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TYPOLOGY OF INNOVATION POTENTIAL OF REGIONAL ECONOMIC SYSTEMS

ТИПОЛОГІЯ ІННОВАЦІЙНОГО ПОТЕНЦІАЛУ РЕГІОНАЛЬНИХ ЕКОНОМІЧНИХ СИСТЕМ

Summary. The article explores the theoretical foundations, methodological approaches, and practical tools for assessing and typologising the innovation potential of regional economic systems. Emphasis is placed on the key role of innovation potential as a strategic resource for socio-economic growth of regions under conditions of digital transformation, global competition, and the rapid development of the knowledge economy. It is noted that Ukraine lacks a unified methodology for classifying regions by their level of innovation potential, which complicates the formulation of effective regional development policies. To address this problem, the author proposes a multi-level classification approach based on a comprehensive assessment of structural components, including scientific and technological, intellectual, human, production, institutional, and infrastructural elements. A normative model of innovation potential is introduced, enabling the comparison of actual parameters with standard benchmarks and identification of development levels across different components. The subject-object structure of innovation potential is analysed, highlighting the main actors (science, business, government, society) and the innovation products they generate. A typology of innovation potential is developed, distinguishing high, medium, and low levels of development, allowing for the identification of leading regions, emerging territories, and underdeveloped areas. A significant aspect of the research is the integration of the quadruple and quintuple helix models, offering a comprehensive view of the interactions among institutions, business, science, civil society, and the environment in shaping regional innovation systems. The study concludes that spatial spillover effects, network connectivity, and innovation transfer capacity must be considered in the formulation of smart specialisation strategies. The practical value of the research lies in the use of innovation potential typology as a tool for strategic regional management and the design of targeted innovation support mechanisms. Future research prospects include the formalisation of adaptive models for managing innovation potential in highly dynamic external environments.

Keywords: innovation potential, regional economic systems, typology, smart specialisation, innovation infrastructure.

Formulation of the problem. In the context of deepening dynamics of globalisation processes, digitalisation of the economy and intensification of competition between countries and regions, the issue of increasing the innovation capacity of territorial entities is becoming particularly relevant. Regions are important centres of innovation activity, which necessitates an in-depth analysis of their innovation potential and its effective use. However, Ukraine currently lacks a unified methodology for typologising regions by the level of innovation potential development, which makes it difficult to make informed management decisions in the field of regional development, innovation policy and strategic planning. There is also an imbalance in the structure of the regions' innovation potential, which deepens territorial inequality and reduces the overall competitiveness of the national economy. Thus, there is an objective need to improve the scientific and methodological approach to the typology of

regional economic systems based on quantitative assessment and qualitative analysis of innovation potential as a key factor in the modernisation and sustainable development of regions.

Analysis of recent achievements and publications. An analysis of modern scientific work shows that domestic and foreign researchers pay considerable attention to the problem of assessing and developing the innovation potential of regions. Ukrainian scholars, such as Khanin (2021), Tulchynska and Dergaliuk (2022), Perepeliukova (2023), as well as researchers from the Institute of Regional Studies of the National Academy of Sciences of Ukraine, emphasise the need for an integrated approach to assessing innovation potential, taking into account digitalisation, intellectual resources, research, education and business infrastructure of the regions. In particular, the papers emphasise the need to combine quantitative and qualitative methods of analysis, use smart specialisation approaches, and form typologies of regions to determine their innovation advantages and strategic priorities. In the foreign scientific literature, there is an increased focus on the mechanisms of formation of innovation ecosystems based on the quadruple and quintuple helix models, which take into account the interaction of government, business, science, the public and the environment. Researchers, such as Tedesco & Ramos Soria (2023), Gaspar & Osawa (2022), Qiu et al. (2018), emphasise the importance of spatial spillover effects, clustering of innovations, and the role of «related variety» – sectoral diversity – as a basis for shaping innovation activity in regions. It is also important to emphasise the importance of local innovations, grassroots initiatives, digital hubs and networking for the formation of sustainable innovative models of regional economic systems development.

