

DOI: 10.15838/esc.2025.4.100.4
UDC 001.895, 338.24, LBC 65.291.551-21
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Innovation Processes Staffing: Issues and Content



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Abstract. In the context of global competition and geopolitical challenges, the issues of outstripping innovative development and achieving technological sovereignty have become particularly relevant for Russia. Innovative development largely depends on an effectively functioning national innovation system, and technological sovereignty is ensured not by innovations themselves, but by highly qualified specialists capable of generating and implementing breakthrough ideas. An analysis of the trends in the development of artificial intelligence technology, a most relevant innovation of our time, allows us to conclude that there are certain barriers in the interaction of elements of the national innovation system regarding the provision of human resources for the development of this technology. The existing scientific groundwork in this area does not have a formalized theoretical and methodological framework for addressing this problem. The aim of our research is to design the conceptual foundations for staffing innovation processes in the context of Russia's national innovation system. Based on the consideration of various points of view on the interpretation of key categories of innovation theory, the article offers a conceptual scheme of their

For citation: Averyanov A.O., Stepus I.S. (2025). Innovation processes staffing: Issues and content. *Economic and Social Changes: Facts, Trends, Forecast*, 18(4), 79–94. DOI: 10.15838/esc.2025.4.100.4

relationship; we formulate our own definition of innovation processes staffing and disclose its content within the framework of Russia's national innovation system. Using the example of artificial intelligence as one of the key innovations, we identify categories of human resources necessary for various stages of the innovation process. Based on the findings of the study, we propose a comprehensive scheme for staffing the innovation process in the context of the Russian national innovation system, where, together with its traditional elements (business; universities and academic structures; the state), society is considered as an important component of staffing innovation development. Taken together, the results obtained make it possible to formalize innovation processes staffing as a scientific category and define the general outline of this process, which needs further elaboration and development.

Key words: artificial intelligence, innovative development, national innovation system, innovation process, innovation potential, resource provision, human resources.

Acknowledgment

The research was supported by a Russian Science Foundation grant, project 25-28-00827 “Staffing the innovation process using the example of artificial intelligence”.

Introduction

Innovation is one of the key factors promoting the development of modern economies. At the same time, there is no single strategic document in Russia for 2025 that regulates the country's innovative development and long-term goal-setting in this direction. However, in 2023–2024, key documents on scientific and technological development (hereinafter referred to as STD) were updated, ensuring the introduction of innovations in the Russian economy in the coming years (medium-term planning horizon). In 2023, according to the RF Government Resolution, the Concept of Technological Development for the period up to 2030¹ was adopted; and in 2024, under the Presidential Decree, the Strategy of Scientific and Technological Development of the Russian Federation² was updated. These documents state

that the main priority of STD in Russia is to preserve the state's ability to create and apply high-tech technologies that are crucial for ensuring independence and competitiveness, which determine technological sovereignty.

It follows from the lecture by Nobel Laureate S. Kuznets that the effective development of advanced technologies requires appropriate institutional structures and ideological prerequisites that facilitate effective implementation and dissemination of innovative solutions³. V.A. Yasinskii and M.Yu. Kozhevnikov, using the example of China, associate the effectiveness of scientific and technological development and, as a result, the formation of technological sovereignty, with the building of national innovation system (hereinafter – NIS) (Yasinskii, Kozhevnikov, 2023). Following these theses, NIS can be considered as the basis for preserving Russia's technological sovereignty.

¹ On approval of the Concept of Technological Development for the period up to 2030: RF Government Resolution 1315-r, dated May 20, 2023. Available at: <https://www.garant.ru/products/ipo/prime/doc/406831204/> (accessed: 16.01.2025).

² On the Strategy of Scientific and Technological Development of the Russian Federation: Presidential Decree 145, dated February 28, 2024. Available at: <https://www.garant.ru/products/ipo/prime/doc/408518353/> (accessed: 16.01.2025).

³ Kuznets S. Prize Lecture. Modern Economic Growth: Findings and Reflections. Available at: <https://www.nobelprize.org/prizes/economic-sciences/1971/kuznets/lecture/> (accessed: 16.01.2025).

The personnel component plays an equally important role in ensuring innovation processes in the country. Scientists agree that human capital is the most important factor in innovative development in Russia, since it is people who act as carriers of knowledge and sources of new ideas (Zemtsov et al., 2016). For example, one of the conditions for achieving the goals of STD in Russia, indicated in the previously mentioned strategic documents, is the training of qualified personnel. Therefore, one of the key functions of STD is to reproduce human resources.

E.V. Lenchuk and V.I. Filatov note that the resource provision of innovative projects is one of the central issues that need to be addressed before their implementation, and human resources⁴ themselves are one of the limitations in innovation processes (Lenchuk, Filatov, 2024). Thus, personnel training should begin long before the direct implementation of innovation processes.

