

Security issues of system innovation strategies

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Abstract. The objective of this study is to consider the main points of system innovation policy within the security strategy. Within the new trends in security science technological trajectory analysis creates an effective field of innovation communications, the main task of which is to stimulate the dialogue of innovation activity stakeholders and their cooperation with the help of specialized approaches. In the framework of the system of national security strategies, we propose the formation of innovation-synergetic design methodology. Industry 4.0 can be considered as a priority project, which can reduce the influence of a number of negative factors, since its implementation will ensure the scientific and innovative security and stability of the positive dynamics of the country's development, increase the competitiveness of the national economy. Thus, the task of coordinating innovation development within the Industry 4.0 is to promote structural reforms, to select the mechanisms for the most effective concentration of resources in priority innovation directions, to create a system for monitoring the efficiency of using innovation infrastructure facilities, to create conditions for the development of competition, coordination of development institutions, implementation of foreign policy orientation of the innovation, regulation of behavior of companies with state participation and natural monopolies, including through innovation development program.

1 Introduction

The modern trends in security science deal with the expanded understanding of security concept, which is no longer limited to military discourse.

The authors proposed sectors in which security issues arise as the most significant (military; political; ecological; economic and societal) and removed the security studies from the area of international relations, giving them the most interdisciplinary character. Multilevel approach for national security is given in studies [1; 2].

Study [3] notes, that public decision maker are faced with the great challenge of detecting the future risks, which concern the national security. So decision makers should be able to identify threats to react to them adequately and reduce risks [4]. A collaboration of subject matter experts of several disciplines constitutes an important part of the process.

The ability to develop effective analytical tools for assessing national security risk is considered as a key determinant of strategic success in the twenty-first century [5; 6]. Research [7] deals with the national capabilities development to protect larger and more complex interests. Such idea is relevant to changing defense and national security thinking [8]. From this point innovations is critical to understand the security context and model integration in order to achieve long-term national security [9].

To develop the successful innovation strategies a strategic foresight in public policy: and cases of UK, Singapore, and the Netherlands [10].

According to [2] the strategic security management framework incorporates the many practicing or knowledge categories of organizational security integrated into a system. The methodology focuses on the interrelationship between the different functions and departments within an organization.

Research deals with the strategic interests concept which in practice should include the list interests. The similar approach is given in study [11] which considers the issues of strategic interests promotion through the military and foreign affairs.

Study [12] addresses the changes in public management environment that have encouraged the growth of collaborative public management.

Within the defense supply chains in studies [13; 14] the role network-level initiatives complement nation-based defense supply chains management, contributing to supply chains adaptivity and efficiency was outlined.

Studies [15; 16] considers security networks as an increasing in number and in importance across the security field as a means of providing inter-agency coordination. According to this definition the detailed qualitative study of networks in the national security field in Australia were done. The author also places cooperation, coordination and collaboration issues to illustrate the performance of security networks. Networks are also considered within the national

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security. The study [6] argues that security can be conceptualized as being produced by various networks of actors (public and private). The article [17] contributes to the public management by exploring the critical challenges that underpin the construction of information and knowledge management strategies in networks. The findings of research [18] suggest that networks can add collaborative public value when approaching nettlesome policy and program problems.

Therefore the new approaches for technological trajectories analytics, given in studies [19; 20; 21], additionally to technologies and innovations development gives new possibilities to manage innovation projects based on infrastructure, informational, scientific and technological, infrastructural and producing elements to solve technologies development and transfer.

The objective of this study is to consider the main points of system innovation policy within the security strategy. These issues will be studied within the Industry 4.0 based transformations.

Within the new trends in security science technological trajectory analysis creates an effective field of innovation communications, the main task of which is to stimulate the dialogue of innovation activity stakeholders and their cooperation with the help of specialized approaches. Technological trends analytics and analytics-based management can be implemented to provide the transition from an extensive export-raw material model of economic development to a model of ecologically balanced (adapted) modernization of economic development. So the practical application of proposed approach will allow more coherently coordinate the implementation of national innovation priorities and enhance the competitive advantages in the "development-security" system on the basis of synergy.

2 Innovation-synergetic methodology: general ideas for Industry 4.0

In the framework of the system of national security strategies, we propose the formation of innovation-synergetic design methodology.

