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BASES OF INTERNATIONAL INNOVATION SYSTEMS FORMATION

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INTRODUCTION

Modern global challenges and trends determinate new dominants of the national economies development. This is accompanied by the search for new ways of innovation intensification and effective innovation systems creation. The specific character of the current stage of world economy globalization is manifested in a level increase of innovation activity internationalization and deepening of international scientific and technical cooperation. Integration trends acceleration leads to the international innovation systems (IIS) formation, that become a new institutional format for innovation and interaction supporting, and fundamentally change the national economies innovative development models. IIS should effectively structure international organizations and country associations, creating conditions for increasing the member countries unity in innovative development accelerating. Thus, a vital scientific and practical task is to develop theoretical, methodological and practical foundations for such systems formation[1,2,3].

There are some reasons of the IIS formation that can be identified:

– the necessity for international research and innovation projects realization;

– knowledge and technology global markets development;

– increasing competition for leadership in intellectual resources;

– expansion of the international company activities, alliances and consortia, the international networks emergence;

[1] Білозубенко В.С. Інноваційна система Європейського Союзу: особливості формування та розвитку: монографія. Донецьк: ДонНУЕТ, 2012. 456 с.

[2] Carlsson B. Internationalization of innovation systems: A survey of the literature. *Research policy*. 2006. Vol. 35, №1. P. 56-67.

[3] Borras S. Introduction to special issue on a European system of innovation. *Science and publ. policy*. 2004. Vol. 31, Iss. 6. P. 422-424.

– knowledge and innovation transformation into international public goods;

– irregularity in the natural and scientific resources distribution among countries, the general asymmetry of scientific development;

– aggravation of global humanity problems.

1. The nature of international innovation systems

IIS are formed as a result of the internationalization processes development of national innovation systems (NIS), international scientific and technical cooperation and integration. The IIS formation is based on the national systems openness and internationalization. It initially depends on the path of NIS construction, namely the convergent path (type) dominance. The IIS concept creates a new systemic aspect, which includes opportunities expanding for innovation, the scientific and technical potential of countries combining and efforts to solve global problems. Hypothetically, the IIS concept makes it possible to:

– cover a wider range of national economies innovative development factors, identify new scientific productivity and innovation factors (at the micro, meso and macro levels);

– highlight a new level of innovation support, justify the format of the international organizations innovation policy;

– establish new models for the organization of innovative processes and their participants interaction;

– create a new (spatial) approach to the development of various networks, clusters, communication platforms, etc., that play a big role in the emergence of innovations and often acquire a cross-border character.

IIS (as national systems) has spatial boundaries, that are defined by administrative boundaries, legal and political features. As the IIS unites several countries, it has more complex cultural characteristics, but presupposes a certain political unity. IIS acquire independent significance. They are formed in integrative manner, combining and covering systems of lower orders, complementing and strengthening their potential. On the one hand, the IIS emergence is based on the certain international space existence with a unified institutional environment, and on the other hand, it leads to further consolidation of this space and its institutional development.

IIS needs to be interpreted as a spatial integration formation, that is based on the general institutional foundations for ensuring of innovation activity and markets (knowledge, labor, capital, goods and services), has a specific architecture, covers the integration of lower levels innovative systems (national, sectoral, regional) and creates a more favorable environment for innovation through the internationalization benefits.

The IIS formation is based on the NIS integration of several countries and on the creation of interconnected international institutions that regulate scientific and technical cooperation, ensure the coordinated implementation of measures to stimulate innovation, and also create an environment for cross-border interaction of participants in innovation processes. IIS can be considered as institutional and social system; this fact makes it possible to determine its legal, organizational and cultural features.

The consideration of IIS complements the existing innovation systems hierarchy covering such types as: a) national; b) technological (that is formed for the specific technology development and implementation); c) regional (that is formed at the regional level); d) sectoral (that is formed at the level of the economy sector). In the modern innovation theory not only the possibility is traced, but also the need to create innovative systems at a higher political and territorial level (that is, international and global), which fact is confirmed repeatedly by theoretical and empirical studies.

