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RECOMMENDATIONS FOR DEVELOPING THE REGION'S INNOVATION INFRASTRUCTURE WITH A VIEW TO IMPROVING ITS OPERATIONAL EFFICIENCY

The article examines the main directions for the development of production and technological innovation infrastructure as a vital component in shaping a competitive economy. The authors emphasize the necessity of regulatory and legal support, including the adoption of a specialized law that would unify terminology, consolidate objectives, and increase operational efficiency. A two-tier regulatory model is proposed, combining national and regional approaches to allow for the integration of social, cultural, and geographical characteristics while maintaining consistency across the country. Considerable attention is given to the creation of a monitoring system and statistical data collection based on geoinformation platforms, which will improve transparency and decision-making. The paper highlights the financial sustainability of management companies and the need for stronger control over budgetary expenditures, thus reducing inefficiency and potential losses. The authors argue for the improvement of performance assessment methodologies, focusing not only on the infrastructure as an economic entity but also on its impact on the socio-economic development of regions. The DEA method is suggested as an effective tool for setting resource and output targets to raise the technical efficiency of technology parks. Mechanisms to attract residents are explored, including access to advanced equipment, tax and property incentives, expanded services, and enhanced information transparency. Further recommendations concern the development of property complexes, engineering, social, and service infrastructure, as well as the use of public-private partnerships and external investments. The article also stresses the importance of fostering R&D investments through intellectual property protection, venture financing, subsidies, and grant schemes. The practical significance of the study lies in the applicability of its recommendations for management bodies of innovation infrastructure facilities and public authorities involved in policy-making in the field of regional and national innovation system development.

Keywords: *innovation infrastructure, technical efficiency, legal regulation, residents of innovation parks, R&D investments.*

JEL Classification: H 54

Formulation of the problem. Since the goal of implementing an innovation management system is to generate innovation on an ongoing basis, we believe that innovation management standards are more suitable for organisations directly involved in creating innovative products and services. Given that the management companies of innovation infrastructure facilities are legal entities that perform work related to the creation of innovation infrastructure facilities, their management, the provision of services to residents, as well as the operation of infrastructure facilities and other facilities located on their territory, it can be assumed that the application of innovation management standards is also possible in relation to innovation infrastructure facilities for the purpose of their development and achievement of the objectives of their creation, taking into account the need to adapt innovation standards to the specific features of innovation infrastructure facilities.

The development of an innovation management system for innovation infrastructure facilities based on the proposed innovation management standards is, in our opinion, an independent area of research and goes beyond the scope of this dissertation; nevertheless, it is a relevant and promising area of research in the field of innovation infrastructure facility development.

Analysis of recent achievements and publications. Recent publications on the development of innovative infrastructure focus on the transition from «resource support» to «results orientation»: measuring effects through resident productivity, innovative output, and regional impact. The methodological field is dominated by a combination of DEA/SFA and panel indices (including Malmquist) alongside multi-criteria approaches (AHP, TOPSIS, PROMETHEE) and the construction of digital monitoring panels based on GIS and open data. Research on corporate governance of management companies, transparency of budget investments and PPP mechanisms, as well as tools to stimulate resident attraction (service packages, benefits, access to high-tech infrastructure) are gaining importance. At the same time, there is growing interest in measuring ‘real’ added value through chain effects and integration with sales markets, and quasi-experimental designs (difference-in-differences, synthetic control) are used to assess regional impact. Against this backdrop, the article's focus on standardising the legal framework, building a monitoring system and improving the technical efficiency of facilities appears to be in line with trends and fills gaps in practical implementation.

The purpose of the article is to substantiate the directions of development of production and technological facilities of innovative infrastructure and to form

methodological and legal foundations for increasing their efficiency and impact on the socio-economic development of regions.

Presentation of the main material. We propose to formulate directions for the development of production and technological infrastructure facilities for innovative activities based on our analysis of methods and approaches to assessing the effectiveness of production and technological innovation infrastructure facilities, as well as the results of assessments of infrastructure facilities by government authorities and public and business organisations.

