

# National Innovation Systems: Conceptual Framework

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**Abstract.** Discusses the conceptual foundations of the formation of the national innovation system (NIS). Various approaches to understanding NIS are considered. The author's definition of NIS is given as a system of interconnected organizations engaged in innovative activities and institutions (legal, financial, social) that establish an administrative and regulatory framework for the interaction of participants for the effective implementation of innovative potential. The article presents a system of subject-object relationships implemented to achieve the goal of the NIS, the classification of NIS subjects according to their functional purpose, the models of building the NIS and their features.

**Keywords:** national innovation systems, conceptual approaches, structural elements, models for building NIS in Kazakhstan.

## Introduction

Within the program for the formation and development of the national innovation system of the Republic of Kazakhstan for 2005-2015 (Approved by the Resolution of the Government of the Republic of Kazakhstan dated April 25, 2005 N 387) [1,3] and the Law of the Republic of Kazakhstan «On Science» dated 18.02. 2011 № 407-IV the ways of innovative development of the economy were identified, and the task was set to form an integral national innovation system (NIS) at the state and regional level, effectively using the existing innovative potential and creating incentives for its growth.

A prerequisite for the creation of national and regional innovation systems at the present stage of development of the Kazakhstani economy is the requirement to increase the level of innovation activity and ensure the continuity of the innovation process of creating new technologies, forms of management, which will ultimately allow achieving sustainable rates of economic growth. However, there are different approaches to understanding NIS.

The first approach proceeds from the representation of the NIS as a network of institutional structures, which are controlled both inside the macrosystem and outside (outside the state) and which ensure the creation and dissemination of innovations (B. Lundwal [10], K. Friedman [8], R. Nelson [9]). This approach is based on the analysis of the relationship of various innovative organizations that create, disseminate and implement innovations that have a specific organizational structure of management and with the existing institutional environment. However,

at the same time, it is difficult to identify the internal and external conditions necessary for the formation of the innovative potential of the system, and to formulate the tools for motivating development.

The second approach considers NIS as a set of subjects operating within a certain territory (country or region) and whose activity is the creation of new knowledge and technologies. At the same time, the interaction between the subjects is carried out by certain institutions (O.G. Golichenko, N.I. Ivanova, V.V. Ivanov), but at the same time it is rather difficult to determine the degree of interrelation between individual subjects, which creates problems in determining the level of formation and the form of implementation of the innovative potential of the system [7].

The third approach is focused on considering NIS as a system of relations between the participants of the innovation process, the peculiarity of which depends on the formed institutional environment (V.A. Demidov, N.N. Lebedeva, O.S. Oleynik). At the same time, the institutional environment is considered as a set of institutions and regulatory framework that create a field of interaction between business entities, and therefore contribute to the implementation of their innovative potential.

Common, uniting all these definitions, is that NIS involves the creation, dissemination and use of knowledge, with a formed institutional environment, in which the links between science, production and transfer of technologies determine the complex of institutions, and which sets the ways of realizing their innovative potential. It is the level of formation of the

institutional environment, climatic and territorial characteristics, the availability of labor resources that determine the rate of innovation processes and their national characteristics.

Thus, NIS is a system of interconnected organizations that fully carry out innovative activities, including the creation, distribution and commercialization of innovations, and institutions (legal, financial, social) that establish the administrative and regulatory framework for the interaction of participants for effective implementation of innovative potential.

### Management of national innovation systems

The NIS is managed through a system of subjective-objective relationships, including:

- the state, which creates conditions for the interaction of science, industry and society, while realizing the function of innovative development,
- research organizations, whose functions include conducting research (fundamental, prospecting, applied) and development (experimental design, technological, design)
- educational organizations that implement the function of
  - formation of human capital (intellectual capital)
  - organizations of the innovation infrastructure performing the function of creating a favorable innovation environment for the innovation process;
  - business entities – organizations engaged in innovative activities,
  - representatives of the scientific community (scientists and innovators).

