

# INSTITUTIONAL STRATEGIES OF SYSTEM SECURITY OF TECHNOLOGICAL & INNOVATION SYSTEMS

Vitaliy Omelyanenko<sup>1</sup>

**Abstract.** *The purpose of this study* is to consider the main aspects of system security providing institutional concept within the technological & innovation systems research methodology development through institutional innovations. In this paper, we will consider how the new evolutionary institutional theory of economic systems in the context of the space-time approach can help in organizing strategic management of development path of the innovation system, increasing system security, and effectiveness of its activities through the balance of system structure. *Methodology.* The scientific novelty of the research and the solution of its tasks deals, first of all, with the application of the non-system approach, which allows one to consider the factors and results of functioning of such complex economic systems as innovation macro projects, innovation processes, institutional and informational environments, etc. within the framework of providing national security. Involvement on a systematic basis of spatiotemporal analysis allows us to consider in the interrelation processes the distribution of flows of innovation resources and functions, on the one hand, and the distribution in time of similar flows. To solve the tasks of research, the classical scientific methods (analysis and synthesis, logical generalization, analogies, comparative comparison, and grapho-analytical methods), and specific methods of high technologies economy and innovation management were used. *Results.* As a result of the study, the features of the systemic socio-economic patterns of the functioning of innovation system institutions and the mechanism of management of innovation development in the conditions of modern global technological transformations have been determined. In the future, this makes possible the substantiation of promising areas of state regulation (participation) aimed at activating innovation processes in the economy according to the priorities related to scientific and educational, cluster and network development, and the development of a set of models for the harmonization of the system of priorities of national security and sectoral priorities of innovation development. Using the gained knowledge in practice will help to improve the state of national security, resource saving, improve conditions, and increase labour productivity, as well as the transition to sustainable development of the national economy. *Practical implications.* Systemic coordination of innovation components of state programs, stimulation of innovation activity, involvement of financial strategies in the innovation economy, expansion of international cooperation and activation of demand for high-tech products, increasing the effectiveness of innovation development programs of companies, and launching of national projects have been proposed as the objectives of forming institutional innovations. The proposed institutional and technological design methodology provides for the selection of institutional tools and scaling of the most effective development tools. *Value/originality.* The proposed network mechanisms for systemic security ensuring provide the improvement of implementing innovative development programs for the largest companies with state participation; further development of priority technological platforms and innovation networks; harmonization of technological priorities and projects formed within the framework of technological platforms, with the tools of state strategies.

**Key words:** system security, national security, national innovation system, technology, analytics, networks, institutions.

**JEL Classification:** C51, O14, O32

## 1. Introduction

In modern conditions, innovative development is critical for both business and society as a whole. At the same time, there is a necessity to improve the

efficiency of state initiatives in the sphere of support and development of innovations and the formation of an institutional basis for systemic innovation policy. We can confidently state that in the development of these

*Corresponding author:*

<sup>1</sup> Sumy State Pedagogical University named after A.S. Makarenko, Ukraine.

E-mail: [omvitaliy@gmail.com](mailto:omvitaliy@gmail.com)

initiatives, insufficient attention was paid to researching the dynamic properties of innovation systems and analysing their management capabilities.

As a methodological base for these purposes, we propose to consider the system theory, especially the system sustainable development theory, which is focused on the searching for opportunities to reorient the system to a development path that promotes a constantly growing rate of growth of opportunities to meet the needs of society. Sustainability is the main and only criterion for system development, ensuring its integrity and further development. The stability of the socio-economic system is associated with the ability of the system to function steadily, to develop, to maintain movement along the planned trajectory with self-development.

Based on these ideas, we clearly see the role of the innovation system in sustainability ensuring. At the same time, innovation factor and its system nature should be considered both as a factor of ensuring the sustainability of development and as a factor of economic shocks that can displace the development trajectory.