Let us consider these conclusions using the example of the development of one of the key innovations of our time – artificial intelligence (AI) technology. The important role of institutional structures in the development of innovation is confirmed by the active process of AI development in the 2020s in Russia. In a short period of time, a number of key strategic documents⁵ were elaborated, federal development programs were

launched, an alliance in the field of AI and other structures were created. At the same time, the example of the introduction of AI technology into the Russian economy shows that, despite the measures taken by the Russian government, there is a shortage of highly qualified workers in the field of AI (Averyanov et al., 2024). Thus, according to the authors, there is a situation when the activities of the established institutional structures in terms of personnel training do not keep up with the speed of implementation of innovation processes. This thesis is confirmed by the results of a study by V.V. Volchik and E.V. Maslyukova, noting that “state management of innovation activity” is the most mentioned problem in the Russian innovation environment (Volchik, Maslyukova, 2022). The given example of the AI field demonstrates the existence of gaps in the field of staffing innovation processes.

Consideration of the problem of personnel shortage through the prism of the concept of national innovation systems and a structural and functional approach allows us to hypothesize the cause of these problems in disrupting the stability of the system and reducing the effectiveness of interaction between the elements of the Russian NIS. The first step to addressing these issues is to analyze the available theoretical and methodological framework.

Review of literature and research

The stages of the genesis of innovation theory have been discussed more than once on the pages of scientific periodicals (Yakovets, 2004; Shcherbakov, 2019). The development of the NIS concept dates back to the 1980s–1990s in the works of foreign scientists C. Freeman (Freeman, 1987), B.-O. Lundvall (Lundvall, 2010), R.R. Nelson (Nelson, 1993) and others. In Russia, the development of the NIS concept began somewhat later, and the foundations for innovative development are revealed in the works of N.I. Ivanova (Ivanova, 2002), V.L. Makarov (Makarov, 2003),

⁴ Despite the fact that the concept of “labor resources” is more “informative” at the national level, the concept of “human resources” will be used here and further in relation to the national innovation system as a cohort of the most qualified workers with special knowledge, labor skills and experience for each stage of innovation process. Currently, the concepts of “human resources/staffing” are actively used operational categories of innovation economics and management practice. The comparison of the categories “human resources” and “staffing” in relation to the theory of innovation is not included in the objectives of this study.

⁵ On the development of artificial intelligence in the Russian Federation: Presidential Decree 490, dated October 10, 2019 (as amended February 15, 2024) (together with the “National Strategy for the Development of Artificial Intelligence for the period up to 2030”). Available at: https://www.consultant.ru/document/cons_doc_LAW_335184/ (accessed: 16.01.2025).

O.G. Golichenko (Golichenko, 2014), and others. The ecosystem (Golova, 2021) and narrative (Volchik et al., 2023) approaches to the consideration of innovation development can be identified as modern research areas.

The emergence of the NIS concept is associated both with the versatility and complexity of innovative development processes that require new explanatory models, and with the response to the long-term crisis in the global economy. O.V. Golichenko writes that the NIS concept helps to overcome the key shortcomings of the main economic theories (Golichenko, 2014). N. Sharif, speaking about the origins of the NIS concept, notes that it is based on a synthesis of scientific and political challenges caused by the need to create a new economic policy (Sharif, 2006). This allows us to consider this concept as a management framework for the development of an innovative economy.

The issues of staffing innovation processes are often studied in the context of the category of innovation potential, or its individual components are analyzed. For example, S.V. Yurin's work separates innovation potential and resource provision, and highlights the availability of highly qualified human resources and infrastructure as key components of resource provision (Yurin, 2010). A research led by L.E. Mindeli notes that personnel is the most important and perhaps the most problematic resource in scientific and technological development (Mindeli, 2019). E.E. Golovchanskaya speaks about the importance of intellectual resources, which are understood as the totality of the abilities of individuals involved in research and innovation activities of the national economy (Golovchanskaya, 2023). A.Yu. Klimentyeva considers the resource support of the innovation process as a combination of personnel, financial, information and organizational security (Klimentyeva, 2018).

