



ЭКОНОМИЧЕСКИЙ РОСТ И СОЦИАЛЬНО-ЭКОНОМИЧЕСКОЕ РАЗВИТИЕ

ECONOMIC GROWTH AND SOCIAL-ECONOMIC DEVELOPMENT

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Methodological tools for managing intellectual resources: overcoming limited resource potential

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Abstract. Intellectual resources, in the form of human (labor) and information resources are increasingly important in an economic environment wherein firms' limited resource potential impedes innovation. Their assessment, analysis, accounting and distribution are necessary for the effective implementation of innovation activities. However, Russia's regions differ in the number of staff engaged in research and development and firm innovativeness. Furthermore, geography can present barriers to innovation that undermine firm competitiveness, which ultimately aggravates the socio-economic development of Russia. This problem can be solved by transforming the methodological tools used in the regional development strategy. Whilst each region is distinctive, the authors propose a methodology for assessing the minimum acceptable levels of available intellectual resources necessary for the implementation of an innovative project. This methodology considers activity at different project stages and can be scaled to any economic level and innovative project. The proposed method evaluates the minimum optimal distribution of intellectual resources necessary for the successful implementation of innovative activities, which are considered necessary for transforming the Russian economy and building resource potential. This methodology also allows to assess the sufficiency of available intellectual resources, create a system of metrics for their accounting and replenishment, and utilize intellectual resources across multiple innovative projects simultaneously.

Keywords: innovation activity, regional strategy, limited resource potential, regional innovation system, optimization of intellectual resources, human resources, management principles, competitiveness, linear programming problem, methodological tools

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Методологические инструменты управления интеллектуальными ресурсами: преодоление ограничения ресурсного потенциала

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Аннотация. Интеллектуальные ресурсы, а именно человеческие (трудовые) и информационные приобретают все большее значение в экономической среде, где ограниченный ресурсный потенциал компаний препятствует инновациям. Их оценка, анализ, учет и распространение требуются для эффективного осуществления инновационной деятельности. Однако регионы России различаются по количеству сотрудников, занятых в области НИОКР. Более того, географические особенности могут создавать препятствия для инноваций, которые подрывают конкурентоспособность фирм, что в конечном итоге усугубляет социально-экономическое развитие России. Эту проблему можно решить путем трансформации методологического инструментария, используемого в стратегии регионального развития. Пока каждый регион самобытен, авторы предлагают методику оценки минимально приемлемого уровня доступных интеллектуальных ресурсов, нужных для реализации инновационных проектов, учитывающую деятельность на разных этапах проекта и масштабирующуюся под любой инновационный проект. Описываемый метод оценивает оптимальное распределение интеллектуальных ресурсов, необходимых для успешной реализации инновационной деятельности, ведущей к трансформации экономики России и наращиванию ресурсного потенциала.

Ключевые слова: инновационная деятельность, региональная стратегия, ограниченный ресурсный потенциал, оптимизация интеллектуальных ресурсов, конкурентоспособность, задача линейного программирования, методический инструментарий

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Introduction

The diversity of Russian Federation regions provides an opportunity for subjects to adopt and implement unique, competitive regional innovation strategies and programs. These could be based on information, knowledge, and competencies of interested groups and public authorities, concerning the available potential of the subject of the Russian Federation, research developments, technologies, innovation development, and market niches.

“The main goal of the regional innovation strategy is to improve the living standards of the region's population and improve the ecological environment on the basis of stable economic development. This is ensured by the effective use of intellectual potential, creation, dissemination and use of new knowledge” (Grechenyuk, 2014).

For effective implementation of innovative activities, increasing competitiveness and sustainable development of the national and regional economies,

it is necessary to have appropriate resources. One of the most acute problems facing most regions, and impeding the implementation of regional innovation programs, is a lack of resources. Proper provision and exploitation of resources is a prerequisite for effective innovation strategy, moreover organizational and economic processes should embody a deep understanding of the modern nature of resources.

