Under the conditions of a gradual transition to the knowledge economy, the system of management of innovative development of territories is actualized in the context of the realization of their economic interests, which is the object of this study. The authors of this paper proceed from the fact that sustainable innovative development is possible subject to the activation of the innovative potential of the territory. This work solves the task of a comprehensive assessment of innovation potential from the standpoint of national economic interests.

As a result of the study, a methodology for assessing the innovative potential of the region was proposed from the standpoint of ensuring the development of innovations, promoting the activity of innovation, guaranteeing its effectiveness and safety. The methodology differs from existing ones in that it takes into account such components as "innovative security" and "innovative support" of the territory.

The methodology was verified using the example of economic regions. The influence of innovation potential on such indicators of realization of national economic interests as gross regional product and real disposable incomes of the population was revealed. Thus, the asymptotic significance of the ANOVA test in establishing the link between innovation potential and gross product is 0.005, and between innovation potential and income of the population – 0.00019. This testifies to the constancy of relations and confirms the hypothesis of the possibility to regulate the processes of realization of the national economic interests of the state through the impact on the innovative potential of its territories.

The feature and advantage of the approach is a comprehensive assessment of the innovation potential and the ability to establish not only its condition but also the prospects for further activation. The results of the study can be useful for the system of state and regional management as they justify the directions of innovation policy formation

Keywords: innovative potential of the region, national economic interests, innovative support, innovative security

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PROCEDURE FOR ASSESSING THE TERRITORIAL INNOVATION POTENTIAL IN THE CONTEXT OF NATIONAL ECONOMIC INTERESTS

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1. Introduction

The success of a state in the global economic space is determined by the extent to which it can defend its national economic interests. This is what determines the independence and influence of the state, the ability to develop and ensure the well-being of its population.

The realization of national economic interests cannot be imagined without the introduction of new technologies in all areas of social relations, the activation of the knowledge economy. This ensures the competitiveness of the state, its dominant position in the world arena. Innovative development of the economy gives a qualitative leap in the promotion of national interests, contributes to the formation of a positive image of the state. The introduction of innovations improves the quality of life of the population, creating more comfortable living conditions and affecting the loyal attitude of the population to the authorities.

Innovative development does not arise by itself, it is possible only if there is a certain potential – the ability to carry out innovative activities in various sectors of science and innovation [1]. The innovative potential of the country is not homogeneous, it is the difference in its regions. This is due to the uneven distribution of resources, varying degrees of development of innovative infrastructure, sociocultural differences, and may complicate the realization of national economic interests, which by their nature are homogeneous. Under such conditions, the assessment of the innovative potential of the regions from the point of view of the realization of national economic interests acquires scientific relevance and practical significance.

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2. Literature review and problem statement

Studies [2–10] spread the discourse on national economic interests, their role in the development of the state, ensuring international cooperation. Interesting in this context is paper [2]. The authors consider the tools for ensuring national economic interests in the context of the implementation of state economic policy. Empirically, the paper provides evidence of the diversity of institutional mechanisms and political strategies that have emerged in the region's four largest economies, such as France, Germany, Italy, and the United Kingdom. However, given the dominant role of innovations in ensuring sustainable development, the authors do not prove how they affect the realization of national economic interests.

From a methodological point of view, also of interest is paper [3]. It reveals the etymology and nature of the national economic interest, determines that an important aspect in its provision is economic security. Recognizing the exceptional role of artificial intelligence in ensuring economic security, the author still does not reveal how it affects the innovation potential. He does not explain how artificial intelligence can be aimed at realizing national economic interests, limiting himself to describing only its supporting role.

From a different perspective, namely from the standpoint of international cooperation, national economic interests are considered by the authors of work [4]. They focus on the formation of national economic interests on the basis of non-discrimination. The authors consider the innovative factor as causing some discrimination – the division of countries into more and less technologically advanced ones. Therefore, it is important to develop the innovative potential of the regions to overcome disparities in economic development. But at the same time, the article does not disclose what the innovative potential is, what its main components are.

Particular attention is paid to innovations in the context of national economic policy in paper [5]. The article explores the role of innovation in ensuring the well-being of the nation. Based on the analysis of literary sources, it is noted that most scientists identify the priority role of innovation at the micro level – the level of firms. The authors of the article consider this approach to be erroneous, focusing on the role of national and international agents and processes in the formation of the innovative potential of the territories. The positive point is that the article also discusses regional and industry disparities in innovative development, justifies diversification in the formation of innovative potential. But the authors do not define the criteria and parameters of this diversification, do not provide procedures for evaluating innovative processes.

An interesting look at the systemic impact of innovation on the economic development of the state is demonstrated by the article of representatives [6] these authors consider various forms of innovation and define "systemic" innovations. However, they focus only on etymology, different interpretations of this term, while how the systemic impact of innovation can be measured remains unaddressed.

The innovative aspect of the realization of national economic interests is investigated in paper [7]. This article assesses the origins, evolution, and perspectives of national innovation systems. The authors offer a research program that is based on three pillars. This is the adaptation of innovative systems to the global economic crisis; adaptation of innovative systems for developing countries; specific inclusion of entrepreneurship and entrepreneurial innovation in scientific research at the national level. However, in assessing the development of national innovation systems, authors use only bibliometric methods, based only on the available data on publications in the Web of Science Core Collection. They substantiate that not only the number of studies but also the number of citations of these studies reflect the influence and growing interest of the scientific community, state administrations, and international organizations in certain problems of innovative development. This is certainly a very interesting approach, but it greatly narrows the scope of analysis. Not only interest in certain scientific topics but also real economic opportunities play a fundamental role in the implementation of innovation policy.

The authors of work [8] agree with the priority of innovative development; it addresses justifying the role of state and regional actors that shape policy in the area of science, technology, and innovation. The authors define the innovative development of the economy as the main national interest and systematize, using the example of Latin America, the main practices of promoting innovation. It was concluded that, despite the diversity of these practices, national innovation systems and regional innovation systems are dominant. But the authors do not pay attention to the possibility of assessing the potential of these systems.

In more detail, the issues of assessing the potential of innovative development are discussed in paper [9]. The authors propose a toolkit for managing innovative potential, namely a scheme for forming a roadmap for its development, which includes a SWOT analysis of potential, as well as an algorithm for its assessment. However, the authors rely only on mapping methods, do not take into account the economic prerequisites for the formation of innovative potentials, based only on its state, which limits the research procedure.

A more comprehensive approach to the analysis of innovation potential is given in [10]. The authors, based on the study of the level of gross production, economic security, and innovative capacity clustering of regions, determine the priorities of their development. Appreciating this approach, it is worth noting that it does not take into account such a component of innovation potential as support for innovation and innovation policy. Namely, they most fully reflect national economic interests in the context of innovative development.

Despite the availability of publications on the formation and implementation of national economic interests, the role in these processes of innovation, these issues do not lose relevance. Important scientific tasks are to substantiate the influence of the innovative potential of territories (regions, states) on ensuring national economic interests, the development of methodological foundations for its assessment, tangential region-centric trends in the economy.

In addition to scientific discussion, these issues are also of concern to practice. There are a number of procedures that make it possible to assess the innovative potential of the national economy. The most common is the Global Innovation Index (GII) evaluation procedure compiled by the World Intellectual Property Organization, Cornell University, and the Insead International Business School [11]. The procedure involves the assessment of both the commercial results of innovation in countries and the activity of governments to encourage and support innovation in their public policy. Not only statistical procedures of analysis are used but also large-scale sociological surveys. They are attended by more than 1000 senior executives from companies – mem-

bers of the National Association of Manufacturers in all industries. The procedure involves in-depth interviews with 30 executives and comparisons of the "innovation appeal" of 110 countries and all 50 US states. The global innovation index is composed of 82 different variables that describe in detail the innovative development of countries around the world that are at different levels of economic development. A deeply differentiated approach, on the other hand, complicates the evaluation process, requires significant resources. For express evaluation, due to its complexity, it is unsuitable. Also, GII does not take into account the heterogeneity of the formation of innovative potential within the country, various prerequisites for innovation in its regions.

Innovation potential can also be assessed using the Global Creativity Index (GCI) – an integrated indicator calculated by Martin Prosperity Institute to assess data on the creativity of the economy and the creative class of individual countries and regions [12]. This index is calculated as the arithmetic mean of three subindexes: the talent index, the technology index, and the tolerance index. It is also called the index of three "T". So far, the results of the study on the definition of the Global Creativity Index have been presented twice: in 2011, it covered 82 countries; in 2015, 139 countries. However, this procedure makes it possible to assess the favorable conditions for the formation of innovative potential, but it does not take into account the problems and threats that hinder innovative processes. GCI is also calculated for the whole country notwithstanding the peculiarities of its regions.