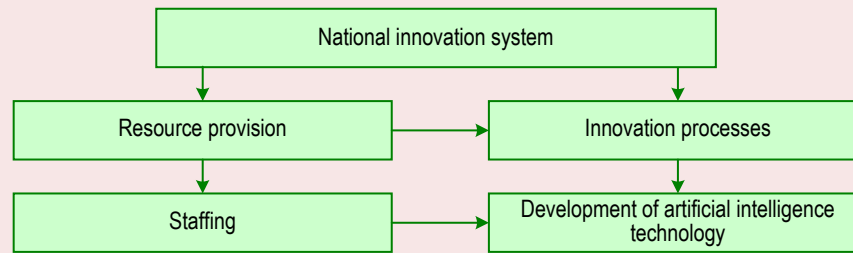
At the same time, the analysis of the content of the above works suggests that both the resource provision of innovation processes and its personnel component have no clear connection with the NIS concept. This conclusion is supported by the thesis that the Russian theory of innovation requires designing a unified terminological paradigm (Cherenkov et al., 2019). Thus, the lack of a unified theoretical and methodological framework requires conceptualizing the staffing of innovation processes as an object of research.

The aim of the study is to conceptualize innovation processes staffing within the framework of the national innovation system of Russia. The research seeks to solve four tasks: positioning human resources for innovation processes relative to the key categories of innovation theory; formulating the concept of "human resources for innovation processes"; correlating the stages of the innovation process with the categories of human resources; designing a conceptual scheme for human resources for innovation processes.

Materials and methods

The study is based on a review of the works of Russian and foreign scientists in the field of innovation theory. The development of AI technologies in the Russian economy is considered as an example of relevant innovation processes. In terms of NIS research, the authors adhere to the structural-object and functional analysis methods proposed by O.G. Golichenko (Golichenko, 2014). Within the framework of this approach, NIS can be considered as a set of individual elements, and resource provision of innovation processes as one of its functions. When identifying the stages of the innovation process, the authors use the approach of G.A. Shcherbakov (Shcherbakov, 2020). Innovation processes staffing is considered as a component of resource provision. Within the framework of this study, we are talking specifically about human resources at the level of the national innovation

Figure 1. Conceptualization of the research object



Source: own compilation.

system, since labor resources are a broader concept that includes the entire working-age population. A distinctive feature of human resources as a scientific category is the emphasis on having special training in the subject area and professional ability to work. Human resources have special skills that allow them to reproduce innovation processes at all stages. An example of such resources are graduates of specialized educational programs in the field of AI. *Figure 1* shows a diagram reflecting this approach to the object of study.

Results and discussion

Interrelation of key categories of innovation theory

Let us consider the content of the key categories of innovation theory, such as innovation, innovation activity, innovation process, NIS, innovation potential and innovation environment.

Comparing Russian research with foreign primary sources, V.I. Cherenkov, V.P. Maryanenko, and N.I. Cherenkova conclude that, in general, innovation is the commercialization of invention (knowledge) (Cherenkov et al., 2019). At the same time, the invention must be understood as broadly as possible, since modern innovation theory considers innovation not only as a product or service in the understanding of J. Schumpeter, but also as a technology. An example of an approach to considering innovation as technology is revealed through the English-language term “General-purpose technology” (Lipsey et al., 2005).

Thus, the concept of innovation process can be defined by the stages of creation, development and use of new knowledge or technology in the economy (Ivanov, 2006). Modeling of innovation process in this sense is presented in the work of G.A. Shcherbakov (Shcherbakov, 2020). We should note that changing the models of the organization of innovation process does not change its essential interpretation – it is always a transition from a new idea to a finished product, even if this process is not linear (Burets, 2014).

Let us move on to the next category – innovation activity (hereinafter – IA). In Russian research, there are concepts of scientific and innovation activity (Sibirskaya et al., 2014), which are also defined at the state level. The federal law “On science and the state policy in the field of science and technology” defines IA as “activity (including scientific, technological, organizational, financial and commercial) aimed at the implementation of innovative projects, as well as the creation of an innovative infrastructure and ensuring its activities”⁶. In turn, scientific activity is aimed at obtaining knowledge. According to M.E. Popov, IA is a type of activity aimed at the implementation of turnkey innovations in public practice (Popov, 2011). However, there are different

⁶ On science and the state policy in the field of science and technology: Federal Law 127-FZ, dated August 23, 1996 (as amended August 8, 2024). Article 2. Available at: <https://base.garant.ru/135919/741609f9002bd54a24e5c49cb5af953b/> (accessed: 16.01.2025).

approaches to the definition of this concept (Bobrov, Medyakina, 2017). In general, innovation activity is a set of specific actions and procedures for the commercialization of knowledge – a set of purposeful actions of NIS entities to implement innovation process. Thus, innovation activity is a broader concept than innovation process. Innovation process formalizes, structures, and describes the sequence of IA in terms of creating, mastering, and distributing innovations. In other words, innovation process formalizes the logic of the movement of innovation over time, and innovation activity is a set of practical efforts that ensure the implementation of innovation process. Following these theses, when developing individual innovations, it is necessary to talk about personnel (resource) support for innovation processes at each of its stages, rather than activities as such.