Given the identified scientific gaps and contradictions, **the purpose of this article** is to develop a scientifically sound approach to typologising the innovation potential of regional economic systems.

Presentation of the main material. When analysing special scientific literature, which reflects the research of innovation potential of economic systems, we observe different methods and approaches to the definition of the essence, content and formulation of the concept under consideration [4]. The presented formulations of various scientists reflect different aspects of the concept depending on the research directions.

In our opinion, the concept of innovation potential is most fully presented in the works of researcher G.I. Zhits. According to his definition, innovation potential is understood as economic resources used by the economic system for its growth and development [7]. These resources are distributed among the sectors of the economic system: scientific and technical, investment and educational, and as a result of their interaction, scientific and technical, investment and educational potentials are formed, which together reflect the innovation potential of the economic system.

Some researchers, analysing the innovation potential of the economic system, present it as the ability of the branches of the economy of the country and regions to produce innovative products that meet the requirements of the market. In his opinion, innovation potential includes scientific, production, technological, design capacities, design developments, knowledge-intensive capacities of laboratories and experimental sites, which are related to the creation of new products, as well as technological and instrumental means of control, etc. [3].

Let us highlight the most significant features of the innovation potential of economic systems:

– a set of resources, balance and sufficiency of their use in the implementation of innovation processes and achievement of planned innovation goals;

– the degree of possibility, readiness and ability of economic systems to produce innovations;

– the ability of an economic system to transform into a more qualitative, new state in the process of innovation activity.

Thus, in the «narrow sense» the innovation potential of the economic system is represented by the resource base and opportunities for the application of innovations on the basis of innovation strategy for the development of regional economic systems [1]. In the «broad sense» the innovation potential of the economic system represents the degree of interaction between the economic system and economic entities in the process of innovation activity, including its reserves determined by the efficiency of application of all types of resources [2].

To determine the essence and content of the innovation potential of an economic system, it is necessary to disclose its component composition, which represents the resource base, internal capabilities of the system, and the result obtained.

We propose a normative model of elements of innovation potential with determining the level of compliance of their actual parameters with normative values. The normative model characterises the degree of development of innovation potential of

regional economic systems and its ability to carry out innovation activities.

Fig. 1 presents a normative model of the elemental composition of the innovative potential of the enterprise with the inclusion of innovative, intellectual, production and infrastructural norms.

To identify the parameters of innovation potential that characterise the economic content by subject, object, functions performed by them, we use the subject-object approach to the study. Fig. 2 shows that the subjects of innovation potential are represented by those structures that are associated with its formation, development and use [5]. They include: subjects of knowledge generation (science, research institutes, education system, direct research personnel); high-tech production complex; investment system; subjects of innovation infrastructure; subjects of institutional activity; bodies of state regulation of innov ations; market (consumers) of innovations and others. The presence of a large number of subjects of innovation potential is determined by the complexity of innovation objectives.

The beginning of the formation of innovation potential is the stage of research and R&D. At this stage, innovation potential is represented by the volume of realised R&D, including the elements of its formation and implementation [6]. Thus, we see that the object of innovation potential of regional economic systems is innovative products and services demanded by consumers.

Economic relations between subjects and objects of innovation activity express the main content of the formed category «innovation potential».

To determine the essential parameters of innovation potential, to systematise the subject-object structure according to the implemented functions, it is necessary to determine its type by linking innovation activity into a single whole. The type of innovation potential is determined based on the development of regional economic systems, their innovation structures, as well as focusing

