ЕКОНОМІКА ПРИРОДОКОРИСТУВАННЯ ТА ОХОРОНИ НАВКОЛИШНЬОГО СЕРЕДОВИЩА

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Metelenko Natalia
Doctor of Economics, Professor,
Director of the Engineering Institute
of Zaporizhzhia National University

Trokhymets Olena
Doctor of Economics, Professor,
Professor of the Department of National Economy,
Marketing and International Economic Relations
Classic Private University

Sobczyk-Kolbuch Anna
Ph.D., Associate Professor,
Dean of International Affairs,
Department of Management and Marketing
Katowice Business University (Akademia Górnośląska), Poland
ORCID: https://orcid.org/0000-0003-0443-9099

Метеленко Н.Г.
доктор економічних наук, професор,
директорка Інженерного навчально-наукового
інституту імені Ю.М. Потебні
Запорізького національного університету
ORCID: https://orcid.org/0000-0002-6757-3124

Трохимець О.І.
доктор економічних наук, професор,
професор кафедри національної економіки,
маркетингу та міжнародних економічних відносин
Класичного приватного університету
ORCID: https://orcid.org/0000-0001-7587-7948

Собчик-Колбух Анна
кандидат економічних наук, доцент,
декан з міжнародних зв'язків,
кафедра менеджменту та маркетингу
Університет бізнесу в Катовіце (Akademia Górnośląska), Польща

INNOVATIVE ECOSYSTEMS IN THE CONTEXT OF MODERN TRANSFORMATIONS AND MILITARY ACTIONS IN UKRAINE

ІННОВАЦІЙНІ ЕКОСИСТЕМИ В КОНТЕКСТІ СУЧАСНИХ ТРАНФОРМАЦІЙ ТА ВОЄННИХ ДІЙ В УКРАЇНІ

The article examines the essence of the concept of "innovation ecosystem", highlights the factors that affect the processes of formation of innovation ecosystems, and provides a proper definition of the innovation ecosystem. The components of the innovation ecosystem were analyzed; the priority areas of Ukraine's innovative activity are highlighted and their correlation with the Strategy of Smart and Sustainable Development of Europe is determined. It has been proven that innovation is a strategic growth factor. The principles of formation and functioning of the national innovation ecosystem are systematized. The importance of technological platforms as a mechanism of effective co-

operation between participants of the innovation ecosystem is highlighted. Guidelines for the formation of innovative ecosystems in the context of cooperation between Ukraine and the European Union are proposed, which take into account the losses caused by the full-scale military aggression of the russian federation against Ukraine.

Keywords: *innovative ecosystem, sustainable development, global responsibility, environmental protection.*

У статті досліджено сутність поняття «інноваційна екосистема», виділено чинники, що впливають на подальші процеси формування інноваційних екосистем в Україні, надано власне визначення інноваційної екосистеми та ключові напрямки підтримки життєдіяльності і збалансованості інноваційної екосистеми. Проаналізовано складові інноваційної екосистеми; виділено пріоритетні напрями інноваційної діяльності України та визначено їх кореляцію зі Стратегією розумного та стійкого розвитку Європи у напряму сприяння розвитку конкурентоспроможної економіки та суспільства України шляхом використання механізмів східного партнерства задля забезпечення дотримання глобальної відповідальності та зобов'язань у таких сферах, як охорона здоров'я, захист навколишнього середовища. Доведено, що інновації є стратегічним фактором зростання, які суттєво впливають на структуру виробництва та організацію економічної діяльності. Систематизовано принципи формування та функціонування національної інноваційної екосистеми, до яких увійшли: принцип гласності та інформаційної прозорості; принцип децентралізації та балансу інтересів зацікавлених сторін; принцип адаптивності; принцип взаємодії; принцип стратегічної спрямованості; принцип урахування інноваційного потенціалу територіальних громад; принцип урахування змін; принцип науковості; принцип орієнтації на потреби ринку. Авторами виокремлено значущість технологічних платформ як механізму ефективної співпраці учасників інноваційної екосистеми у напряму розвитку національної економіки. Запропоновано орієнтири формування інноваційних екосистем в контексті співпраці України та Європейського союзу, які враховують втрати, що спричинені повномасштабною військовою агресією російської федерації проти України, зокрема, територіальні інвестиції конкретних регіональних стратегій розвитку; об'єднання інструментів регіональної та промислової політик; координація розвитку та узгодженість дій міст та регіонів із науковою, освітою, промисловістю, соціальними та адміністративними організаціями.