A more differentiated approach that overcomes these methodological shortcomings is used in the calculation of Portfolio innovation ndex (PII). It is used to measure the innovative development of US territories. The index consists of resource (Human capital and economic dynamics) and effective (Productivity and Employment and Well-being) blocks with expertly established weight values. The procedure makes it possible to evaluate the processes of innovation in different regions of the state but does not take into account such components of innovation potential as innovation safety and innovative support [13].

The procedure of comprehensive assessment of the innovative potential of territories is also used in the calculation of indicators of the European Innovation Scoreboard (EIS). The indicators are clearly divided into input (evaluating the resources of scientific and innovation activities) and output (reflect the effectiveness of scientific and scientific-technical work and innovation) [14]. EIS indicators are presented in five groups that reflect various aspects of the innovative development of territories. This is the state and structure of innovation potential (Driving forces of innovation); levels of research funding (Creation of new knowledge); levels of innovative business activity (Innovation and entrepreneurship); employment and commercial activities in innovation sectors (Application); patent activity (Intellectual Property). But the procedure is more focused on assessing real business opportunities, to a lesser extent attention is paid to institutional support for innovation.

Thus, the assessment of innovative potential and its role in determining and realizing the economic interests of countries require further both theoretical and practical justification, expansion of methodological approaches, and adaptation of existing national economies. Analysis of literary sources showed that there are no procedures for assessing the innovative potential of territories that would comprehensively diagnose it both from the standpoint of the activity of innovative processes and from the standpoint of the presence of relevant prerequisites. Therefore, it is necessary to devise an appropriate procedure that would take into account these positions and reveal the potential of territories in the context of ensuring national economic interests.

3. The aim and objectives of the study

The aim of this study is to devise a procedure for assessing the innovative potential of the regions of the country in the context of ensuring its national economic interests. This will expand the methodological apparatus for assessing the innovative potential and make it possible to diagnose the state and determine the prospects for the development of innovation, taking into account the characteristics of each specific territory.

To accomplish the aim, the following tasks have been set:

– to propose components for assessing the innovative potential of territories and systematize them into a comprehensive procedure;

– to verify the procedure for assessing innovative potential using the example of specific territories;

– to identify the influence of the innovative potential of the regions of the country on the realization of its national economic interests.

4. The study materials and methods

The object of our study is the management system of innovative development of territories.

The hypothesis of the study was as follows: as a comprehensive indicator, the innovative potential of the territory should take into account the possibilities of realizing national economic interests. Therefore, it is necessary to supplement the existing procedures for assessing the innovative potential of territories with components such as innovative security and innovative support that correlate with national economic interests. It was suggested that there is a relationship between the innovative potential of the state (region) calculated according to the proposed procedure and such indicators of the realization of national economic interests as gross regional product and real disposable incomes of the population. To identify this connection, an ANOVA test was performed.

The methodological basis of the study is the dialectical method of cognition of reality, a systematic approach to the study of elements of innovative potential, the fundamental provisions of the knowledge economy.

The study was conducted at the theoretical and empirical levels. The sequence of scientific research was achieved by the procedure of logical generalization. System-structural analysis was used to streamline and comprehensively study the components of innovation potential; system analysis – to assess the innovation potential as a single system in the interrelation of its components. Determination of features, problems, prospects for the formation and dissemination of innovative potential, its impact on national economic interests were carried out through observation and generalization. To calculate the integrated index of innovation potential and interpret the results of the study, the index method and the method of comparisons were used. ANOVA

has made it possible to establish the impact of innovation potential on key indicators for the realization of national economic interests.

To analyze the dynamics of indicators of innovation potential and conduct the ANOVA test, the capabilities of the MS Excel data analysis package (USA) were used. The information base of the study consists of official statistical data on the development of regions of Ukraine.

5. Devising and testing a procedure for assessing the innovative potential of regions in the context of ensuring national economic interests

5. 1. Formation of components for assessing the innovative potential of regions and systematizing them into a comprehensive procedure

The innovative potential of the region is not unambiguously defined, there are several approaches to its interpretation. The most common is the understanding of potential as a set of resources that provide innovation, and the possibility of using them, in order to achieve specific goals. Proponents of this approach consider the availability of scientific personnel, sources of financing of innovation activity, intellectual property objects as indicators for assessing innovation potential [1, 15]; research infrastructure [16].

Representatives of a different approach to assessing the innovative potential of the territories focus more on the innovative activity of economic agents. The results of scientific and technological works, inventions, design and development, samples of new equipment and products covering all stages of the scientific and technological cycle are subject to evaluation [17]. The structure of the costs of innovation activity is investigated and the analysis of innovative cooperation of enterprises is carried out [18, 19].

Both approaches reveal the state of innovation in the regions, make it possible to analyze the prerequisites for its development. However, they do not reflect how innovation potential allows the realization of national economic interests, and therefore need to be supplemented and clarified. For a more comprehensive assessment, we propose a procedure for assessing the innovative potential of the regions, which is based on four criteria: "innovative provision", "innovation activity", "innovative security", and "innovative support". The last two criteria reflect the interest of the state in the purposeful development of innovation in the context of the implementation of national economic interests.

To assess the potential for each criterion, individual indices will be used, which express the ratio of a set of phenomena that consist of heterogeneous, directly incommensurable elements. This approach makes it possible to take into account the specifics of indicators of innovation potential, which have completely different bases for calculation (cost, percentage, quantitative, per person, etc.). It will also save the analysis from the impact of the current territorial size, level of economic development or the population of each region.

Individual indices will be integrated into the general index of innovation potential, expressed as the geometric mean weighted by its components. This type of average is used to calculate the average coefficients (rates) of growth in the dynamics series. This will make it possible to establish the general level of the indicator of innovation potential, subject to its fluctuations over the years. It is not the absolute values of the potential components that are averaged (which are heterogeneous and cannot be summed up – therefore, other calculation approaches averages are not suitable), and the coefficients of the ratio to the average level for each component. Based on the geometric mean weighted, it is possible to give a general description of the potential, which is sufficient for this stage of diagnosis, and to make comparisons by different regions. In the future, it is possible to expand the assessment on the basis of factor and correlation analysis in order to establish the influence of the components on the overall innovation potential. This is a promising direction in the development of the procedure, which will complement (but will not replace) the overall assessment.

In general, the formula for calculating the integrated indicator is as follows:

$$I_{reg.pot} = \sqrt[4]{I_{prov} \times I_{act} \times I_{sec} \times I_{sup}}, \quad (1)$$

where $I_{reg\,pot}$ is the integrated index of innovation potential of the region;

I_{prov} – general index of innovative provision of the region;

I_{act} – general index of innovation activity of the region;

I_{sec} – general index of innovation security of the region;

I_{sup} – general index of innovative support for the region.

Below we consider separately each of the four criteria for innovation potential in more detail.

"Innovative provision". The criterion characterizes the availability of resources for innovation and how successfully they are used to achieve the goals of the development of territories. The assessment is carried out on the basis of indicators revealing the state of innovation infrastructure, material, and personnel support of innovation activities (Table 1).

The index of innovation provision of the region is calculated according to the following formula:

$$I_{prov} = \sqrt[8]{I_{sc} \times I_{prof} \times I_{\sup.staff} \times I_{grad} \times I_{PhD,doc} \times I_{res.org} \times I_{sc.park} \times I_{high.ed}}. \quad (2)$$

«Innovative activity». This criteria characterizes the development of innovation in the region. It covers two areas – production and investment activity. Production activity reveals the degree of development of innovative business, cooperation in the scientific and technological areas, updating technologies and the range of innovative products, entering international markets [20]. Investment activity reflects the volume and intensity of financing of innovative projects, intensification of investment activities at the regional level (Table 2).

The index of innovation activity of the region is calculated according to the following formula:

$$I_{act} = \sqrt[9]{I_{in.bus} \times I_{in.co} \times I_{in.\exp} \times I_{in.prod} \times I_{in.proc} \times I_{in.impl} \times I_{in.invest} \times I_{in.project}}. \quad (3)$$

"*Innovation security*". This criterion reveals how innovations are protected from non-sanctioned reproduction, how they meet global challenges, are relevant and competitive, and how much the state ensures effective business innovation (Table 3). The assessment is carried out on the basis of indicators that comprehensively reflect how innovative activity is aimed at the realization of national economic interests, as well as how much attention is paid to this criterion in the concept of national security.