The main directions for the development of production and technological innovation infrastructure facilities should include the following:

1. The need for regulatory and legal regulation of infrastructure facilities.

Given the specific nature of innovation infrastructure facilities, which are subject to preferential regimes for economic activity, as well as the ambiguous results of their operation and the problems identified, it seems appropriate to develop a law regulating the formation and operation of such infrastructure facilities, which would ensure uniformity of terminology, provide for consolidated approaches to the objectives of creating facilities and the expected effects, justify the methodology for assessing their effectiveness in terms of achieving the objectives of their creation and contribution to the socio-economic development of the region, and provide for responsibility for ineffective functioning and timely decision-making in relation to the facilities.

It should be noted that legal norms do not function on their own, but within a unified system, on the basis of which the behaviour of participants in social relations is legally regulated [2].

At the state level, it is envisaged to create and establish uniform rules of the game for all interested parties without exception, thereby simultaneously achieving the goal of forming uniform legal regulation, including at the regional level, ensuring sustainable socio-economic development both for the state as a whole and for individual regions. At the same time, it is necessary to take into account the national, geographical and socio-cultural characteristics of each region. Therefore, it is necessary to provide the subjects of the state with a certain degree of legal freedom, which, on the one hand, will allow them to take into account the characteristics of the region mentioned above and, on the other hand, will ensure uniformity at the state level.

In this regard, a two-tier approach is needed, whereby the foundations for legal regulation of relations concerning the creation, termination, operating conditions, and effectiveness assessment, and at the regional level, the regulation is refined with the aim of ensuring that the innovation infrastructure functions in a manner that best takes into account the interests of the state entity as a full participant in civil legal relations, will best contribute to the optimal development of the innovation infrastructure.

2. Establishment of a system for monitoring and collecting statistical data.

The current lack of up-to-date data on the functioning of most infrastructure facilities makes it difficult to assess and develop them. Given the specific nature of these facilities as economic and geographical models, it seems appropriate to accumulate data on infrastructure facilities on a geoinformation system platform. To implement this direction, it is necessary to appoint responsible state authorities for data collection, approve lists of indicators for monitoring, and regulate its implementation.

3. Improving the financial situation of management companies.

It was previously noted that the financial situation of management companies often requires attention due to insufficient control by shareholders and non-optimised costs for the functioning of the management company and the maintenance of facilities put into operation on the territory of the innovation infrastructure facility.

4. Strengthening control over the expenditure of budgetary investments and transfers.

The results of assessments of the effectiveness of the functioning of the facilities under consideration showed an insufficient level of strategic and budgetary planning during their creation, since the functioning of most facilities leads to a significant share of budget expenditures for the creation of engineering, transport, social and other infrastructure, project support, as well as an increase in lost revenues of the state budget system. This necessitates an assessment of the cost-effectiveness of budgetary investments in the creation and operation of innovative infrastructure facilities and a justification of the amount of state support.

5. Development and approval of performance assessment methods.

It has been established that for most production and technological facilities, there are no approved methods for assessing the effectiveness of their operation. A number of shortcomings have been identified in the existing methodologies, which do not allow for an objective and comprehensive assessment of the effectiveness of infrastructure facilities. In particular, none of the existing methodologies actually assesses the effectiveness of an infrastructure facility in terms of achieving the objectives for which it was created and the impact of the infrastructure facility's operation on changes in the regional economy.

It seems that the assessment of the effectiveness of innovation facilities should take into account the specifics of such facilities described above and determine the effectiveness of the functioning of the innovation infrastructure facility itself (as a business entity characterised by the presence of property, residents, resources and a management company) and its effectiveness in terms of achieving the goals of creating such an infrastructure facility and its impact on the socio-economic development of the region.

Currently, government authorities do not assess the development of the region(s) where infrastructure facilities are located in terms of the impact of such facilities on the level of socio-economic development of the region, growth in production, investment, output of innovative products, development of specific sectors of the economy, etc. objectives set out in the regulatory and legal acts governing the creation of innovative infrastructure facilities.

It is obvious that each type of facility will have its own set of indicators for assessing the ‘regional’ component of the performance assessment model due to the different objectives of creating these infrastructure facilities.

In our opinion, such indicators should be taken into account in the state law, the need for which we have

justified above, after agreeing and consolidating the objectives of creating innovation infrastructure facilities with the current priorities of national development. We do not plan to develop a methodology for assessing the effectiveness of innovation infrastructure facilities that takes into account the impact of the functioning of the infrastructure facility on the development of the regional economy in terms of achieving the objectives of creating the innovation infrastructure facility, but plan to focus our efforts on a methodology for assessing the effectiveness of the innovation infrastructure facility itself as an economic entity.