The processes of globalization and new technological paradigm formation have led to the emergence of a whole range of new economic, social, and political-legal problems of the nation's socio-economic development. In this context, sustainability can be considered in the context of developing adaptation mechanisms with innovation nature, as well as a set of measures, the implementation of which will enable the innovation system to perform functions and achieve the nation's development goal under normal conditions and in the presence of disturbances of endogenous and exogenous factors.

Successful implementation of these tasks requires the creation and development of innovation system that will support innovation at all stages of the innovation cycle, which is a key backbone factor in the socio-economic development and overcoming the current technological backwardness in the number of industries. At the same time, the formation of an institutional environment for the development of the balanced sector of research and development and effective national systems, which ensure technological modernization of the economy and increase its competitiveness on the basis of advanced technologies and large-scale investment in human capital, is a key task.

Thus, the formation of systemic innovation strategies within the framework of evolutionary institutional theory is a relevant scientific and practical task.

So, the purpose of this study is to consider the main aspects of system security providing institutional concept within the technological & innovation systems research methodology development through institutional innovations.

In this paper, we will consider how the new evolutionary institutional theory of economic systems in the context of the space-time approach can help in

organizing strategic management of development path of the innovation system, increasing system security and effectiveness of its activities through the balance of system structure.

## 2. Review of institutional aspect of innovative development

Modern analyses of technological & innovation systems are focused on emerging technologies often in early phases of development (Reichardt, Rogge, Negro, 2017; Jacobsson, Bergek, 2004). Typical for these early stages is the existence of a number of failures hindering the development and diffusion of new technologies so that it is particularly hard for them to compete with established technologies. For overcoming these failures and allowing the new technologies to become market-ready, government intervention is needed.

According to the models of the real business cycle (Long, Plosser, Prescott), technological shocks directly affect the economy and, in the result of supply fluctuations, the nation can face a number of changes in socio-economic processes. Technological shifts can be considered as the most important type of economic shocks causing fluctuations in the level of business activity. The models are based on Schumpeter's ideas: capitalism is characterized by waves of "creative destruction," during which the introduction of new technologies constantly pushes existing firms out of business. Analysing the modern trends, we can note that the same conclusion could be made also for the institutions (e.g. e-government can replace the traditional institutions with communication functions).

In the 1970s, the followers of Veblen have proclaimed technology and industrialization the driving forces value and source, and hierarchical structures as an opposite to the new forces. The followers of Commons (socially legal institutionalism direction) have interpreted institutions as the way of choosing between the technological alternatives.

At the same time, technological ideas of comparative advantages theory emphasize the fact that the international economy has also formed a critical direction in the study of international labour division, related to the scientific and technological revolution and technological progress. It was also revealed that "accelerated development" (based on modern Western technologies), recommended by experts for less developed countries, often leads to a decrease in the standard of living of a significant part of society. This can be explained by the institutional differences and their impact on economic strategies. Also, it is necessary to take into account the possibility of a technological gap and losing competitive advantages as a result of slowing down the rates of full cycles of innovative development.

As a result, we face the question arises of developing the new foundations for institutional development

strategies. In particular, the evolution of organizational forms is developing towards the widespread application of informal multidimensional self-organizing associated corporate entities, which meet the requirements of growth dynamics and complexity of new technologies and globally integrated production (Mizjun, 2014).

Analysing dynamics of business associations and state in Latin America, private sector organizations in China etc., Doner (2010) affirms the vulnerability approach by the demonstrating how various types of crises precede and stimulate of institutional changes. Explaining the institutional innovations implementation, the author argues that they require such situations, in which leaders (public or private) observe themselves as highly vulnerable to internal pressures and external threats alone with the lack of means to address them.

Research of Schot & Steinmueller (2017) considers post-World War II growth experience that continued with relatively minor interruptions until the oil shocks of the 1970s and 1981 serious recession have intensified the competition between countries and highlighted differences in national industrial innovation and productive performance. These differences were caused by the different institutional innovations within the national innovation systems development. In this situation, we face the task of facilitating the emergence and stability of institutions, as well as the possible role of the state within the institutional evolution processes (Hodgson, 2002).

