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The Essence and Economic Features of University Innovation Infrastructure Formation

Abstract: In modern conditions, universities perform research activities not only for the development of fundamental science but also for the practical use of applied research results and their integration with the regional and national economy. There is a need for innovative competencies formation aimed at the formation of innovative thinking among students and employees of higher educational institutions. Practically directed scientific research is being integrated into the educational process, and a technology transfer center is being created between the scientific and educational departments of the university. The study purpose is to analyse university innovation infrastructure concept and consider its formation economic features. The scientific novelty of the study results lies in the systematisation of approaches to defining the university innovation infrastructure concept. The concept basis is a set of mechanisms and systems ensuring the innovative university activities. The theoretical foundations of university innovation infrastructure formation and development, its elements and subsystems composition and functionality at the desk study level are analysed. In this process, the key focus is on the economic features of innovative infrastructure formation and its economic effectiveness assessment. In the study course, such methods as comparison, generalisation, comparison, abstraction, deduction, and induction were used. To achieve the study purpose and solve the tasks set, the works of J. Yuti, F. Shapiro, N.N. Pogrebnyak, N.P. Khveseni, V.V. Sokolova, A.M. Nosonov, A.V. Romyantseva, and I.P. Mitrofanova were used.

Keywords: university innovation infrastructure, business incubator, innovative university activities, innovation infrastructure elements.

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Сущность и экономические особенности формирования инновационной инфраструктуры университета

Аннотация: В современных условиях университеты осуществляют научно-исследовательскую деятельность не только для целей развития фундаментальной науки, но и для практического использования результатов прикладных исследований и их интеграции с региональной и национальной экономикой. Возникает потребность в формировании инновационных компетенций, направленных на формирование новаторского мышления у обучающихся и работников высшего образовательного учреждения. В образовательный процесс встраиваются практически направленные научные исследования, создается центр трансфера технологий между

научными и учебными подразделениями университета. Целью статьи является анализ понятия инновационной инфраструктуры университета и рассмотрение экономических особенностей её формирования. Научная новизна результатов исследования состоит в систематизации подходов к определению понятия университетской инновационной инфраструктуры. Основой данного понятия является совокупность механизмов и систем, обеспечивающих инновационную деятельность университета. Проанализированы теоретические основы формирования и развития инновационной инфраструктуры университета, состав и функционал её элементов и подсистем на уровне камеральных исследований. Ключевой акцент в данном процессе сделан на экономические особенности формирования инновационной инфраструктуры и экономическую оценку её эффективности. В ходе исследования были использованы такие методы как сравнение, обобщение, сопоставление, абстрагирование, дедукция и индукция. Для достижения цели решения поставленных задач были использованы работы Ж. Юти, Ф. Шапиро, Н.Н. Погребняка, Н.П. Хвесени, В.В. Соколовой, А.М. Носонова, А.В. Румянцевой и И.П. Митрофановой.

Ключевые слова: инновационная инфраструктура университета, бизнес-инкубатор, инновационная деятельность университета, элементы инновационной инфраструктуры.

Abbreviations:

IAR is intellectual activity results,

ISTC is innovative scientific and technological centers.

Introduction

At the present global economic development stage, the university is involved in the innovation activities of a region or country through interaction with government agencies and representatives of the private sector of the economy. It is necessary to modernise traditional methods of conducting scientific research and development to accelerate the latest technologies transfer created on a university basis and to the innovative goods, works, and services market. According to the new conditions, new departments are being formed at universities to implement their innovation activities.

The university innovation infrastructure is a method of organising and implementing innovative university activities. It consists of several subsystems providing various kinds of services. Budget subsidies are the main source of financing for creating and operating university innovation infrastructure. From an economic viewpoint, it is necessary to consider the cost ratio of creating an innovation infrastructure at the university with the proceeds from the sale of innovative goods, works, and services developed within the framework of the elements of this structure. It is necessary to assess the economic feasibility of forming an innovation infrastructure within each university individually.

Having become a participant in the innovative economy, the university participates in government projects, providing its innovative resources and developments. Universities also attract private investors to implement joint innovative projects. At the same time, university departments created to perform innovative activities allow students to create innovative business projects and provide them with assistance in obtaining support measures.

The stated provisions indicate the study topic's relevance.

The study purpose is to consider the concept and features of the formation and development of university innovation infrastructures in Russia and foreign countries.

The study object is the innovation of higher school sector activities.

The study subject is the university innovation infrastructure in Russia and abroad.

The scientific novelty of the study results lies in the systematisation of approaches to defining the university innovation infrastructure concept. The concept basis is a set of mechanisms and systems that ensure the innovative university activity. The theoretical foundations of the university innovation infrastructure formation and development, its elements and subsystems composition and functionality at the desk study level are analysed. In this process, the key focus is on the economic features of innovation infrastructure formation and its economic effectiveness assessment.

In the study course, such methods as comparison, generalisation, comparison, abstraction, deduction and induction were used.

