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**NATIONAL INNOVATION SYSTEMS AS PLATFORMS FOR THE  
DEVELOPMENT OF HIGH-TECH COMMERCIALIZATION**

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*The article deals with the main structural elements of the innovation system and the preconditions for their formation and influence on the innovation system as a whole. The author's understanding of the concept of "national innovation system" has been presented. The stages of the life cycle of the national innovation system have been presented. It has been proved that international cooperation is a powerful driving force for the development of world industries, the main form of international high-tech cooperation. The main mechanisms of international cooperation of national innovative systems in the field of high technologies have been outlined.*

*Keywords: national innovation system; R&D; innovation cluster; industrial park networking; technological platform.*

*аспірант, Бутко Б. О., Національні інноваційні системи як платформи для розвитку високотехнологічної комерціалізації, Київський національний університет імені Тараса Шевченка, Україна, Київ*

*У статті розглянуто основні структурні елементи інноваційної системи та передумов їх формування та впливу на інноваційну систему в цілому. Подано авторське розуміння поняття «національна інноваційна система». Представлено етапи життєвого циклу національної інноваційної системи. Доведено, що міжнародне співробітництво є потужною рушійною силою розвитку*

*світових галузей промисловості, основною формою міжнародного високотехнологічного співробітництва, матеріальною основою процесів міжнародної економічної інтеграції та глобалізації. Окреслено основні механізми міжнародного співробітництва національних інноваційних систем у сфері високих технологій.*

*Ключові слова: національна інноваційна система; R&D; інноваційний кластер; створення мереж промислового парку; технологічна платформа.*

**Relevance of a subject.** With the depletion of raw materials, relatively extensive economic growth and the weakening of their influence, the innovation process becomes the main factor for overcoming the crisis and further social and economic development, its role and significance are rapidly growing in context of civilization progress. At same time, modernization on basis of innovations is only a part of the complex process of technical and economic evolution, it involves changing not only the technology of production and consumption of products, but also changes economic relations, mechanisms and institutions. This causes the formation of invariant national innovation systems and the constant search for improvement of international cooperation models in creating high-tech products.

**Analysis of the latest publications on a research subject.** Significant contribution to the disclosure of the phenomenon of the systemic nature of innovative processes was carried out by F.Linn, K.Freeman, J.Schumpeter, F.Hayek, R.Solow, P.Romer, R.Lucas, D.Nort, F.Lundwall, P.Nelson and others.

**Unresolved parts of research body.** Complexity of the analysis of formation of national innovation systems and their interaction is primarily related to the difficulty of fixing system-forming technological shifts by

traditional methods of measurement, where the indicators of physical volume production do not reflect the development of economy in sufficient measure. Technological changes are becoming more and more "blurred" and show significant deviations from traditional scientific and production technological cycles.

**Body of the research exposition.** Increasing speed of new inventions and emergence of radically new areas of research, which more often become independent branches of scientific knowledge, contribute to the increasing rate of obsolescence of existing technology. Subsequent depreciation of constant capital causes a significant increase in cost, as well as a drop in competitiveness. Therefore, most manufacturers have developed a high interest in the results of scientific research, therefore they tend to multiply contacts with science. This caused the shift of vector of competitive struggle in the global market towards high techn. Thus, with rapid development in high tech field, the process of cognition can no longer remain on the evolutionary basis of development. The giant speed of the emergence of fundamentally new information, its scale and modification, makes necessary maintenance of high competitiveness through creation of new format and principles for responding scientific and experimental results: "innovation, development of human and institutional capacity continues to play a leading role in determining the most competitive economies." (2014-2015 Report on Global Competitiveness) [1].

The rapid development of "knowledge economy", growing interconnection between capital markets and new technologies, strengthening of social orientation of new technologies, large-scale nature of the creation and use of knowledge, technologies, products and services have led to the emergence of national innovation systems as the institutional basis for innovative development of states. It is the national innovation systems that are the fundamental basis on which various models

of international interaction for the creation of high-tech products are subsequently formed.

The concept of national innovation system was proposed by Christopher Freeman in the late 1980s to explain the differences in technological development of states. The research was based on results previously obtained by J. Schumpeter (the theory of economic dynamics), F. Hayek (the concept of scattered knowledge), D. North (institutional theory), R. Solow (the role of STP in economic growth), P. Romer and R. Lucas ("new" theory of growth). The concept is based on idea of innovation as a process and result of a multitude of random interactions in which various people and organizations participate. Each of the authors proposed their definition of national innovation system, focusing on individual elements and interrelations. At the same time, they all adhered to general methodological principles:

- knowledge plays a special, significant role in economic development;
- main factor of economic dynamics is competition between entrepreneurs, which is based on innovation;
- The institutional context of innovation has a direct impact on its content and structure.