Ключові слова: *інноваційна екосистема, стійкий розвиток, глобальна відповідальність, захист навколишнього середовища.*

Statement of the problem. The experience of formation and development of innovative ecosystems of the European Union countries is very important for its practice in Ukraine. Conceptually, the innovation ecosystem is based on a knowledge economy that drives basic research and a commercial economy. The transition from a knowledge economy to a commercial economy requires the joint efforts of a significant number of participants and resources necessary for the creation and implementation of innovations (entrepreneurs, investors, research scientists, scientific organizations, universities, venture capital organizations, enterprises, public authorities). Innovation is the result of scientific research that has the potential for a cycle of investment in the production of prototypes, their testing and implementation in innovative enterprises, which directly affect economic growth and increase the profit of the commercial economy. Innovation is the result of scientific research that has the potential for a cycle of investment in the production of prototypes, their testing and implementation in innovative enterprises, which directly affect economic growth and increase the profit of the commercial economy. The Agreement on the association of Ukraine with the EU and the involvement of Ukraine in the Horizon 2020 program provided the following opportunities: for using the mechanisms of the Eastern Partnership for cooperation between Ukraine and the EU in the field of science and technology; involvement in the Strategy for the Smart and Sustainable Development of Europe; promoting the development of a competitive economy and society of Ukraine. All the mentioned above opportunities "pushed" us enough to intensify innovation activities in Ukraine during 2016–2021. But the full-scale russian invasion in February 2022 changed our joint plans.

Analysis of recent research and publications. In our persuasive opinion, along with the study of the definitions of the concept of "innovation ecosystem" [1–4], it's necessary to take into account the critical conditions of today in Ukraine, which directly affected the key components of the innovation ecosystem. The authors [5] include, in particular, the infrastructure that ensures the functioning of innovative companies. It can be both tangible (technology parks, business incubators, development institutes, etc.) and intangible (various services specially adapted to the needs and specifics of innovative companies, such as services for the protection of intellectual property, for the introduction and promotion of innovative products to foreign markets). As of 16.05.2023, the infrastructure that belongs to the innovative and is an integral component of the innovative ecosystem was significantly damaged and partially destroyed in Ukraine, therefore the emphasis in creating innovative ecosystems in Ukraine should be on territorial communities (cooperatives); joint action in the field of creating knowledge flows; governmental support for technological development.

Objectives of the article. The purpose of the article is to study and systematize the influencing factors and components of the innovation ecosystem in the conditions of modern transformations and military actions in Ukraine.

Summary of the main results of the study. Strategic changes in the concept of forming innovative ecosystems have taken place in Ukraine since the full-scale invasion of the sovereign territory

of Ukraine by the russian invaders on 24.02.2022. And another act of ecocide, which was committed on 06.06.2023 by blowing up the Kakhovka Hydroelectric Station, threatens unprecedented environmental consequences for the south of Ukraine and the entire Black Sea region. The Chernobyl disaster became a spark for the formation of a powerful environmental movement in Ukraine and the world. In 2000, the Chernobyl Nuclear Power Plant stopped producing electricity, and in 2018, a new solar power plant started operating on its industrial site. The share of electricity produced from renewable sources (solar, wind and bioenergy plants of Ukraine) increased from 1% in 2014 to more than 7% in 2020, and the number of owners of home "solar" stations during the same period increased from a few dozen to 30 thousand owners. At the same time, the russian war in Ukraine, in addition to all other destruction and suffering, continues to harm the planet's climate. According to an updated estimate by the War Greenhouse Gas Emissions Accounting Initiative war-related greenhouse gas emissions in just twelve months of war totaled 120 million tons of CO2eq. This is equivalent to the total annual greenhouse gas emissions of Belgium [6].

This is one of the effects of the war that will be felt not only in Ukraine, but also far beyond its borders, including the countries of the Global South and, in particular, the least developed countries, which are often the most vulnerable to the effects of climate change. Such an impact will consist both in the direct increase in the risks of the manifestation of catastrophic consequences of climate change (increased temperatures and extreme heat waves, droughts, heavy rains and other natural disasters, loss of biodiversity, etc.), and in the possible risk of redirecting financial resources from helping to reduce emissions and reducing vulnerability to climate change on strengthening security and militarization [7]. Also, russian troops, while destroying our forests, use wood for building fortifications, laying infrastructure, heating and cooking.

After the war, we will inevitably face such results of hostilities – the destruction of ecosystems, soil pollution, a decrease in biodiversity, and an increase in the number of pests in forests. In addition, the reconstruction of the country will require a significant amount of natural resources. There is also a risk that Ukraine will not fulfill the already set climate goals, because the war influences climate change, and the recovery of the country will inevitably be accompanied by significant greenhouse gas emissions. Therefore, it is already necessary to form the conceptual foundations of the vector of innovative ecosystems, to determine the directions and principles of ensuring the innovative development of Ukraine.