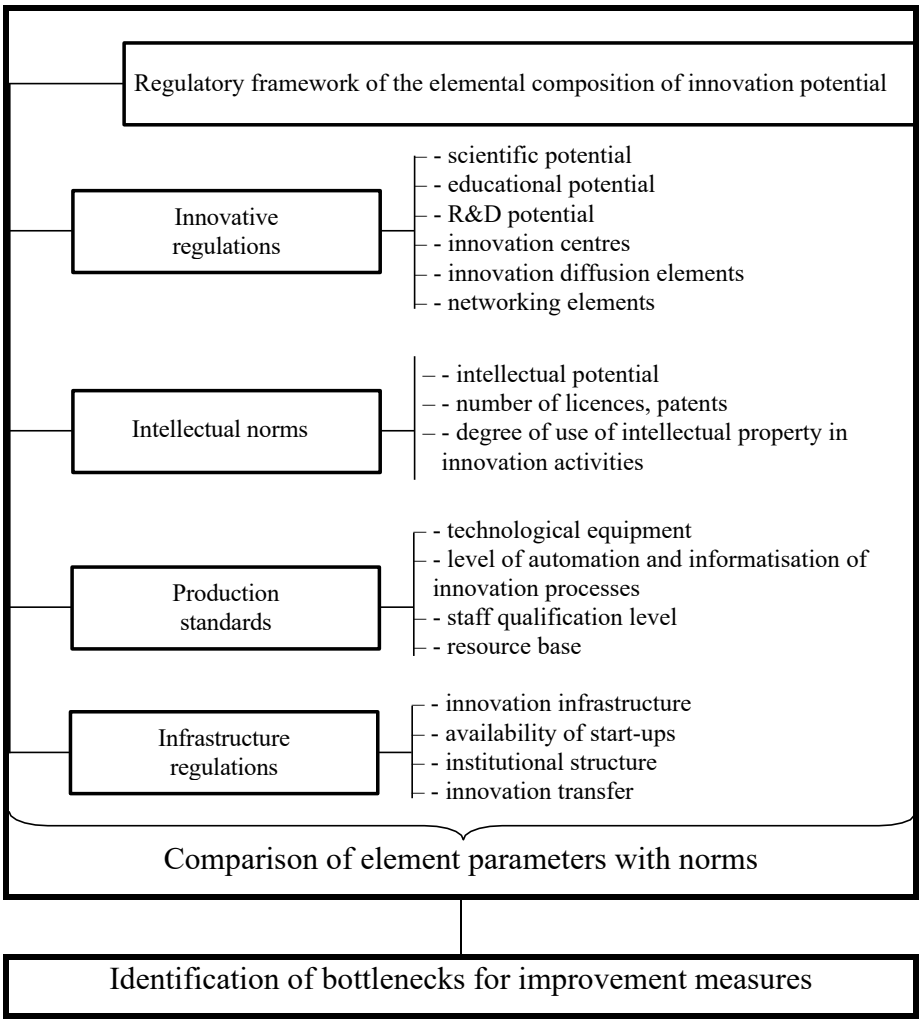

Fig. 1. Normative model of the elemental composition of innovation potential of regional economic systems

on the potential readiness of regional economic systems to carry out innovation activities [3].

The typology of innovation potential is represented by the classification and systematisation of innovation potential objects with the allocation of its elements and their essential features, the specifics of its functioning (fig. 2).

In the author's opinion, the types of innovation potential presented in Fig. 2 do not reflect its specificity, but refer to all types of potentials. In this regard, it is proposed to approach the typology of RPS innovation potential taking into account the level of its development, proposing the following gradation:

– innovation potential of high level;
– innovation potential of medium level;
– innovation potential of low level.

Table 1 shows the typology of innovation potential of enterprises proposed by the author.

The proposed typology of innovation potential implies the classification of its elements and objects, supplementing them, highlighting the main features, identifying the specifics of their functioning.

The functionality of innovation potential of regional economic systems is reflected by the creation of innovations, including the functions of science, education, R&D, pilot testing of innovations, serial production, commercialisation and diffusion of innovations [8].