Literature review

In economics, resources are typically understood as factors of production. Hence, in our opinion, there is a “narrow” interpretation of such categories as “resource provision” and “resource potential”. But the nominal state of these characteristics of economic activity is significant, in terms of the development potential and competitiveness of companies.

The economic terms “resource” and “factor” can be synonymous if the degree of aggregation is not significant. For example, it is common to refer to such generalized, aggregated concepts as “land”, “labor” and “capital” as factors of production, whilst specific professional and labor competencies can act as resources.

It appears the role of resources is currently broader than the factors of production, so at this stage, it is most appropriate to consider resources as potential.

Notably, the importance of individual resources has changed over time. For example, natural and labor resources dominated the pre-industrial era, whilst information and labor represent key resources in post – industrial economies.

Schumpeter first identified the importance of knowledge for economic development, referring to the “new combinations of knowledge” underlying innovation and entrepreneurship (Schumpeter, 1934). Penrose argued that information represents the most important economic resource (Penrose, 1959). Freeman, Metcalfe, Nelson and Romer wrote that high-tech production, which relies heavily on intellectual resources, stimulates the greatest economic developments (Freeman, 1995; Metcalfe, 1998; Nelson, Romer, 1996). Later, Nonaka и Takeuchi argued that knowledge is the key to the competitiveness of both production units (i. e. firms) and territories (regions) (Nonaka, Takeuchi, 1995; Edmonds, 2000). The latter are increasingly seen as economic entities, and knowledge is considered the main element for achieving regional competitiveness (Huggins et al., 2008).

In modern economies, information and people are highly valued with information serving as the basis for human intellectual activity. When properly collected, accumulated, analyzed, synthesized, formed and distributed, information increases companies’ potential.

Information is the main resource in a global digital economy, which is the product of digitizing human knowledge and turning it into a key resource of economic development – human capital. In other words, the integration of information resources with human (labor) resources forms intellectual resources.

Nevertheless, there are various definitions of this term in the scientific community. A.I. Tatarkin defined intellectual resources as a system of relations of knowledge production that can enrich the intellectual abilities of companies, including ensuring a stable, expanded and balanced reproduction of national wealth on an intensive basis, in order to preserve the integrity of the Russian Federation and improve the welfare of its population (Tatarkin, 2010).

E.E. Golovchanskaya and E.I. Strelchenya have a similar point of view, but they focus on the set of intellectual resources that is formed when creating high-tech products based on the latest knowledge (Golovchanskaya, Strelchenya, 2015).

V. Kazakov, L. Lapidus, I. Svetlov believe intellectual resources consist of a set of human (labor) resources of a certain standard that are located within a fruitful infrastructure for the implementation of their work (Kazakov et al., 2016)

M.Sh. Minasov, D.V. Petrov consider intellectual resources from the perspective of their endogenous and exogenous nature, emphasizing that the process of expanded or simple reproduction of goods in the economy occurs thanks to accumulated knowledge. They also specify that these resources are a collective concept consisting of the state of human capital, provision of information, financial and natural resources of economic entities (Minasov, Petrov, 2017).

E.S. Balashova and T.V. Fedosova in their scientific works classify the composition of intellectual resources and note their commercial value (Balashova, Yuriev, 2014; Fedosova, 2018).

C. Boedker, J. Guthrie, S. Cuganesan understand them as the basis for the company's development and achievement of its goals (Boedker et al., 2005).

A. O'Cass and P. Sok note the intangible basis of human knowledge necessary for the development of an economic entity (O'Cass, Sok, 2014).

These definitions characterize intellectual resources as a set of competencies, knowledge, and abilities of a person and base this definition primarily on human skills. The above terminology also conveys the inseparability of information and human resources. Most authors note a unique characteristic of intellectual resources – an increase in the efficiency of resources at all stages of reproduction.

In modern economies, human resources are transformed and acquire specific features dictated by the process of reproduction. In the innovation economy employees and information become an indivisible whole, as people without information and knowledge have no economic value or importance. Thus, intellectual resources are central to the implementation of innovative activities and the development of society and the economy.