In the study (Nelson, 2002), the authors have noted that institutional structure at any time has a profound effect on the technologies that are in use and are being developed. Theoretical review confirms that increasingly evolutionary economists are coming to see institutions as moulding the technologies used by society, and technological changes itself.

As a result of understanding these aspects in the study (Bogatova, 2009), the appearance of innovation theories in the 1990s was noted. These theories are oriented on the practices of promoting the high-tech industries and models of socio-cultural assistance for the scientific and technological development, formed on the basis of economic cycle theories and socio-economic development concepts. In the latter (including the theory of the cycle), the role of innovations as a factor in economic dynamics is manifested in the following points:

- 1) technological dynamics (innovations in the real sector of the economy) lies in the basis of economic cycles;
- 2) there is a certain dependence of employment dynamics on the dynamics of new high-tech industries development;
- 3) the role of institutions plays a great role in the development of innovation activity; they are treated both as a brake for innovations and as a method of choice between technological alternatives;

- 4) there is an objective necessity to strengthen the role of the state in connection with innovation development (monitoring of innovations, planning, and forecasting);
- 5) in the innovation economy, disruptions occur due to a lag in the development of a new institutional structure;
- 6) the organizational forms and sizes of firms are largely determined by the technology used.

The guiding idea of research (Werle, 2011) deals with the fact that technologies and institutions are changed in an interactive process, which is mediated and influenced by activities of individual and collective actors. Evolution of technical innovations proposed to be considered as a result of coordinated efforts whereby the mode of coordination can take the institutional forms of market, network, and hierarchy. Also from an institutional perspective, it is important to note that innovation networks link different institutional sectors with each other.

Saviotti (2005) underlines that “innovations are created by the system, constituted by different parts or components interacting and determining the final outcome”. By stressing mainly the interactions between technologies and institutions, the author assumes that these interactions are much stronger and more important in determining the behaviour of the system.

Under the conditions of new technological paradigm and appropriate changes and challenges, according to (Golichenko, 2012), the main direction of technology and innovation policy should focus on creating conditions and incentives for mutual orientation of public sector of R&D and industry, establishing equal cooperative linkages between them, including innovative development resources management.

In the study (Potts, 2017), it is highlighted that because of distributed information and fundamental uncertainty, an efficient institutional context for innovation economic organization in its early stages is often that of common pool resource. The theory of innovation commons comes from studies of Hayek, Williamson, and Ostrom and presents an innovation problem as combined knowledge problem, implicit contracting problem, and the problem of collective action management. In the study (Potts, 2016), the new economics of innovation based on such points of innovation commons approach was formulated:

- 1) it is based around market process theory (economics of entrepreneurship, economics of institutions). Basic idea – innovation problem is actually an entrepreneurial discovery problem combined with a collective action problem (solved with institutions).
- 2) innovation problem: rules to coordinate knowledge for value discovery;
- 3) examples: coordination the processes between the new technology and emergence of industry (e.g., 3D-printing, blockchain etc.);
- 3) implication: new technology is not a new industry; new industry emergence requires governance

(i.e. cooperation and rules, these eventually become industry groups or associations).

The study (Golichenko, 2012) notes the need to find a balance between the processes of cooperation, competition, and standardization. To increase the coherence of innovation resources, it is necessary to create institutional conditions.

Research (Saviotti, 2005) points out the fact of technologies and institutions co-evolution and considers innovation systems as an example of systems that “is of collections of parts (or components) interacting in such a way that in presence of environmental variations the system adapts while preserving its structural identity.” In this context, the different institutional configurations or compositions can be considered within the specific structural features.

To identify the trajectories of institutional transformation, the concept of innovation system foresight, which includes mobilizing of joint actions to improve an innovation system performance with the ultimate goal of improving desirable socio-economic performance, can be used (Andersen & Andersen, 2014). In (Piiirainen, et al, 2016), it was noted that foresight enables mutual understanding of key priorities, goals, and values and makes a connection between innovation policy and important social issues. So, an output of innovation system foresight can be considered within the consensus and coordination actions. It can be more-or-less jointly constructed statement about future priorities, actions, goals, visions, which leads to action as the collaborative process, resulting in new actions and initiatives.