To achieve the study purpose and solve the tasks set, the works of J. Utı, F. Shapiro, N.N. Pogrebnyak, N.P. Khveseni, V.V. Sokolova, A.M. Nosonov, A.V. Rumyantseva and I.P. Mitrofanova were used.

Results

Currently, the term “innovation infrastructure” is entrenched in the scientific literature to a greater extent in relation to national and regional structures. The works of scientists and researchers consider various approaches to the essence of innovative university activity. For example, N.N. Pogrebnyak considers one of the key functions of universities the involvement of students in research activities, which is conducting research aimed at obtaining new knowledge, just like its subsequent systematisation and practical application (*Pogrebnyak, 2019*). N.P. Khvesenya focuses on assessing the commercial significance and protecting the rights to the results of innovative activities, just like attracting investors (*Khvesenya, 2018, pp. 84-86*). V.V. Sokolova divides innovation infrastructure into tangible and intangible (*Sokolova, 2014*). A.M. Nosonov considers the university innovation infrastructure as a set of management systems, information technologies and financing sources (*Nosonov, 2019*). A.V. Rumyantseva suggests various approaches to assessing the effectiveness of innovation infrastructure subjects' activities (*Rumyantseva et al., 2017*). I.P. Mitrofanova offers a university innovation infrastructure effectiveness assessment based on coefficients (*Mitrofanova & Zakharova, 2017*).

In modern conditions, the digital transformation of all public life spheres is intensifying, which, in turn, leads to the digitalisation of educational processes and research activities in the process of forming a new innovative university development model. The life cycle of a higher education system based on a research model is coming to an end. There is a need to improve the existing university management system, leading to the issue of higher educational institutions' transformation into a space for innovation and the development of new business lines.

The innovative university model, undergone transformation according to the global challenges of our time, consists of four main blocks presented in the article appendix (*Table 1*).

So, having considered it, the author concludes that the innovative university transformation represents integrating innovative activities process into the core university activities, just like the

creation of new management systems to ensure the sustainable functioning of higher education institutions in the face of modern challenges.

Research activities are worth distinguishing from innovative university activities. If the first is aimed primarily at obtaining new knowledge, then the second aims at the subsequent commercialisation of this knowledge.

The university's research activities include:

- fundamental scientific research aimed obtaining new knowledge about the basic laws of the functioning and development of nature and society;
- applied scientific research aimed primarily at applying new knowledge to solve specific problems;
- exploratory scientific research aimed scientific research focused on the practical application of the acquired knowledge (*Garanin & Sandler, 2020*).

The innovative university activity includes scientific, technical, organisational, financial, and commercial activities aimed at implementing innovative projects and creating innovation infrastructure.

The term innovation is based on the Latin word “*innovationem*”, meaning “to change” or “to modernise” in English. The innovation essence is renewal based on changing the way decisions are made and abandoning the usual methods (*Ivashchenko, 2020*). Innovation serves as a bridge between science and entrepreneurship.

The innovative university development is a purposeful process of forming the innovative higher educational institution potential to develop scientific, technical, and entrepreneurial activities aimed at obtaining significant results for the innovation national economy development and strengthening the university's position (*Yurchenko, 2019*).

The innovative university development is characterised by innovation introduction in all areas of the university activities to increase the university competitiveness at the regional, national, and global levels. The following conditions that are necessary for the innovative development of the university are identified:

- free interaction of subjects of innovative activity;
- availability of resources for research and entrepreneurial activities;
- consideration of the mutual interests of participants in innovation activities;
- practical usefulness of potential results of innovative activity (*Yurchenko, 2019*).

The main objectives of innovative university development are:

- introduction of innovations in educational activities;
- motivation of staff and students to conduct scientific research;
- interaction with external actors within the framework of scientific activities;
- introduction of innovations in the promotion of educational services on the foreign and international market;
- attracting investors to finance the innovative activities of the university;
- formation and development of the innovation university infrastructure;
- development of information technology support for the University (*Yurchenko, 2019*).

Next, it is necessary to consider the definitions of the term “innovative infrastructure”, presented by various authors, to derive the concept of “university innovation infrastructure”, which will be used in this research work. The main approaches to the definition of the “innovation infrastructure” concept are presented in the appendix to the article ([Table 2](#)).

Based on the definitions of the term “innovation infrastructure” presented in Table 2, the author concludes that, in general, innovation infrastructure is a set of institutions that support innovation activities.

Thus, within the framework of this research work, based on the definitions presented in Table 5, the “university innovation infrastructure” concept is derived, presented as follows: a set of organizational and managerial, logistical, financial, personnel, and information systems of the university interacting throughout the period of scientific knowledge transformation into the final innovative product and ensuring the innovation activities implementation.

Functional subsystems reflecting the essence of the university innovation infrastructure are presented in the article appendix ([Table 4](#); [Table 5](#)).

The university innovation infrastructure elements ensure the innovative university activities. The university innovation infrastructure development and implementation is to maintain and develop the scientific and logistical university potential. It is worth noting that the university innovation infrastructure can be considered as information and communication support for innovation activities in higher educational institutions of the humanities.