According to the sectoral specifics, innovation potential is divided into industry and types of economic activity, due to which the prospective specialisation of regions, strategies of innovation and technological development of the industrial

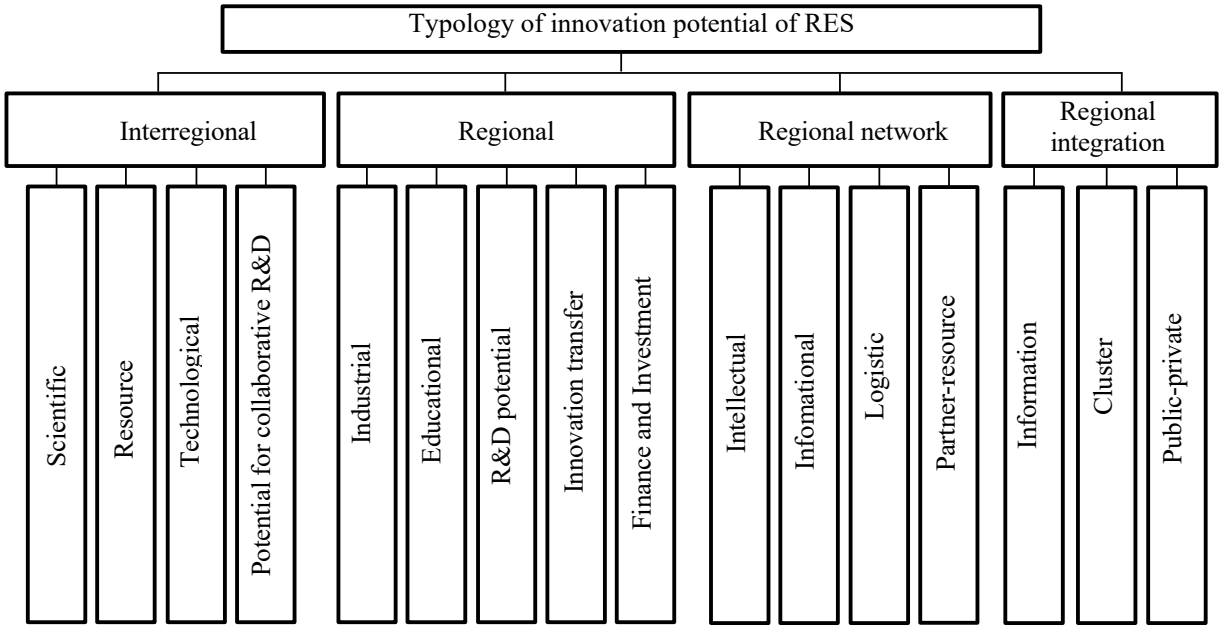

Fig. 2. Typology of RPS innovation potential

Table 1

Typology of innovation potential of regional economic systems by level of development

Type of RES innovation potential	Evaluation criterion, %	Characterisation of the type of RPS innovation potential
Innovation potential of high level	≥ 80	1. High availability of innovation resources. 2. RES innovations correspond to the world level. 3. innovation activity is carried out without the use of credit resources
Innovation potential of medium level	≥ 40; <80	1. RES innovations are in line with the national level of economic development. 2. Sufficient supply of innovation resources. 3. Credit resources are required to implement innovation activities
Innovation potential of low level of development	< 40	1. Lack of groundwork for innovation. 2. Application of transfer innovations. 3. Deficit of financing of innovation activities

sector and, in general, directions of socio-economic development of regions are formed.

By levels of management, the innovation potential of regional economic systems is divided into the potentials of interregional, regional and local levels, the levels of innovation project and industrial enterprise.

The regional innovation system (RIS) is a subsystem of the regional economic system, as well as regional policy implemented at the state level, which is aimed at levelling regional economic development through the effective use of its innovation potential [5]. RIS is based on the strategy of innovation development, innovation infrastructure and resource potential of the region, being unique for each region, representing the main element of the national innovation system (NIS).

RIS includes the following elements:

– education system of the region, which prepares labour resources for innovation activity [3];

– sphere of scientific research and R&D: research institutes, scientific and innovation centres, universities, science cities, research organizations, etc.;

– sphere of entrepreneurship;

– system of institutional support;

– innovation infrastructure: economic, financial, organizational, technological, information, service infrastructure; infrastructure for the development of innovation potential of the region.

The key characteristic of the RIS is that the central place in innovation activity is given to high-tech industrial enterprises of regional economic systems, which represent the final result of the RIS activity - the production of innovative products.