The innovation ecosystem is a synergy of the state, business and research environment, aimed at joint actions in the field of creation of knowledge flows, support of technological development and commercialization of innovations [8].

In general, the innovation ecosystem consists of the following components:

– human capital: people, competences, demand, ambitions, knowledge – intangible assets that are important for creating innovations;

– relationship capital: shared vision, confidence, trust, behavior;

– structural capital: companies, organizations, programs, financial infrastructure funds, which develop innovative activity in geographical and branch areas, which is important for the implementation of innovations [9].

The innovation ecosystem allows entrepreneurs, companies, universities, research organizations, investors and government agencies to interact in order to maximize the potential of research and innovation in terms of obtaining economic results. Each innovation ecosystem has its own individual character (space, potential, opportunities, challenges), long-term vision and pioneers who develop new innovative ways (experiment and explore) to more fully use the potential.

The role of public policy in the formation and development of innovative ecosystems includes the process of improving the current situation and opening new opportunities through the provision of resources, education, infrastructure, demand articulation, for example, public procurement. Territorial investments of specific regional development strategies are an important tool for creating a balanced innovation ecosystem.

Scientific research is the basis of economic growth, but must be carried out at the expense of the profits generated by the commercial economy. Innovation, as a result of scientific research, which has the potential for a cycle of investments in the production of prototypes, their testing and implementation at innovative enterprises, which directly affects economic growth and increase the profit of the commercial economy [10].

An innovation ecosystem can be structured around almost any technology, organization, city, region, industry, country. The main thing is to determine how to turn the results of research into innovative products that bring profit. Increased investment in the knowledge economy comes at the expense of increased profits in the commercial economy. Increasing the speed of innovation transfer from scientific research to the commercial sphere does not yet guarantee the prosperity of the innovation ecosystem. It is necessary to maintain a high-quality innovation cycle of investments and a high growth of net profit. The innovative effects of the increasing profits of the commercial economy exceed the initial investment in the knowledge economy.

The priority areas of innovative activity for the period of 2011–2023 (amended from 02.05.2023) defined by Art. 4 of the Law of Ukraine "On Priority Areas of Innovative Activity in Ukraine" [11] are the following:

– development of new energy transportation technologies, implementation of energy-efficient, resource-saving technologies, development of alternative energy sources;

– development of new technologies of high-tech development of the transport system, rocket and

space industry, aircraft and shipbuilding, weapons and military equipment;

– development of new technologies for the production of materials, their processing and joining, creation of the industry of nanomaterials and nanotechnologies;

– technological renewal and development of the agro-industrial complex;

– introduction of new technologies and equipment for high-quality medical care, treatment, pharmaceuticals;

– wide application of cleaner production and environmental protection technologies;

– development of modern information, communication technologies, robotics.

The Association Agreement between Ukraine and the EU [12] provides opportunities for using Eastern Partnership mechanisms for Ukraine's cooperation with the EU in the field of science and technology and involvement in the Strategy of Smart and Sustainable Development of Europe and promoting the development of Ukraine's competitive economy and society.

In particular, according to Art. 374 of this Agreement "the parties develop and strengthen scientific and technological cooperation with the aim of both scientific development as such and strengthening of their scientific potential to solve national and global challenges. The parties are making efforts to achieve progress in the acquisition of scientific and technological knowledge, important for ensuring sustainable economic development, through the development of research capacities and human potential. Accumulation and exchange of scientific information contribute to increasing the competitiveness of the Parties by expanding the opportunities of their economies to acquire and use knowledge for the commercialization of new products and services. After all, the Parties develop their scientific potential in order to comply with global responsibilities and obligations in such areas as health care, environmental protection, including climate change, and other global challenges" [12].

According to Art. 376 of the same Agreement "cooperation is ensured, in particular, by: exchanging information on the policy of the Parties in the field of science and technology; participation in the next EU Framework Program for Research and Innovation "Horizon 2020"; joint implementation of scientific programs and research activities; joint research activities aimed at encouraging scientific progress, transfer of technologies and know-how; training through implementation of exchange programs for researchers and specialists; organization of joint activities on scientific and technological development; taking measures aimed at developing favorable conditions for conducting research and introducing new technologies, as well as proper protection of intellectual property of research results; activation of regional and other international cooperation, in particular in the Black Sea context and within the framework of multilateral organizations, in particular the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organization for Economic Cooperation and Development (OECD) and the Great Eight (G8), and also in the context of multilateral agreements, such as the UN Framework Convention on Climate Change of 1992; exchange of experience in the field of management of scientific research institutions with the aim of developing and improving their abilities to carry out and participate in scientific research [12]. In Art. 375 states that "cooperation takes into account the current framework of cooperation established by the Agreement on cooperation in the field of science and technology between Ukraine and the European Community [13], as well as the goal of Ukraine to gradually approach the policy and law of the EU in the field of science and technology.