In a broad sense, V.V. Sokolova identifies two types of innovation infrastructure—tangible (technoparks, business incubators, technical and innovation centers, technology transfer centers, etc.) and intangible (intellectual property protection services, intellectual product promotion services, outsourcing, etc.) ([Sokolova, 2014](#)).

In a narrower sense, the following fundamental elements of the university innovation infrastructure can be distinguished:

- innovative educational programmes;
- scientific and production facilities (business incubators, technology parks, laboratories, etc.);
- small innovative enterprises (MIPS);
- university departments, whose activities are aimed at supporting innovation activities;
- structures that ensure the innovation activities management ([Sokolova, 2014](#)).

Another approach to determining the composition of the university innovation infrastructure is proposed by S.V. Valdaytsev, N.N. Molchanov and K. Petsoldt. In their work, scientists consider innovative infrastructure as the primary basis and tool for developing its innovative potential. In this case, the innovation infrastructure will include the following elements:

- problem-oriented small innovative firms whose activities are aimed at solving scientific and industrial problems;
- innovative structures that promote the commercialisation of the results of scientific and technical activities;
- incubator of small enterprises;
- a system for training managers ([Valdaytsev et al., 2013](#)).

The essence of some of the above-mentioned elements of the university innovation infrastructure is presented in the article appendix ([Table 4](#)).

It is worth noting that it is customary to distinguish between full- and incomplete-cycle business accelerators. The former supports the functioning of projects differing in life cycle stages, including projects that are just emerging. Incomplete business accelerators work with already proven projects already backed by a registered legal entity, a working team, or some working prototype ([On Innovative..., 2017](#)).

ISTC activities are regulated by Federal Law No. 216-FZ. The innovative scientific and technological centre territory means a set of land plots or parts thereof operating in a specific legal regime intended for implementing the project and included in the innovative scientific and technological centre territory boundaries ([On Innovative..., 2017](#)).

The innovative scientific and technological center includes buildings, structures, and objects of communal, social, and transport infrastructure.

Yu.V. Daneikin and O.P. Ivanova propose to evaluate the university's contribution to the ISTC creation and development using the following indicators:

- the number of high-tech jobs created with the participation of the university ISTC;
- increase in the volume of total revenue of the participating ISTC companies;
- the number of people enrolled in the university's continuing education programmes designed to meet the needs of the ISTC for specialists;
- the number of patent applications of the participating ISTC companies;
- the share of participating enterprises' products exports in the total volume of products shipped, works performed, and services rendered;
- increasing the number of intellectual property objects;
- the share of the products of the high-tech and knowledge-intensive industries ISTC in the gross regional product of the region;
- the share of new and improved high-tech products in the total volume of shipped products;
- the ratio of actual and target values of successfully implemented and stably functioning innovative projects of industrial enterprises with the university support;
- technological readiness coefficient—an indicator characterising the readiness of an enterprise for innovation, for introducing and developing innovative technologies and modernising production;
- the production readiness level of the ISTC participant's projects, developed with the participation of the university (determines the readiness to create a product production from the layout level to the industrial sample and shows the creation of effective production (experimental, pilot, serial)) ([Daneikin & Ivanova, 2020](#)).

The elements of various innovation infrastructures of some Russian universities are presented in the article appendix ([Table 3](#)).

Based on the data in the appendix, the author can conclude that the Russian universities under consideration have similar innovation infrastructures; their elements include technoparks, collective use centres, business incubators, technology transfer centres and small innovative enterprises created based on the university.

In the Russian Federation, the most well-known business accelerator was created at Moscow State University. It is part of the innovative scientific and technological centre of Moscow State University “Vorobyovy Gory”. Residents are provided with seed investments, access to the business incubator infrastructure and assistance in developing a business model. Participation in the startup development programme lasts four weeks. However, it is worth noting that you can use the services of a business accelerator if you only have an idea.

The combination of university innovation infrastructure contributes elements to the creation and development of small innovative enterprises established on a university basis, just like the implementation of innovative university activities, thereby ensuring the functioning of the academic entrepreneurship system.

Small innovative enterprises are the general academic entrepreneurship system element. Under a small innovative enterprise, it is customary to designate an economic company created by an educational or research institution with joint participation with a private partner. Its activities are aimed at introducing innovative activity results to the market (*Gubin & Lakbno, 2017*). It is customary to refer to small innovative enterprises as knowledge-intensive organisations operating in innovative technologies.

The Strategy for the Development of Science and Innovation in the Russian Federation for the Period up to 2015 presents a small innovative enterprise concept. In the specified regulatory framework, this term refers to a small enterprise. Its activities are aimed at performing works or providing services to create new or improved products, just like the modernisation of production processes (*Strategy..., 2006*).