In Ukrainian economic literature, the following main characteristics of NIS are noted:

- 1) a systematic character, that is, treating it as a collection of interacting elements in a special way;
- 2) institutional aspect, that is, the influence of existing formal and informal institutions in society on the pace and scale of innovation development;
- 3) dissemination of new knowledge and technologies as the main function of NIS.

"The national innovation system," says K. Freeman, "is a complex

system of economic entities and public institutions (rules of law) that participate in creation, storage, dissemination and transformation of new knowledge into new technologies, products and services consumed by society" [2].

According to the classical definition of Lundvall and Nelson, innovations is a complex process that unites different actors - firms, producers of new knowledge, technological and analytical centers, which are connected by a multitude of interrelations, thus creating an innovative system. The overall results depend not only on each element of the NIS, but also on their interaction of parts of the collective system of creating and using knowledge supported by public institutions, values and norms.

National innovation system is a special type of the state's economic system, grewed from and with its institutional features, based on the innovative model of interaction between economic entities, whose goal is to increase the role of competition among actors on the basis of innovation as a key factor of economic dynamics, directly affects both the structure and maintenance of the economy of the state. International practice adheres a more practical definition. National innovation system is a set of institutions belonging to private and public sectors, which individually and in interaction determine the development and dissemination of new technologies within a particular state.

First, NIS as an open system manifested in the interaction of organizations (structures) of different forms of ownership, engaged in production of scientific knowledge, intellectual property objects and their preparation for commercialization.

Secondly, the result of the activities of NIS as an open system involves the entry of new organizations and withdrawal of previously operating ones,

Thirdly, subjects of NIS can be incorporated in structural divisions of large companies engaged in production of scientific knowledge, objects to

intellectual property; in addition, laboratories and departments of universities, academic units, technology parks, innovative small enterprises engaged in commercialization of intellectual property and a set of legal, financial and social institutions that support innovative processes.

Fourth, the results of NIS activities are an integral part of national wealth, which produces and accumulates scientific knowledge as public goods, which in turn take the form of intangible assets and form part of the national wealth, which affects the balance of various structures in GDP, in the value structure of national wealth. Thus, national innovation system is a set of institutions, rules, conditions that ensure the emergence of such intangible assets (part of the national heritage) within the national economy.

Key elements of the national innovation system:

- Innovation-active companies;
- Public and private institutions;
- Higher education system;
- Macroeconomic environment and structure.

In recent years, the notion of elements and subsystems of NIS has expanded significantly - it included not only higher education, but also the entire educational system, services, culture and even the way of thinking.

Summarizing the results of domestic and foreign research, some economists represent the structure of NIS as a system of ten blocks:

- 1) strategy and priorities of innovation policy;
- 2) the regulatory and legal framework in sphere of development and stimulation of innovation activities;
- 3) innovative infrastructure;
- 4) the system of generation and dissemination of knowledge;
- 5) innovative enterprises, including large scientific and industrial corporations, high-tech industrial production;

6) institutions in the field of education and vocational training, which train personnel in the organization and management of innovation;

7) market conditions conducive to the introduction of innovations;

8) marketing and financial components of the system for creating and promoting innovations;

9) the system of interaction with the international innovation environment;

10) the mechanism of innovative development, reflecting the system of mutual relations between the listed elements [3].

The main dimensions of NIS are number, size and degree of centralization of participants in the innovation process, the volume and structure of financial, human and material resources, results of innovation in the form of patents, new products and technologies, scientific publications. The most important structural characteristic of NIS is the ratio of public and private financing of R&D.

It should be noted that international cooperation, labor cooperation has become a powerful driving force for the development of industries in general, the main form of international industrial cooperation, the core of the transnationalization of production, the material basis of the processes of international economic integration and globalization in global economy. Change in place and role of international cooperation in modern global economy is due to its objective advantages. Among the others: synergetic effect, reduction in investment (one-time) and current production costs for the implementation of cooperation projects by each of their participants, as well as the timing of production development and product renewal, a joint or coordinated solution of a complex of interrelated problems of the entire innovation-reproduction cycle (production and technology, management, marketing, sales and after-sales service of products, research and development (R&D) for improvement of production and creation of new

products). Nowadays such international cooperation has actually been transformed into international scientific and industrial cooperation. This is evidenced by analysis of many international cooperative projects and related agreements, carried out by the United Nations Economic Commission for Europe. On its basis, the following five main models of international scientific and industrial cooperation, characterizing the overwhelming specificity of the cooperative relations between the cooperant, the licensor and the licensee can be distinguished.