To understand the nature of IIS, it is to be expected that the affinity postulate (from the Latin word *affinitas* – close link, consanguinity) of national and international innovation systems, as they have similar tasks, structure, functions, formation features, development direction, etc. Moreover, taking into account the level and composition of national and international innovation systems they have natural differences: institutional (IIS covers both national and international institutions); spatial (IIS forms a space where several countries are included) and structural-functional (IIS includes international organizations and forms new interaction structures, provides for the new institutional environment creation and the appropriate policies implementation). This makes it possible to describe the attributes and properties of NIS and IIS from a more general point of view, which should be perceived exogenously and

endogenously; this fact is determined by the following features of the system: a) link with the external environment (communicativeness, interactivity), integrity (as a result, the openness or the closeness); interconnection and interaction between elements; information interaction of elements; hierarchy (hierarchical ordering); the presence of feedback; equifinality; unity in understanding the processes occurring in the system and with the system participation, as well as the factors of its development; dependence on the properties of the included elements; b) as a whole: autonomy, adaptability, maneuverability, flexibility, stability (maintaining the structure), reliability, relevance, specificity, alternativeness, organization, integration; c) as an organizational structure: emergence, non-additivity, hierarchy, differentiation, synergy, structuredness, etc.; d) as a social education: purposefulness, manageability (the need for external management), self-regulation, self-organization and self-development[4].

The predicate *"international"* defines the international nature of the system, however, the value of the system can vary significantly depending on the area. Typically, international organizations, treaties, standards, relations or communications can be considered in relation to international systems. International systems encompass a certain group of states that have assumed relevant obligations and joined in a common infrastructure that provides flows, interactions, and transactions.

The international system, in general, should be considered as a way of relations organizing between countries, ensured by a set of special institutions (norms, requirements) and infrastructure, and allowing coordinated realization of each country national interests. Institutions form the international system environment, and its infrastructure can be represented by special partnership institutions, executive bodies, information exchange mechanisms, etc. The information technologies using forms a new paradigm of international systems.

International systems can be created as independent elements of international life or as functional (sectoral) subsystems of certain forms of international relations. Strengthening of pluralism and decentralization

[4] Білозубенко В.С. Інноваційна система Європейського Союзу: особливості формування та розвитку: монографія, Донецьк: ДонНУЕТ, 2012. 456 с.

is natural for modern international systems; it determines the possibility of their configuration changing.

IIS are formed and developed on the following conceptual principles: 1) identification of innovations as an interactive process where various participants from several countries interact; 2) the international competition dominance based on innovation; 3) innovation recognition as the main factor in economic dynamics on an international scale, in structural, institutional and social transformations in general; 4) the need to create a special institutional framework for ensuring and regulating of innovation activity at the international level; 5) the feasibility of innovation activity stimulating at the international level, in particular in the field of global problem solving; 6) taking into account the direct dependence of the appearing and spreading of innovations on the structural, institutional and social features of international processes; 7) the need to improve the quality of relations between countries and other actors at the international level.

It is necessary to take into account significant differences in the construction of functional blocks (research, technological, managerial, educational, infrastructural) in national and international innovation systems. However, the idea of structural relationship serves as the basis for the IIS creation in a configuration similar to NIS. The functional blocks of IIS are formed by the relevant elements generalization (integration) of the innovative systems of the countries. Their structure is determined by the goals and objectives of the IIS. It is important to take into account that macro-level innovation systems cover the private and public sectors.