The goal of NIS is to create the necessary conditions for interaction between science, industry and society, while innovation is seen as the basis for economic development. Let's give a classification of NIS subjects according to their functional purpose (Table 1).

NIS objects include:

- state innovation policy,
- objects of intellectual property,

- objects of innovation infrastructure providing services

- subjects of innovation,
- innovative processes, innovations and innovations.

Consequently, the structural elements of the NIS are:

1. Scientific and educational sector is a source of innovative ideas;
2. The business sector is a consumer of innovation;
3. Innovation infrastructure is an environment for the commercialization of knowledge.

Thus, the following structural elements of the NIS with their inherent functions can be distinguished (Table 2).

### Models of the national innovation system

Today, two models of NIS are distinguished:

- market;
- administrative-command model for creating scientific and innovative products (Figure).

The NIS market model includes relatively independent sectors of the economy, the relationship between which is determined by market relations, but with the regulatory role of the state:

- the main research cluster;
- academic sector;
- applied research cluster;
- government sector;
- the corporate sector.

The differences between one model of building NIS (market) from another are as follows:

- in the context of the creation or transformation of new knowledge, an individual economic entity is aimed at realizing its own interests and values;
- the main thing in the innovation process is the system of relations, formed between its members;
- the quality and efficiency of relationships between economic entities depends and is determined by legislation.

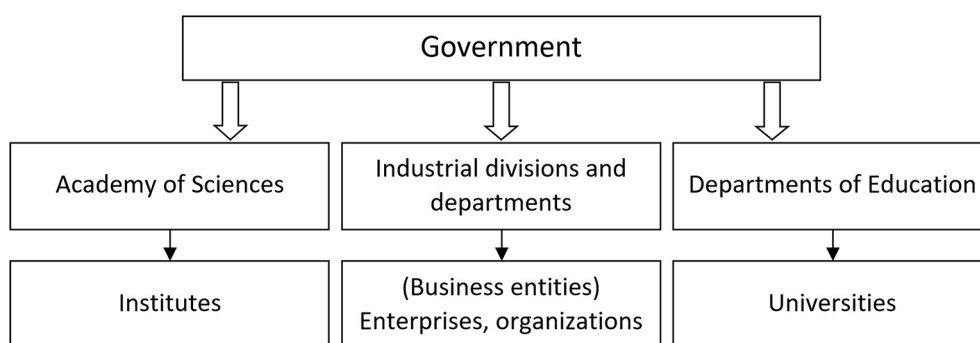
The model of transforming knowledge into innovation is changing. If under the administrative-

Table 1 – Classification of NIS subjects by functional purpose

Segment	Purpose	Subjects
1. Segment of ensuring coordination and regulation of innovation activity	formation and implementation of state innovation policy	policy development and coordination bodies, funding agencies, regulatory organizations
2. Knowledge generation segment	formation of intellectual property objects	scientists, engineers, research structures, design bureaus
3. Segment of subjects of educational activity	human capital formation	Universities, academies, scientific and educational centers
4. Technology transfer segment	knowledge transfer	Technology Transfer Center (TTC), ITC, scientific and technical information systems, experimental bases
5. Segment of introduction of new technologies into practice	technology commercialization	innovatively active enterprises, innovative entrepreneurs

Table 2 – Structural elements of the NIS and their functions

Structural element of NIS	Subjects	Functional purpose	Features
The first element is knowledge generation	research organizations, scientists, engineers	Carrying out R&D, carrying out research activities, education and training, performs the functions of creating human capital	research activities are related to the educational process, feedback allows you to intensify innovative activities
The second element is innovation infrastructure	technoparks, business incubators, scientific and technical centers, consulting, engineering, leasing firms, venture funds, technology transfer centers, patent services, licensing and accreditation, certification and standardization services, innovation expertise	Formation of knowledge transfer mechanisms, implementation and commercialization of developments, technology transfer	The connecting link between the elements of the NIS «Knowledge Generation» and «Entrepreneurial Sector» provides the generation of business ideas with a commercialization perspective
The third element is the business sector	organizations engaged in innovative activities (industrial enterprises, innovative firms, applied science and the innovation sector of the scientific and educational complex)	implementation and use of innovations, diffusion of technologies	Carrying out the entire cycle of innovation activities from obtaining knowledge to their implementation in science-intensive products and services



NIS administrative-command model

command model it was a linear structure, then in the market one a network structure is used. The result in the form of new knowledge, ideas, innovations can be obtained at any stage of the innovation cycle. That is why the management system is being improved in the direction from the administrative-command to the market model of NIS, as it is more consistent with the requirements of sustainable economic development.