Let us move on to the content of the key research category – national innovation system. It can be most clearly represented through the classic definition of B.O. Lundvall: NIS – “elements and interrelations that interact in the production, dissemination and use of new economically useful knowledge” (Lundvall, 2010). The elements of the system include universities and R&D departments, as well as marketing and financial subsystems. Thus, NIS study takes into account not only the elements of the system themselves, but also the relationship between them.

According to J.S. Metcalfe, NIS is “a system of interconnected institutions that create, store, and transfer knowledge, skills, and artifacts that define new technologies” (Metcalfe, 1995). From this point of view, NIS is an institutional foundation for the creation, accumulation and implementation of resources necessary for innovation processes.

A different approach to the definition of NIS can be traced in the works of C. Edquist. The scientist defines innovation system as a set of factors that determine innovation processes, or as “all important economic, social, political,

organizational, institutional and other factors that influence the development, dissemination and use of innovations” (Edquist, 2009).

Let us consider the views of Russian scientists on the concept of NIS. O.G. Golichenko interprets innovation system as a set of public, private and public organizations and institutions, as well as the mechanisms of their interaction, within which activities are carried out to create, store and disseminate new knowledge and technology (Golichenko, 2012). A similar approach can be traced in the works of V.V. Volchik’s research team: they consider NIS as a set of institutions and organizations that ensure social and economic interactions: from the creation of knowledge and technologies to their introduction into production (Volchik et al., 2023). Thus, the national innovation system can be interpreted as a set of organizations and institutions whose interaction is aimed at supporting the innovation process.

Let us move on to the next category – national innovation potential. The concept of national innovation potential is considered in the works of D. Furman, M. Porter and S. Stern. Scientists conclude that innovation potential is a country’s ability to produce and commercialize a stream of innovative technologies in the long term (Furman et al., 2002). In other words, innovation potential can be described as a country’s ability to reproduce innovation processes over and over again.

At the same time, as M. Porter notes, “without skilled scientists and engineers working in an environment where there is access to advanced technology, it is unlikely that the country will be able to produce a significant number of innovative products that did not previously exist in the world” (Porter, 1990). This means that innovation potential can be considered both as the ability to implement innovation processes, and as a set of resources providing this ability.

Russian scientists consider innovation potential as “a sign of a socio-economic system that

characterizes the feasibility and maximum possible result of purposeful activities to change the structural and functional properties of this system” (Gureev, Grishin, 2017). The feasibility emphasized by the authors can be interpreted as the ability of NIS to carry out an innovation process, and this opportunity, among other things, determines the level of resource availability necessary for the creation and development of innovations.

On the one hand, innovation potential is a multicomponent evaluation category that characterizes the possibility of implementing innovation process in the long term. On the other hand, the very existence of such an opportunity is due to the presence of some reason, whether it is the effectiveness of the interaction of the elements of an innovation system or the availability of certain resources. Thus, national innovation potential is a measure that determines the sufficiency of the resources and infrastructure available in the country for the implementation of innovation process. Following the stated theses, the staffing of innovation process can be considered as the realization of innovative potential.

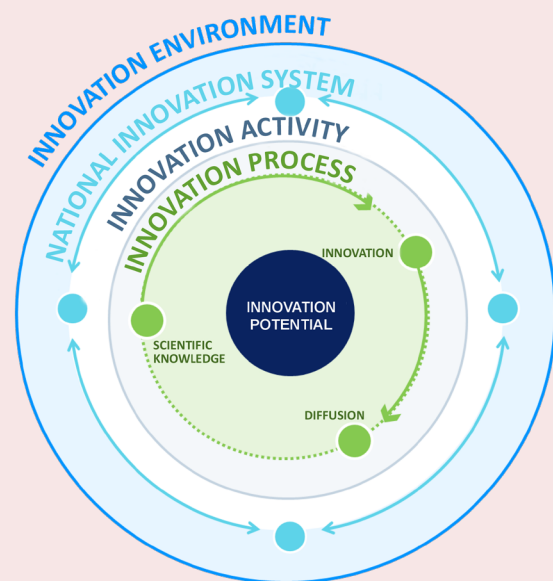
Let us move on to the last highlighted category – innovation environment. Developing V.L. Makarov’s thesis that the number one task in the development of an innovative economy is to create a favorable innovation environment (Makarov, 2010), we can conclude that the current innovation environment characterizes the effectiveness of realizing the country’s innovation potential during innovation processes within the framework of NIS. The concept of innovation environment, introduced by M. Castells is a specific set of relations between management and production aimed at generating new ideas, knowledge and technologies (Castells, 2000). Innovation environment has the ability to create a synergistic effect through the interaction of its elements. Researchers note that a favorable innovation environment significantly increases both the number of innovations and their spread in the existing NIS (Ma et al., 2024).