By intellectual resources, we mean the result of combining human (labor) and information resources. This integration has a unique ability to increase the efficiency of the resource potential involved in innovation at all stages of the reproduction cycle, and contributes to an intensive type of economic growth. Intellectual resources help transform companies' knowledge and information into economic value.

The tendency to turn intellectual resources into the primary type of resource potential of modern companies is most clearly manifested in innovative enterprises. Because of this, the availability of intellectual resources (intellectual resource security) and their use are of interested to this study.

Data and methods

Within management studies, intellectual resources exist in a single system with other types of resources, in unity and interrelation, representing a rather complex object. Additionally, any actions on intellectual resources can be difficult to implement, due to the unique characteristics of individual elements, the lack of

comparability of criteria for these resources, the complexity in determining property rights, not all intellectual resources have a material basis and there are limited unified structural elements whereby to assess and select intellectual resources, which leads to different assessment methods.

To form scientifically-based approaches to resource management, it seems appropriate to study the methods for their assessment. The most modern methods are used by the following researchers: S.S. Kudryavtseva proposed an institutional matrix that evaluates the conditions for the transformation of intellectual resources into capital (Kudryavtseva, 2010); K.M. Ohanyan developed a multidimensional classification of parameters of intellectual resources (Ohanyan, 2013); Y.V. Vertakova and M.Y. Lankin worked with integral indicators of the quality of intellectual resources and a map of the qualitative characteristics of organizational intellectual resources to assess the efficiency of resource utility, to identify “strengths” and “weaknesses” of the organization and to develop actions to improve the quality of intellectual resources (Vertakova, Lankina, 2014).

The author's team developed indicators for assessing intellectual resources in the context of innovative economic development. They also developed a means of evaluating indicators of the innovative potential of these resources using expert assessments, and evaluating indicators of innovative development of intellectual resources. The latter were based on companies' internal reporting data (Shakhovskaya, Popkova, Pozdnyakova, Oreshina, Ostrovskay, 2015).

Existing methods are mainly focused on assessing organizations' intellectual resources, which makes it difficult to evaluate all participants in innovation activities. According to the authors, this undermines organizations' ability to effectively perform research and development, and development work. The use of value indicators in the assessment of intellectual resources is a subjective measure because the levels of these indicators vary widely between different regions of the Russian Federation.

Of course, the rational use of the resource base impacts the effective development of regions and the competitiveness of the regional development strategy. Moreover, each region is unique and has its own specific differences, so it is difficult to develop a universal strategy that would cater to all modern challenges. “Based on these conditions, considerable attention is paid to the feasibility of the chosen strategic direction of development and the use of existing potential in the development of regions. It also focuses on the final results of the implementation of the goals and objectives, on the qualitative study of the strategic development of the regions” (Shkhalakhov, 2019). But in the context of the functioning of the innovative economy, in order to preserve, progress and develop the region's positions, it is necessary to consider the tools and implementation plan of the proposed strategy. The main difficulties in developing a strategy, first of all, are contained in an adequate analysis of the state of implemented methods and their comparison with the needs of the region.

The preservation and development of human (labor) resources is essential to stimulate innovation and national development. It was therefore necessary to consider the condition and distribution of human (labour) resources in the territories of the Russian Federation.

At present, retired workers in many professional sectors are not being replaced. This may threaten the leading industries of the economy. Moreover, employment issues have become more acute due to the development of scientific and technological progress, which has led to increased requirements for professional competencies and intellectual capital of employees. “For example, in an innovative economy, every person should strive to release their own innovative potential, when innovative activity is transformed from a one-time act into a constantly reproducible process” (Gorbunova, Shestakova, 2015). Due to the lack of necessary qualifications for the majority of the working-age population of our country, this process is difficult to implement, and this threatens increasing unemployment and employment problems.