It is necessary to highlight individual subsystems in addition to the functional blocks in the structure of the IIS. The most important ones are subsystems of: new knowledge generating; development and commercialization of innovations; regulation; intellectual property protection; monitoring and control. Such subsystems selection should be supplemented with a proposal for the industrial systems structuring that includes the following elements: a) object structure (enterprises, organizations); b) the process structure (innovative processes, support processes); c) project structure (projects and goals); d) environments (communities, institutions, communications). It is also advisable to

separate the various centers (“nodes”) in the innovative systems structure on the basis of concentration of resources and activity that makes it possible to detail spatial and industry specifics. The IIS configuration defines its “functional” models (financial, organizational, managerial, infrastructural, etc.) that are more and more prone to “transition” to the Internet.

The IIS formation, as well as other innovative systems, is aimed at reducing the various costs that arise in the field of innovation activity, including transactional, transformational and informational costs. Besides, the IIS should provide more effective protection of the participants interests in innovative processes, streamline individual processes of new knowledge generation and diffusion. IIS reduce the significance of various institutional and physical constraints by creating an optimal regime for innovation activity. Within the framework of such a regime the level of uncertainty decreases, more favorable conditions for the innovation commercialization and better access to resources arise that makes it possible to accept a higher level of risk.

Among the main functions of IIS should be highlighted the following:

– communication function (the system ensures the interaction of participants in innovation processes (at the international level));

– stimulating function (the system provides scientific progress, the new knowledge creation, implements new incentives for innovation);

– transformational function (the system provides the transformation of knowledge into innovation, change of institutions, and the reform of national systems;

– cooperative function (the system provides cooperation among participants of innovation processes, maintains a constant relationship);

– integrative function (manifests itself multidimensionally and applies to various organizations, communities, institutions, subsystems, components, etc.; integration is necessary for a synergistic effect);

– institutional function (the system leads to the creation of new formal and informal institutions);

– organizational function (the system becomes the basis for the organization of innovative processes at the international level);

– information function (the system provides information exchange, creates a new information space, flows and mechanisms).

IIS covers all levels of innovation support. IIS forms the structure of institutions that mediate the flow and support of innovative processes at the appropriate level. Moreover, the system must be adequate to the level of complexity, variability and diversity of innovations, covering all the types. IIS should reproduce the whole range of conditions necessary for innovation activity, and be organically linked to knowledge markets. IIS covers various interactions and transactions of innovation processes participants; it is manifested in cooperation, the provision of services, and the exchange of resources at the micro level.

The IIS emergence process can be described by several conceptual models[5,6,7]: a) „stage transition" (IIS arises as a result of a transition to a new development level of international relations, innovative systems; it is accompanied by an improvement in the institutional environment); b) „common benefits" (the IIS is considered as a result of a specific advantages understanding that are manifested during its creation); c) "management structure evolution" (the IIS emergence is the result of the consistent evolution not only of institutions, but also of the management structures development that enter the international arena).

IIS should be considered as a certain space that is distinguished by more favorable conditions in comparison with the global environment. Its creation is due to the fact that the resources and structures necessary for the innovation emergence are located in different countries. New incentives arise for the innovation internationalization in the process of market integration.

The differences between IIS and national systems are not limited by the spatiality and complement of functions. NIS can be combined with different specializations, and this requires its certain universality and flexibility. Taking into consideration the IIS scale, the degree of integration and internal fluctuations are its the most important characteristics; integrity and coordination are differently provided there.

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[5] Carlsson B. Internationalization of innovation systems: A survey of the literature. *Research policy*. 2006. Vol. 35, № 1. P. 56-67.

[6] Borras S. Introduction to special issue on a European system of innovation. *Science and publ. policy*. 2004. Vol. 31, Iss. 6. P. 422-424.

[7] Stein J.A. Is there a European Knowledge system? *Science and publ. policy*. 2004. Vol. 31, № 6. P. 435-447.

All countries that are integrated in it should necessarily adhere to common interests and development directions.

IIS is a multi-level system; this fact determines the features of its management and internal communication. The complexity of IIS as a large system is not only due to the composition of the elements, but also to the lack of centralized management. This requires additional legal, administrative and political support (multinational or supranational).