Table 1

Criterion "Innovative provision" for analyzing the innovative potential of the region

Indicator	Components	Designation	Characteristic
Staffing subindex	Innovative staff	I_{sc}	It is determined by the number of employees and researchers involved in the implementation of research, per 1000 people of the employed population (aged 15–70 years). Characterizes the quantitative provision of innovation activities by specialists
	Scientific personnel of innovation activity	I_{prof}	It is calculated as the share of employees who have a scientific degree in the total number of those involved in the implementation of research and development. Determines the quality of innovation by specialists
	Technical personnel of innovation activity	$I_{sup.staff}$	The number of technical and support personnel in the total number of involved in the implementation of research and development. Determines the quality of innovation activities by specialists
	Potential personnel of innovation	I_{grad}	It is defined as a regional distribution of graduates of higher education (bachelors, masters). It is calculated as the ratio of the number of graduates in a particular region to the total number of graduates in the country. Reveals the prospects for the development of staffing, updating scientific personnel
	Updating scientific personnel	$I_{PhD,\ doc}$	It is defined as a regional distribution of graduates of postgraduate and doctoral studies. It is calculated as the ratio of the number of graduates of postgraduate and doctoral studies in a particular region to the total number of graduates of postgraduate and doctoral studies in the country. Reveals the prospects for the development of staffing, updating scientific personnel
Sub-index of infrastructure provision	Scientific organizations	$I_{res.org}$	It is calculated as the share of organizations engaged in research work in the total number of innovatively active enterprises. Determines the availability of its own infrastructure for the implementation of research and development
	Industrial, technological, and scientific parks	$I_{sc.park}$	Determines the regional distribution of industrial, technological, and scientific parks. Calculated as the ratio of the number of parks in the region to the total number of parks in the country. Characterizes the state of development of the production and technological infrastructure of the regions, which provides support for all stages of the innovation cycle
	Educational institutions	$I_{high.ed}$	Determines the regional distribution of higher education institutions. It is calculated as the ratio of the number of higher education institutions in the region to the total number of such institutions in the country. Reveals the provision of institutions for the training of specialists in various fields of innovation

Table 2

Criterion "Innovation activity" for analyzing the innovative potential of the region

Indicator	Components	Designation	Characteristic
Subindex of production activity	Innovative activity of companies	$I_{in.bus}$	It is calculated as the share of innovatively active companies in the total number of business entities. Reflects business activity in the development and implementation of innovations
	Innovative cooperation	$I_{in.co}$	It is calculated as the share of enterprises involved in innovative cooperation in the total number of innovatively active enterprises. Reveals the degree of development of cooperation in the innovation sphere
	Export of innovations	$I_{in.exp}$	It is calculated as the share of industrial enterprises that have sold innovative products (goods, services) outside Ukraine in the total number of innovatively active enterprises. Reflects the activity of innovative enterprises in the international market
	Sale of innovative products	$I_{in.prod}$	It is calculated as the share of sold innovative industrial products (goods, services) in the total volume of industrial products sold (goods, services). Characterizes the degree of development of the market for innovative products
	Activity of registration of inventions and utility models	$I_{intel.prop}$	It is defined as the regional distribution of applications for inventions and utility models submitted for registration of intellectual property rights. It is calculated by the ratio of the number of applications in the region to the total number of applications in the country. Shows the activity of innovative creativity at the regional level
	Introduction of new technological processes	$I_{tech.proc}$	It is defined as a regional distribution of introduced new technological processes. Calculated by the ratio of the number of introduced new technological processes in the region to the total number of implemented technological processes in the country. Reflects the renewal of technologies, their degree of development at the regional level
	Introduction of innovative products (goods, services) by industrial enterprises	$I_{prod.impl}$	It is defined as the regional distribution of introduced innovative products (goods, services) by industrial enterprises. It is calculated by the ratio of the volume of introduced innovative products in the region to the total volume of such products in the country. Reflects the renewal of innovative products of enterprises at the regional level
Subindex of investment activity	Investments in innovative projects	$I_{in\cdot invest}$	It is calculated as the share of investments in innovative projects in the total volume of regional investments. Reveals investment support for innovation
	Regional distribution of innovative projects	$I_{in.project}$	It is calculated by the ratio of innovative projects implemented in a particular region to the total number of such projects in the country. Characterizes the intensification of investment activities at the regional level

Table 3

Criterion "Innovation Safety" for analyzing the innovative potential of the region

Indicator	Component	Designation	Characteristic
Security subindex	Legal protection of innovative projects	$I_{intel.prop}$	It is calculated as the ratio of the number of applications for inventions and utility models to the total number of innovatively active enterprises. Reflects the legal regulation of intellectual property relations
	Cybersecurity of innovation activity	$I_{cyber.sec}$	The share of solved cybercrimes in the field of intellectual property protection and protection of research results in the total number of cybercrimes. Reveals the effectiveness of cyber defense of the results of innovation
	Ecological safety of innovation activity	$I_{eco.saf}$	It reflects the environmental responsibility of innovation, its focus on "green" development and environmental protection. It is calculated as the share of new or significantly improved low-waste, resource-saving technologies in the total volume of new technological processes introduced
Security subindex	Personnel stability of research activities	$I_{per.stab}$	It is calculated as an inverse indicator of personnel turnover. Personnel turnover reflects the ratio of the number of employees involved in the implementation of research who emigrated abroad to the total number of employees involved in research and development
	State financing of innovative projects	$I_{st.fund}$	It is calculated as the ratio of the amount of state financing of innovative projects in the total amount of investment in innovation. Reflects the state guarantee of investment stability

The index of innovation security of the region is calculated according to the following formula:

$$I_{\text{sec}} = \sqrt[5]{I_{\text{int}el.prop} \times I_{cyber.\text{sec}} \times I_{eco.saf} \times I_{per.stab} \times I_{st.fund}}. \quad (4)$$

"*Innovative* support". The criterion reveals the degree of state assistance to innovative development, which can be carried out in two directions – financial support and the creation of scientific infrastructure (Table 4). With the help of support indicators (Table 4), it is possible to assess the effectiveness of the innovation policy of the state, to find out how national economic interests are realized in this area.

The index of innovative support for the region is calculated according to the following formula:

$$I_{sup} = \sqrt[7]{I_{bud.fin} \times I_{fin.\text{sup}} \times I_{stip} \times I_{st.order} \times I_{sc.center} \times I_{lib} \times I_{ac.net}}. \quad (5)$$

To ensure the same direction of influence of all components of the evaluated index on the formation of the innovative potential of the region, they will be reduced to the same form. That is, factors that have the opposite effect (for example, the turnover of scientific personnel, the number of cybercrimes in the area of intellectual property, etc.) on the image indicator of the region will be taken into account as $(1/I)$.

Table 4

Criterion "Innovative support" for analyzing the innovative potential of the region

Indicator	Component	Designation	Characteristic
Financial support subindex	Financing of scientific projects from the state (regional) budget	$I_{bud.fin}$	It is defined as the planned share of expenses for research work of the state (regional) budget. Characterizes the participation of the state in scientific projects
	Financial support of scientific institutions	$I_{fin.sup}$	It is calculated as the ratio of the number of scientific organizations that are provided with financial support from the state to the total number of organizations that carry out research work by region. Characterizes the interest of the state in certain areas of scientific research
	Financial support for young scientists	I_{stip}	It is calculated as the ratio of the number of young scientists under the age of 35 who receive a state scholarship to the total number of young scientists. Determines the interest of the state in involving young people in scientific activities
	Regional distribution of projects implemented for state procurement	$I_{st.order}$	It is calculated as the ratio of the number of innovative projects completed for state procurement in a particular region to the total number of such projects in the country. Determines in the regional context the priorities of scientific developments that are funded by the state
Infrastructure Support Subindex	Regional distribution of state research centers and centers for collective use of scientific equipment	$I_{sc.center}$	It is calculated as the ratio of the number of state research centers and centers for the collective use of scientific equipment in a particular region to the total number of such centers in the country. Characterizes the presence of state infrastructure that promotes the development of scientific creativity and provides access to scientific equipment
	State network of scientific libraries	I_{lib}	It is calculated as the ratio of the number of scientific libraries that are funded by the state (or local government) in a particular region to the total number of scientific libraries in the country. Determines the regional distribution of scientific libraries that contribute to the information support of scientific research
	Regional distribution of subscribers of the academic Internet network	$I_{ac.net}$	It is calculated as the ratio of the number of subscribers of an academic Internet network in a particular region to the total number of such subscribers in the country. Determines the formation of a single scientific information space. It characterizes the provision of the needs of scientific and educational institutions in access to the resources of a specialized academic information network. In Ukraine, such a network is UkrainianAcademicandResearchNetwork (uar.net)

To assess the values of the index of innovation potential and its corresponding components, it is worth using the following scale (Table 5). Moreover, the higher the value of the indicator, the higher the innovative potential of the region.