According to a study by the Federal State Statistics Service “On the number and need of organizations for employees by professional groups as of October 31, 2018 (based on the results of a sample survey of organizations)”¹ highly skilled professionals represent the largest occupational group (6.6 million people), the Russian Federation needs 723 548 people, including 30 208 heads and 184 670 specialists with higher qualifications.

According to the Federal State Statistics Service, the number of personnel engaged in research and development in the Russian Federation amounted to 682 580 people in 2018, the number of scientific personnel has been declining since 2015 (2015 – 738 857 people, 2016 – 722 291 people, 2017 – 707 887 people), and this includes all categories of personnel engaged in research and development.

It is important to note that “the structure of employment in science sectors has not changed significantly over the past ten years. As before, the business sector accumulates more than half (53.3%) of the personnel potential of Russian science” (Ratay, Tarasenko, 2018) as of 2017, this is followed by the public sector (37.9%), the higher education sector (8.4%), and non-profit organizations (0.4%).

Let's look at the number of employees engaged in research and development by category in the period from 2000 to 2018 (Table 1).

Table 1

Number of employees engaged in research and development, by category in the Russian Federation (people)

Year	Number of persons, total	Researchers	Technics	Support staff	Other staff
2000	887 729	425 954	75 184	240 506	146 085
2005	813 207	391 121	65 982	215 555	140 549
2010	736 540	368 915	59 276	183 713	124 636
2015	738 857	379 411	62 805	174 056	122 585
2016	722 291	370 379	60 441	171 915	119 556
2017	707 887	359 793	59 690	170 347	118 057
2018	682 580	347 854	57 722	160 591	116 413

Source: based on Rosstat data. Retrieved August 1, 2020, from <https://rosstat.gov.ru/folder/14477>

¹ Federal State Statistic Service. (2018). On the number and need of organizations for employees by professional groups as of October 31, 2018 (based on the results of a sample survey of organizations). Retrieved November 15, 2019, from https://gks.ru/free_doc/2019/potrorg/potr18.htm

Based on the presented statistical data, in 2018 the number of personnel engaged in research and development in the territory of the Russian Federation amounted to 682 580 people, which is 3.6% less than in 2017, and 23% less than in 2000. The downward trend in the number of scientific personnel is observed throughout the period under review, with only a slight increase in the number of employees engaged in research and development in 2013 and 2015, compared to 2012. The number of employees increased by only 0.1 % in 2013, or 711 people, and by 0.9%, in 2015 – compared to previous years, which amounted to 6583 people. This trend can be seen in all categories of staff: the number of researchers decreased by 18.3% compared to 2000, technicians decreased by 23.2 %, whilst support staff reduced by 33.2%. Finally, the number of “other staff” decreased by 20.3% over 18 years.

Reviewing the structure of the staff engaged in research and development, in 2018 the predominant part seemingly consists of researchers (51%), followed by support personnel (23.5%). Other personnel represent 17%, whilst technicians occupy the smallest share (8.5%).

Analyzing official statistics on the federal districts of the Russian Federation for four districts, the number of personnel engaged in research and development is declining (Central, Northwestern, Southern, Volga federal districts). The largest increase (16%) in the number of scientific personnel compared to 2010 is observed in the North Caucasus Federal District. The number of researchers increased by 21.8%, the number of technicians increased by 22.6%, other staff increased 37% between 2010 and 2018, whilst support staff decreased by 18.3%. Compared to 2010, the number of personnel engaged in research and development increased in the Ural, Siberian and Far Eastern federal districts by 3.2, 1.4 and 0.7% respectively.

In the context of the federal districts of the Russian Federation, the largest increase in researchers and technicians in 2018 compared to 2010 was recorded in the Volga Federal District and amounted to: researchers – 6.3%, technicians – 37.7%, the number of support staff in the Northwestern Federal District increased by 8.7%, and the maximum increase in other personnel in 2018 was observed in the Siberian Federal District (up 10.8%).

As of 2018, most researchers are concentrated in the Central Federal District – 175 219 people, accounting for 50.3% of the total, the Volga Federal District is in second place – 53 249 people (15.3%), followed by the Northwestern Federal District the number of researchers is 46 573 people (13.4%). In other words, three federal districts employ 79% of the Russian Federation’s researchers.