Creating a favorable environment for the self-realization of human resources is primarily a tool for their conservation and accumulation. I.V. Shatskaya notes that “in the management of human resources for innovation development, the partnership of innovative enterprises and educational organizations is a system of relations that provides for the creation of conditions for the development of their innovative potential, that is, the formation of resources that make them susceptible to the development, generalization and implementation of new ideas, products and technologies” (Shatskaya, 2022).

The content of the considered key categories of innovation theory allows us to formulate a conceptual scheme of their interrelation (Fig. 2).

With regard to innovation processes, NIS is a mechanism that structures and directs the use of national innovation potential in conditions determined by the established innovation environment during the implementation of innovation activities. These three categories complement each other: innovation potential

Figure 2. Conceptual scheme of interrelation of key categories of innovation theory



Source: own compilation.

characterizes the available resources and infrastructure necessary for innovation; NIS organizes and directs innovation processes through resource and infrastructure management, innovation environment determines the external and internal conditions for the implementation of innovation processes in the country.

Innovation processes staffing

According to the scheme proposed in Figure 2, innovation processes staffing is a coordinated interaction of NIS structural elements aimed at reproducing the human component of innovation potential necessary to maintain innovation processes in the country at a competitive level.

We note several accents of the proposed definition. First, the interactions of NIS elements must be coordinated, since it is the synchronization of the actions of various structures that determines the existence of a synergetic effect in the development of innovations, which was mentioned earlier. Second, the reproduction of the personnel component of innovation potential includes both their creation (training) and the accumulation, attraction and allocation of appropriate resources – actions aimed at increasing national innovation potential. Third, the competitive level of implementation of innovation processes is understood as the amount of resources necessary for the successful development of an innovative economy, taking into account the preservation of national technological sovereignty (proposed as the minimum efficiency limit) and competitiveness at the international level (proposed as the target efficiency limit). The study of O.S. Sukharev (Sukharev, 2024) can be cited as an example of assessing technological sovereignty. Fourth, the interactions of NIS elements occur permanently on two levels. The first level is the staffing of the overall national innovation process. The second level is the concentration of efforts to reproduce human resources for the development of certain breakthrough innovative technologies.

Structure of innovation processes staffing on the example of artificial intelligence

We agree with E.E. Golovchanskaya who points out that one of the current trends is the increasing role of highly intelligent personnel as a generator of scientific ideas reproducing new knowledge (Golovchanskaya, 2024). I.V. Shatskaya summarizes that highly competent engineering personnel, ready for proactive, creative activities, are becoming the leading driving force of innovation development (Shatskaya, 2022), which allows considering human resources as a key source of ensuring the dynamics of innovation processes in the country.

Thus, the effectiveness of innovation process, and the very possibility of its implementation, directly depend on the availability of appropriate human resources. We should note that we are talking not only about scientists, designers and engineers, but also marketers, businesspeople, and experienced managers. In a study by V.V. Volchik and S.A. Panteeva, one of the experts expressed the opinion that the importance of an immediate idea (innovation) in a successful business is 10–20%, the rest is the contribution of marketers, economists, etc. (Volchik, Panteeva, 2024).

As noted earlier, innovation process can be formalized in several key stages (Shcherbakov, 2020). Accordingly, a specific category of human resources can be allocated for each of them. In turn, this will make it possible to structure the content of human resources for innovation processes. Within the framework of this study, it is proposed to consider the process of staffing using the example of the development of artificial intelligence technologies as the most relevant innovation.

The first stage of innovation process is the acquisition of knowledge. This stage involves both fundamental research and the generation of ideas by individual innovators. The resource support for this stage is based on highly skilled scientists (Melekh et al., 2023). In the field of AI, this category of human resources is involved in the development

of breakthrough scientific and design solutions, including those formalized by new methods or algorithms in the field of data analysis. As a rule, the main difference between this category of human resources is the availability of scientific publications or an academic degree. As an example of significant AI researchers, we can cite the rating of Russian scientists who have three or more publications at A* conferences⁷. As a rule, researchers in the field of AI can be classified as “one-of-a-kind experts”, but their achievements make a significant contribution to the country’s innovation development.

This is followed by the R&D stage. The activities within this stage are aimed at identifying ways to apply the results of fundamental research, as well as the development of individual AI products. Focusing on the “Basic model of professions and competencies” in the field of AI, developed by the AI Alliance, an example of this category of human resources are representatives of “Data Scientist” and “ML Engineer” professions⁸. Their main focus has shifted to working with big data, as it is the basis for the development of these technologies. This category of human resources is more widespread, but it must also have high skills in the subject area.