Table 5

Scale of the integrated index of innovative potential of the region

Indicator value	The level of innovation potential of the region
0–0.1	very low
0.11–0.3	low
0.31–0.6	average
0.61–0.9	high
0.91–larger	very high

The proposed components for assessing the innovative potential of the territories and their systematization provide an opportunity to comprehensively assess the innovative potential of the territory from the standpoint of the ability to develop innovative activities, actively promote creative initiatives, protect innovative processes, and promote their development.

5. 2. Verification of the procedure for assessing the innovative potential of territories

Practical testing of the proposed procedure for assessing the innovative potential of the territories was carried out using the example of the regions of Ukraine. For this purpose, the economic zoning of the territory was used according to the factor of specialization in the all-Ukrainian division of labor and the integrated development of the economy. Specialization of territories is formed under the influence of various factors. These are natural conditions and resources, and social factors (the needs of the population and the economy, the quantity and quality of labor, economic and financial potential, scientific and technical base). Important are the features of geographical location and historical development of the territory [21]. Under the influence of these features, the innovative potential of the territory is formed. A single sociocultural space, close production ties, similarity of conditions of economic development make it possible to distinguish nine regions, which are integrated territorial production complexes and unite certain groups of administrative-territorial units:

– Carpathian: Lviv, Ivano-Frankivsk, Zakarpattia, Chernivtsi oblasts;

– Polissya: Volyn and Rivne oblasts;

– Podilsky: Vinnytsia, Ternopil, and Khmelnytsky oblasts;

– Capital: Kyiv, Chernihiv, and Zhytomyr oblasts, and the city of Kyiv;

– Central Ukrainian: Kirovohrad and Cherkasy oblasts;

– Northeastern: Poltava, Sumy, and Kharkiv oblasts;

– Black Sea coast: Odessa, Mykolaiv, Kherson oblasts;

– Donetsk: Donetsk, Luhansk oblasts;

– Prydniprovsky: Dnipropetrovsk, Zaporizhia oblasts.

These regions have different economic conditions but, through the system of sustainable ties, they activate the innovative potential for gradually overcoming problems and achieving promising areas of development.

Evaluation of innovation potential will begin with the criterion "Innovative provision" (Table 1). The source of data for the calculation was statistical reporting published on the official website of the State Statistics Service of Ukraine [22–24]. Based on the analysis of personnel and infrastructure provision, we calculated the integrated index using (1). The results of our calculations that were carried out using data [22–24] are given in Table 6.

Table 6

Assessment of the innovative potential of the regions of Ukraine according to the criterion "Innovative provision", 2017–2021

Region	Year					Mean value	Evaluation of the level of potential
	2017	2018	2019	2020	2021		
Carpathian	0.40	0.45	0.55	0.44	0.48	0.46	average
Podolsky	0.27	0.30	0.28	0.28	0.28	0.28	low
Polisky	0.19	0.19	0.19	0.19	0.18	0.19	low
Capital	0.73	0.72	0.74	0.75	0.74	0.73	high
Central Ukrainian	0.25	0.23	0.21	0.22	0.21	0.22	low
Northeastern	0.58	0.52	0.50	0.51	0.51	0.52	average
Black Sea coast	0.45	0.42	0.42	0.43	0.42	0.43	average
Donetsk	0.31	0.28	0.25	0.26	0.25	0.27	low
Prydni-provskyi	0.42	0.40	0.37	0.38	0.38	0.39	average

After analyzing the calculation data, we can conclude that according to the criterion "Innovative provision", no region of Ukraine has a rating of "very high level". Only the Capital Region has a rating of "high level" mainly due to the fact that it includes the capital city of Kyiv where the indicators of innovation provision are high. This situation is due to the uneven development of innovative infrastructure. Higher educational institutions, research institutions, industrial, technological, and scientific parks are mainly concentrated in large industrial cities – Kyiv (Capital Region), Kharkiv (North-Eastern Region), Lviv (Carpathian Region), Odesa (Black Sea region), Dnipro (Prydniprovsky region). The leader in the number of higher educational institutions is the Capital Region (125 educational institutions), followed by the Northeast (88 educational institutions), the Carpathian (85 educational institutions), Prydniprovskyi (72 educational institutions). By the number of industrial, technological and scientific parks, the Capital Region (38 educational institutions) holds the championship, the Carpathian region (25 educational institutions) takes the second place, the North-Eastern (18 educational institutions) and the Black Sea (14 educational institutions) regions take the third and fourth place by a large margin.

Low rates of innovation security of the regions of Ukraine are also due to the low share of organizations engaged in research activities in the total number of innovatively active enterprises (in general, in Ukraine it is 6 %). This is due to the significant level of import of innovations, the use of ready-made innovative solutions instead of local developments.

Low rates are demonstrated by the number of employees and researchers involved in scientific research per 1000 people of the employed population. In general, in Ukraine in 2021 it amounted to 4 %, while the total figure for the European Union was 14 %. Among the closest neighbors of Ukraine are Poland, Slovakia, and Hungary, this figure is 12 %, 11 %, and 10 %, respectively. In the regional context, the largest share of workers and researchers involved in sci-

entific research falls on the Capital (13 %), Northeast (6 %), and Prydniprovsky (5 %) regions [24].

At the same time, the share of the number of researchers with a scientific degree in the total number of employees involved in research and development in Ukraine is quite high. In 2021, it was 33 %, which corresponds to the average for the European Union. This indicates the high quality of staffing innovation provision [24, 25].

The problem for all regions of Ukraine is the renewal of scientific personnel. Thus, the share of young scientists under the age of 35 in 2021 was only 33 % in the total number of researchers. Although over the past five years there has been a tendency to increase it (in the period from 2017 to 2021, it increased by 1.5 times). This was due to an increase in the number of graduates of postgraduate and doctoral studies. The highest rates of updating scientific personnel are observed in the Black Sea (55 %), Prydniprovsky (52 %), Central Ukrainian (51 %) regions. As for the regional distribution of graduates from higher educational institutions, their largest share falls on the Capital (27 %), North-Eastern (18 %), and Carpathian (15 %) regions [24, 25].

Thus, we can conclude that according to the criterion "Innovative provision" there is an uneven development of the regions of Ukraine. So a number of regions need to develop innovative infrastructure (Central Ukrainian, Podolsk, Polissya). And the Donetsk region, which is partially occupied and therefore does not have access to the innovative infrastructure of such large cities as Donetsk, Luhansk, Gorlovka, etc., needs its restoration. As for the provision of scientific personnel, for almost all regions their renewal, the development of effective motivation for attracting university graduates to scientific and innovative activities, and the stimulation of scientific creativity are relevant.

Innovation provision determines the ability to innovate, and therefore is closely related to such a criterion for assessing potential as "Innovation activity". At the same time, this criterion shows how intensively the innovative potential is used.

The results of calculations of innovation potential according to the criterion "Innovative activity", which were carried out using data [22–24], are given in Table 7.

Table 7

Assessment of the innovative potential of the regions of Ukraine according to the criterion "Innovation activity", 2017–2021

Region	Year					Mean value	Evaluation of the level of potential
	2017	2018	2019	2020	2021		
Carpathian	0.47	0.44	0.34	0.46	0.43	0.43	average
Podolsky	0.28	0.31	0.33	0.28	0.31	0.30	low
Polisky	0.17	0.18	0.18	0.21	0.20	0.19	low
Capital	0.69	0.73	0.80	0.77	0.72	0.74	high
Central Ukrainian	0.42	0.42	0.30	0.35	0.28	0.35	average
Northeastern	0.90	0.78	0.84	0.75	0.70	0.79	high
Black Sea coast	0.43	0.40	0.50	0.42	0.41	0.43	average
Donetsk	0.30	0.30	0.38	0.40	0.40	0.36	average
Prydni-provskyi	0.82	0.77	0.70	0.79	0.75	0.77	high

The first line according to the overall assessment of innovation activity is occupied by the Northeast region. It has high rates of output of innovative products (goods, services) by industrial enterprises (in 2017–2021, 4099 items of such products were introduced). The region is also leading in the number of new technological processes introduced (during this period, 1936 technological processes were introduced). By the number of applications for inventions and utility models (with an indicator of 8261 for 2017–2021), the region is second only to the Capital [26]. The region is the leader in terms of the share of innovatively active enterprises in the total number of business entities (it is about 20 %), one of the three leaders in all other indicators of innovation activity.