Federal districts’ unique regional specializations and natural resources affects the degree of development and their competitive advantages. “On the one hand, the huge size of territories and diverse natural and climatic conditions are obvious competitive advantages of Russia. On the other hand, the extremely uneven distribution of scientific potential across the Russian Federation leads to serious imbalances in the level of scientific development in the regions and affects their economic and social development” (Mindeli, Chistyakova, 2016). Additionally, regional innovation activity is impeded by limited human capital, transformation, foreign policy relations and inter-regional economic relations. That is why updating the methodological equipment and tools in regional strategies is necessary for the de-

velopment of regions. According to the authors, guidelines should initially focus on enterprises and enterprise hubs, since they represent “growth points” that determine regional competitiveness.

Model

Replenishment of human resources is a long process. The state, businesses and scientific and educational organizations should jointly propose and implement measures to solve this problem. Currently, the scientific-technical progress required for digitization is impeded by constantly shortening innovation lifecycles, which may generate a regional and international “innovation gap”.

The authors propose a method for assessing the minimum acceptable levels of private indicators of the availability of intellectual resources necessary for the implementation of an innovation project, considering the content of its stages (hereinafter, the method) will be based on the theories of human and intellectual capital, focusing on skills, competencies, innovative thinking, intellectual characteristics, physical and the psychological health, knowledge, information and abilities of each potential participant in innovation.

The method enables the evaluation of the abilities, skills and knowledge of each potential participant in innovation activities in a certain time interval, and identifies “strengths” and “weaknesses” of potential participants in innovation activities, which can later become the basis for the formation, development and management of organizational intellectual resources at strategic and operational levels. The developed method enables the optimal use of employees’ potential intellectual resources in the implementation of an innovative project and allows user to “see” which participants the organization needs to include in an innovative activity. The method can be used to organize the accounting of intellectual resources, assess their sufficiency for project implementation, as well as to optimize the distribution of resources between several innovative projects.

The purpose of this method is to identify the minimum allowable intellectual resources for the implementation of an innovative project. This technique facilitates the distribution of the intellectual resources needed to execute an innovation project and to determine which stakeholders should be involved for its effective implementation.

The method aims to optimize intellectual resource utility by outlining a minimum allowable amount for a project. This task entails an assessment of the intellectual resources necessary for the implementation of innovation and compares this with the available intellectual potential – this comparison drives the allocation of employees.

Stage 1. The assessment of potential participants in innovation activities is informed by employees’ professional skills, experience, and education. Socio-psychological factors also have a direct impact on behavior, effective states, and ultimately affect effectiveness and efficiency. Thus, each employee’s suitability is calculated using three groups of indicators.

Group 1. Personal indicators:

- 1) ability to work in a team;
- 2) creativity;
- 3) learning and the desire to acquire new knowledge;
- 4) receptivity and openness to innovation;
- 5) stress tolerance;

6) punctuality and responsibility;

7) the degree of risk taking.

Group 2. Functional/professional indicators:

1) completion of retraining and/or advanced training programs over the past 5 years and/or current postgraduate/doctoral studies;

2) experience in organizations engaged in innovation activities;

3) participation in professional groups/communities;

4) knowledge in the field of research.

Group 3. Smart indicators:

1) confirmed amount of income from participation in research and development;

2) participation in patent applications and obtaining patents for utility models, inventions, industrial designs over the past 5 years;

3) participation in the development of advanced production technologies, grants for the last 5 years;

4) publications in scientific journals indexed in international citation databases and/or publications in the list of peer-reviewed scientific publications included in the core of the RSCI with the presence of citations (excluding self-citation and citation of co-authors);

5) the economic result of commercialization of innovations of a potential participant in innovation activity.

It is worth noting that the listed individual indicators, as well as the number of groups, can be changed if necessary, for example, depending on the technical task of the innovation project.