The development and testing of appropriate organizational and economic support for the implementation of competitive advantages in the inter-sector high-tech sectors in the context of the formation of Industry 4.0 involves:

- 1) allocation of the innovative component of national security and the development of the foundations of the creation of inclusive economic institutions in order to create innovative networks;
- 2) analysis of the features of Industry 4.0 in the context of the strategy of ensuring national security in terms of qualitatively new opportunities and threats;
- 3) systematization and analysis of global analytical researches and publications on the current state of global innovation networks and directions of their development in the conditions of Industry 4.0, as well as the development of the foundations of the methodology of innovation-synergetic designing;

4) development of typology (global) of innovative networks, determination of factors and prospects of their development in the conditions of Industry 4.0;

5) analysis of new challenges for the economic and national security of countries in connection with the development of network ICT as a technological base of innovation networks;

6) analysis of technological features and technological dynamics of the sectors providing national security under the conditions of Industry 4.0;

7) disclosure of internal and external threats, substantiation of the system of interdependent criteria and indicators, which need to be guided in terms of strengthening the innovative component of national security through system interactions within the Industry 4.0 model;

8) identification of the main actors of innovation within the Industry 4.0, forming the resource potential and providing a way of coexistence of modern innovative technologies and society;

9) analysis and synthesis of factual material on the impact of the development of innovative networks on the economic and national security of Ukraine and the development of appropriate innovation-synergetic projects;

10) development of the concept of economic and national security at the present stage of development (global) innovation networks.

The difference of the innovation-synergetic methodology of the formation of innovation-technological systems under the conditions of Industry 4.0 is, first, in the availability of significant volumes of data for analysis, which allows us to identify and assess the impact of factors that were not previously subjected to direct measurement methods.

Secondly, the emergence of new economic models and approaches, such as innovation networks, venture financing, energy service contracts, various technological development programs, scientific and educational projects, etc. These tools affect both the process of substantiating the innovation policy and the sources of funding for programs.

The methodology is based on the modern economic synergetics which are reduced to the fact that innovation in economic systems is accompanied by phase, structural and synergetic transformations. Economic synergetics considers synergetic effects as the most important factor of accelerated development in economic systems and sees the main task of management in the modern conditions of competence development in technologies for the formation of synergistic effects.

Also, the methodology takes into account the idea that the development of high technologies is inextricably linked to a strong industrial base and an active industrial policy based on the unification of science, production and education into a single system. Under these circumstances, the main challenge is to create tools for inter-sectoral interaction and to jointly direct the overall move towards faster modernization of industry by implementing Industry 4.0 technologies.

Industry 4.0 can be considered as a priority project, which can reduce the influence of a number of negative

factors, since its implementation will ensure the scientific and innovative security and stability of the positive dynamics of the country's development, increase the competitiveness of the national economy, create attractive conditions for investing in innovation activities, and development of infrastructure, increase export of high-tech products. The strategy also foresees the formation of a neo-industrial society, the most significant features of which are formed on the basis of interdisciplinary intellectual technologies, new quality of economic growth and humanization of the economy.

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

On the basis of this we propose approaches to the formation of state innovation policy, which takes into account trends in business processes. In particular, the formation and development of a modern digital economy is accompanied by three most important directions of transformation.

Firstly, it is a transformation of the business model, which leads to a revision of the principles of interaction with customers, suppliers and partners, including changing the product line in line with the changing customer preferences, as well as the conditions for the provision of products and services.

Secondly, this is the transformation of business processes in the direction of strengthening their cross-cutting characteristics and controlling quality parameters, among which the quality of interaction procedures becomes important.

Thirdly, it is a transformation of the infrastructure for the introduction of new technologies and platforms for the provision of services, including in a networked format, which involves connecting resources to partners and counterparties resources.

3 Security component of national innovation strategies

In modern conditions the role of international factor in the innovation area is constantly expanding. Within the global competition context and the innovation resources dispersion, the implementation of large-scale innovation projects and market promotion of its results is often possible only through the transnational innovation networks. In this regard, the development of international innovation cooperation can be considered as one of state policy priorities. However, this aspect is characterized by both opportunities and risks. This aspect forms the necessity for strategic coordination management, which considers the various security issues related to international competition and cooperation between nations.

Such coordination is essential not only for technologies development and commercialization, but also for the introduction of new methods of innovation

development management, including at the state level. So it is necessary to take into account the changes of innovation policy of developed countries and to adopt the best practices of security based policy. E.g. the experience of EU countries on the formation of technology platforms can be successfully used in strategic planning documents of developing countries.

The international security component of national innovation strategies includes the following components:

- highlighting the list of the most important technologies for national security and defense capability (possibly the list of interrelated technologies) in the framework of long-term scientific and technological forecast in order to monitor and forecast the situation in these areas on the world markets;

- organization of an effective joint work of scientific sector, government institutions and business agents on scientific research, development work and the introduction of appropriate technologies into production;

- strengthening of support for domestic companies working in key areas of technological development to ensure national security, including the application of the public procurement system for these purposes;

- using the potential of development institutions to accelerate consolidation processes in high-tech sectors of the economy to create companies that are world-class technological leaders.