Model 1. The licensor, under the agreement on interaction, transfers to the licensee its technologies, licenses for the use of industrial and (or) intellectual property rights and certain types of technological equipment. Whole sum gets paid by the licensee of the products produced, and also, upon the request, services and their licenses.

Model 2. Contains additional obligations of the licensor to supply the licensee with a part of the components of production.

Model 3. In contrast to the first model, it provides transfer of complete technological lines (rather than individual equipment), together with the corresponding technologies, on terms of financial leasing.

Model 4. Contract cooperation, in which the contractor fulfills the order of the licensor for manufacturing intermediate products of the chain for him. At the same time, the licensee is provided with necessary technical documentation, and in some cases, separate , additional equipment and/or part of the product's components produced by the licensor.

Model 5. Joint production of the agreed nomenclature is accompanied by the exchange of certain types of equipment and mutual deliveries of the clay as well as intermediate cooperative products. Often, joint R&D is also contemplated.

But the abovementioned models only partially represent of the forms of development of international interaction in the process of creating high-tech

products. Globalizational, technological, innovative and competitive rate growth have intensified the search for new forms of cooperation between economic actors in different jurisdictions and in various national innovation systems. Yet most modern and dynamically developing segments of high tech market attribute the following forms of international interaction:

- International strategic alliances;
- International innovation clusters;
- Network technoparks;
- Technological platforms.

Concept of "strategic alliance" appeared in the 1980s as a form of defining various agreements on long-term mutually beneficial cooperation between companies, universities and research institutes. R.Wallace considers the model of a strategic alliance as a combination of the following elements: establishing trust; definition of mission, goals and objectives; allocation of a range of goods and services for the buyer; comprehensive self-assessment, acquaintance with a partner; establishing the boundaries of relations; identification of the framework of the initial project; preservation of relations; preservation of independence; legal support; exit strategy [4]. Cooperation between enterprises that are part of strategic alliances can take various forms:

- complex alliance, in which the parties participate in all business processes, from development of a new product to its commercialization;
- an alliance with limited functions, where efforts are focused on one or more processes.

The depth of cooperation between participants depends on the main goals of each partner.

International innovative clusters appropriately distinguished for transboundary and transnational clusters. For example, A. Yasheva notes that international clusters are:

1) network associations of suppliers, producers and buyers - residents of different countries geographically concentrated in a transboundary region (a transboundary cluster);

2) international networks of national clusters (transnational cluster), which cooperate and compete, are connected to technological chains and complement each other, cooperate with cross-border institutions (including scientific, educational, business infrastructure), state and interstate government bodies, and also by international organizations with the aim of increasing the competitiveness of cluster entities and the national economy [5].

The concept of “technological platforms” was developed by the European Commission in 2002 as one of the tools for the thematic development of the EU. Today, the European technological platform is a mechanism for the formation of scientific and technical priorities. A distinctive feature of technological platforms is their direct focus on practical implementation of scientific achievements of medium and small businesses. To date, considerable experience has been accumulated in the activities of the European technology platforms, which are created, on the one hand, by combining the intellectual and financial resources of the EU itself and the largest European industrial producers on the other, with the aim of carrying out the scientific research necessary for modern industrial production. Currently, there are more than 36 ETPs covering the most important European technology sectors, which generally reflect the effectiveness and effectiveness of cooperation between science, business and the state.

Networking parks rely on the expansion of opportunities that enable them to provide a wider range of services, achieve improved performance indicators and provide a presence in cities or other areas important for the technopark in order to interact more quickly with partners. Networking technology parks are a kind of regional or university technology parks.

When choosing this or that form of international interaction for the creation of a high-tech product, one should take into account the main modern globalization trends, namely:

- wide diffusion of new and high technologies in industry and services, which is accompanied by changes in the system of production and management;

- the impact on the processes of globalization of powerful and adaptive information technologies that cause the formation of new innovative contours active interaction between market actors;

- expansion of opportunities for the development and efficiency of the financial sector;

- the impact of global financial and economic crises on international– and regional economic activity (to a lesser extent – in the high-tech sector);

- the interdependence of development of national economies and globalization processes;

- significant influence on the globalization of production and development of national innovation systems of international knowledge flows;

- use of new forms of robotic and automatized systems, adaptive to the needs of consumers.

So, summing up the national innovation system is, first, a complex of legal, financial and social institutions that provide innovative processes. This is a set of institutions, that is, conditions and rules for which organizations operate, the purpose of which is the production and dissemination of new technologies, innovations in the organization of management within a particular state

International cooperation is becoming a powerful driving force for development of world industries in the world, the main form of international high-tech cooperation, the core of transnationalization of production, the

material basis of the processes of international economic integration and globalization in global economy.

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