According to the same model, a category of human resources can be distinguished for the stage of introducing innovation into production. These include Data Engineer, Technical analyst in AI, and managers. We note that the model under consideration is more applicable when describing production processes, but it differentiates the stages of development or implementation of an innovative product, clearly showing the difference in human resource requirements at different stages of innovation process.

⁷ The Artificial Intelligence Index in Russia: Analytical collection # 13. Artificial intelligence: An almanac. Moscow: Competence Center of the National Technological Initiative based at MIPT in the field of Artificial Intelligence, 2024. December. 48 p. Available at: https://aireport.ru/ai_index_russia-2023 (accessed: 21.03.2025).

⁸ The basic model of professions and competencies. Available at: <https://skills.a-ai.ru/education/methodology/models/> (accessed: 21.03.2025).

If an innovation is aimed not only at solving problems within a development company, but is positioned as a separate market product or service (good), its dissemination (the stage of innovation diffusion) requires involvement of qualified executives, managers, marketers, etc. The transformation of scientific and technological developments into an innovative product can be provided by professionally trained specialists in the field of innovation management (Pligina, 2010).

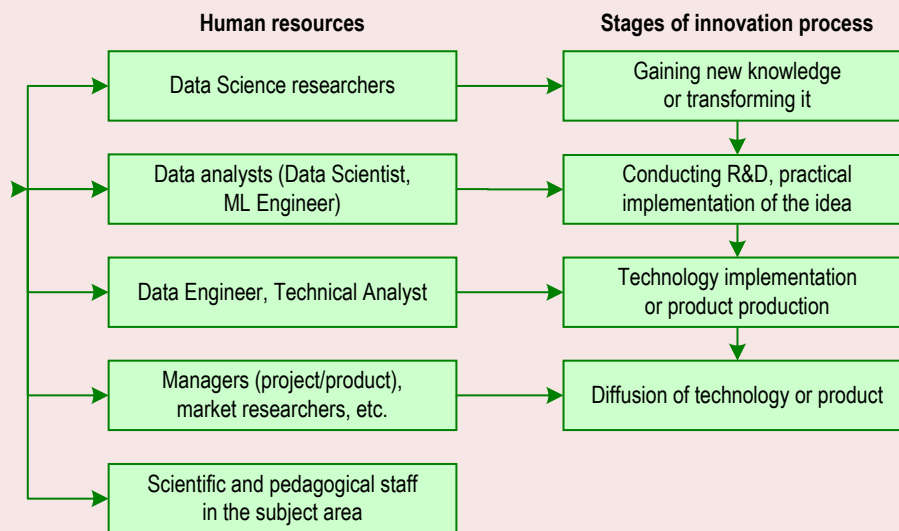
Also, the reproduction of human resources requires the availability of scientific personnel in the field of innovation, capable of training qualified employees in the field of innovation management (Rudskoy, Tukkell, 2015). A similar conclusion is true for the field of AI under consideration. D.V. Livanov, rector of MIPT, noted that there are not enough professors in Russia who teach students in AI programs⁹. Following this thesis, we can conclude that personnel reproduction requires the presence of scientific and pedagogical staff with competencies in the subject area. Accordingly, innovation processes staffing implies training of scientific and pedagogical staff.

Figure 3, using the example of the AI field, shows the correspondence between the categories of human resources and the stages of innovation processes.

We should note that the list of these professions is not exhaustive; they may not be linked to individual stages of innovation process. However, the model provides general ideas about the structure of human resources in the development of AI technologies, and is also a methodological example for allocating human resources to a particular stage of innovation process. The lack of ensuring the human resource needs of the economy for each of the groups of human resources will lead to a violation of the effectiveness of innovation processes. Given that the training of personnel

⁹ MIPT stated that there are not enough teachers in the Russian Federation who teach AI programs. Available at: <https://tass.ru/obschestvo/21698283> (accessed: 21.03.2025).

Figure 3. Correlation of the stages of the innovation process with the categories of human resources using the example of the field of AI



Source: own compilation.

by the higher professional education system is a long-term process, the development of appropriate educational programs in a particular field should begin long before its active development.

Conceptualization of innovation process staffing

Let us move on to understanding the staffing of innovation process from the point of view of NIS elements. In general, researchers note that it is difficult to judge whether Russia has an integrated human resources system for innovation activities (Ivanova et al., 2020). If we talk about the elements of NIS, the interaction of which affects innovation process staffing, first of all these are universities and the state, since the training of qualified personnel is one of the social functions of the state (Volchik et al., 2023). An example of the purposeful activity of the state in the field of human resources reproduction is the implementation in 2018–2024 of the federal project “Personnel for the digital economy”¹⁰.