The selection of specific indicators necessary for the implementation of a particular stage of an innovation project should be entrusted to a high-ranking decision-maker, for example the General Director of the organization or Deputy Director.

Stage 2. Identifying the minimum level of intellectual resource required for innovation project implementation. The general view of the set of intellectual resources required for innovation project implementation is expressed by the following function:

$$b_1x_1 + b_2x_2 + \dots + b_nx_n \rightarrow \min, \quad (1)$$

where b_n – the arithmetic mean of the arguments of the n -th group of each stage of the innovation project; X_n – group of private indicators of intellectual resources.

To evaluate the intellectual resources required for the implementation of an innovation project stage, we take the ratio of distributed indicators of intellectual resources of one group (\bar{q}_i), $i \in (0,1 \dots n)$ at a certain stage to the maximum number of indicators of the same group used for the entire innovation project.

Then, define a_n as follows:

$$a_n = \frac{\sum_{i=1}^n q_i}{q_{\max}}, \quad (2)$$

where a_n – the ratio of the involved intellectual resources of the n -th group to the maximum possible in the project.

A linear inequality is constructed for each stage of the innovation project. The right part of the inequality (Y_m) is calculated as the arithmetic mean of the stage arguments (a_{mn}), and the system of inequalities describing the innovation project has the form:

$$b_1x_1 + b_2x_2 + \dots + b_nx_n \rightarrow \min; \tag{3}$$

$$\begin{cases} a_{11}|X_1| + a_{12}|X_2| + a_{13}|X_3| + \dots + a_{1n}|X_n| \geq Y_1; \\ a_{21}|X_1| + a_{22}|X_2| + a_{23}|X_3| + \dots + a_{2n}|X_n| \geq Y_2; \\ a_{31}|X_1| + a_{32}|X_2| + a_{33}|X_3| + \dots + a_{3n}|X_n| \geq Y_3; \\ \dots \dots \dots \dots \dots \dots \\ a_{m1}|X_1| + a_{m2}|X_2| + a_{m3}|X_3| + \dots + a_{mn}|X_n| \geq Y_m; \\ |X_{\min}| \leq X_{1,2,3,n} \leq 1, \end{cases}$$

where $X_{1,2,3,n}$ – sets of particular indicators for each group

$$X_1 = \begin{pmatrix} x_{11} \\ \dots \\ x_{1n} \end{pmatrix}; X_m = \begin{pmatrix} x_{m1} \\ \dots \\ x_{mn} \end{pmatrix}.$$

The values of the minimum acceptable levels of intellectual resources of potential participants in innovation activities $|X_{\min}| \leq X_{1,2,3,n}$ must be taken as non-zero, having made a preliminary assessment of the complexity of the technical task, considering the requirements for personnel and the preferences of the high-ranking decision-maker. In other words, the decision maker can decide to introduce additional constraints, for each group of indicators, into the system of equations that these values are minimal, which can be implemented in an innovative project.

Based on the system of linear inequalities, a set of functions is formed that characterize the distribution of the involvement of intellectual resources of potential participants in innovation activities for the implementation of an innovative project. This type is the “ideal” distribution of intellectual resources in the project.

Next, we solve a system of linear inequalities with respect to a set of indicators. The result is a minimum acceptable solution to the problem of allocating intellectual resources, in accordance with the groups defined by the methodology, necessary for the implementation of the evaluated innovation project.

Stage 3. Assessing the expected demand for individual indicators of each group according to innovation project stage. To determine the expected demand for private a high-ranking decision-maker indicators, it is necessary to sum up each private indicator involved in the implementation of an innovation project (Table 2).

Table 2

Distribution of private indicators of intellectual resources in the implemented innovation project

Group of private indicators	Project stage			
	Stage 1	Stage 2	Stage 3	Number of repetitions
Private indicator	Involved	No	Involved	2
...				
...				

Source: compiled by the authors.

Further, to determine the expected demand for a particular indicator, a search is made for its share relative to the maximum number of repetitions of the indicator at the stage for each group.