- support for the entry of domestic enterprises into business alliances, focused on the creation of technologies and products with a high level of competitiveness, subject to technology transfer;

- elimination of restrictions on domestic access of enterprises to modern foreign technologies;

- ensuring participation in global technology projects, international programs and research networks for integration into the global scientific and technological space;

- development and implementation on the basis of a long-term technological forecast of large-scale projects in the development of individual technologies;

- the integration of the domestic research and development sector into the global innovation system, the development of international cooperation, and the access of scientists to the research base of leading foreign research centers;

- the adoption and implementation of a program to support the export of high-tech products, services and technologies;

- formation of a mechanism to support the creation and capitalization of high-tech brands through foreign patenting, the creation of special units of embassies and trade missions, as well as within the framework of intergovernmental activities.

For the practical conceptualization of these directions the institutional design of national innovation system should be considered. This mechanism includes coordination of a system of state, private and public structures (institutions), as well as national institutions and their interaction within the creating, modifying, transferring and using knowledge and technology. The condition for the effectiveness of the consistency of these processes can be called the rule of “four i”:

- institutionalization, which provides for the creation of new institutions (for example, departments, research and educational centers, etc.) or the reorganization of existing structures in order to solve the priority tasks of innovation development, as well as the formation of an appropriate infrastructure;
- integration presupposes the use of an interdisciplinary approach in research and the creation of scientific teams, coordination of efforts to solve problems of a fundamental and applied nature;
- innovation is characterized by the fact that a qualitatively new intellectual product is being manufactured or a technology transfer takes place;
- image that provides for the formation of a positive image of technological opportunities and changes, as well as the country's prospects as a result of transplantation of institutional innovations.

4 Case studies

Within the framework of consideration of security questions on the identification of aims of coordination, we propose to consider four models of scientific and innovation development of countries:

- countries focused on innovation activity, the implementation of large-scale innovation projects, but, as a rule, in the defense sector of industry (USA, England, France);
- countries that are focused on creating a favorable innovation environment in the world, rationalizing the structure of the national economy (Germany, Sweden, Switzerland);
- countries that stimulate the development of innovations and innovations through an innovation infrastructure, with the state coordination of the development of various sectors of industry in the field of innovation (Japan, South Korea);
- China, which is focused on leadership and innovation activity, developing a universal model of the scientific and innovation industry through the coordination of public investment.

Without refuting any of these models, we can point out that they correspond to institutional patterns and trajectories of innovation development of countries in the Industry 4.0 conditions.

In the study for the review of the basic approaches to the coordination of sectoral and territorial development in foreign countries, the approach of Japanese researchers is indicated, within which such factors are necessary for the successful development:

- lack of investment alternatives to high-tech industries;
- reliance on the already existing competitive technological potential of local industrial enterprises and scientific organizations;
- existence of enterprise leaders who can lead innovation processes and consolidate around themselves other organizations during the formation of the cluster;
- availability of highly professional specialists of world level;
- specific interaction between universities, research institutes and industrial companies;

- commercial efficiency of the established venture companies;
- cooperation of new venture companies with leading corporations and universities;
- existence of a developed support infrastructure, including financial, production and management;
- existence of highly effective coordinating organizations for universities and enterprises;
- presence of high-quality leaders capable of developing a unique regional development strategy and attracting high-quality specialists, including from other countries;
- interaction with other clusters;
- implementation of the strategy of innovation market expansion with a focus on the global market;
- corporate development and attraction of national and foreign capital through the initial public offering;
- presence of a high international reputation.

Proceeding from these directions, it is necessary to develop an organic model of coordination of innovation development, which should be based on existing institutional models and trajectories, as well as technological specificity of priority areas.

Therefore, the country needs such innovation macro technologies, the development of which should be formed jointly with the business of the development program, as the main tool for implementing innovation industrial policy, which will ensure the flow of funds to the budget and will invest in industrial innovation.

As a tool for coordination and economy structural reorganization within the security strategy, we propose to consider strategic macro-projects that enhance competitiveness and aimed at increasing the effectiveness of the use of strategic development resources. In the wrecks of successful coordination, these projects have not only sectoral, but also macroeconomic significance.

Macro projects can be considered as anti-crisis measures ad security-related products, which include a powerful comprehensive program of support for “points” in growth in the real economy and stimulate small and medium-sized innovation entrepreneurship with the creation of new workplaces.

Innovation macro projects are interrelated and provides targeted improvement not only to the structure of the economy, but also to the territorial structure. There are three types of macro projects:

1. Creation and development of strategic poles of growth. These macro-projects are in fact projects for large-scale development and development of territories.
2. Comprehensive development of support points of growth. The reference points of growth are complex projects implemented within one or several settlements within a single municipal district or city district. Within the framework of such projects, it is planned to implement complex projects for improving the central parts of cities and increasing economic density in their territories, improving the availability and accessibility of basic social services, as well as implementing some major projects in the real sector of the economy that can make a significant contribution to job creation and increase wages in the given municipality.