Experts of Deloitte (Hagel, Seely Brown, 2013) underline that “institutional innovation (redefining the rationale for institutions and developing new relationship architectures within and across institutions to break existing performance trade-offs and expand the realm of what is possible) allows organizations to re-architect themselves to scale learning and generate richer innovations at other levels, including products, business models, and management systems.” Research also deals with the learning effects, i.e. new institutional architectures have the potential to scale learning so that everyone learns faster by working together. Experts note that economic actors no longer deal with static resources in the network but create an environment, in which participants learn faster as a result of participation in the network. Within this networks, the scaling relationships (in addition to short-term transactions, institutional platforms that focus on building longer-term relationships are created) and scaling learning (realizing the longer-term opportunity to evolve institutional designs to accelerate learning among a growing number of participants) effects can be successfully established.

Allen & Potts (2016) have proposed an alternative theory, which identifies the institutional origin of new technologies further back in commons when

self-organizing groups of technology enthusiasts develop effective governance rules to pool distributed information resources. The study (Egbetokun, et al., 2017) has concluded by proposing that for innovation systems theory to remain relevant in the near future there has to be a shift from systems to networks, i.e. network of actors within the same element and across elements.

Considered researches prove that institutional transformation and institutional innovations can be viewed as a tool for a system of technological & innovation systems but this aspect requires further studies.

### 3. Proposed methodology of system security of innovation system providing analytics

The scientific novelty of the research and the solution of its tasks deal, first of all, with the application of the non-system approach, which allows one to consider the factors and results of functioning of such complex economic systems as innovation macro projects, innovation processes, institutional and informational environments, etc. within the framework of providing national security.

Involvement on a systematic basis of spatiotemporal analysis allows us to consider in the interrelation processes of the distribution of flows of innovation resources and functions, on the one hand, and the distribution in time of similar flows.

To solve the tasks of research, the classical scientific methods (analysis and synthesis, logical generalization, analogies, comparative comparison, and grapho-analytical methods), and specific methods of high technologies economy and innovation management were used.

Also, the following specific methods were used to determine the objectives of innovation communications:

- adapted decision-making methods based on optimization of performance indicators;
- methods based on the analysis of schemes for the strategic development of innovation systems and intersectoral high-tech complexes;
- methods of searching for innovative ways of development and methods of integrated economic analysis of development policy.

The fundamental principles of purposeful management of institutional dynamics within the framework of development strategies require constant research, as in the current conditions the situation in the innovation sphere is constantly changing. This requires identifying pressing problems and determining the prospects for its development in the conditions of technological changes. So the proposed methodology allows combining the system security strategy (Kudrina, Omelyanenko, 2018) and the nation's development prioritization (Prokopenko, Omelyanenko, 2017).

#### **4. Innovation aspect of institutions and interactions development (Industry 4.0 case)**

The urgency of considering the transformation of institutions in innovation aspect is caused by the fact that the world is on the verge of the Fourth Industrial Revolution, which leads to the restructuring of economic processes, and as a consequence, economic growth and competitiveness of the leaders. According to PwC experts, industrial manufacturers from around the world plan to invest \$4.0 billion annually into the development of Industry by 2020.

Recognizing the importance of ongoing developments in the field of system security, it should be noted that systematic research devoted to ensuring national security in the new conditions of innovation development has not been carried out so far. This is especially true in the processes of ensuring the interconnection of national security, innovation activities, and institutions, the formation of the concept of national innovation security, and its implementation in practice.

Talking about the security issues, the main reason for the critical (sensitive) dependence of the economies of developing countries on the external factor is the dysfunctionality of economic and innovation policies. It can be regarded as a condition, in which there are insufficient power and means to identify threats, to develop an algorithm for their disposal, and to find the appropriate resource. This is due to the fact that at all levels of the system, there are not generated biased strategies for the future to achieve the common desired for all economic actors and institutions.