IIS becomes a new institutional entity, provides economic ties between countries, and becomes a gradient in the transformation of countries innovation systems. A new type of international institutions is emerging; these institutions support innovation processes and are an integral part of international integration and globalization. The IIS emerging demonstrates the general strategic course of countries innovative development.

Nevertheless, the accelerated development of international scientific and technical cooperation should be considered as the main driving-force of the IIS formation. This form of relationship develops quite intensively, and this requires new institutions and mechanisms creation. As part of the international division of labor, scientific and technical cooperation complies with the common patterns of its deepening in the context of globalization. International cooperation affects the various innovations development and using in different ways.

The IIS emergence is a consequence of the global economic paradigm establishment. Globality expects the influence of global factors and patterns of innovative development that are determined by megatrends of human civilization and problems. This determines the need for new institutions and special systems, including such areas as management, resources, commercialization, protection of property rights, and incentivation.

The improvement of international institutes of scientific and technical cooperation is an important dominant that promotes the IIS creation and development. At the present stage, institutions are gradually uniting into a holistic world regulatory system including international organizations and treaties. The activity of international organizations significantly changes the global political support for innovation processes making it more strategic.

The basic prerequisite for the IIS formation is the creation of international innovation and research spaces (as institutional structures). It is proposed to understand the international space as the territory of several countries, where uniform institutes for regulating certain processes operate, and relatively more liberal conditions for the subjects interaction and the mobility of knowledge, people and capital are provided. Besides the political impulses, this requires the legal framework, international structures and partnership mechanisms; uniform regulatory standards using; unified information dissemination systems creation, etc.

On the one hand, integration in space allows a country to realize its potential at a higher level, and on the other hand, it allows to use the potential of partner countries attracting new resources for development. A certain knowledge "bank" also arises within the space framework that becomes the basis for general development and attracts new participants. The knowledge "bank" is associated with knowledge intensive circulation within the IIS space.

The context for the IIS formation is created by international scientific and technological integration that develops on the basis of international research centers and may be the direction of the countries general economic integration. IIS is meant to be a new basis for the such integration development contributing to the various barrier elimination (physical, institutional, cultural, structural, technological, etc.) and the international complexes emergence.

IIS is a special international regulatory structure that has developed as a result of international division of labor deepening, the science and innovative processes internationalization. This structure is designed to regulate the interaction processes in the innovation field; it creates the necessary legal mechanisms, infrastructure and resource conditions for innovation activity.

2. Basics of the IIS formation

The IIS formation should be considered as a process of international space creation for innovation activity and within its framework there is a NIS unification of several countries, and the factors for multilevel ties

and cooperation in the field of research, technology and innovation are created.

IIS institutes mainly arise in two ways: a) through the harmonization and transformation of national institutions where new institutional structures arise and operate at the international level; b) the special international institutions and structures creation; harmonization and/or unification of national institutions is carried out on their basis. The institutional nature of IIS requires considering it as an environment and a mechanism for regulating a whole complex of processes related to the acquisition of new knowledge, development, implementation and diffusion of innovations. IIS creates a new type of support for innovative processes at the international and national levels by combining the institutions of several countries.

NIS operate in a free market and they are a fairly complex integration object. Therefore, the IIS creation requires special foundations for individual elements uniting of the NIS. NIS integration is a consistent process where new models and mechanisms of innovation activity should appear as a result. IIS is not a simple "sum" of national systems, it is the innovation processes uniting throughout the stages and phases, individual operations, participating entities as well as the development of a unified approach to stimulate and regulate innovations.

The scope of the IIS functions as well as the international character of this system gives rise to certain structural differences with the NIS. The IIS includes various international organizations, innovative systems elements of countries such as those related to the public, private and social sectors. The IIS formation directly affects public authorities that regulate innovation processes and are international cooperation subjects. The stage of such authorities involvement to the IIS depends on the content of state innovation policy at the country level and on the IIS goals.