3. Network projects that form the infrastructure of balanced development. A strategic approach to the development of infrastructure is to ensure the widest possible access of the population and business to this infrastructure. Network projects that form the infrastructure of balanced regional development are groups of investment projects in the social, transport and engineering infrastructure.

The strategy identifies a number of priority industry groups that are able to expand their niches in the sphere of import substitution and export, which have a significant potential to increase production and sales in the emerging conditions of the external conjuncture.

In the production sector, activities that are significantly ahead of the country's average labor productivity indicators are singled out, which have the most favorable prerequisites for import substitution and expansion of the presence in the domestic market:

- engineering, an oriented defense-industrial complex;
- production of building materials (including, innovation, environmentally friendly);
- production of medicines and hygiene products;
- agriculture (first of all, growing vegetables and flowers in a closed ground, producing environmentally friendly products on suitable for this purpose);
- production of food products in high price segments.

Among export-oriented types of activity it is expedient to place a stake primarily on those in which experience of foreign economic contracts already exists. Many of these activities will also make a significant contribution to import substitution. First of all, it is:

- power engineering (for example, production of equipment for nuclear power plants);
- aerospace (production of missile and aircraft engines) and railway engineering;
- chemical production (for example, the production of mixed fertilizers, tires);
- food industry (for example, the production of chocolate and animal feed);
- production of electronic equipment and household appliances.

The volume and export potential in these areas is quite large, but historically developed markets are subject to significant geopolitical risks. Significant work is under way to diversify the geography of exports, and often the assortment.

Priority activities focused on import substitution and export growth cover not only the production of goods, but also the provision of services – transport-logistical, educational, cultural-leisure, tourist.

A promising group of export business services is engineering and software development, as well as outsourcing research and development.

In the short term, innovation production of products and services that previously were not represented or characterized by small scales may be favorable prerequisites for import substitution.

Examples of such activities are: innovation production of specialized tools and mechanization tools, applicable in both small business (farming, construction and repair services, etc.), and in everyday life; production of technically complex children's toys;

production of high-tech inventory and clothing for an active lifestyle, equipment for equipping “smart houses”.

Projects in these types of activities are already reflected both in the current work of the sectoral ministries, and in the concepts of the development of specific strategic poles and points of reference for economic growth. These same lines should be studied in detail in the framework of development strategies.

5 Conclusions

Thus, the task of coordinating innovation development within the Industry 4.0 is to promote structural reforms, to select the mechanisms for the most effective concentration of capital and human resources in priority innovation directions of economic development, to create a system for monitoring the efficiency of using innovation infrastructure facilities, to create conditions for the development of competition, to stimulate the innovation behavior of non-state companies in the real sector and financial institutions, coordination of development institutions, implementation of foreign policy orientation of the innovation, the creation of conditions for attraction of foreign high-tech companies to the projects of innovation development, regulation of behavior of companies with state participation and natural monopolies, including through innovation development program.

These functions can be implemented through the project approach in such areas:

- coordination of innovation activities of companies with state participation, as well as specialized state development institutions;
- coordination of actions on formation of innovative demand within the framework of all state programs;
- coordination of state targeted programs aimed at the innovative development of individual industries;
- implementation of special measures for the development of infrastructure for supporting small and medium-sized businesses, creating a demand for innovation (technology parks, business incubators, regional business support tools);
- development of additional measures to stimulate the implementation by private business of innovative projects, including the creation of corporate research and development centers by large multinational companies.

From a theoretical point of view, the research findings are in line with the latest trends in the development of world economic theory and applied economics, reflecting the transition from a fragmentary study of certain aspects and objects of the economy in general and the innovation system in particular, characteristic of the neoclassical tradition, to the systematic study of their mutual influences, which is characteristic of institutional, evolutionary and systemic economic theory.

Thus, the proposed methodology is systemic and takes into account the specificity of innovation activities under the conditions of Industry 4.0 and covers the entire spectrum of tasks for managing the development of innovative networks at different levels, taking into

account a number of existing problems. The practical application of foreign experience will enable more coherently to coordinate the implementation of national innovation priorities and strengthen the competitive advantages in the system “development-security” on the basis of synergy. Within the study, the knowledge about the systemic socio-economic patterns of the functioning of high tech economy and the mechanism of innovative development management that are new in the field of fundamental and applied sciences was gained. Using the gained knowledge in practice will contribute to improving the state of national security, saving resources, as well as the transition to sustainable development of the national economy.

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