¹⁰ Passport of the federal project “Personnel for the digital economy”. Available at: <https://legalacts.ru/doc/pasport-federalnogo-proekta-kadry-dlja-tsifrovoy-ekonomiki-utv-prezidiumom/> (accessed: 19.03.2025).

Speaking about the social responsibility of the state in terms of the development of science and education, L.I. Dmitrichenko and I.B. Avanesova note that investing in education and science ensures stable growth, innovative development and competitiveness of the country on a global scale (Dmitrichenko, Avanesova, 2024). Following the theses of the authors, we can conclude that against the background of international pressure and economic instability, state support and financing of Russian science are becoming one of the main conditions for preserving the technological sovereignty of the country.

Thus, we see that, despite the presence of various categories of human resources necessary to ensure innovation process at all its stages, the main element of NIS influencing their reproduction is the state. The state, as an institution, determines the admission targets for certain specialties, creates conditions for personnel training, allocates the necessary funding, and also controls the work of universities to train human resources. At the same time, universities provide the environment where

human resources are trained, since the university complex serves as the basis for ensuring the high scientific and technical potential of the state (Pligina, 2010). Accordingly, we can talk about the dual status of universities, since, on the one hand, universities are involved in R&D and scientific activities, and on the other, they are a tool that reproduces human resources.

The role of the institutes of the Academy of Sciences is equally important, since they are involved in the training of highly qualified personnel. V.M. Polterovich builds a chain of NIS elements: “universities – academic institutions – branch research institutes – research departments of large firms and development institutes”, where the function of reproducing human resources is assigned to universities (Polterovich, 2022). We note that this scheme correlates well with the stages of innovation process. A similar approach to staffing an innovative breakthrough is presented in the work of L.N. Svirina, which emphasizes that the basis of this process is the integration of universities, academic and industry institutes, design bureaus and innovatively active enterprises (Svirina, 2010).

In a market economy, in addition to the government and universities, business representatives who are interested in their innovative development should be directly involved in the training of human resources. It is also worth noting such an up-to-date modern source of personnel training as additional professional education (hereinafter APE) It is an important subsystem of the institute of education, as it allows retraining existing human resources (Chikileva, 2020). Russian practices of implementing APE in the field of AI show that, as a rule, it is the leading universities in this field (for example, MIPT) and large companies with expertise in the field of AI (for example, Yandex) that act as educational organizations; specialized educational organizations – less often¹¹.

¹¹ University 2035. Additional professional education in the field of artificial intelligence and related fields with financial support from the state. Available at: <https://ai.2035.university/> (accessed: 19.03.2025).

This makes it possible not to single out APE as a separate element of NIS in terms of personnel training.

An alternative example of the interaction of participants in the staffing of innovation development is proposed by I.V. Shatskaya. It provides a conceptual framework consisting of four elements: state, educational organization, innovative enterprise, and individual. In this scheme, the state is responsible for regulating relations between participants in the personnel provision of innovation development; an educational organization, interacting with enterprises, trains qualified personnel, an innovative enterprise shows social responsibility in terms of improving the quality of education of human resources; the individual (person) acts as a link between the participants in the staffing of innovation development (Shatskaya, 2021). Thus, the individual is assigned the role of a point of application of the efforts of the state, educational organizations and business. The inclusion of an individual in the process of staffing innovation processes is natural, since, on the one hand, it is a person who is the bearer of knowledge and the creative component necessary for generating new ideas, on the other hand, taking into account the interests of an individual in the modern world is a fundamental task for most states.

This approach is consistent with the model of the “quadruple spiral” of innovation development proposed in the work (Carayannis, Campbell, 2009). The model assumes the involvement of the public in the process of innovation development, in addition to the state, universities and business. According to this concept, the implementation of innovation process must meet the requirements and needs of individuals. Thus, individuals, being the object of interaction of NIS elements in the course of resource provision of innovation processes, should simultaneously be the subject of interaction. Based on these theses, it is proposed to consider society as a set of interests of individuals. The specifics of NIS’s interaction with society will be considered in subsequent studies.

Thus, innovation process staffing should be ensured by the interaction of society, the state, business, universities and academia, both in terms of personnel training, and in terms of their preservation and attraction – reproduction of the personnel component of innovation potential. *Figure 4* shows a scheme for staffing innovation process based on the considered elements of the Russian NIS.