After that, you need to normalize the obtained partial indicators to determine the values of the $|X_n|$. To do this, perform a linear operation using the following rule:

$$|X_n| = \sqrt{(k_n a_1)^2 + (k_n a_2)^2 + \dots + (k_n a_n)^2}, \quad (4)$$

where a_n – value of expected demand for a particular indicator; k_n – coefficient of compliance of particular indicators in the n group.

The coefficient of compliance k is calculated using the following formula:

$$k_n^2 = \frac{|x_n|^2}{(a_1)^2 + (a_2)^2 + \dots + (a_n)^2}. \quad (5)$$

To compare the required minimum allowable intellectual resources for the implementation of an innovation project and the intellectual resources of potential participants in innovation activities, it is necessary to proceed to their absolute assessment. Systematization of absolute values is completed through the reverse substitution of criteria for evaluating the ownership of private indicators of intellectual resources of potential participants in innovation activities according to the following formula:

$$\left(\begin{matrix} \overline{c_{i1}} \\ \dots \\ \overline{c_{in}} \end{matrix} \right) = \frac{1}{x_i} \left(\begin{matrix} x_{i1} \\ \dots \\ x_{in} \end{matrix} \right), i \in (1, \dots, m), \quad (6)$$

where $\overline{c_{in}}$ – the minimum acceptable value of individual indicators of intellectual resources of a potential participant in the innovation activity in the corresponding group of analyzed characteristics (professional/functional, personal or intellectual indicators); X_i – the corresponding solution to the linear programming problem (3), which determines the minimum acceptable values of particular indicators to meet the requirements for innovation project implementation; x_{i1}, \dots, x_{in} – corresponding values of the estimation vector established as a result of the methodology algorithms.

The result of the systematization of absolute indicators is a vector:

$$X_n = \left(\begin{matrix} x_{m1} \\ \dots \\ x_{mn} \end{matrix} \right). \quad (7)$$

The resulting vector shows the minimum value of indicators at which it will be possible to implement an innovative project. It is essential that potential participants in the innovative activity must meet all the minimum requirements at each stage.

Stage 4. Assessing the intellectual resources of a potential innovation participant. After selecting individual indicators and the expected demand for innovation project implementation has been calculated, it is necessary to consult an expert group to decide who participates in the innovation activity.

To do this, we will set weight coefficients for potential participants, according to the previously selected individual indicators. This method recommends assigning weight coefficients ranging from 0 to 1, 0 indicates a potential participant does not have this characteristic, and 1 indicates the characteristic is completely fulfilled.

The preparatory step in the formation of an expert group is the selection of its leader, this person organizes the work of the expert group and analyzes the results obtained. In this method, the head of the expert group should ideally appoint the high-ranking decision-maker, at the first stage, expert group candidates are selected and this list is passed to the heads of departments for approval and adjustment.

The selection of experts should be based on their competence, since they directly impact the effectiveness of innovation project implementation. Candidate competence is determined independently according to the questionnaire (Table 3).

Table 3

Expert group candidate questionnaire					
Criterion	The value of the weighting factor				
Level of education	Average	Secondary special education	Bachelor course	Magistracy	Specialist degree
	0.1	0.2	0.3	0.4	0.4
Experience	1 year	More than 1 year, but less than 5 years	More than 5 years, but less than 10 years	More than 10 years, but less than 15 years	More than 15 years
	0.2	0.4	0.6	0.8	1
Scientific qualification	Absent	Candidate of Sciences	Docent	Doctor of Science	Professor
	0	0.7	0.8	0.9	1
Availability of scientific papers on the profile for the last 5 years	Absent	Up to 2	Up to 5	Up to 7	Over 7
	0	0.2	0.4	0.6	0.8

Source: compiled by the authors.

The sum of points scored by the expert on all criteria is calculated as follows:

$$E_x = \frac{\sum_{j=1}^n a_{ij}}{i}, \quad (8)$$

where a_{ij} – the value of the weighting factor; i – number of criteria.

