

## SCIENTIFIC AND PRODUCTION CENTERS: ESSENCE, STRUCTURE, AND INSTITUTIONAL MECHANISMS

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### **Abstract**

The article examines the essence, functions, and institutional role of scientific and production centers (SPCs) in the development of domestic technologies. It analyzes their functional structure, which includes research, production, marketing, and educational components, and outlines their position within the national innovation system. Special attention is given to the context of Uzbekistan, where SPCs support import-substitution technologies, foster cooperation between science and industry, contribute to startup development, and facilitate the implementation of national strategies such as "New Industrialization" and "Uzbekistan-2030".

### **Keywords**

Scientific and production center; innovation infrastructure; import substitution; technological ecosystem; technology transfer; industrialization; national innovation system (NIS); artificial intelligence (AI).

In the era of economic globalization, Scientific and Production Centers (SPCs) occupy a central place in platform ecosystems, combining scientific research, industrial production, and digital technologies to create new value. Their activities are based on data exchange, integration of digital solutions, and adoption of platform business models, which promotes innovative development, efficiency growth, and sustainable development in the digital economy.

Presidential Decree No. UP-60 of January 28, 2022, "On the Strategy for the Development of New Uzbekistan for 2022-2026," considers "the development of industrial cooperation between large industrial sectors and regional enterprises" as one of its key objectives. Similarly, the "Uzbekistan-2030" strategy emphasizes the need to "strengthen applied research in the fastest-growing sectors of the economy, implement the cluster system of enterprise-university-research organization, and broadly introduce innovative activity in all directions, with support for scientific research and innovative initiatives." In pursuit of these goals, Uzbekistan is actively establishing technoparks and IT centers, supporting technological startups,

introducing modern agrotechnologies, and developing biotechnology. However, in order to make an aggressive transition to full industrialization, there is now a need to consolidate all machinery and equipment acquired by business entities together with laboratory and testing facilities into a single production platform – the proposed "Scientific and Production Center" (SPC). This center would create a unified digital scientific-production electronic platform linked to artificial intelligence (AI), enabling the construction of a common cooperative-industrial chain among enterprises of the Republic, aimed at localizing imports and producing new lines of products and technologies.

The relevance of this research is determined by Uzbekistan's strategic objective of forming technological sovereignty and developing a creative national innovation ecosystem. In the context of global competition, growing demand for high-tech products, and the necessity of accelerated industrial modernization, the creation of scientific and production centers is becoming a key institutional instrument for localizing products and technologies, introducing innovations, and training qualified personnel.

The aim of this research is to determine the essence, structural characteristics, and institutional role of SPCs, as well as to identify their contribution to the development of national technologies in Uzbekistan and the promotion of innovation in the industrial sector through the production of localized imported products.

The creation and development of SPCs is directly linked to the implementation of the state program "Uzbekistan-2030," which is aimed at increasing the share of domestic developments, strengthening scientific-production cooperation, and reducing dependence on imported technological solutions. The role of SPCs is also reinforced by the formation of technoparks, industry-specific innovation centers, and platform ecosystems, which are becoming important mechanisms for integrating science, business, and government.

Thus, the study and implementation of modern models of innovative SPCs is currently the most pressing issue for identifying optimal approaches to their organization, improving the effectiveness of innovation policy, and forming sustainable technological development in Uzbekistan.

Research by foreign and domestic scholars underscores the systemic role of SPCs in national innovation systems. According to C. Freeman, the effectiveness of an economy depends on learning and innovation. J. Schumpeter emphasizes their importance in the process of "creative destruction," which provides technological breakthroughs: innovations – new products, technologies, sources of raw materials, or forms of organization – destroy old economic structures and replace

them with more efficient ones, leading to economic development. Etzkowitz and Leydesdorff, developing the "triple helix" model, point to the necessity of active interaction between universities, business, and government for sustainable innovative development.