From the point of system security, the national security should be considered not only as a condition for the protection of national interests but also the availability and the possibility of using instruments of influence on economic and innovation processes to ensure long-term social welfare. Thus, there is the possibility of developing tools for creating an effective system of people-to-people relationship and governance, aimed at innovation, a minimal conflict of interest, which will provide maximum opportunities for self-realization.

In this context, we will particularly highlight the study of Harmon, Stevens & Swim (1991), which can be considered as a fundamental work that reveals the interrelationships between national security and innovation with an appropriate financial strategy.

Also, the analytical report of the National Science and Technology Council of the United States (2016) (A 21<sup>st</sup>, 2016) is particularly useful for defining the strategic guidelines for state security policy, which provides an opportunity to review the example of a systematic analysis of the impact of innovation on US national security and the identification of relevant strategic aspects, taking into account the active interaction between the institutes.

So in the United States, innovation policy is seen as a coordinated, state-funded initiative to mobilize national resources to accelerate technological change and maintain leadership in global competition. This is realized through the mechanisms of institutional interaction. In these conditions, developed countries are faced with the issue of developing national innovation strategies since the new technological revolution represents a chance for them to change their role in global economic competition (the phenomenon of leapfrogging) but economies do not yet fully exploit the potential for development.

The Industry 4.0 Workgroup Group report states that these new system strategies should be based on a completely new approach to production as a conglomeration of major industrialists, experts, economists, academics, and the state. Therefore, the question arises about the design of appropriate strategies and networks for innovative development (the author of the study dismisses them as innovation networks and institutions, which support their development) that will form interaction synergies.

Experts have formed a new typical feature of Industry 4.0 solutions as "interaction efficiency." Often this idea is the starting point for assessing the readiness (conformity) of the particular economic system (state, region, enterprise) to Industry 4.0 conditions. Ability to interact with other innovation system participants, i.e. quickly integrate into the innovation networks or adapt to new conditions, openness to such interactions becomes an essential factor of competitiveness of any economic agent. For this reason, one of the key topics in advancing Industry 4.0 technologies is the theme of interoperability and communications standards. Support for a standard makes the product, service or system open to interactions for other participants. In our opinion, the same approach should be applied also for institutional interactions strategies.

Industry 4.0 and new technology modes as a tool for increasing productivity and creating economic independence and information security of country within the framework of system design will ensure the high level of use of industrial networks; autonomous and self-regulating production systems; the combination of modern information technology and classical methods of production.

Industry 4.0 due to its systems effects requires system decisions as for the business sector, as well as for state authorities. In a further section, we'll consider the evolutionary approaches for the intuitional base of the national innovation system.

#### **5. System-institutional approach to innovative development**

For the purposes of this study, innovation system as an example of the social and economic system

should be considered as an integral set of interrelated and interacting social and economic institutions and relations regarding the distribution and consumption of innovation resources, production, distribution, exchange, and consumption of goods and services.

The system is called stable structurally (dynamically, computationally, algorithmically, information, evolutionarily or self-organization) if it maintains a tendency to strive for the state that most closely matches the goals of the system, the goals of preserving quality without changing the structure, or leading to strong structural changes (behaviour dynamics; system functioning algorithms, information flows, evolution or self-organization) of the system on a certain set of resources (for example, on a time interval).

Based on the approach (Samosudov, 2008), we can identify the following factors that determine the system stability of the innovation system:

- stability of dynamics of the structure of participants in innovation processes;
- institutional structure and its development;
- structure of the resource base and its dynamics;
- information interaction with participants of corporate relations.

Thus, a system approach to innovation development is more coherent to coordinate the implementation of national innovation priorities and to enhance the competitive advantages within the system "development – security" based on synergy. Using the knowledge gained in analytical practice will contribute to improving the state of national security, saving resources, labour productivity, as well as the transition to sustainable (stable) development of the national economy.