The second stage of forming an expert group is determining its size. There are many opinions in the scientific community, but most scientists conclude that large expert groups lead to organizational problems, whilst small groups generate overly subjective results. Therefore, an expert group of 8 to 12 people is proposed, selecting candidates with the highest competence coefficient.

There are human factors involved in expert assessment, thus it is necessary to individually interview experts to avoid any attempts to influence their opinion, e. g. by managers or more authoritative experts. The experts are invited to use the following scale to evaluate each employee (Table 4).

Table 4

Scale for evaluating individual indicators of the organization's employees' intellectual resources				
Assessment of ownership of private indicators of intellectual resources, C_i				
0	0,25	0,50	0,75	1
The employee does not have this characteristic	The characteristic does not manifest itself fully or systematically, and requires development	The employee demonstrates satisfactory (average) development of this characteristic	The characteristic is shown in most situations, and is highly developed	The employee perfectly knows this characteristic and shows it in all situations

Source: compiled by the authors.

After the formation of the expert group and the expert evaluation procedure, the high-ranking decision-maker needs to establish the degree of consistency of the received opinions. For this procedure, the Kendall concordance coefficient is calculated.

The value of the Kendall concordance coefficient ranges from 0 to 1. The expert opinion is considered agreed if the Kendall concordance coefficient is greater than or equal to 0.7.

There are likely situations when experts will hold contrary opinions about the significance of a particular indicator of the high-ranking decision-maker. Expert opinions that contradict group consensus should be further examined. If there is no consistency, reasoned justifications should be provided from each expert.

Based on the obtained the high-ranking decision-maker values, it is necessary to compare the available intellectual resources of the organization with the necessary ones and distribute them by stages of implementation throughout the innovation project. If there is a shortage of intellectual resources, the organization should clearly understand what additional intellectual resources are required for the effective innovative project implementation.

Results

The proposed method allows managers to evaluate the minimum requirements for intellectual resources used at each stage of an innovation project. It works by evaluating the minimum acceptable levels of private indicators of availability of intellectual resources required for each project stage.

The methodological tools were formulated using a linear programming problem, estimating the expected relevance of particular indicators at each stage, according to their group. This enabled the codification of absolute values for comparison between the minimum values required for implementation and the potential intellectual resources involved in innovative activities. Finally, an expert group evaluates the intellectual resources of potential participants to inform staff allocation.

This methodology outlines a step-by-step process for optimizing intellectual resources, which makes it possible to effectively implement an innovative project in conditions of limited resource potential. The method provides an opportunity to analyze the sufficiency of intellectual resources for a period of time and then create a system of metrics for their accounting and replenishment. By evaluating the minimum acceptable levels of individual indicators of intellectual resources, it is possible to distribute resources between several innovative projects.

Conclusion

Shortening innovation lifecycles may generate an ‘innovation gap’ that threatens the Russian Federation’s regional and national competitiveness during an era of rapid global digitalization. Transforming the resource base and optimizing resource utility is essential to preserve and enhance global competitiveness.

The measures outlined in this study can be used to improve regional development strategies. Nevertheless, the regions of the Russian Federation face unique climatic, geopolitical, geographical conditions, levels of socio-economic development, and resource limitations. As such, it is impossible to develop a universal regional development strategy. This study identified that research and development staff, the main human resource required for stimulating innovation, are unevenly

distributed across regions. Therefore, new measures are required to replenish and redistribute human capital in the long term.

The authors propose to modernize the tools of regional development strategies. One of the proposed changes is a new methodology to assess the minimum acceptable levels of private indicators of the availability of intellectual resources necessary for the implementation of innovative projects. Despite its complexity, the process of evaluating, analyzing, accounting and distributing intellectual resources can be managed. Moreover, this new methodology helps identify an optimal resource distribution, facilitates the simultaneous use of intellectual resources across several innovative projects and enables their rapid replacement. Together, these benefits will stimulate innovation whilst saving financial resources and scarce human capital.

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