The IIS formation in practice is possible with the NIS complementarity of the countries and the additionality of their scientific and technical complexes. The IIS emergence is caused by the countries interdependence, the problems commonality. Moreover, the positions of countries and their potential, naturally, can differ significantly; this leads to different behavior strategies within the IIS. Countries with

fundamentally different economic structure forms cannot be included in IIS, and this is also reflected in the innovative development model. The IIS formation basic principles are considered in relation to the conditions of the capitalist economy to a greater extent.

Let's divide the IIS formation principles into system-wide (inherent to all systems) principles and specifical (used only when IIS creating) principles. The system-wide principles should include the following principles of: equality; objectivity; the decisions validity and the sequence of their implementation; efficiency; realism; flexibility; cooperation deepening; universality and specificity combination (in the activities of international organizations); balance; reality check; continuous improvement and development of individual elements; support sufficiency and legal framework quality.

It is proposed to distinguish the following specific principles of the IIS formation: 1) international organizations specialization; 2) institutional convergence of national innovation systems; 3) international scientific and technical cooperation deepening at various levels; 4) the IIS model relevance to the existing globalization challenges; 5) preparedness to perceive uncertainty and paradoxicalness in the international systems functioning; 6) harmonious element interaction at various levels; ensuring stability and compliance with desired goals.

The formation core principle is based on the institutional convergence principle, especially for uniting of various national innovative development models with their advantages, disadvantages and differences. This convergence achieving requires additional measures at the grouping level and in individual countries. Due to the significant differences between countries, it is possible to use a differentiated approach to their NIS integration. Similar NIS located at the same stages of the life cycle have a great tendency to unite.

The IIS formation provides for the international organizations creation. Two types of international organizations should be distinguished for scientific and technical cooperation reasons: Type 1 – individual specialized institutions (scientific unions, centers, forums, associations, etc.) that have different functions, but their activity focuses exclusively on the scientific research and innovation field (usually in one field of knowledge); Type 2 – integration organizations (associations) with such

activity areas as the support of scientific research and innovation in general (in all areas of knowledge); organizations of the Type 1 can also be created inside organizations of the Type 2.

Fundamentally, these two types of organizations create two IIS models. Their institutional features are[8,9,10,11]:

1) IIS formed on the basis of a specialized international organization operates primarily in the form of an individual, independent, non-governmental international organization; it most often unites participants in one category (research institutes, universities); it has clearly defined activity area (field of knowledge or economy sector); organization structure is formally established there;

2) IIS formed on the basis of an integration association operates on the basis of integration institutions and an extensive network of international organizations, covers the reproduction and market space of the association, providing for the conditions creation for the interaction of all categories of innovative processes participants; functioning is subordinated to single governing bodies (interstate or supranational) there.

The second model is more complex and it is one of the lines of general economic integration; therefore, this system itself becomes one of the forms and components of the integration process; and so, the IIS formation is supported within other interaction areas.

Each model has its own advantages and disadvantages (Table 1).

[8] Білозубенко В.С. Інноваційна система Європейського Союзу: особливості формування та розвитку: монографія / В.С. Білозубенко. – Донецьк: ДонНУЕТ, 2012. – 456 с.

[9] Borras S. Introduction to special issue on a European system of innovation. *Science and publ. policy*. 2004. Vol. 31, Iss. 6. P. 422-424.

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[11] Barkin J.S. International Organization: Theories and Institutions. Palgrave Macmillan, 2006. 185 p.