An example of an effective industrialization process is provided by the newly industrialized countries of Asia – the Republic of Korea, Singapore, and Taiwan – which demonstrated high rates of economic growth and transformation of their production structures. In the 1960s, the economies of these countries were based primarily on the export of raw materials and the use of low-skilled labor. However, through targeted structural reforms, active investment in education, and the development of scientific and technical potential, they managed to transition to the production of electronics, automobiles, and high-tech equipment. As of 2023, the Republic of Korea ranked 6th in the world in terms of high-tech exports (\$135 billion), while Singapore was ranked 20th (\$45 billion). Uzbekistan has enormous potential to adopt this development model, drawing on its own competitive advantages, including relatively low production costs and significant reserves of raw materials.

The transition of a national economy to an innovation-driven development model is only possible if a globally competitive national innovation system is established. This ecosystem collectively constitutes the structure of SPCs through the interconnection of organizations engaged in the production, dissemination, and commercialization of knowledge and technologies, and includes a complex of legal, financial, and social institutions that ensure effective interaction between educational, scientific, entrepreneurial, and non-profit structures across all sectors of the economy and public life.

The term "national innovation system" was first introduced by Professor Christopher Freeman of the University of Sussex (United Kingdom). According to his definition, a national innovation system is a network of public and private institutions and organizations whose interaction and activities facilitate the emergence, adoption, adaptation, and diffusion of new technologies.

In 1986, Moses Abramovitz published an article in the *Journal of Economic History* titled "Catching Up, Forging Ahead, and Falling Behind," in which he investigated the key components of the economic-technological potential of various countries and the factors determining the pace of its development. According to Abramovitz's concept, the totality of these factors forms the so-called "social capability" of a state – its baseline potential for increasing its economic and technological level. Among the most significant factors he identified were: national technical competence (including the level of education), experience in organizing

and managing large-scale production processes and projects, the presence of developed financial institutions and markets capable of directing capital into these areas, the level of integrity of public and private institutions and the degree of public trust in them, as well as political stability and the effectiveness of state governance in establishing and maintaining institutional rules. Lin Su Kim developed Abramovitz's concept of "social capability" by adding the category of "technological capability." In his view, a state's technological capability is formed through the interaction of three key components: innovation activities, production development, and investment activity. For countries oriented toward achieving economic leadership, the processes of attracting investment, modernizing production, and stimulating innovation must not proceed sequentially but in parallel, ensuring mutual reinforcement and sustained growth.

Professor Jorge Niosi of the University of Quebec notes that, unlike financial capital which crosses national and regional borders relatively freely, the spread of knowledge across these borders occurs considerably more slowly. This is due to its specific, "hermetic" character, since much knowledge is embedded in the human factor. Accordingly, the transfer of knowledge is directly tied to the movement of the human factor, whose mobility remains limited. The level of this mobility, according to Niosi, is determined by parameters of state regulation and the effectiveness of public and quasi-public institutions, which makes national borders an important factor in analyzing these processes. These considerations also apply within individual states, where the development of a national innovation system generally takes a clustered or networked form: local centers with favorable conditions for innovative activities are formed, their number gradually increases, and successful experience is scaled up.

As Academician V.M. Polterovich of the Russian Academy of Sciences has noted, "modern national innovation systems are very complex systems; in a broad definition, one is forced to include virtually all economic institutions in them." Each researcher formulates their own definition of the national innovation system, highlighting specific elements and the nature of interactions between them. At the same time, all authors draw on common methodological approaches and conceptual principles for analyzing this system. In domestic economic science, SPCs are interpreted as an institutionally formalized system of interaction between science, production, and government, oriented toward the development, testing, and implementation of knowledge-intensive technologies. In world innovation theory, SPCs are associated with the concept of an "innovation platform" or "technology transfer center."

The proposed research underscores the importance of accumulating in SPCs a strategy of industrial development and import substitution policy through sectoral cooperation in Uzbekistan, accelerating the process of universal industrialization and the transition from import to export-oriented production, which will create new jobs through the use of modern technologies (AI, digitalization of industry and equipment, and scientific and raw material potential) to build a new production chain for localizing and improving the quality of products. The functional-methodological structure of SPCs includes research, production, marketing, and educational units. Each of them provides a specific stage of the innovation cycle: from idea generation to commercialization. The typology of SPCs by functional-methodological structure is presented in Table 1.