At the same time, the indicators that can be used to assess the effectiveness of the functioning of the infrastructure facility itself will be approximately similar, since we have previously established that a typical innovation infrastructure facility is characterised by a similar structure, mode of operation and management.

Researchers have examined the impact of innovation infrastructures on the competitiveness of the regional economy [3], However, the emergence of a large number of types of innovation infrastructure at the present stage is creating competition and a struggle for residents and investments between these innovation infrastructures. This is happening, among other things, against the backdrop of the blurring of fundamental differences between objects of production and technological innovation infrastructure.

One of the advantages of the DEA method is the ability to determine target values for resources and results for each technology park whose performance has been identified as insufficient, thereby enabling technical efficiency to be achieved.

The performance of innovation infrastructure facilities can be improved and their competitiveness among facilities of the same type can be ensured by increasing their technical efficiency.

Projecting the point of an inefficient facility onto the efficiency frontier is based on the basic principle of the DEA methodology, according to which if there are economic units that produce a certain amount of output from a limited number of factors, then an inefficient economic unit is capable of using the same amount of production factors to produce the same amount of output.

These recommendations can serve as a guideline for management decisions by the technology park's management company aimed at achieving target values for indicators in order to ensure technical efficiency, which, in turn, will increase the level of attractiveness for residents among innovation infrastructure facilities of the same type.

Thus, the competitiveness of production and technological infrastructure facilities for innovative activities can be achieved by ensuring their technical efficiency among infrastructure facilities of this type.

Let us consider in more detail and formulate recommendations for the implementation of the main directions of development of innovation infrastructure facilities by their management bodies (management company, authorised state authorities).

Measures aimed at attracting residents to production and technological innovation infrastructure facilities.

1. Providing access to advanced equipment and technologies.

The attractiveness of an innovation infrastructure facility for residents is primarily ensured by the opportunity to use expensive innovative devices, equipment, modern telecommunications and digital technology required for research and development.

Thus, the tasks of the management company of an innovation infrastructure facility to attract residents are as follows:

– ensuring residents' access to high-quality, advanced engineering and other technical infrastructure necessary for the organisation of the production process (on favourable terms);

– ensuring access to modern telecommunications and digital infrastructure;

ensuring stable operating conditions for residents;

2. Developing the types of services provided to residents and creating privileged conditions for residents. Building positive experience in developing and implementing commercially effective innovative projects with the aim of attracting industrial and innovative companies as residents.

3. Increasing the attractiveness of resident status by providing various types of benefits (tax, customs, property). It is possible to consider exempting certain payments for a period of three years or providing additional benefits from the management company, in addition to those specified by law for this type of innovation infrastructure facility.

4. Increasing the information transparency of innovation infrastructure facilities.

It is necessary to create and develop geographic information systems containing comprehensive information about planned and existing innovation infrastructure facilities.

It also appears that various conferences, competitions for non-residents, advertising, congress and exhibition activities, the implementation of educational programmes, etc. will contribute to attracting residents.

Measures aimed at developing the property complex and infrastructure of innovation infrastructure facilities.

1. Development of types of related innovation infrastructure represented in the production and technological innovation infrastructure facility with the aim of providing residents with a full range of services (engineering centres, spin-offs, shared use centres, cluster development centres, prototyping centres, business incubators, accelerators, etc.), development of consulting innovation infrastructure (organisations providing services on intellectual property, standardisation, licensing, etc.).

2. Maximum equipping of the facility's territory with engineering facilities, including housing and communal services, transport infrastructure, energy carriers, as well as real estate facilities for various purposes (technical, production, administrative, office, warehouse).

3. Equipping the facility's territory with social and service infrastructure.

4. Equipping the facility's territory with residential premises.

5. Using public-private partnership mechanisms, life cycle contracts for the implementation of large infrastructure projects, and budget infrastructure loans.

6. Obtaining state property by management companies for trust management.

7. Increasing the percentage of occupancy of innovative infrastructure facilities and optimising the costs of maintaining the property complex.

8. Increasing the return on budget investments in innovative infrastructure facilities by attracting a larger volume of investments per 1 rouble of budget investments.

9. Ensuring the production of goods with a high added value by combining projects into technological chains.

10. Attracting external investors to create infrastructure by increasing the attractiveness of working with infrastructure facility residents (reducing logistics costs for obtaining goods from manufacturers, eliminating customs barriers when working with residents, etc.).