Table 1

Advantages and disadvantages of IIS formation models

	IIS formation models	
	1 – based on a specialized international organization	2 – within the integration grouping
Advantages	– specialization; – ease of organization; – the possibility of freer entrance and exit of countries; – formation at an accelerating pace; – sector-specific measures to support research and innovation; – ease of resources accumulation	– the formation of a single market of knowledge and technologies, the creation of a closed innovation cycle with access to the world level; – comprehensiveness, coverage of a large number of innovation areas; – full range of measures implementation to support science and innovation;
Disadvantages	– focusing primarily on scientific research; – difficulty in long-term interaction ensuring and large projects implementation; – limitation by a separate science or an economy sector	– complexity of organization and legal support; – political contradictions possibility; – mandatory integration deepening that is accompanied by additional difficulties

The first model (creation of specialized organizations) can be completely recreated within the framework of the second model, including for the purposes of interaction with third countries. The second model focuses IIS on ensuring of large-scale developments commercialization within the framework of an educated common market and in accordance with direct consideration of new market incentives and it is the main thing in the emergence of innovations. Therefore, the second model, being more complex, is more effective in the globalization context. It reproduces all the conditions necessary for innovation, and the functions of innovative systems. Especially its advantages are manifested in conditions of external environment instability as it is possible within the grouping to ensure the stability of the exchange and commercialization processes, the development course observance by the member countries.

Models differ by the IIS formation temporal parameters that also significantly depend on the scenarios. The first scenario is inert evolutional. It does not provide for active actions on the part of the

countries governments that are in the grouping as well as its interstate (supranational) authorities. In this case, the IIS is formed on the basis of relations and institutions that arise at the micro level without the conditions specified from "above". The IIS functions are determined by the market forces, so the scenario requires a long time, but reflects the real system need.

The second scenario is the reformist one; it assumes proactive actions made by states to create a new relations system by reforming structures that exist at the national level and by creating new (international) mechanisms. The conditions for the subjects relations development are set from "above" taking into account trends and problems that occur at the micro level. This scenario is accelerated one and it is accompanied by radical NIS transformations. The specific feature of the IIS model "integration" is that the involved countries should ensure the convergence of a wide range of institutions that provide innovative development. This is reflected on the parameters of using the existing scientific and technical potential of countries.

Using the example of the innovation support system created in the EU, we can distinguish such IIS key elements as:

– a single legal framework for adopting a common innovation policy;

– a system of supranational authorities and other international organizations that support innovative activities through coordination and implementation of joint activities;

– stable ties of international scientific and technical cooperation;

– joint surety of innovative processes (financial, managerial, social, political, etc.);

– a single information space and interaction networks (channels);

– a single market of knowledge, technology, capital, labor, goods and services;

– a common approach to investing in knowledge and related mechanisms;

– joint research and innovation infrastructure;

– a unified system of intellectual property rights protection.

Global experience shows that the IIS formation can take place only if a sufficiently high level of political and economic integration is achieved, when it is really possible to create new effective organizations and pursue a single innovative policy. The IIS effectiveness directly depends on the integration processes quality; and it is built within their framework. On the other hand, IIS is turning into a separate unifying mechanism by which countries are consolidating around innovative development common problems solving.

IIS as a spatial-integration formation arises in specific historical conditions as a result of the driving forces that are common to the regional space. IIS acquires a geo-economic dimension by influencing the position and strategy of integration grouping in the global space. The IIS geoeconomic importance is constantly growing due to the innovation increasing importance as the basis for creating competitive advantages in world markets.

The IIS is not intended to limit the interaction of countries with the global environment, but it is aimed at creating of a new procedure for its regulation in accordance with the general goals and potential configuration. Taking into account the global environment turbulence, escalating competition, the spread of crisis and so on, the IIS should provide a certain "immunity", that is, promote stabilization of the grouping economic complex, absorb the "shocks", and allow countries to meet challenges jointly. The attractiveness of a particular IIS may extend to third countries.

The proposed IIS interpretation as a space-integration formation makes it possible to generalize the IIS basic properties, among which are: 1) multi-level integration, including the integration of NIS, of elements of the countries scientific and technical potential, etc.; 2) political consolidation that is implemented in the member countries general innovation policy; 3) the institutional environment harmoniousness that is achieved through the national institutions unification, as well as the international institutions creation; 4) eclecticism, that is, a combination of countries with different levels and models of innovative development; 5) hierarchy due to the lower orders systems inclusion. It follows from these properties that the IIS can

be built as a network structure that ensures the interaction of subjects with specific "network" effects (freedom of interaction, combination of resources, mutual learning, dissemination of experience, concentration of efforts, competition, etc.). Despite being flexible, networks increase system resilience that takes on dynamic properties. The network structure allows IIS without losing its stability to combine heterogeneous elements, ensure the mobility of the participants. The network paradigm development is important for a balanced system and internal convergence.