In second place is the Prydniprovskyi region. It is the leader in terms of the cost of innovation in the structure of the regional budget, as well as the cost of innovation carried out by industrial enterprises. The trend of their growth is positive: in 2017–2021, these indicators increased by 33 % and 27 %, respectively [24].

The third place is occupied by the Capital region, which has very high rates of scientific development. Over the past five years, business structures and scientific institutions of the region have submitted 14427 applications for state registration of intellectual property rights to inventions and utility models. 4143 technological processes were introduced into the activities of enterprises in the region) [24]. Also, the region is the leader in the number of innovatively active enterprises involved in innovative cooperation – in 2021 there were 509 such enterprises, which is a third of the total in Ukraine.

The lowest rates of innovation activity are in the Polissia region, which is an outsider in terms of innovation security as well, which explains this situation. Due to the low development of innovative infrastructure and low rates of staffing, the region lags far behind others. A significant lag in such indicators as the volume of financing of innovative projects, the share of regional budget expenditures on research, the volume of innovative products sold, the number of innovatively active enterprises. However, there is also a positive trend: this is how the index of innovative activity of the region over the past five years has changed from 0.17 to 0.2. This was observed mainly due to an increase in the number of innovative products (goods, services) introduced by industrial enterprises. For 2017–2021, this figure in the region increased from 13 to 171 units [23, 25].

The intensification of innovation depends largely on favorable conditions, including its safety. Therefore, an important criterion for assessing potential is "Innovative Security". The results of calculations of innovation potential according to this criterion, which were carried out using data [22–24], are given in Table 8.

The "safest" from the standpoint of innovation development is the Polissya region. This region leads in terms of state guarantee of financial obligations for innovative projects (financial security). A high share of innovative projects is financed from the regional budget – this is 82 % of the total. This region has primacy in terms of environmental safety of innovative developments. The share of new or significantly improved low-waste, resource-saving technologies in the total volume of new technological processes introduced in this region is 62 % [23, 24].

High rates of innovation security are in the Podolsk and Black Sea regions.

Podolsk region has a high rate of legal protection. Thus, one innovatively active enterprise in the region accounts for an average of 18 registered inventions and utility models per

year. While the average in Ukraine is 12, and in such innovatively active regions as the Capital and Northeastern, it is 16 and 9, respectively [26]. The Black Sea region is the leader among other regions in terms of cybersecurity of innovation. The share of solved cybercrimes in the area of intellectual property protection and protection of research results in the total number of cybercrimes in this region is the highest in Ukraine and amounts to 30 % [27].

Table 8

Assessment of the innovative potential of the regions of Ukraine according to the criterion "Innovation Security", 2017–2021

Region	Year					Mean value	Evaluation of the level of potential
	2017	2018	2019	2020	2021		
Carpathian	0.58	0.53	0.53	0.53	0.50	0.53	average
Podolsky	0.80	0.89	0.57	0.49	0.61	0.67	high
Polisky	0.60	0.76	0.75	0.61	0.76	0.70	high
Capital	0.44	0.52	0.59	0.65	0.69	0.58	average
Central Ukrainian	0.43	0.37	0.46	0.32	0.78	0.47	average
Northeastern	0.44	0.51	0.56	0.68	0.80	0.59	average
Black Sea coast	0.58	0.71	0.64	0.71	0.67	0.66	high
Donetsk	0.70	0.53	0.58	0.59	0.46	0.57	average
Prydni-provskyi	0.31	0.43	0.44	0.58	0.51	0.45	average

The lowest rates of innovation security are in the Prydniprovsky and Central Ukrainian regions. The Prydniprovsky region is an outsider in terms of state guarantee of investment stability. The ratio of state funding for innovative projects in the total amount of investment in innovation is 24 % in this region, while the national figure is 48 %. The Central Ukrainian region has low rates of legal security of innovation activity: so only 4 % of developments created in the region are protected by intellectual property rights [26].

In all regions of Ukraine there is a problem of turnover of scientific personnel. So, in the period from 2017 to 2021 about 60 thousand scientific workers emigrated (this is 15 % of the total number of personnel involved in the research). The highest rate of emigration is in Polissya (38 % of scientific staff), Black Sea (29 % of scientific staff) and Central Ukrainian (25 % of scientific staff) regions. More stable in this regard is the Capital region (personnel turnover rate 9 %) [22, 28, 29]

Favorable for the development of safety of innovation in the regions of Ukraine is a gradual increase in the environmental responsibility of innovation, its focus on "green" development and environmental protection. Thus, the share of new or significantly improved low-waste, resource-saving technologies in the total volume of new technological processes introduced is gradually increasing. Over 2017–2021 it doubled and at the beginning of 2022 amounted to 51 %. The highest loans of environmental safety of innovation activity are in Polissya (62 %), North-Eastern (61 %), and Capital (55 %) regions. Donetsk (31 %) and Carpathian (36 %) regions have the lowest rates [24].

Thus, the overall estimates of the regions according to the criterion of innovative "security" are quite high (the index is more than 0.45). However, a number of regions need support from the state to financially guarantee innovation, develop institutions for the protection of intellectual property, combat cybercrime, and ensure personnel stability. It is these areas that should become a priority in the formation and implementation of national innovation policy.

How effective is the state policy in the area of innovation and its consistency with national economic interests is demonstrated by the assessment according to the criterion "Innovation support". The results of calculations of innovation potential according to this criterion, which were carried out using data [22–24], are given in Table 9.

Table 9

Assessment of the innovative potential of the regions of Ukraine according to the criterion "Innovation Support", 2017–2021

Region	Year					Mean value	Evaluation of the level of potential
	2017	2018	2019	2020	2021		
Carpathian	0.57	0.39	0.41	0.36	0.34	0.41	average
Podolsky	0.63	0.64	0.26	0.33	0.45	0.46	average
Polisky	0.56	0.39	0.78	0.29	0.26	0.46	average
Capital	0.73	0.63	0.65	0.51	0.64	0.63	high
Central Ukrainian	0.30	0.30	0.41	0.14	0.32	0.29	low
Northeastern	0.39	0.42	0.41	0.42	0.43	0.41	average
Black Sea coast	0.22	0.31	0.22	0.19	0.25	0.24	low
Donetsk	0.20	0.21	0.19	0.15	0.11	0.17	low
Prydni-provskyi	0.20	0.21	0.16	0.15	0.16	0.18	low

According to the criterion of "Innovation support", only the Capital region, which is the leader in all components of the assessment, has a high potential. Thus, according to 2021 data, 148 scientific institutions are concentrated in the region, which are supported by the state (in total, Ukraine had 251 such institutions in 2021), that is, 60 % of the total. In the Capital region, 204 research projects for 2019–2021 were funded from the National Research Foundation of Ukraine (the period of existence of the Fund). This is 57 % of the total number of funded projects in Ukraine [24].

The Capital region has a very extensive system of national scientific centers that conduct comprehensive scientific research of national importance and are recognized at the world level. Centers of collective use of scientific equipment – specialized organizations created to provide access to unique equipment for scientific research and scientific and technical (experimental) developments – are actively operating in the region. In total, as of 2021, 124 such centers in Ukraine were created, of which 72 operate in the region (mainly in Kyiv). A large number in the region and state libraries (in total in 2021 there were 2378), although according to this indicator the region is inferior to the Carpathian region, in which there are 2796 libraries, and the Podolsk region, in which there are 2525 such institutions [22, 24].

In the Capital region, "youth" science is developing. Thus, in 2021, 305 young scientists (under the age of 35) working in the region received a state scholarship – which is almost half of the total number of young scholarship holders in Ukraine. However, in terms of the ratio of the number of young scientists who have received a state scholarship to the total number of young scientists, the region has an indicator of 7 %. It is significantly inferior to the Polissya region, in which 31 % of young scientists received a state scholarship [24, 27].