That is, it is clear that one of the key trends in the modern development of the world economy is the deployment of globalization processes, which significantly affect the system of international economic, political and socio-cultural relations, transform directions and determine the development trends of national economies. In view of these trends, the highly developed countries of the world are already reorienting themselves from science and technology to innovation policy; innovation is a strategic growth factor and significantly affect the structure of production and the organization of economic activity.

However, it should be emphasized that they become a source of development only under the condition of their active and effective use, as well as the presence of a favorable environment for their implementation, namely innovative ecosystems. Therefore, one of the most urgent questions facing domestic and foreign scientists today is the definition of directions, methods and principles of ensuring the innovative development of Ukraine in the conditions of the European vector of development. As a result of the full-scale invasion of the russian occupiers on February 24, 2022, the processes of forming innovation ecosystems in Ukraine and the development of national innovation ecosystems were forcibly suspended. But, already today, scientists and business are oriented and motivated by the processes of intensive recovery of Ukraine in the post-war period.

Therefore, we believe that the main principles of the formation and functioning of the national innovation ecosystem should include the following:

– *the principle of openness and information transparency* (the system is open to new participants with innovative ideas (there is no information asymmetry between participants and external parties; there is a positive return on investment, high investment risk is compensated by the principle of diversification);

– *the principle of decentralization and balance of interests of interested parties* (ecosystem management is distributed between the state, key partners, investors, innovators);

– *the principle of adaptability* (activity is aimed at the development of industries that are attractive taking

into account the current state, degree of damage or destruction, territorial resource capabilities);

– *principle of interaction* (participants actively interact in order to exchange ideas and resources both inside the ecosystem and outside);

– *the principle of strategic orientation* (ensuring the achievement of general goals within the chosen strategy of formation and functioning of the innovation ecosystem);

– *the principle of taking into account the innovative potential of territorial communities* (key areas of research are determined within the ecosystem as a result of the interaction of the governing parties, while 80% of resources are focused on priority research fields with a high potential for commercialization);

– *the principle of taking changes into account* (presupposes the need for research and the use of a problem-oriented approach during the development and implementation of innovations in wartime and postwar times);

– *the principle of sxientific character* (based on real possibilities and taking into account the peculiarities of the national economy using world experience regarding the activity of innovative ecosystems);

– *the principle of orientation to market needs* (presupposes the study of market needs and the determination of types of innovations capable of satisfying consumer needs and providing competitive advantages).

It should be noted that all over the world the state takes an active part in the formation of the ecosystem. Let's note state initiatives on the formation of ecosystems: in Finland, the development and implementation of the ecosystem approach is carried out by the state Research and Innovation Council and the agency "TEKES", and in Sweden – the Swedish Government Agency for Innovation Systems "VINNOVA". In many national economies (USA, Canada, Great Britain, South Korea, Israel, China, Australia, etc.), regional innovation ecosystems are being formed, designed to achieve world-class innovation effects. They form innovation hubs, or network innovation communities, which enable countries to continuously carry out innovative reproduction, flexibly responding to technological and market changes, and at the intersection of various network environments to promote the birth and transfer of powerful flows of new knowledge.

According to [9], the ranking of national innovation ecosystems according to the Global Innovation Index (GII) is the following: Switzerland (1st place), Sweden (2nd place), the Netherlands (3rd place), Great Britain (5th place), Denmark (6 place), Finland (8th place), Germany (9th place), Ireland (10th place), Estonia (25th place), Poland (38th place), Hungary (39th place), Romania (42nd place), Russia (45th), Ukraine (50th place), Moldova (54th place), Armenia (59th place), Georgia (68th place), Kazakhstan (78th place), Azerbaijan (82nd place), Belarus (88th place). According to the GII 2020, Switzerland is also the world's most innovative economy, followed by Sweden, the United States of America (US), the United Kingdom (UK), and the Netherlands [14].