So the balanced innovation policy ensures the coordination of qualitative and quantitative connections of all elements in the innovation system. The development of a balanced innovation policy is very relevant because of the system of internal contradictions between goals, limited resources, and structure (Platonova, 2016):

- system imbalances in the group of contradictions "goals-resources" and "structure-resources," reflecting the imperfection of material and technical basis of the system (lack of resources or their unsatisfactory distribution by system elements);
- system imbalances in the group of contradictions "resources-structure" and "structure-goals," related to the structure inefficiency, its inadequacy relative to goals and resources;
- system imbalances in the group of contradictions "resources-goals" and "goal-structure," related to the discrepancy of the goal-setting.

These system imbalances can be in the base of proposed institutional and technological design methodology, which is oriented on the implementation of institutional innovations (Omelyanenko, 2018).

From the practical point of institutional and technological design methodology within the framework of system theory of innovation system balance application in the context of spatial-temporal approach and system paradigm of innovation development, systemic factors of the balance of the economy can be identified, the methods of system dimensional measurements can be developed, quantitative analysis of their impact can be carried out, the possibilities of controlling systemic stability and the measures of economic policy, aimed at improving the balance of the economy in order to innovate its development and ensure national security, can be developed.

An integrated result of the implementation of such logic should promote a system approach for national security purposes development management, which will be based on forecasting socio-economic changes, including those caused by the processes of innovation.

The appropriate organizational and economic mechanism involves the ability of the economic system:

- 1) to realize the function of strategic system analytics (identification the paths of development based on technological analytics and institutional matrix efficiency);
- 2) to ensure sustainable development on the basis of innovation transformations through ensuring the principle of symmetry of intersectoral links;
- 3) to ensure functioning under the most unfavourable conditions through the use of own intellectual and technological resources (the principle of satisfaction of basic needs, the system ability to self-redevelopment and self-development);
- 4) to generate, implement, and accept innovations within the framework of innovation networks, providing a critical mass of qualitative transformations in the economy.

An example of the evolutionary management of institutional transformations can be Japan. The development of Japan innovation system is based on an evolutionary approach: borrowing foreign scientific and technical achievements (buying licenses, setting up joint ventures, participating in multinational research projects) and subsequently encouraging the development of their own research, primarily on a corporate basis (based on large corporations).

Until the late 80s of the XX century, the first approach prevailed, although its importance in the overall strategy was gradually reduced. In the 80s, a course for maximum scientific and technical self-sufficiency with an emphasis on national innovation was formulated.

The next stage in the formation of Japan's national innovation system can be attributed to the beginning of 2000s, when the Council for Science and Technology Policy, based on an analysis of global trends in the development of the world economy and current problems facing Japanese society, developed a plan for a national strategy in the field of scientific and technical development. At the heart of the strategy is the nomination as the main

national priority for basic research and the identification of two large-scale priority areas.

The modern perspective plan, which is the basis of Japan's national innovation system, is based on the formulation and systematic approach to the interconnection of scientific and applied sectors and

1) includes four sections: life sciences, computer science, and telecommunication nanotechnology and materials, ecology;

2) mainly applied research and technology, including energy and resources, industrial technology, industrial and social infrastructure, problems of Earth and Space.

The same logic can be put in the base of institutional and technological design methodology and eliminate the system imbalances because the institutional context has a direct impact on its content and structure.

## 6. Strategical aspects of system innovation policy

From the strategical point of view, we propose to consider the systemically acquired sustainability (in the framework of national innovation system), as well as localized acquired sustainability (in the framework of elements (actors) of national innovation system). So it is critically important to build effective institutions of innovation system that will allow timely detection of "windows of opportunities" in new markets where leaders have not yet been formed. For these purposes, it is necessary to learn how to anticipate new markets, to form technological images of the future, and to make purposeful efforts so that this future will take place in the most favourable institutional configuration.

When we consider the strategical factors of institutional transformation, we should take account of the state of the innovation system. In particular, at the formation stage, it is necessary to create conditions for the transfer of final and intermediate results of R&D to industry, monitoring and elimination as institutional obstacles that limit innovation processes. When the level of maturity of the innovation system is reached, open procedures for the formation of cooperative interaction programs with representatives of industry and government and science are needed, in particular, the creation of technological platforms and networks that provide vertical interactions.