As a conclusion, we note that the innovation potential of regional economic systems includes various processes such as formation, accumulation, development, use, and ultimately forms objective conditions, factors and prerequisites for the functioning of the economic system of the region and further development of innovation activity.

Conclusions. As a result of the study, it is found that typology of the innovation potential of regional economic systems is a prerequisite for the formation of an effective regional innovation policy and smart specialisation strategies. The proposed approach allows to systematically assess the innovation potential, taking into account the multidimensional structure – human, scientific and technical, institutional, financial and digital components that determine the ability of regions to create, adapt and disseminate innovations. The analysis confirms a high level of differentiation of Ukraine's regions by the level of innovation potential development, due to imbalances in the location of innovation infrastructure, human resources, R&D funding, and digital transformation. The results of the typology showed the existence of groups of regions with different innovation profiles – from innovation centres to peripheries with limited innovation potential. This creates the basis for the development of targeted tools to stimulate innovation activity, taking into account the typological affiliation of each region. The expediency of applying the quadruple and quintuple helix concepts to reveal the interaction between the key actors of the innovation process – business, science, government, civil society and the environment – is proved. In addition, taking into account the factors of spatial spillover effects and network ties allows us to assess not only the internal but also the external innovation impact on regional development.

The practical value of the obtained results lies in the possibility of using the typology of innovation potential as a tool for making informed management decisions at the national and regional levels aimed at reducing territorial innovation inequality, increasing the efficiency of resource use, and activating regional innovation ecosystems. Prospects for further research are related to improving the indicative apparatus for assessing innovation potential, as well as developing adaptive models for managing the innovative development of regions in conditions of high turbulence of the external environment.

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Анотація. У статті досліджено теоретичні засади, методичні підходи та практичні інструменти оцінки й типологізації інноваційного потенціалу регіональних економічних систем. Акцентовано на ключовій ролі інноваційного потенціалу як стратегічного ресурсу соціально-економічного зростання регіонів в умовах цифрової трансформації, глобальної конкуренції та динамічного розвитку знаннєвої економіки. Зазначено, що в Україні відсутня уніфікована методика типологізації регіонів за рівнем розвитку інноваційного потенціалу, що ускладнює прийняття ефективних управлінських рішень у сфері регіональної політики. З метою подолання цієї проблеми автором обґрунтовано багаторівневий підхід до класифікації інноваційного потенціалу, що базується на комплексній оцінці структурних елементів – науково-технічного, інтелектуального, кадрового, виробничого, інституційного та інфраструктурного компонентів. У межах дослідження запропоновано нормативну модель інноваційного потенціалу, що дозволяє співвідносити фактичні параметри з нормативними значеннями та визначати рівень розвитку кожного елемента. Визначено суб'єктно-об'єктну структуру інноваційного потенціалу, в якій виділено ключових учасників процесу (наука, бізнес, держава, суспільство) та інноваційні продукти як об'єкти діяльності. Побудовано типологію інноваційного потенціалу за рівнями його розвитку (високий, середній, низький), що дозволяє виділити регіони-лідери, регіони з потенціалом зростання та депресивні території. Важливою складовою дослідження є інтеграція концепцій quadruple та quintuple helix, які забезпечують комплексне бачення взаємодії інституцій, бізнесу, науки, суспільства та екологічного середовища у формуванні регіональних інноваційних систем. Зроблено висновок про необхідність урахування просторових spillover-ефектів, мережевої взаємодії та потенціалу інноваційного трансферу при формуванні політики смарт-спеціалізації регіонів. Практична цінність дослідження полягає в можливості використання типологізації як інструменту стратегічного управління розвитком регіонів, а також у розробці адресних механізмів підтримки інноваційної діяльності. Перспективи подальших досліджень пов'язані з формалізацією моделей адаптивного управління інноваційним потенціалом в умовах високої динаміки змін зовнішнього середовища.

Ключові слова: інноваційний потенціал, регіональні економічні системи, типологія, смарт-спеціалізація, інноваційна інфраструктура.