As for other regions of Ukraine, such regions as Carpathian, Podolsk, Polissya, Northeastern have almost the same indicators. Thus, in the Carpathian and Podilsky regions, the system of scientific libraries is quite extensive. The north-eastern region occupies the second place after the Capital in terms of the number of national research centers and centers for collective use of scientific equipment (there are 28 of them in the region in total). 37 scientific institutions of the region were provided with state support. 64 innovative projects were funded through the National Research Foundation of Ukraine [30]. In the Polissya region, there are high rates of support for "youth" science.

Significantly lower support rates are in the Central Ukrainian and Black Sea regions. Although these regions have higher than the average indicators of support for "youth" science in Ukraine (11 % of young scientists in each of these regions will receive a state scholarship). They have high rates of state funding for innovative projects (80 % of projects received state funding in 2021 in the Central Ukrainian region and 74 % in the Black Sea region). But still the positions of these regions are much lower than others [22, 24, 31].

Outsiders of innovation support are Donetsk and Prydniprovsky regions. They occupy the last positions in a number of indicators, although they have quite high marks of innovation activity. This suggests that most innovative projects are implemented in these regions by business structures and scientific institutions on their own.

So, the assessment according to these four criteria gives a comprehensive idea of the conditions for the implementation of innovation. It characterizes the specifics of innovation processes in a particular region and focuses on specific aspects of their provision in the context of the implementation of national economic interests. The results of calculations of the integrated indicator of innovation potential, which were carried out using data [22–24], are given in Table 10.

Table 10

Integrated assessment of the innovative potential of the regions of Ukraine, 2017–2021

Region	Year					Mean value	Evaluation of the level of potential
	2017	2018	2019	2020	2021		
Carpathian	0.50	0.45	0.45	0.44	0.43	0.46	average
Podolsky	0.44	0.48	0.34	0.34	0.39	0.40	average
Polisky	0.32	0.32	0.38	0.29	0.29	0.32	average
Capital	0.64	0.64	0.69	0.66	0.70	0.66	high
Central Ukrainian	0.34	0.32	0.33	0.24	0.34	0.32	average
Northeastern	0.55	0.63	0.62	0.57	0.59	0.59	high
Black Sea coast	0.39	0.44	0.42	0.40	0.41	0.41	average
Donetsk	0.34	0.31	0.32	0.31	0.27	0.31	average
Prydni-provskyi	0.38	0.40	0.37	0.40	0.39	0.39	average

An integrated assessment of the innovation potential shows that no region of Ukraine has a very high level, but there are high prospects for the development of innovation in regions such as the Capital and Northeast (but this is as of 2021). These regions have a strong innovative infrastructure, better indicators of staffing, educational activities, introduction of innovative products and new technologies than other regions. Powerful scientific centers of these regions are Kyiv and Kharkiv. Business in these territories is characterized by high innovation activity, but in terms of innovation security, these regions are inferior to others.

Most regions of Ukraine have an assessment of the "average level of innovation potential" but the conditions of innovation in these regions differ significantly from each other. Thus, the Carpathian region has a fairly developed innovative infrastructure. By the number of industrial, technological, and scientific parks, the region is second only to the Capital region (in the Carpathian region, as of the beginning of 2022, there were 25 of them, in Capital – 38). The region has the largest number of scientific libraries in Ukraine, 12 research centers and centers for collective use of scientific equipment are active [31]. There are also high rates of staffing and investment in innovative projects. However, in terms of sales of innovative products, introduced new technological processes, environmental safety of innovations, the region has low marks.

Approximately the same assessment of the innovative potential of the Podolsk and Black Sea regions, although there are different prerequisites for the development of innovation. Thus, the Black Sea region has a fairly developed innovation infrastructure, high rates of innovation activity, innovation security, but low marks of innovative support. And the Podolsk region, on the contrary, ranks second in terms of the assessment of innovative support, but in a number of indicators it lags far behind the rest.

With a small margin from these regions is Prydniprovskyi. This region has high rates of innovation activity, second only to the Capital and Northeast. According to such an indicator as the share of innovation costs of industrial enterprises in the structure of gross regional product, it even leads. This share is about 6 %, while the average for other regions ranges from 3 to 4 % [22]. However, the Prydniprovskyi region occupies the penultimate position in almost all indicators of innovation support. Low performance of the region and in the area of cybersecurity innovation. The share of solved cybercrimes in the area of intellectual property protection and protection of research results in the total number of cybercrimes in the Prydniprovskyi region is the lowest in Ukraine. It accounts for 15 % of solved crimes, while in other regions it ranges from 20 to 45 % [27].

The penultimate place in the ranking of innovative potential is shared by the Central Ukrainian and Polissia regions. They have the lowest rates according to the criterion of "Innovation security". However, the Polissia region is the leader in terms of innovation security, its significant positions and in terms of innovative support. The Central Ukrainian region has a high share of innovatively active enterprises in the total number of business entities, which is 20 %, according to this indicator, the region ranks second in Ukraine, second only to Prydniprovskyi [24].

Donetsk region has the lowest assessment of innovation potential, which is largely due to the occupation of a significant part of its territory since 2014. Because of this, the region lost most of its innovative infrastructure (part of it was destroyed, some remained in the occupied territory), many scientific personnel emigrated from the region. At the same time, in the region during 2017–2021 the intensification of innovation activity was observed: the number of innovatively active enterprises during this period increased almost 3.5 times [22, 24].

Thus, all regions of Ukraine have a significant innovative potential and prospects for its development in the direction

of ensuring national economic interests. Important aspects of capacity building are to ensure the maintenance and safety of innovation.

The war, which began on February 24, 2022, made significant adjustments to the development of the innovative potential of all regions of Ukraine without exception. The innovative infrastructure of Ukraine suffered significant destruction, the Black Sea, North-Eastern, Capital, and Donetsk regions were particularly affected. As of the beginning of September 2022, more than 2 thousand educational institutions were damaged, 215 were completely destroyed, 68 scientific institutions were partially damaged, 2 were completely destroyed. There is no information about the state of 9 scientific institutions located in the occupied territory. Also, about 15 % of the research infrastructure of higher education institutions and scientific institutions was damaged. And these figures are growing weekly [32].

A large number of scientific institutions and educational institutions were relocated from the territory of hostilities. During the times of military aggression 34 higher education institutions (institutes, universities, and academies), 42 institutions of professional pre-higher education (colleges) and 65 separate structural subdivisions moved to the western and central regions of Ukraine. Higher education institutions and scientific institutions of such cities of Ukraine as Berdyansk, Severodonetsk, Mariupol remained under occupation. Centers for collective use of scientific equipment, scientific, industrial, and technological parks in the occupied territories and territories where hostilities are taking place have ceased to operate. Among them are such leading objects of innovative infrastructure as the science park of the Kherson State Maritime Academy "Innovations of the Maritime Industry", the science park "Melitopol travel university", the technology park "Textile", industrial parks "Dzherelo", "Azov Aqua Invest", "Eastern region", and others. The construction of such industrial parks as the agroport "Red Lighthouse", "Skadovsk Industrial Invest", "Rost Agro", "Industrial Park Berdyansk" has been suspended. Frequent shelling of Ukrainian infrastructure limits access to scientific equipment and causes loss of scientific information. Scientific libraries were significantly destroyed: 101 libraries lost a significant part of their holdings, and not a single document was preserved in 21 libraries [32, 33].

At the same time, the relocation of innovative infrastructure facilities predetermines the redistribution of centers of scientific activity, their movement from the east and south to the west of Ukraine. This affected the growth of innovative potential of the Carpathian, Volyn, Podilsky, and Central Ukrainian regions.

The volume of financial support for innovation has also changed. In the State Budget of Ukraine for 2022, funds to support the activities of the National Research Foundation of Ukraine and provide grant support were provided in the amount of about USD 23 million. This would be 25.1 % higher than cash expenditures in 2021. But these plans were not destined to come true due to Russian aggression [33]. In March 2022, by the decision of the Cabinet of Ministers of Ukraine, the funds of the National Research Foundation were directed to meet the needs of the Armed Forces of Ukraine. The Foundation appealed to partner institutions, research centers, laboratories, universities, industrial corporations in the EU, the USA, Canada, Switzerland, Japan, other developed countries with a request to assist Ukrainian scientists in financing their research projects. Priority is given to projects in the areas of security and defense, energy, social rubbing, infrastructure restoration. In collaboration with Western partners, a systematic search for grant proposals for Ukrainian scientists is carried out. The first significant results are the signing of Memorandums of Understanding with the Swiss National Science Foundation (SNSF) and the University of Cambridge [33].