Also, the definition of a small innovative enterprise is presented in paragraph 2 of the Recommendations on Ensuring Coordination of Programmes Implemented for State Support of Small and Medium-Sized Businesses, Promoting Self-Employment of Unemployed Citizens, Supporting Small Forms of Farming in Rural Areas and Supporting Small Forms of Innovative Entrepreneurship. In this regulatory legal act, a small innovative enterprise is defined as a legal entity operating in the small or medium-sized enterprise form and performing activities for producing innovative goods or providing innovative services. The core condition for classifying an organisation as a small innovative enterprise is the implementation of costs for technological innovations (*Recommendations..., 2011*).

At this moment, an exhaustive list of regulatory legal acts regulating the activities of small innovative enterprises established at universities has not yet been created.

The basic list of normative legal acts regulating innovation activities in the Russian Federation as a whole includes the Constitution of the Russian Federation, the Civil Code of the Russian Federation, the Tax Code of the Russian Federation and Federal Law No. 39-FZ “On Investment Activities in the Russian Federation Performed in the Form of Capital Investments”.

The regulatory system and legal regulation of small innovative enterprises established based on higher educational institutions are presented in the article appendix (*Table 5*).

In addition, according to Law No. 209-FZ (*On the Development..., 2007*), at least one of the following must be performed to classify an organisation as a small enterprise conditions:

1. For business companies, business partnerships, and business partnerships, at least one of the following requirements must be met:

- the shares of the organisation traded on the securities market belong to the shares of the high-tech sector;
- the main activity of the organisation is the introduction of innovative activity results to the market;
- the status of a participant in the Skolkovo Innovation Center project;
- the organisation providing state support for innovation activities is the founder or participant of a business company;
- if the organisation is a public joint-stock company, at least 50% of its shares must be owned by the state;
- the organisation was created in the form of a state corporation;
- the organisation was created through the reorganisation of the Russian Nanotechnology Corporation.

2. The average number of employees for the previous calendar year of business companies, business partnerships, and business partnerships that meet one of the requirements:

- up to 100 people for small enterprises (microenterprises stand out among small enterprises—up to 15 people);
- from 101 to 250 people for medium-sized enterprises.

3. The organisation's income received from entrepreneurial activity for the previous calendar year should not exceed the limits established by the Government of the Russian Federation for each category of small and medium-sized businesses.

The procedure for creating a small innovative enterprise consists of the following steps (*On Science..., 1996*):

- the management of an educational or research institution decides on the creation of a small innovative enterprise;
- registration of the intellectual property right to innovation and calculation of its cost;
- collection and preparation of documents necessary for registration of a small innovative enterprise, including constituent documents, license agreement, minutes of the general meeting, etc.;
- registration of a legal entity;
- notification of the Ministry of Education and Science on small innovative enterprise establishment (*Small innovative enterprise..., 2023*).

State support for the activities of small innovative enterprises established at universities is performed in the following areas:

- financing the innovative infrastructure facilities development;
- legal protection of innovation activity results;
- development and implementation of training and advanced training programs for personnel engaged in the innovation sector;
- internship and professional development of personnel;
- consulting services (*Small innovative enterprise..., 2023*).

It is worth noting that the existing regulatory framework governing the activities of small innovative enterprises regulates their definition and concept to a greater extent than business activities, sources of financing and functioning features.

State support for creating and developing the university innovation infrastructure consists of providing financial resources in the following areas:

- creating and developing innovative infrastructure facilities in universities, just like their equipment with modern equipment and software;
- legal protection of the IAR;
- evaluating the IAR;
- implementing and developing targeted training and advanced training programmes in small innovative entrepreneurship;
- developing educational, methodological, scientific and methodological support for small and medium-sized businesses;
- internship and advanced training of university staff in foreign universities to apply positive experience in the formation and development of innovative infrastructure;
- consulting services of Russian and foreign experts in technology transfer;
- creating and developing small innovative enterprises (*On State Support..., 2010*).

In these areas, budget allocations are provided on a competitive basis based on the results of innovative infrastructure development programme selection. In the Russian Federation, universities performing fundamental and applied scientific research in priority areas of science, technology and technology development can participate in the competition (*On State Support..., 2010*).

The core indicators for evaluating the implementation of the university innovation infrastructure development programme include:

- the complexity of the created innovative infrastructure of the educational institution and the amount of work and services performed on its basis;
- an effective IAR registration and accounting system;
- the number of reeds accepted for budget accounting;
- the number of legal entities created by an educational institution that contributes to the practical innovative product implementation;
- the number of jobs in the created innovation infrastructure and legal entities described above;
- the number of students, postgraduates and representatives of the teaching staff involved in the work of these persons;
- the number of ongoing projects supported by the Fund for Assistance to the Development of Small Enterprises in the Scientific and Technical Field and other organisations, just like the amount of extra-budgetary funds raised;
- the volume of research and development work performed in an educational institution;
- the number of trained and qualified innovation-oriented representatives of small and medium-sized innovative businesses according to programmes developed in an educational institution;

- the number of faculty and staff who have completed internships and advanced training programmes in innovative entrepreneurship and technology transfer based on innovative infrastructure facilities of leading foreign universities;
- the volume of high-tech products created using innovative educational institution infrastructure elements (*On State Support..., 2010*).