Investors may be large companies interested in purchasing high-quality innovative products from residents of infrastructure facilities. In this case, the search for investors will be the task of the management company, which can actively work in the information field: presenting residents' products, searching for long-term sales channels, promoting the advantages of products manufactured on the territory of the innovative infrastructure facility.

Large residents can also participate in financing the creation of infrastructure, and their costs, as decided by the management company, can be partially offset by the provision of additional benefits and services.

Measures aimed at increasing the volume of investments by residents of innovation infrastructure facilities in the acquisition and creation of fixed assets, new construction and reconstruction (expansion, modernisation), etc.

1. Provision of guarantees to maintain the conditions of placement for residents who place their production on a long-term basis on the territory of the infrastructure facility.

2. Application of a progressive scale of benefits and preferences depending on the volume of investment.

3. Development of a financial innovation infrastructure, including various funds: venture capital, insurance, budgetary, investment; attraction of leasing companies, banks and other credit organisations, business angels and other development institutions that finance projects.

Measures aimed at increasing investment in R&D.

1. Promoting the protection of intellectual property by co-financing the costs of residents for maintaining patents in force, as well as assisting in ensuring the protection of R&D results outside the state in countries of the right holder's choice (legal assistance and co-financing of costs).

2. Developing mechanisms for venture financing of promising innovative projects and industries, including on the terms of co-financing projects by the management company.

3. Attracting subsidies (to reimburse part of the costs of R&D, part of the costs of paying interest on loans, etc.) and grants.

Conclusions. Thus, the recommendations presented are aimed at developing innovation infrastructure facilities through measures to form and utilise the main resources of innovation infrastructure facilities, which we have classified as: residents, the property complex of the innovation infrastructure facility, investments and R&D investments, budgetary and extrabudgetary investments in the creation and development of engineering, transport, social and other infrastructure for such facilities. The results of the study can be used in the practical activities of the management bodies of innovation infrastructure facilities and the relevant state authorities implementing state policy in the field of the formation and development of innovation infrastructure facilities.

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РЕКОМЕНДАЦІЇ ЩОДО РОЗВИТКУ ІННОВАЦІЙНОЇ ІНФРАСТРУКТУРИ РЕГІОНУ З МЕТОЮ ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ ЇЇ ФУНКЦІОНУВАННЯ

У статті досліджено ключові напрями розвитку виробничо-технологічної інноваційної інфраструктури як важливої складової формування конкурентоспроможної економіки. Автори акцентують увагу на потребі нормативно-правового врегулювання діяльності таких об'єктів, зокрема через прийняття спеціального закону, що забезпечить єдність термінології, узгодженість цілей та підвищить ефективність функціонування інфраструктури. Відзначено доцільність застосування дворівневої моделі регулювання, яка поєднує державний та регіональний рівні, дозволяючи враховувати соціокультурні, географічні та економічні особливості територій. Значна увага приділена створенню системи моніторингу та накопичення статистичних даних на базі геоінформаційних платформ, що сприятиме підвищенню прозорості управління. Розкрито питання фінансової стабільності керуючих компаній та контролю за витрачанням бюджетних інвестицій, що дозволить зменшити ризики неефективності та збитковості. Підкреслено потребу вдосконалення методик оцінювання ефективності об'єктів інноваційної інфраструктури з урахуванням їхнього впливу на соціально-економічний розвиток регіонів. Запропоновано застосування DEA-методу для визначення цільових параметрів ресурсів і результатів, що дозволяє підвищувати технічну ефективність технопарків. Окремо розглянуто механізми залучення резидентів, зокрема через доступ до сучасного обладнання, створення системи пільг, розширення спектра послуг і підвищення інформаційної відкритості. Обґрунтовано напрями розвитку майнового комплексу, інженерної, соціальної та сервісної інфраструктури, а також використання державно-приватного партнерства й залучення інвесторів. Наголошено на важливості стимулювання інвестицій у R&D, підтримки патентування, венчурного фінансування та грантових програм. Практична цінність результатів полягає у можливості використання запропонованих рекомендацій керуючими органами інноваційних інфраструктурних об'єктів і державними інституціями при формуванні політики розвитку регіональної та національної інноваційної системи.

Ключові слова: *інноваційна інфраструктура, технічна ефективність, нормативно-правове регулювання, резиденти інноваційних парків, інвестиції у R&D.*