The IIS formation as a complex system is carried out on several stages; the characteristics of these stages are presented in the Table 2.

Table 2

IIS formation stages based on the integration grouping

Stage	Description
Preparatory (initial) stage	the IIS concept and model are developed; alternative formation scenarios are evaluated; various participants consultations are held; economic and financial base for the necessary activities is created
Regulatory and constructional stage	regulatory acts are being introduced, goals are formulated and a strategy for the IIS formation is developed; business event schedule is drawn up and methodologies for evaluating its effectiveness are adopted; the basic elements of infrastructure are created, a system of international organizations is designed, and the algorithmic closureness of their functions is justified
Practical stage (implementation stage)	the necessary organizations and mechanisms are created in accordance with the goals; the IIS general structure is adjusted and its legal support is improved

The IIS should undergo a certain "maturing" to achieve the necessary parameters, and as a result of this "maturing" the system enters a stable state and self-maintains. During its formation, the IIS participants are consolidating, including through informal ties and the wider use of the created infrastructure.

The IIS formation meets the needs of innovation processes participants, creates new requirements for innovation policy pursued by countries at the national level.

Each of the countries in the IIS adopts a transition to collective innovative development management, including through the transfer of certain functions to international institutions.

Certain IIS disadvantages are possible for individual countries that are included in it. For example, the dependence of individual countries (outsiders) on leading countries may increase. However, in general, IIS should provide a push to overall progress, and it should separately give incentives for outsider countries in order to reform and develop its own innovation system.

The IIS formation effectiveness is evaluated in relation to the countries that are in it and the integration grouping as a whole. It seems necessary to highlight the primary and secondary IIS effects. Primary effects are effects that increase the innovation effectiveness. These include such effects as synergy; concentration; resources accumulation and mobility; social mobilization; knowledge diffusion; social networks activation, resource saving, etc. The secondary IIS effects are consequences and outcomes that contribute to level increase of competitiveness and economic growth. These effects include structural changes stimulation, export development, enhancement of economic activity, etc. It is necessary to distinguish IIS internal and external effectiveness. Internal efficiency concerns the internal problems solution of the association countries (general or individual problems). External efficiency is a change in the position of countries and associations generally in the world market, the solution of various geo-economic and geopolitical problems.

The IIS formation is associated with the characteristic costs for creating international institutions and ensuring the system integration. They should be presented as the integration interaction costs (Table 3).

Table 3

The integration interaction costs in the IIS formation

Interaction components	Cost characterization
Cognition	costs for the exchange of information and the new environment knowledge that provides the system with integrity and evolution
Communication	costs for the communications model changing, including for the purposes of establishment of contacts, interaction mechanisms development, information processing, information flows regulating, etc.
Congregation (consolidation)	costs for rapprochement, association and integration of national systems
Adaptation	costs for new environment factors assessing, new fence mending, protecting interests in the integration process, implementing special measures for a new space development and new conditions adapting
Convergence	costs for the interaction of objects and their transformation to achieve certain convergence criteria and a single environment formation, as well as the convergence mechanisms formation and control over this process
Institutionalization	costs for the institutional integration framework formation and the related complex interactions normalization, that is: necessary institutions identification, their coordination; new institutions development and their implementation, etc.
Symbiosis	costs for the coexistence of various elements integrated into a single system, that is: protection of interests, general organization, equivalent exchange ensuring, etc.
Succession	costs for problem solving associated with the new elements superimposition on pre-existing systems elements, that is: changing of systems and communities, control, negative effects compensation, etc.