However, innovative infrastructure is worth creating at universities, regardless of their profile. The social sciences and humanities are not represented in the priority areas of the Russian Federation's science and technology development, and, therefore, universities of this profile cannot participate in the above-mentioned competition.

At the same time, creating a business incubator based on the University of Social Sciences and Humanities would increase the implementation of innovative services developed in this industry. It is advisable to add additional indicators related to the provision of intangible innovative services to the assessment indicators listed above.

According to T.V. Mirolyubova and P.A. Sukhanova, the cost-effective innovative infrastructure of the Russian university is worth forming in the context of the following four directions:

1. Stimulating university research through the creation of an R&D marketing department aimed at providing assistance in obtaining grants and finding business partners for promising projects.
2. Ensuring technology transfer through the creation of an appropriate office related to the management of the university's intellectual property created in its laboratories, in terms of preparing documentation and providing financial, legal and marketing services. In addition, within the framework of this direction, it is proposed to create an experimental production centre at technical universities, whose activities are related to the provision of services for the development of design, regulatory, technical and operational documentation, just like the creation of experimental products and prototypes of an innovative product. The authors consider the creation of a collective centre for experimental production, whose services can be used by several universities, to be the most appropriate.
3. Development of entrepreneurial abilities. Within the framework of this direction, it is proposed to create a club of entrepreneurs providing educational services and mentoring support, just like mediation in attracting investors' process.
4. Stimulating entrepreneurial activity within the framework of a range of services provided by the university business incubator (*Mirolyubova & Sukhanova, 2013*).

In addition to the listed areas, it is necessary to add a direction for implementing scientific and practical projects by creating small innovative enterprises based on universities. Participation in the distribution of profits from the activities of small innovative enterprises will increase the economic effect of the university's investments in forming and developing innovative infrastructure.

D.Y. Mironova believes that forming the university innovation infrastructure is worth considering from the viewpoint of innovative projects' development and commercialisation. Therefore, the main focus is on creating the university's project office and technology transfer centre.

One of the core goals of creating a project office at the university is to conduct project-oriented management aimed at obtaining cost-effective results from promoting ideas to the market. The implementation of research projects created at the university is aimed at further IAR commercialisation (*Mironova, 2023*).

Technology transfer centre activities are significant for building long-term cooperation between scientific organisations, and universities with industrial enterprises. They solve the tasks of finding orders and introducing university developments into the real sector of the economy, just like from the agenda of applied research (*Chernysbenko, 2023*). Technology transfer centres are focused on building long-term cooperation between universities and scientific organisations with enterprises in the real sector of the economy.

The mechanism for developing technology transfer centres was launched in 2021 as part of the federal project “Development of Large-Scale Scientific and Technological Projects in Priority Research Areas” of the national project “Science and Universities”.

When forming the university innovation infrastructure, it is advisable to use qualitative criteria for evaluating the regional innovation systems’ effectiveness, including the following indicators:

- the degree of regional economy readiness for introducing innovations;
- the amount by which each unit of investment in science and education increases the size of the gross regional product on average;
- the time interval during which innovations, just like professional development, have an impact on the gross regional product size;
- increase in the share of intangible assets in the total asset structure of the organisation;
- the growth of investments in the labour reproduction;
- the amount of absolute savings in working time due to increased labour productivity;
- the service sector’s predominance in the overall gross regional product structure (*Sukhanova, 2012*).

P.A. Sukhanova, based on the analysis of the financial results of US universities’ innovation activity, identifies the following indicators of the economic efficiency of the university innovation infrastructure:

- the amount of financial support for scientific research;
- the number of registered inventions;
- the number of patents;
- the number of technologies released to the market that have generated revenue;
- the number of licenses issued;
- the total amount of royalties received;
- the number of startups;
- income from the sale of shares in the ownership of startups (*Sukhanova, 2012*).

It is advisable to supplement this list with such indicators as “the number of ‘surviving’ startups”, “the number of income-generating small innovative enterprises”, “the number of business partners of the university” and “the share of innovative products of the university in the total volume of innovative goods, works and services”. The new indicators will provide more

information about the economic impact of the innovative university activities, just like allowing the assessment of the availability of university partnerships that contribute to its intellectual activity results commercialisation.

At the same time, it is worth noting that the listed indicators of economic efficiency are more related to technical areas, which corresponds to the priority areas of the Russian Federation's science, technology and technology development. Innovation activity regulation in the social and humanitarian sphere is less developed since the short-term economic effect in this industry is almost difficult to determine, and the medium-term one is inferior to the technical sphere since the vast majority of such projects are designed for the future, i.e., they are long-term.

It is advisable to supplement the above indicators with criteria for assessing economic efficiency in the social and humanitarian sphere:

- the number of copyright objects created in the university department;
- the number of income-generating implemented social and humanitarian projects;
- the number of innovative services users;
- the methods of promoting innovative services and the effectiveness of their application;
- the number of private investors who financed social and humanitarian projects;
- the annual revenue amount ratio to the volume of investments, both for the reporting period and incrementally, to last year, considering the project implementation plan.