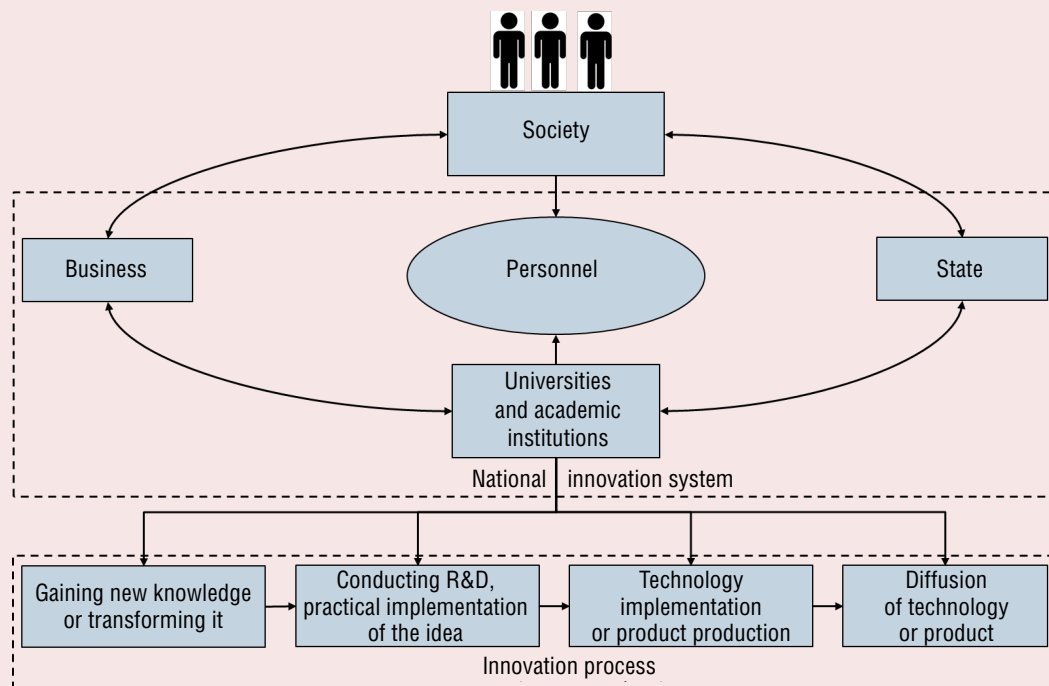
According to the above scheme, human resources for ensuring innovation processes are formed during the interaction of elements of innovation system and society aimed at professional training of individuals by universities and academic structures. The dominant role of universities is due to the fact that they are responsible for the direct training of human resources for various stages of innovation processes. The synergetic effect of the interaction between universities, the state, business and society makes it possible to preserve and accumulate the human component of the national innovation potential.

We should note that organizations of secondary vocational education (SVE) are excluded from the scheme. Although vocational education organizations also train the workers necessary to introduce innovations, for example, in the specialty 09.02.13 “Integration of solutions using artificial intelligence technology”, their graduates are less involved in science.

With such a system, the presence of an imbalance in interaction or the exclusion of one of the elements will lead to problems in staffing innovation processes and to the erosion of national innovation potential itself.

The authors believe that in the context of a constant shortage of personnel and the lack of alternatives to the innovative way of developing national economies, the preservation and enhancement of innovation potential is one of the key tasks of all elements of the national innovation system. Only through the coordinated interaction of all its elements is it possible to preserve the

Figure 4. Conceptual scheme of innovation process staffing



Source: own compilation.

technological sovereignty of the country. A unified strategy for Russia's innovation development serves as one of the tools that ensures, on the one hand, the coordination of all interests, and, on the other hand, proactive training of personnel. Thus, it can be assumed that the solution to the problems of disrupting the stability of NIS and reducing the effectiveness of interaction between its elements is in the plane of strategic documents of innovation development. The existence of a single long-term strategy would make it possible to build a smooth and system-wide work of all NIS elements and change the approach of "extinguishing fires" to strategic management.

Conclusion

The authors attempted to consider innovation processes staffing through the prism of the NIS concept. The results obtained contribute to the increase of scientific knowledge in the field of innovation theory. Based on the analysis of modern research in this field, a conceptual scheme of the relationship of its key categories was formed. It was determined that human resources form part of the

country's innovation potential. Based on this thesis, the content and main provisions of the category "innovation processes staffing" were formulated. Using the example of the field of AI, a methodology for identifying the structure of human resources for innovation processes was proposed. The necessity of training scientific and pedagogical personnel to maintain the process of reproduction of human resources was determined. Based on the analysis of the main elements of the NIS of Russia, a conceptual scheme for staffing innovation processes was drawn up. Together with the traditional elements of NIS, it is proposed to consider society as a direct source of human resources.

In conclusion, we note that the conceptual approach to innovation processes staffing presented in the framework of the study defines only the general outline of this scientific category and needs further specification and development.

The findings of the work can be used by scientists, teachers and students in the framework of studying modern innovation processes in Russia.

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Received June 9, 2025.