International support for the activities of Ukrainian entrepreneurs-innovators continues. A good example of such support is the U.S. Department of State's Global Innovation through Science and Technology (GIST) initiative, which involves cooperation with dozens of startups and organizations in Ukraine. It is a business incubator that will bring together the best Ukrainian innovators in science and technology and American business to create new opportunities for cooperation. The support of Ukraine by the scientific community of Poland is also indicative. Thus, the National Scientific Center of this country has announced a special program that will allow Ukrainian researchers to continue their scientific activities in Polish academic and scientific units.

During the times of military aggression, Ukraine became a member of a reputable scientific organization – the Association for European Cooperation in Science and Technology (COST), which was created to support international scientific and innovative networks. This opens up an additional opportunity for Ukrainian innovators and researchers to join the single scientific space of the European Union. Opportunities for participation of Ukrainian researchers and educators in the framework programs of the European Union Erasmus+, Euratom, and HorizonEurope have also been expanded [33].

Also, during the war, virtualization of scientific activity intensified – virtual scientific and educational platforms became significantly developed. An example of this is the successful work of the electronic platform "Science and Business", created by the Ministry of Education and Science of Ukraine on February 1, 2022, but actively working during martial law. The purpose of this online platform is to create conditions for interaction between representatives of business and the scientific community, to establish effective communications on the development and implementation of innovative projects. During the platform's operation, 645 users joined it, as well as received 86 proposals for the implementation of scientific research and 26 proposals for cooperation, among which are those aimed at supporting the country under martial law [33].

The National Electronic Scientific Information System "URIS" (Ukrainian Research Information System) was also created, which is aimed at optimizing the storage, exchange, and management of data on scientific, scientific and technical activities of employees at Ukrainian educational and scientific institutions.

Science&Business Startup Hackathon is regularly held in the virtual space. This is a series of events under the auspices of the Innovation Development Fund (Ukrainian Startup Fund) and the Ministry of Education and Science of Ukraine. They are held to combine the innovative potential of scientists, innovative entrepreneurs, investors, experts, media in order to find new technological solutions, raise awareness of project management, marketing, investment, and innovation [33].

The development of virtual innovation infrastructure is also facilitated by Ukraine's international cooperation in the scientific and educational areas, which has intensified

significantly during the war. Ukrainian higher education institutions and scientific institutions continue to join electronic resources on the "Research4Life" platform. Currently, more than 500 institutions from Ukraine have registered or resumed registration on the platform. And this is more than 114 thousand books, 40 thousand journals. As of the beginning of September 2022, 39 databases are already available for Ukrainian users, including 24 open access databases and 15 databases, which were previously accessed via subscription. Most of these resources are English-speaking. The platform offers free access to the sites, tools, and learning resources of Elsevier, Springer Nature, Taylor&Francis, Cambridge University Press, Oxford University Press, IOP Publishing, Emerald Publishing, Centrefor Agriculture and Bioscience International [33].

Within the framework of such cooperation, Elsevier, one of the largest publishers of scientific literature in the world, provides support to Ukrainian scientists. Thus, the company has created an electronic resource center, with the help of which Ukrainian researchers can register and gain access to important research tools of the company. Among them – abstract, bibliographic database "Scopus", full-text database "ScienceDirect", a search module for researchers for cooperation "Researcher Discovery", a training platform "Researcher Academy" and software for managing bibliographic information "Mendeley" [33].

Ukrainian scientists were given continued access to the resources from the company "Clarivate" – the manager of the database "Web of Science". The experience of Bentham Science publishing house is also positive, which provided 200 Ukrainian higher education institutions and scientific institutions with free access to its electronic journals, books, and databases. Fruitful cooperation of Ukrainian educational institutions with educational platforms Coursera and EdX [33].

But, despite the positive trends in expanding international cooperation and virtualization of the scientific space, a very big problem for the innovative potential of the regions of Ukraine is the outflow of scientific personnel. Thus, during the war, 1392 scientific and scientific-pedagogical workers left the territory of Ukraine, of which the number of persons who continue to carry out scientific, scientific-technical, scientific-organizational, scientific-pedagogical activities is 1026 people [32].

According to a survey of Ukrainian scientists conducted within the framework of the UA Science.Reload project on 01.04–02.05.2022, 84 % of scientific and scientific-pedagogical workers indicated that their financial situation had worsened compared to the pre-war time. Almost half of the scientists changed their place of stay. 47.2 % stayed in Ukraine and did not change their place of residence due to the war. 38.1 % are located in Ukraine but have changed their place of residence. 14.6 % of scientists are abroad. The highest number of scientists was recorded among those who are in Ukraine in Kyiv (almost 20 %), Cherkasy (10.6 %), Lviv (9.9 %), Kharkiv (9.7 %), Vinnytsia (5.7 %) oblasts. Among those who are abroad, in Germany (26.8 %) and Poland (25.1 %). When asked whether it is possible to engage in scientific activities in the same amount as in the pre-war period, 72.9 % answered that they could not afford it. Among the main reasons, scientists named lack of interest, apathy, security factor, the specifics of work that involves staying in the workplace (for example, if a person has moved, he does not have access to the laboratory). Relevant are the technical reasons, such as interruptions on the Internet and communication, power outages [33].

Thus, during the war, the innovative potential of the regions of Ukraine changes significantly, the indicators of innovation security and innovation security deteriorate. But at the same time, innovative support is gaining further development, involving leading international organizations, and leading institutions in these processes, virtualization of innovation processes takes place, and cooperation is spreading. New centers of innovative development are being formed in the western regions of the country. At the end of the war, a new division of the regions of Ukraine according to the innovative potential will be observed and the proposed procedure will be able to assess it.

5. 3. Assessment of the impact of the innovative potential of the regions on the realization of national economic interests

The national interests of the state in a democratic society are aimed at ensuring the well-being of the population through economic development and activation of entrepreneurial activity. Therefore, an important marker for assessing the realization of national interests is the growth of gross regional product per person of the population, which determines the level of development of the region's economy and business activity. Another indicator that reflects the welfare of the population is the real disposable income of households. Their growth testifies to the success of economic policy, and therefore the realization of national economic interests. The influence of the innovative potential of the regions is determined by the national indicators (Table 11).

To establish the impact of the innovative potential of the regions on the gross regional product on the person of the population, we shall use the statistical test ANOVA. The calculations were carried out on the basis of index indicators for 2021, the source of data for the calculation was statistical reporting published on the official website of the State Statistics Service of Ukraine [22].

Table 11

Indicators for the implementation of the ANOVA test regarding the impact of the innovative potential of the region on the main indicators of the realization of national economic interests, 2021

Region	Index of innovative potential of regions	The level of innovation potential of the regions	Gross regional product index per capita	Real disposable income index per capita
Carpathian	0.43	average	0.72	0.69
Podolsky	0.39	average	0.75	0.86
Polisky	0.29	average	0.70	0.77
Capital	0.70	high	2.03	1.46
Central Ukrainian	0.34	average	0.91	0.88
Northeastern	0.59	high	1.05	1.03
Black Sea coast	0.41	average	0.81	1.00
Donetsk	0.27	average	0.40	0.49
Prydniprovskyi	0.39	average	1.14	1.19

The results of the ANOVA test, which are given in Table 12, suggest that the hypothesis that there is a link

between the region's innovation potential and gross regional product per capita is true. This is evidenced by the indicator P-value (asymptotic significance) of the test, which is lower than 5 %.

A similar test was conducted to confirm the hypothesis of the impact of the innovative potential of the region on the level of income of the population. As an indicator of the level of income, indicators of real disposable income (income after taxes, taking into account the price factor) per person of the population are used. According to the results of the ANOVA test (Table 13), it is possible to establish the correctness of the hypothesis regarding the relationship between the innovative potential of the region and the real disposable income of the population. The asymptotic significance of this test is also lower than 5 %.