At the present stage of economic development, Russian universities of the social and humanitarian profile are creating clubs of entrepreneurs and business accelerators that provide consulting, just like logistical services for student innovation project development. Communication platforms are being developed for the exchange of various participants' practices.

To improve the economic efficiency of university innovation infrastructure, according to I.V. Titovich, it is necessary:

- develop and approve a regulatory legal act providing for creating endowment funds in universities (endowment fund), i.e., a part of the property of a non-profit organisation formed and replenished by donations, property received by will, just like by unused income from the trust management of the specified property and transferred by a non-profit organization to the trust management of a company to generate income used to finance the statutory activities of such a non-profit organisation or other non-profit organizations (*On the Procedure...*, 2006);
- review the legislative framework to expand the capabilities of customers to participate in forming modern and innovative educational, scientific and laboratory facilities at universities;
- stimulate the domestic manufacturers' interest in purchasing technologies and patents for producing products from universities (*Titovich, 2019*).

The coefficients presented in the appendix to the article (*Table 6*) can be used to assess the university innovation infrastructure effectiveness.

The coefficients presented in Table 6 make it possible to assess the profitability and profitability of the innovative infrastructure, the growth rate of its development and the potential

of personnel. From the viewpoint of the economic efficiency of the innovative infrastructure, the IAR commercialisation coefficient and the IAR creation efficiency coefficient are of the greatest interest. These coefficients allow you to estimate the return on invested funds. The growth coefficient, involvement coefficient, and human resource potential coefficient can be used to economically assess the innovative infrastructure quality.

The presented coefficients can be supplemented with indicators characterising the various innovation stages' cost-effectiveness:

1. Cost-effectiveness of the R&D stage [34]:

$$CE_{R\&D} = \frac{\sum_{i=1, t=1}^{NT} H_{it} + \sum_{j=1, t=1}^{KT} H_{jt}}{\sum_{r=1, t=1}^{RT} H_{rt} - \sum_{q=1, t=1}^{QT} H_{qt} - \sum_{t=1}^T (H_2 - H_1)}, \quad (1)$$

N is the number of independently developed innovations;

K is the number of intellectual property objects acquired;

R is the total number of innovations as R&D result and intellectual property acquisition in the external environment;

Q is the number of intellectual property objects of R&D results implemented in the external environment and not used in the activity of the subject;

H_{it} is the cost of resources in monetary terms for the independent creation of the i^{th} innovation in t year;

H_{jt} is the cost of acquiring the j^{th} intellectual property object in the external environment for t year;

H_{rt} is total actual R&D costs and intellectual property acquisition in the external environment in t year;

H_{qt} is profit from the implementation of q innovations in the external environment in t year;

H_1 is incomplete studies at the beginning of the analysed period in value terms;

H_2 is incomplete studies at the end of the analysed period;

T is the number of analysed period years.

2. Cost-effectiveness of IAR development (implementation) stage ([Rumyantseva et al., 2017](#)):

$$CE_{IS} = \frac{\sum_{i=1, t=1}^{NT} C_{it}}{\sum_{j=1, t=1}^{NT} C_{jt}}, \quad (2)$$

N is the number of implemented innovations (inventions, technical solutions, ideas);

K is the number of developed innovations (inventions, technical solutions, ideas);

C_{it} is the cost of resources for the development of the i^{th} implemented innovation (invention, technical solution, idea) for t year;

C_{jt} is the cost of resources for the development of the j^{th} innovation (invention, technical solution, idea) for t year;

T is the number of analysed period years.

3. Cost-effectiveness of innovation activities ([Rumyantseva et al., 2017](#)):

$$CE_{IA} = CE_{R\&D} \times CE_{IS}, \quad (3)$$

$CE_{R\&D}$ is cost-effectiveness of the R&D stage;

CE_{IS} – cost-effectiveness of the invention implementation stage.

An economic assessment of the university innovation infrastructure quality as a set of individual properties, characteristics, and functions of an object is, on the one hand, an assessment by the university of the economic costs of creating and operating an innovation infrastructure and a possible economic effect, on the other hand, an assessment by consumers of the costs of using innovative infrastructure services and the degree of satisfaction of their needs ([Petrov, 2020](#)).

The following methods can be used for the economic assessment of quality:

- registration method based on systematic observations and fixation of the number of some events or objects with their subsequent statistical processing (manufacturability, efficiency, unification (standardization), patent and legal indicators, etc.).
- calculation method based on the use of formulas, just like theoretical or empirical knowledge about the dependence of quality indicators on various parameters of a product or service ([Methods..., n.d.](#)).

Conclusion

Thus, the innovative university transformation is a response to the global challenges of modernity, due to the obsolescence of the research model of higher educational institutions. The core significance is acquired by the innovative university development, which is the process of introducing innovations to develop scientific, technical and entrepreneurial activities to ensure the university's competitiveness and national welfare growth. The innovative university development takes place in close cooperation with external organisations, ensuring innovation development and implementation.