The World Intellectual Property Organization had published the Global Innovation Index 2021 (hereinafter GII 2021). In 2021, Ukraine worsened its rating and took the 49th position (in 2020 it took the 45th position) in the overall rating (scored 35.6 points out of 100), and also took the 32nd position among 39 European economies [15]. The trends of changes in the rating components are the following: regulatory environment – 78th position (– 2 positions); business environment – 104th position (no changes); human capital and research – 44th position (– 5 positions); education – 23rd position (no changes); R&D – 58 position (– 14 positions); information and communication technologies – 69th position (+ 13 positions); knowledge and results of scientific research – 33 position (– 5 positions). In 2022, Ukraine took the 48th position in the rating, which is quite a high result, considering that the country is in a state of war.

It is clear that the purpose of the Global Innovation Index (GII) is to provide in-depth data on innovation and in turn to help economies assess their innovation performance and make informed decisions about innovation policy. Ukraine, even today, in the conditions of full-scale hostilities, demonstrates the growing dynamics of the development of innovative activities. Key obstacles to the innovative development of Ukraine against the backdrop of a full-scale war include: insufficient development of innovative infrastructure: clusters, technoparks, industrial zones; low level of attracting foreign direct investment and technology transfer; insufficient level of funding for applied research and its weak connection with industry.

The effectiveness of innovative ecosystems directly depends on a number of factors that have a significant impact on the effectiveness of both the subjects of innovative activity and integrative interaction with business, as well as the functioning of the ecosystem as a whole. The key directions of supporting vital activities and the balance of the ecosystem are the following: availability and timeliness of provision of resources (financial, administrative, human, intellectual, etc.), their optimal and balanced distribution, continuous investment in scientific and scientific and technical infrastructure; clear strategic goals and objectives with the definition of relevant evaluation indicators for their achievement; system management, which involves disciplinary and social responsibility, wide use of Internet platforms for effective interaction between partners; formation of a flexible system for ensuring integration and expansion of partnership relations; permanent monitoring and control of ecosystem functioning; formation of organizational culture within economic and legal conditions (protection of intellectual property, inflation rate, corruption, taxes, financial state of the state, insurance system, competitive and consumer environment, national characteristics, etc.).

It is obvious that the main participants of the innovation ecosystem are scientific organizations, universities, state and private research organizations

that are part of large companies, as well as subjects of scientific and scientific and technical innovation activities, consulting services, etc. Scientific organizations play a key role in the functioning of the innovation ecosystem, ensuring the performance of not only fundamental, applied and exploratory research as a result of the implementation of technological works, the generation of new knowledge, the commercialization of the results of innovative activity, but also are active participants in network forms of integration of science, education and business, which helps the continuous movement of the life cycle of innovations according to the priority directions of the high-tech sector of the national economy.

Conclusions. Thus, the "innovation ecosystem" is a highly coordinated system of dynamic relationships that arise between economic agents and institutions, the result of which is innovative activity, commercial success of projects, and technological modernization of the economic structure of the state, the effectiveness of which depends on the degree of conformity of the institutional environment to the needs science, education and business and the ability of the latter to ensure the closure of the innovation cycle. Any national innovation ecosystem is built by the joint efforts of the state (with the help of legislation that implements a certain macroeconomic policy), the scientific sphere (fundamental research and training of research personnel) and the entrepreneurial environment (applied research, commercialization of technologies, production and sale of innovative products).

Taking into account the destructive processes caused by the full-scale war of Russia against Ukraine during 2022–2023, technological platforms become especially important as a mechanism for effective cooperation of the participants of the innovation ecosystem, whose activities are aimed at supporting the process of creation and commercialization of innovative developments. Today and in the post-war recovery period of Ukraine, the concept of technological platforms is especially relevant for the national economy due to: the destruction of strategic sectors of the economy; innovative challenges; fierce competition and insufficient technological development until February 24, 2022; use of imported technologies; inefficiencies of management tools for stimulating innovative activity; openness of ecosystem participants. Therefore, the creation and functioning of technological platforms should be aimed at ensuring the integration interaction of subjects of innovative activity; creation of new scientific and technological directions; accelerated transfer of potentially promising technological developments; establishing contacts between developers of innovations and representatives of the real sector of the national economy. The vector of the formation of innovative ecosystems in the context of cooperation between Ukraine and the European Union, in our convincing opinion, should be oriented towards:

– creation of new opportunities through provision of resources in science, education, infrastructure;

– territorial investments of specific regional development strategies, research, innovation, entrepreneurship;

– unification of regional and industrial policy tools, which is especially relevant in connection with the systemic destruction of strategic industries in the period 2022-2023;

– creation of a smart specialization platform;

– implementation of the smart specialization strategy;

– coordination of development and coordination of actions of cities and regions with science, education, industry, social and administrative organizations.

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