**Table 1**  
**Types of Proposed Activities in SPCs**

SPC Type	Main Functions	Implementation Examples
<b>Research and Development</b>	Development and implementation of new technologies	Scientific research institutes and laboratories
<b>Pilot Production</b>	Introduction of technological solutions, experimental testing and pilot assembly processes	Scientific production centers, industrial production-technology clusters
<b>Marketing</b>	Market analysis and development of technology commercialization strategies	Centers for coordination, transfer, and commercialization of technological developments
<b>Educational</b>	Transfer and dissemination of scientific and technological competencies through commercialization	Innovation-technology complexes operating at higher education institutions

SPCs, playing a key role in the formation of the country's technological sovereignty, will ensure the localization of imported products by building new cooperative links and involving scientific institutions in industrial production.

The proposed SPC model will contribute to addressing the following scientific-methodological objectives:

1. Scientific and production centers will become the core of the innovation infrastructure, ensuring the link between science and industry and serving as an effective tool for delivering knowledge-intensive services.
2. SPCs will encompass research, production, marketing, and educational components.

3. SPCs in Uzbekistan will contribute to accelerated localization of imported products and technologies, and will broaden the development of national competencies to ensure economic growth and innovation.

4. The platform-based interaction model of SPCs will become a principal element of the country's technological ecosystem.

5. The innovative activities of SPCs will serve as a key factor in economic development, based on the integration of R&D into production.

6. The institutional environment of innovative activities will directly influence the content, direction, and organizational structure of SPCs.

Based on the research methodology applied internationally, this scientific article proposes a combination of the following approaches within SPCs:

1. Systems analysis – examining SPCs as a holistic socio-economic system comprising scientific, production, and institutional components.

2. Comparative analysis – studying and comparing the functions, structures, and models of SPCs in international practice and in the context of Uzbekistan.

3. Institutional approach – examining the normative, legal, and organizational mechanisms governing the activities of SPCs.

4. Structural-functional method – analyzing the research, production, marketing, and educational functions of SPCs in terms of their interrelationship and role within the system.

5. Logical analysis – studying the content of strategic documents, legislative acts, scientific works, and materials related to the activities of SPCs.

The proposed SPC construction model, in contrast to existing models, introduces the following scientific novelty:

– The content of the category "scientific and production centers" has been clarified within the context of the national innovation policy of the Republic of Uzbekistan.

– The main functions of SPCs have been systematized taking into account trends in the development of modern platform ecosystems.

– The role of SPCs in the implementation of the state programs "New Industrialization" and "Uzbekistan-2030" has been defined.

– The institutional and organizational mechanisms for the formation of national technological competencies have been identified.

– A conceptual model has been developed reflecting the significance of SPCs as a key link in the country's technological ecosystem.

The new industrialization of Uzbekistan requires a comprehensive approach: investment in technologies, reforms in education, and modernization of infrastructure through the creation of SPC clusters. The success of this process will

allow the country to reach a new level of economic development, reduce dependence on imports, and take a leading place in the global economy. The conducted research has comprehensively revealed the innovative role of scientific and production centers in achieving further and accelerated industrial development, and has led to the following proposals. To consider the entire technological park and the equipment acquired by the economic entities of Uzbekistan during the period of independence as a single unified producer, consolidated by a specialized body – an SPC – that provides scientific potential services to create a new intra-sectoral production chain, linked to artificial intelligence, R&D, and university research laboratories through comprehensive digitalization of industry and equipment across the country. This process will undoubtedly produce a multiplier effect on the country's economy – in particular, it will noticeably reduce technological import dependence, actively localize imported products, stimulate high-tech entrepreneurship, provide additional orders for production facilities at enterprises, create new jobs, and increase the country's GDP.

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