The university innovation infrastructure is a set of mechanisms and systems ensuring the innovation institution's activity. The innovation infrastructure elements include innovative educational programmes, research and production facilities, small innovative enterprises, and university departments whose activities are aimed at supporting innovation activities and structures ensuring innovation activities management. Large Russian universities have similar innovative structures, including technoparks, collective use centres, business incubators, technology transfer centres and small innovative enterprises established based on the university. The university innovation infrastructure development contributes to strengthening academic entrepreneurship by providing the necessary resources.

Academic entrepreneurship is a new form of interaction between science and business aimed at the introduction and subsequent commercialisation of innovations. A new market for innovative educational services is emerging. A key element in the system of academic entrepreneurship is a small innovative enterprise established at the university. At this stage of society's development, the legal regulation of academic entrepreneurship is insufficiently developed. The main normative legal acts regulating the activities of small innovative enterprises are federal laws, resolutions of the Government of the Russian Federation and an order of the Ministry of Education and Science of the Russian Federation.

The main economic feature forming the university innovation infrastructure is that at this economic development stage in the Russian Federation, the general financing source for innovation activities is budget subsidies on a competitive basis. However, in the medium term, universities should strive to obtain additional financial resources from IAR commercialisation to

ensure further R&D development, increasing their funds. Also, the main features to form the university innovation infrastructure include stimulating university research, entrepreneurship and technology transfer, the creation of project offices and small innovative enterprises.

When forming an innovation infrastructure, it is necessary to consider and the economic capabilities of the university, both the state of the regional and national economies, their readiness to introduce innovations. Regulatory legal acts regulating this area are worth reviewing to improve the mechanism of innovative activities implementation. In addition, it is necessary to encourage domestic producers to create research and production clusters using the research university potential. It is also possible to attract universities' research resources to solve business problems.

To assess the economic efficiency and quality of functioning the university innovation infrastructure, indicators such as the amount of financial support for scientific research, income from the sale of shares in the ownership of startups, the number of registered inventions, patents, startups, technologies, licenses and royalties received can be used. At the same time, to assess profitability and human resources, the IAR commercialisation coefficient, IAR creation efficiency coefficient, growth coefficient, involvement coefficient, and human potential coefficient, just like indicators of various innovation stages cost-effectiveness.

Conflict of Interest

The author declares that there is no conflict of interest.

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Appendix

Table 1. Model of an innovative university

Name of the block	Content
Education and research	The basic block represents the main university's activity, supports the sustainable existence and functioning of the university.
Innovations	An innovation management system that stimulates innovation activities within the university.
Transformation	The university's management system, responsible for establishing the relationship between research and university's innovation activities.
Strategic management	This unit is responsible for forecasting the university's activities, preparing it for new transformations and developing strategic development plans.

Resource: [Garanin, 2019](#).

Table 2. Approaches to innovation infrastructure definition

Source	Definition of "innovation infrastructure" concept
1	2
On Science and State Scientific and Technical Policy. Federal Law No. 127-FZ dated August 23, 1996	A set of organizations contributing to the implementation of innovative projects, including the provision of managerial, logistical, financial, information, personnel, consulting, and organizational services (On Science..., 1996).
On the Concept of Long-term socio-economic Development of the Russian Federation for the period up to 2020. Decree of the Government of the Russian Federation No. 1662-r dated November 17, 2008	A set of interacting organizations engaged in the production or commercial sale of knowledge and technologies, just like a complex of legal, financial and social institutions (On the Concept..., 2008).
K.Y. Kulakov, N.G. Verstina, T.S. Meshcheryakova	A set of elements systematized into five subsystems (financial, production and technological, information, personnel, expert consulting), and supporting innovative activities (Kulakov et al., 2022).
G. Shienstock, T. Hamalainen	A set of institutions and mechanisms functioning to ensure the knowledge transformation process including the following stages such as acquisition, production, dissemination, standardisation, application, and further optimisation (Schienstock & Hämäläinen, 2001).
J. Youtie, F. Shapiro	A structure that ensures the interaction of components of the external and university's internal environment to manage and coordinate innovative activities (Youtie & Shapira, 2008).
M.F. Zozulya, S.V. Khakhanova	A specific complex of interacting systems and organisational elements having a multilevel structure and covering the entire period of scientific, scientific, technical and innovative activities (Zozulich & Khakhanov, 2017).
M.Z. Ilchikov	A set of scientific and technical, educational, industrial, technological and innovative organisations ensuring the implementation of innovative activities (Ilchikov, 2021).
A.M. Nosonov	a set of management systems, institutions, information technologies, research and educational institutions and sources of financing that create prerequisites for realising regional innovation potential (Nosonov, 2019).

R.V. Komisaruk	a set of organisations whose activities are aimed at providing support for scientific and scientific-technical activities, just like providing support for the implementation of innovative projects including the provision of managerial, logistical, financial, information, personnel, consulting and organizational services (<i>Komisaruk, 2022</i>).
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Resource: Author's research on scientific articles.