So for the purposes of institutional and technological design, we propose to consider innovation networks, which realize such functions:

1. Search for partners for the joint implementation of projects for the commercialization of technology, R&D, access to new markets, etc. This is one of the most popular services for companies of early stages of development that need technology partners that can provide them with a new level of development (e.g., the organization of production of serial products or components);

2. Dissemination of technological information is an actual service for scientific organizations that are interested in broadly informing industry and companies about their research capabilities and competencies;

3. Promotion of technological projects – using the various tools of network interaction, the centres participating in networked work can address the ideas of new projects more effectively and study the potential interest;

4. Conducting technological marketing – carrying out continuous monitoring of technological information distributed among the members of the network (in particular, technological requests and proposals), the centres can conduct a primary analysis of demand and proposals in particular subject areas of research.

Considering institutional network strategies, we underline the necessity of ensuring the systematic participation of technology platforms, industry business associations and development institutions in the formation of an annual review, adaptation and actualization system of lists of priority technologies in cooperation with independent representatives of the expert community.

Figure 1 illustrates the strategical aspects of system innovation policy based on institutions.

Specified in Fig. 1 mechanism is based on the following points and ideas:

- systematization of global economic & innovation trends, which causes intensification of innovation processes, taking into account the features of high technologies as a factor in the formation of competitive advantages and mechanisms of formation of infrastructure (intersectoral high-tech complexes – military-industrial complex, space industry), which allow combining the potentials of influence of individual subsystems of the economy and its analysis as a holistic formation;
- disclosure of the status of an institutional component of innovation development from the point of view of realizing national interests and identifying a list of key innovation priorities that will ensure effective neutralization of both real and potential threats (determined based on global foresight research) and thus maintain an appropriate level of national security;
- identification of place of innovation system in the system of national security, analysis of the impact of innovations on the state of economic security at the national and international levels, as well as the establishment of a clear quantitative linkages between the results of innovation activities of various sectors, including scientific, industrial, technological, and level national security.

The implementation of these points requires the improvement of the mechanisms of interaction between the state, development institutions, and business actors. This requires active coordinating participation in this work as an integrator and coordinator of the process of developing effective solutions in a number of areas.