#### National scientific and innovation system of Kazakhstan

Today the Industrialization Program is being successfully implemented in Kazakhstan, the Third Modernization of Kazakhstan has been launched. The Development Strategy «Kazakhstan-2050» was adopted, which sets the goal of creating conditions for the transition to the fourth industrial revolution [1,2,4]. However, we must clearly understand that

this cannot be achieved without reliance on science and innovation. Thus, the focus on innovative development remains important and mandatory for achieving the goals set in the program documents [5,6].

The national scientific and innovation system is considered as a set of interrelated legislative, structural and functional components, provides innovative development of the economy of the Republic of Kazakhstan. At the same time, NIS is considered both as a set of economic entities, and as a system of relationships between them.

The national innovation system cannot be imported. The Republic of Kazakhstan creates and develops it independently. The main thing here is to select the priority scientific and technical areas and the mechanism for their implementation. In Kazakhstan, there are prerequisites for the reorientation of the

state's priorities to support innovation. For the successful and rapid transfer of new scientific knowledge to the economy, it is required to create a modern effective national innovation system and achieve a high national innovative ability of society, following the example of economically developed countries.

### Conclusion

For the formation of the country's innovative economy, the following points are necessary:

- creation of innovative technologies;
- a set of measures of a systemic nature, ensuring a quick change of marketable products, outstripping competitors;
- implementation of the innovative principle: «Everything that works is already outdated»;
- prioritizing the problem of high quality of manufactured products;
- transition to «innovative» education, with the development of creative abilities, the formation of a national innovative mentality, innovative culture.

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### Ұлттық инновациялық жүйелер: тұжырымдамалық негіздері

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**Аңдатпа.** Ұлттық инновациялық жүйені (ҰИЖ) қалыптастырудың тұжырымдамалық негіздері қарастырылған. Инновациялық қызметті жүзеге асыратын өзара байланысты ұйымдардың және инновациялық әлеуетті тиімді іске асыру үшін қатысушылардың өзара іс-қимылының әкімшілік және нормативтік-құқықтық негізін белгілейтін институттардың (құқықтық, қаржылық, әлеуметтік сипаттағы) жүйесі ретінде ҰИЖ-нің авторлық анықтамасы келтірілген. ҰИЖ мақсатын жүзеге асыру үшін іске асырылатын субъектілік-объектілік қатынастар жүйесі, ҰИЖ субъектілерінің функционалдық мақсаты бойынша жіктелуі, ҰИЖ құру модельдері және олардың ерекшеліктері ұсынылған.

**Кілт сөздер:** ұлттық инновациялық жүйелер, тұжырымдамалық тәсілдер, құрылымдық элементтер, Қазақстанда ҰИЖ құру модельдері.

**Национальные инновационные системы: концептуальные основы**

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**Аннотация.** Рассмотрены концептуальные основы формирования национальной инновационной системы (НИС). Рассмотрены различные подходы к пониманию НИС. Приводится авторское определение НИС как системы взаимосвязанных между собой организаций, осуществляющих инновационную деятельность, и институтов (правового, финансового, социального характера), устанавливающих административную и нормативно-правовую основу взаимодействия участников для эффективной реализации инновационного потенциала. Представлены система субъектно-объектных взаимосвязей, реализуемых для осуществления цели НИС, классификация субъектов НИС по их функциональному назначению, модели построения НИС и их особенности.

**Ключевые слова:** национальные инновационные системы, концептуальные подходы, структурные элементы, модели построения НИС в Казахстане.

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