Table 12

Results of the ANOVA statistical test regarding the impact of the region's innovation potential on gross regional product

Group	Calculation	Total	Average	Variance		
Column 1	9	3.818812455	0.424312495	0.019191342		
Column 2	9	8.508670487	0.945407832	0.211416128		
Dispersion analysis						
Sources of variation	SS	df	MS	F	P-value	F critical
Between groups	1.221931576	1	1.221931576	10.59750214	0.004964481	4.49399848
Within groups	1.844859757	16	0.115303735			
Total	3.066791333	17	–			

Table 13

Results of the ANOVA statistical test regarding the impact of the innovative potential of the region on the real disposable income of the population

Group	Calculation	Total	Average	Variance		
Column 1	9	3.818812455	0.424312495	0.019191342		
Column 2	9	8.390872877	0.932319209	0.080517908		
Dispersion analysis						
Sources of variation	SS	df	MS	F	P-value	F critical
Between groups	1.161318695	1	1.161318695	23.29410161	0.000186047	4.49399848
Within groups	0.797673996	16	0.049854625			
Total	1.958992691	17	–			

The presence of a link between the innovative potential of the region and indicators revealing the state of its economic development indicates the possibility of using innovative potential as a tool for realizing national economic interests. Through the activation of innovative potential, it is possible to attract investments in the region, contribute to improving the welfare of the population, and ensure the competitiveness of the territory.

6. Discussion of the procedure for assessing the innovative potential of the region

The proposed methodology involves the assessment of innovative potential precisely from the standpoint of the formation and realization of national economic interests. It differs from [2], which emphasizes the impact of innovations on the formation of state economic policy, but how they affect national economic interests is not explained. A distinctive feature of the author's approach is that the innovative potential is the basis for the realization of national economic interests, in contrast to [8], where it is considered as the goal of such implementation.

The devised procedure provides an opportunity to comprehensively assess the potential of the territory for the introduction of innovative activities in the context of the implementation of national economic interests. This is achieved through a criterion approach, which makes it possible to characterize the potential from the standpoint of innovation provision (Table 1), innovation activity (Table 2), innovation security (Table 3), innovation support (Table 4). Due to the last two criteria, the degree of interest of the state in the purposeful development of innovation in the context of the implementation of national economic interests is explained.

The proposed methodology is comprehensive, unlike others, which are considered innovation potential either through the influence of intellectual capital [3], or through technological development [4], or due to disproportions of innovation infrastructure [5, 6]. The toolkit of the procedure is wider than those presented in works [7, 9, 10]. They propose to use only certain types of assessment procedures: either bibliometric [7], or situational analysis [9], or cluster analysis [10].

The generalized characteristic of the innovation potential of a particular region is carried out according to the integrated index (1), which makes it possible to compare it with other territories from the standpoint of the prospects for innovative development. Approbation of the procedure using the example of assessing the innovative potential of the regions of Ukraine testifies to its practical suitability. The obtained results of the assessment (Table 10) can be explained by the heterogeneity of the conditions of innovation in different regions of the state. The procedure made it possible to establish that some regions have a strong innovative infrastructure and high rates of staffing, others – more effective protection and support of innovative processes. This provides a justification for determining the prospects for innovation, taking into account the specifics of each individual region.

The influence of the innovative potential of the regions on the realization of national economic interests has been established. This is explained by the presence of a link between the integrated indicator of the innovative potential of the region and indicators such as gross regional product and real disposable incomes of the population (Tables 12, 13). Through the effective use of innovative potential, it is possible to influence the improvement of the welfare of the population and the development of entrepreneurship in each individual region. The competitiveness of both the regions in particular and the state as a whole increases, and, thus, national economic interests are realized.

The advantage of the developed procedure is the ability to assess the innovative potential of the state through the prism of heterogeneous conditions for its development in each individual region, unlike, for example, the GII procedure. The latter gives an overall assessment of innovation processes in the country, not taking into account the regional specifics of innovation processes.

The proposed advancement differs from the GCI procedure, which makes it possible to establish positive conditions for the formation of innovative potential but leaves out the assessment of the dangers of innovation. Due to the analysis according to the criteria of "Innovation Safety", the author's procedure is devoid of this drawback.

Unlike the PII and EIS procedures, which allow for a differentiated assessment of innovation potential in different regions of the state, the author's development takes into account the criterion of innovative support. It is through this criterion that it is possible to establish conditions for the activation of innovative potential and direct it to the realization of national economic interests.

The proposed procedure solves the problem of effective diagnosis of innovation potential since it makes it possible to comprehensively assess the prerequisites for innovative processes from the standpoint of ensuring the creation and promotion of innovations, the activity of the state and business, and the guarantee of innovative security. A comprehensive indicator – an index of the innovative potential of the region – is used to study the impact of innovation processes on various indicators of economic development, including indicators of the implementation of national economic interests. As the ANOVA test shows, such an impact exists. Therefore, through the activation of innovative potential, it is possible to contribute to the realization of national economic interests. The procedure also provides an opportunity to compare the conditions of innovation in different regions, to identify the prospects for using innovative potential.

However, the procedure has a significant limitation – it allows only for a quantitative assessment of the innovative potential of the territories. Such qualitative indicators as the level of scientific/technological novelty of developments, the relevance of their application, the availability of new technical solutions for business, the degree of protection of innovations, etc. do not take into account the proposed procedure. Therefore, it should be supplemented with tools for qualitative assessment, for example, expert methods.

The disadvantage of the methodology is its dependence on a large number of statistical data that can be scattered, which requires a lot of time to collect and process information from different sources. The incompleteness of statistical information on innovation (especially for information provided by business entities), its fragmentation, restriction of access for public acquaintance complicate the objective assessment of innovation potential.

At the same time, the procedure provides a number of opportunities for analyzing the processes of innovation. It can be used for express diagnostics of the innovative potential of the territory since it makes it possible, on the basis of a system of indicators, to give a general description of the state and capabilities of innovation in a particular region. With the help of the index, it is possible to compare regions, determine their role in the innovative development of the state. The methodology can be combined with other types of analysis (SWOT, PEST analysis, competitive advantage analysis, spatial analysis, etc.).

The dissemination of the proposed procedure consists in combining it with Forsyth technologies, which will make it possible to develop scenarios for innovative development of the territory on the basis of rapid diagnostics. In the future, it is possible, on the basis of the proposed methodology, to develop a system of rating assessment of regions according to their innovative potential.

A promising direction of future research on this issue is modeling the impact of the innovative potential of territories on the system of indicators for the realization of national economic interests, as well as supplementing the procedure with tools for expert assessment. Thus, it becomes possible to streamline the system of information support for innovation, to further stimulate the attraction of targeted investments and technology transfers in the context of the implementation of national economic interests.

7. Conclusions

1. The proposed methodology involves the assessment of innovation potential according to the criteria of innovation provision, innovation activity, innovation safety, and innovative support. The criterion of innovation provision allows you to assess the prerequisites for innovation (availability and use of innovative resources). The criterion of innovation activity establishes the level of development of innovative business, scientific cooperation, technology transfer, expansion of the range of innovative products, intensity of investment in innovative projects). The key role of the criterion of innovation security is to assess the degree of protected innovation from non-sanctioned reproduction, compliance with global trends, state guarantees to innovative business. According to the criterion of innovation support, the conditions and amounts of state funding, the creation and support of innovative infrastructure, and institutional support are disclosed. A comprehensive assessment according to these criteria reveals the relationships between different indicators of innovation, and also makes it possible to establish the position of state regulation of innovation in the context of the implementation of national economic interests. An overall assessment of the possibilities of developing innovation activity is provided by an integrated index of innovative potential. According to this indicator, it is possible to compare territories, establish the most promising among them for investments and other forms of support in order to realize national economic interests most fully.

2. Testing the procedure for assessing innovative potential using the example of economic regions of Ukraine has made it possible to establish that most of them have an assessment of the "average level of innovation potential". However, the conditions of innovation in these regions are significantly different from each other. The highest prospects for the development of innovation in such regions as the Capital and Northeast (but this is as of 2021). These regions have a strong innovation infrastructure, better indicators of staffing, production of innovative products and development of new technologies than other regions, but in terms of innovation security, these regions are inferior to others. The innovative potential during the war is significantly changing, the indicators of innovation security and innovation security in most regions of Ukraine are deteriorating. At the end of the hostilities, a new division of the regions of Ukraine

according to the innovative potential will be observed and the proposed methodology will make it possible to comprehensively assess these changes, to establish the most priority regions for the development of innovation.

3. The influence of the innovative potential of the regions on the realization of national interests was established by identifying the relationship between it and such indicators that reflect the priorities of national economic policy as gross regional product and real incomes of the population. The conducted ANOVA test indicates the presence and constancy of such a connection. And this confirms the possibility of regulating the economic development of territories and developing a system for realizing the national economic interests of the state at the regional level, taking into account the innovative potential of these territories and the peculiarities of its activation.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study and the results reported in this paper.

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Data availability

All data are available in the main text of the manuscript.

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