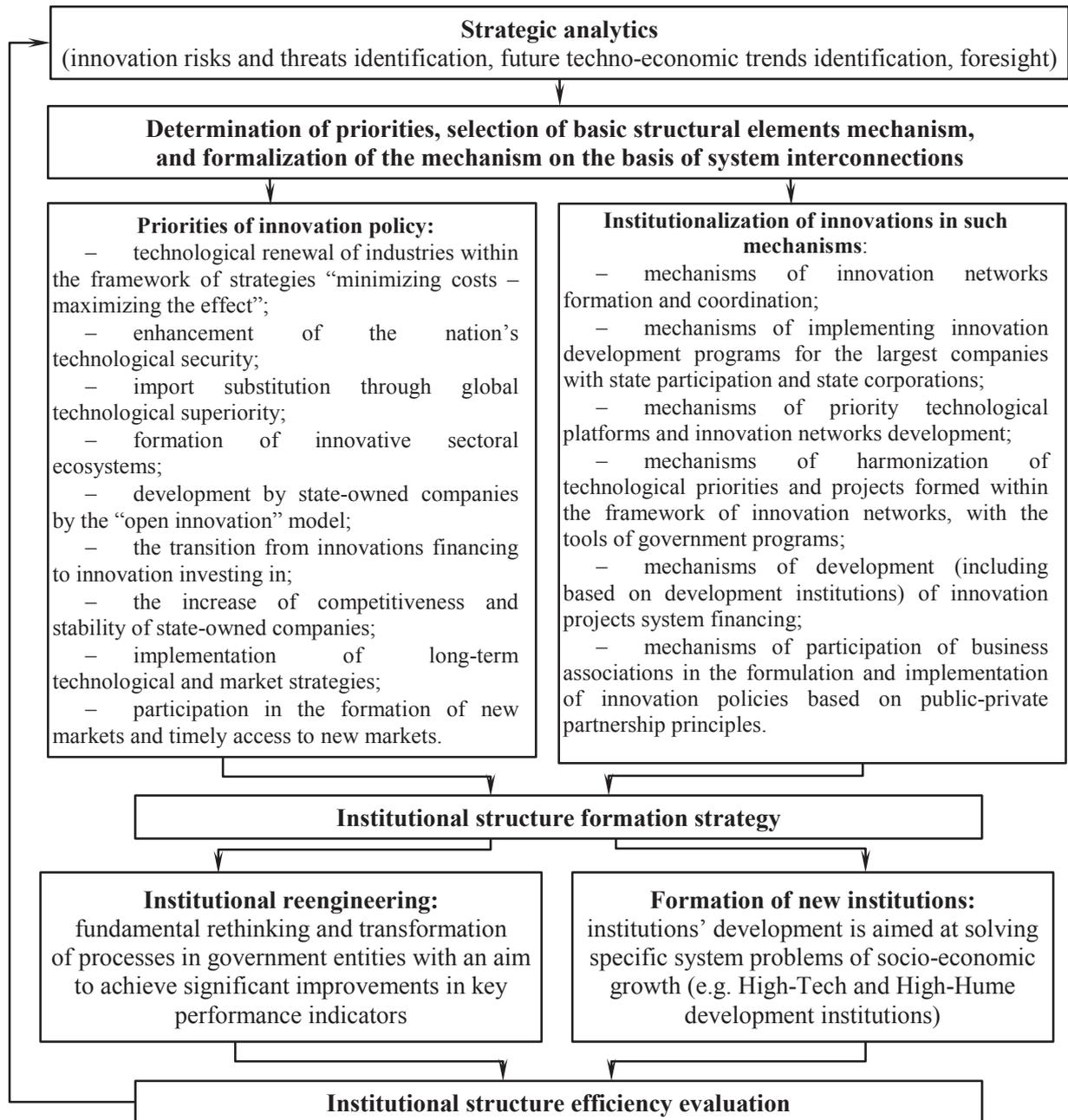


Figure 1. Institutional and technological design framework within the system security

Source: the author's development

This is possible through ensuring the systematic participation of technology platforms, industry business associations, and various development related institutions in the formation of an annual review, adaptation and actualization system of lists of priority technologies in cooperation with independent representatives of the expert community.

It is important to take into account that new technologies require tools of a new type, aimed not at catching up but at advancing development. It is precisely such mechanisms that are lacking so far in order to achieve a decisive breakthrough in the innovation

sphere and to provide the country with a confident position in the emerging markets.

## 7. Conclusions

As a result of the study, the features of the systemic socio-economic patterns of the functioning of innovation system institutions and the mechanism of management of innovation development in the conditions of modern global technological transformations have been determined. In the future, this makes possible the substantiation of promising areas of state regulation

aimed at activating innovation processes in the economy according to priorities related to scientific and educational, cluster and network development, and the development of a set of models for the harmonization of the system of priorities of national security and sectoral priorities of innovative development. Using the gained knowledge in practice will help to improve the state of national security, save resources, improve conditions, and increase labour productivity, as well as the transition to sustainable development of the national economy.

Systemic coordination of innovation components of state programs, stimulation of innovation activity, involvement of financial strategies of the innovation economy, expansion of international cooperation and activation of demand for high-tech products, increasing the effectiveness of innovation development programs of companies and launching of national projects have been proposed as the objectives of forming institutional innovations. The proposed institutional and technological design methodology provides for the selection of institutional tools and scaling of the most effective development tools.

The proposed network mechanisms for systemic security ensuring provide the improvement of implementing innovative development programs for the largest companies with state participation; further development of priority technological platforms and innovation networks; harmonization of technological priorities and projects formed within the framework of technological platforms, with the tools of state strategies.

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