It is necessary to evaluate the costs for inclusion in IIS at the country level, where the costs for internal transformations performing should also be allocated, besides the contributions for organizations creation.

When assessing the IIS effectiveness, it is necessary to take into account the possibility of a greater synergistic effect at two levels: a) internal level that arises inside the IIS as a result of the potentials uniting of the included countries in it; b) external (global) level that arises as a result of knowledge and resources attracting that are necessary for innovation from the outside due to a more attractive knowledge

market and opportunities for innovation. The scale of the synergistic effect should be considered from the economy perspective of individual countries and the entire grouping, as well as national regions and companies. The innovative activity indicators diagnostics at the level of countries association is dominated in the IIS study and should include, for example: 1) assessment of attracted resource level to the innovation area at the grouping level; 2) innovation activity overall effectiveness assessment; 3) comparison of IIS parameters with other countries or country groups. The IIS interpretation as a space also necessitates its internal differentiation analysis, in particular: an assessment of the countries innovative development unevenness, the convergence and synchronism degree of parameter changes; countries NIS openness diagnostics, their orientation to interaction with internal and external space.

The quality of the formed IIS is measured by the functions completeness that it is tasked to perform, and it is also represented by the innovation activity effectiveness. The IIS efficiency is largely determined by the degree of its stability in a dynamic external environment and the potential for self-organization. A high level of efficiency always implies a high independence, the ability to generate missing elements. The process of IIS forming cannot be detached from economic system transformations of an integration association as a whole, scientific progress and technological dynamics.

CONCLUSIONS

IIS makes it possible to bring innovation support to a new institutional level, to combine national scientific and technological potential and to derive numerous cooperation benefits. IIS is formed integratively by combining lower orders systems (national, regional, sectoral), complementing and strengthening their potential. IIS functional blocks and subsystems are formed by summarizing the corresponding NIS elements. Some of the IIS main functions are: communicating, stimulating, transformational, cooperative, integrative, institutional, organizational, informational. IIS covers all levels of innovation maintaining by creating a new institutions structure. A new type of

international institutions that support and regulate innovation is emerging.

IIS can be formed on the basis of two types of international organizations: Type 1 is represented by separate specialized institutions (scientific unions, centers, forums, associations, etc.); Type 2 is represented by integration organizations (associations) which activities include support for science and innovation. This creates two IIS models with own characteristics, advantages and disadvantages. A more complex second model assumes either an inert evolutionary scenario for the IIS creation or a proactive reformist one. The main IIS elements (using the EU as an example) are: a single legal framework for innovation policy; system of supranational authorities and other international organizations; stable ties of international scientific and technical cooperation; joint provision of innovative processes; a single information space, a single market of knowledge, technology, capital, labor, goods and services; a common approach to investing in knowledge and related mechanisms; joint research and innovation infrastructure; unified system of intellectual property rights protection.

The IIS has specific properties as a spatial-integration formation, and it is designed to facilitate the interaction of countries with global space. Each of the countries in the IIS adopts a transition to collective management of innovative development.

SUMMARY

The principles leading to the emergence of international innovation systems (IIS) are presented in the article. The essence of such systems is elaborated on the basis of the attitude determining of national innovation systems, their properties and differences, as well as the specific characteristics of IIS. The principles of the IIS concept establishing and the functions of such systems in relation to the included countries are also discussed.

The IIS formation foundations with an emphasis on the institutional aspect and the element integration of national systems are formulated. General and specific principles of the IIS construction are presented, separately explaining the institutional convergence principle. Two models of the IIS formation are proposed (based on a specialized

international organization and within the framework of an integration association) based on the international organizations typification, as well as their advantages and disadvantages. It is proposed to consider the inert evolutionary and reformist scenario of the IIS creation. The main IIS elements, that use the innovation support system created in the EU as the example, are presented. The features of the IIS construction and its role as a spatial-integration formation are explained.

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