Table 3. Functional subsystems of the university innovation infrastructure

Subsystem	Functions	Structure
Financial	Managing the university's financial flows	Financial institutions and funds
Material and technical	Providing the material resources and technological base	Technoparks, business incubators, technology transfer centers, innovation and technology centres
Personnel	Training of highly qualified personnel capable of working in an innovative environment	Innovative educational programmes and advanced training courses within the university
Information	Ensuring access to information resources and their free exchange	Software, Internet resources, information centres, hardware
Organisational and managerial	University innovation management	University departments

Resource: *Onishchenko, 2020, pp. 27*.

Table 4. The essence of the main elements of the university innovation infrastructure

Element	Essence
Technopark	A scientific and industrial territorial complex, whose activities are aimed at creating a favourable environment for innovative enterprises development (<i>University, 2023</i>). The technopark includes research institutes, industrial facilities, business centers, exhibition grounds, educational institutions, and service facilities.
The Collective Use Center	A university division created to ensure the collective use of expensive, unique devices and installations by structural university divisions.
Business Incubator	An organisation whose activities are aimed at supporting newly established and developing innovative companies through the provision of a full range of services, including office space, equipment, legal, and consulting services.
Business Accelerator	It is a model of support for a developing business to accelerate the qualitative development of the project. This model offers office space, consultations, trainings, legal, and accounting support, mentoring, information, logistics and PR support. Also, within the framework of the business accelerator, cycles of lectures, seminars, trainings and master classes can be held aimed at the formation of special knowledge, skills and abilities. The key function of the business accelerator is to provide financial support to a business that is just starting to function.
Technology Transfer Center	A university division created with the aim of commercialising the results of scientific research and development obtained by research institutes.
Innovative Scientific and Technological Center (ISTC)	A set of organisations engaged in scientific and technological activities and other persons ensuring the functioning of such a center operating on a territory determined by the Government of the Russian Federation (<i>On Innovative..., 2017</i>).

Resource: Author's research.

Table 5. The system of small innovative enterprises regulatory and legal regulation

Regulatory document type	List of regulatory documents	Scope of regulation
Federal Law	The Constitution of the Russian Federation, the Civil Code of the Russian Federation, the Tax Code of the Russian Federation	Basic regulation of innovation activity in the Russian Federation
Federal Law	On Investment Activities in the Russian Federation Performed in the Form of Capital Investments. No. 39-FZ On the Development of Small and Medium-Sized Enterprises in the Russian Federation. No. 209-FZ	Criteria for classifying organisations as small or medium-sized businesses
Federal Law	On Education in the Russian Federation. No. 273-FZ On Science and State Scientific and Technical Policy. No. 127-FZ	Regulation of the establishment of small innovative enterprises at universities, just like their subsequent activities' regulation
Resolution of the Russian Federation Government	On State Support for the Development of Innovation Infrastructure in Federal Educational Institutions of Higher Professional Education. No. 219	State support for small innovative entrepreneurship in universities to create an innovative environment
Order of the Russian Federation executive authority	On the Organisation of Work in the Ministry of Education and Science of the Russian Federation on the Registration of Notifications on the Creation of Business Companies and Business Partnerships. Order of the Ministry of Education and Science of the Russian Federation No. 43.	Regulates the accounting of business entities established at higher educational institutions

Resource: Author's research.

Table 6. Coefficients for evaluating the innovation infrastructure effectiveness

The coefficient name	The coefficient content	Formula	Symbols
IAR commercialisation coefficient	Assessment of the IAR demand in the market	$C_c = \frac{n_{iar}}{N_{iar}}$	C_c is IAR commercialisation coefficient; n_c is the number of commercialised IARs of the reporting period; N_c is the total number of IARs of the reporting period.
Efficiency factor of IAR creating	Evaluating the effectiveness of IAR commercialisation transactions	$C_e = C_c \times \frac{P_c}{C_{cc}}$	C_e is IAR creation efficiency coefficient; C_c is IAR commercialisation coefficient; P_c is profit from IAR commercialisation; C_{cc} is the costs of IAR creation and its commercialisation.
Growth rate	Assessment of the innovation infrastructure development	$R_g = \frac{n_{iie}}{N_{iie}}$	R_g is the growth rate of the innovation infrastructure;

	sustainability, considering the dynamics of jobs created by it		n_{iie} is the number of innovation infrastructure elements created in the reporting period; N_{iie} is the total number of innovation infrastructure elements.
Engagement rate	Assessment of the level of students, postgraduates and university staff involvement in innovative activities	$R_e = \frac{n_s + n_e}{N_s + N_e}$	R_e is engagement rate; n_s , and n_e are the number of students and university employees engaged in innovative activities, respectively; N_{ct} , and N_{pa6} are the total number of students and employees of the university, respectively.
Human resource potential coefficient	Assessment of the qualification level of employees	$C_{hrp} = \frac{n_{ea}}{N_e}$	C_p is human resource potential coefficient; n_{ea} is the number of university employees advancing their qualifications in innovative entrepreneurship and technology transfer; N_e is the total number of university employees

Resource: [Mitrofanova & Zakharova, 2017](#).