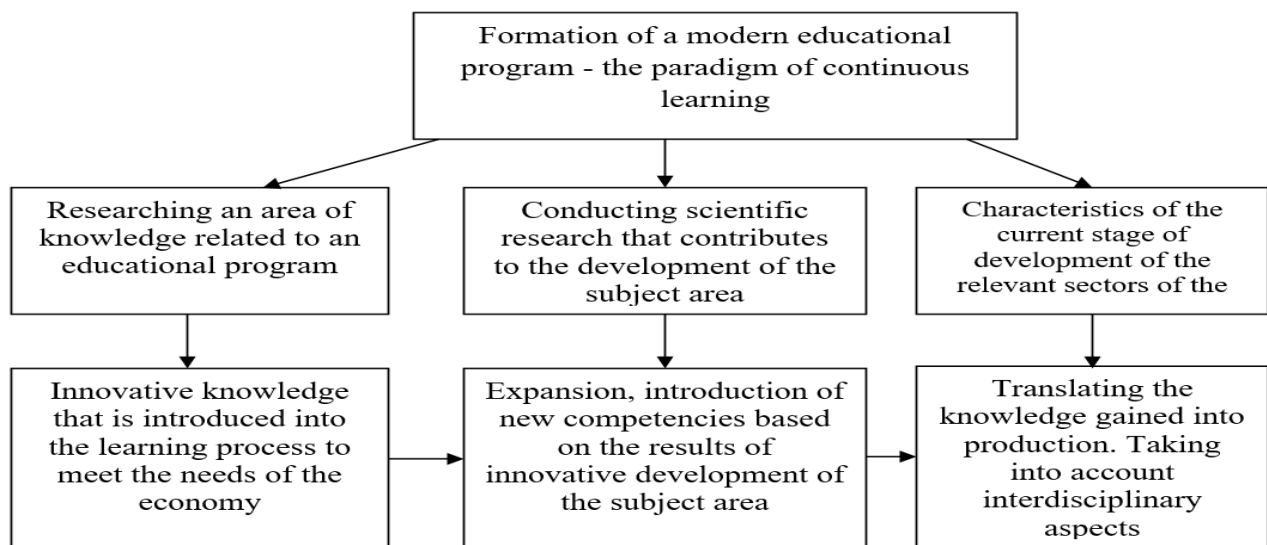


Figure 10. - The paradigm of lifelong learning
Source [550]

The developed paradigm of continuous acquisition of knowledge will promote further development, the emergence of new knowledge, accelerate the transformation of quality educational services and the content of acquired competencies that meet the current rate of diffusion of innovative knowledge in the socio-economic system.

The effectiveness of knowledge-intensive socio-economic system is manifested in the growing human capacity for intellectual and managerial work, as well as its desire for creative self-realization. It follows that the results of science-intensive production largely depend on the capabilities and potential of the subject of innovative development.

Therefore, to ensure the diffusion of innovative knowledge in the context of modern development of socio-economic systems in terms of stable growth of indicative financial and economic indicators and efficiency of enterprise assets, it is necessary to

include targeted investment projects to form human capital in a number of mandatory procedures included in the strategy development of the organization.

Summing up, it should be emphasized that the diffusion of innovative knowledge in the context of modern socio-economic systems is impossible without improving the training of knowledge-intensive industries, which should be focused on the strategic needs of the economy. Solving this problem requires high-quality modernization in the system of higher professional education by combining the efforts and communications of higher education institutions, research organizations, business structures, the state and the public.

Based on the results of the study, it can be noted that the development of innovative diffusions of socio-economic systems in the knowledge economy is possible through determining the scale of innovative diffusions and the introduction of diffusion of innovative knowledge in the context of their constant modernization and mastering the main trends of changing knowledge.

Many measures to support innovative diffusion currently have a weak impact, as their effectiveness is limited by a number of factors. The predominant emphasis in innovation policy on supporting government research institutions and technology startups, rather than on gradual, adaptive innovation in general, undermines much of the innovation potential. Private sector development policies tend to focus on individual industrial sectors and small and medium-sized enterprises, rather than on a small subgroup of innovative, potentially fast-growing entrepreneurs conducting innovative experiments. Finally, financial resources and institutional capacity are insufficient to implement ambitious innovation diffusion plans.

Current trends in the development of socio-economic systems in the knowledge economy lead to the emergence of new factors, mechanisms and approaches that ensure the spread of innovative diffusions. The analysis shows that the driving force is the formed intellectual society, which accelerates the development of socio-economic system.

The theoretical value of this study lies in highlighting the trends of innovative diffusions of the socio-economic system of Ukraine in the knowledge economy. Given

the above study, to revive the innovation of the socio-economic system, we can offer the following recommendations:

1. The education sector of the socio-economic system should focus on openness and accessibility of educational services in which theoretical and practical components will fully ensure the diffusion of innovative knowledge.

2. Combining the world of science and business by applying existing knowledge in business and producing new ones by raising funds for research and development will be the key to increasing the scale of innovative diffusion in the socio-economic system under ever-changing knowledge.

From the practical side of the study, the authors summarize the structure of all elements of sustainable development of the socio-economic system in a knowledge economy; stages of achievement of innovative diffusions of system are formed and the paradigm of constant acquisition of knowledge which will provide diffusion of innovative knowledge is developed.

Thus, the main problem of widespread implementation of innovation diffusions in socio-economic systems is the long-term mismatch of innovation strategy with the priorities of sustainable development and the priorities of central policy initiatives in the field of industrial development.