

CONTROL OF FINANCIAL RESOURCES OF INFRASTRUCTURE FACILITIES WITH THE ACCEPTION OF HAZARD ANALYSIS

Bayguzina L.Z.^{1*}, Bagratuni K.Yu.², Fedyunin D.V.³, Agakishiyeva G.R.⁴,
Allahverenov M.Sh.⁵, Stokov A.I.², Mikhailova A.E.⁶, Dzobelova V.B.⁷

¹*Ufa University of Science and Technology, Russia
32, Zaki Validi Street, Ufa, 450076*

²*Financial University under the Government of the Russian Federation, Russia
49/2, Leningradsky Avenue, Moscow, 125167*

³*Plekhanov Russian University of Economics, Russia
36, Stremyanny Lane, Moscow, 117997*

⁴*Institute of Geography, Ministry of Science and Education of the Republic of Azerbaijan
117, H. Javid Ave., Baku, AZ1073*

⁵*Mingachevir State University, Azerbaijan
21, D. Aliyeva Street, Mingachevir, AZ4500*

⁶*Saint Petersburg State Forest Technical University named after S. M. Kirov, Russia
5, Institutsky Lane, Saint Petersburg, 194021*

⁷*North Ossetian State University named after K. L. Khetagurov, Russia
44–46, Vatutin Street, Vladikavkaz, 362025*

*Corresponding author: lyuzab@mail.ru

Keywords: *infrastructure systems, economic efficiency, economic potential and risks, strategic management, sustainability, management*

Summary. The purpose of this study is to investigate the methods of regulating the economic resource of infrastructure complexes, taking into account the impact of risk factors. Infrastructure complexes play an important role in the progress of the economy, but they are subject to various dangers, such as financial, environmental and operational difficulties. The present study identifies the basic components of infrastructure complexes, their economic potential and the risks associated with their regulation. Based on an analysis of existing scientific views and relevant publications, the study suggests a unified framework for regulating infrastructure complexes with a focus on hazard reduction and cost-effectiveness. The results include a mathematical model of an economic resource, a systematization of infrastructure complexes, and a detailed analysis of risk management principles. The study argues that effective regulation of infrastructure complexes requires a strategic approach combining hazard assessment, economic analysis, and adaptive management. This work contributes to this field by providing a comprehensive understanding of infrastructure regulation and offering applied advice to all stakeholders.

© 2026 Earth Science Division, Azerbaijan National Academy of Sciences. All rights reserved.

Introduction

Infrastructure complexes, including transport networks, energy systems, water supply, and communications, are a vital foundation for economic development. Effective management of these systems is critical for sustaining economic growth and improving the living standards of the population. Over the years of research, numerous scientific approaches to infrastructure management have been proposed. For example, Bertalanffy's Systems Theory emphasizes the interrelationship of infrastructure components and their combined impact on economic indicators. E. Hollnagel's Resilience Engineering concept is similarly aimed at increasing the resilience of infrastructure systems to failures and their ability to recover. These approaches are widely discussed in the scientific literature, particularly in the works of L Hong, M Ouyang, M Xu, P Hu, Terje Aven, Enrico

Zio and other authors who emphasize the importance of adapting to change and reducing risks in infrastructure management. (Hollnagel et al., 2006; Hong et al., 2020)

Russian scientists are also actively studying various aspects of managing the economic potential of infrastructure systems, considering the impact of risks. For example, S.P. Kirilchuk, S.M. Yergin, E.V. Nali-vaychenko, and I.V. Artukhova have investigated methods for assessing the development of the region's production infrastructure, justifying the impact of production infrastructure drivers on economic growth. (Kirilchuk et al., 2022)

E.A. Trofimov and T.I. Trofimova emphasized the need to divide social production into material production (identified with the real sector of the economy) and the infrastructure complex, which includes diverse components such as production, energy, social, institutional, information, and environmental elements. This approach necessitates a rethinking of the traditional understanding of a region's economic potential and the approaches to its assessment. (Trofimov & Trofimova, 2021)

Y.I. Mikhailov, V.P. Semenov and N.V. Mikhailova examined methods for assessing the effectiveness of the production infrastructure of mining enterprises.

Research in the fields of information technology, drivers of economic growth, high-tech industries, social infrastructure, features of digital economy development etc., has indicated the existence of numerous connections, factors, and phenomena between industries and infrastructure systems, uniting them into a single socio-economic system that requires a comprehensive approach.

Analysis of scientific sources revealed a variety of methodologies for determining the economic potential of both the infrastructure as a whole and its individual components. These methodologies primarily reveal the economic aspects of infrastructure potential, although increasing attention is also being paid to social, environmental, and other aspects, and the methods are based on mathematical calculations, discounting, and complex mathematical models. The assessment of economic potential, in a general sense, is primarily considered as the determination of the totality of resources, opportunities, and conditions available to the infrastructure.

The aim of this study is to address these gaps by developing a comprehensive framework for managing the economic potential of infrastructure systems, with a focus on minimizing risks.

Methods

The theoretical and methodological basis of the study were the works of domestic and foreign scientists in the field of economic geography, geopolitics, location of production, network economy, development of regions and clusters, as well as works revealing methodological issues of identification, structural construction of clusters, mechanisms of formation and state support of cluster development. The article uses methods of system, logical, comparative analysis, methods of determining efficiency, groupings, cluster analysis, etc.

Results

For the uninterrupted functioning of the economy a developed infrastructure is necessary. It ensures the unity of production and consumption processes, deepens the specialization of activities, and increases the efficiency of the division of labor. The concept of “infrastructure” is multifaceted and encompasses a set of conditions for economic development, a complex of interconnected industries, the non-productive sector, the service sector, etc. In this context, infrastructure is viewed as a complex, organized system of interconnected economic entities that provide services to support socio-economic activity. Infrastructure systems are divided into transport, energy, heat and water supply, information and communication systems, and others.

There are many classifications of infrastructure systems based on various criteria. In the field of design and management, it is possible to present an original classification of infrastructure systems, based on the criterion of their hierarchy (4 levels) in ensuring the life of the population, functional role, and relationship with the urban environment.

The first level includes essential services for the population, such as water supply, sewage systems, electricity supply, heating, trade, healthcare, security, and others that provide for the basic needs of the population and the economy, supporting the functioning of the urban environment.

The second level of infrastructure covers transport systems, including roads, railways, public transport and airports. They provide mobility for the population and economic entities, the transportation of goods, connecting different parts of the city and regions.

The third level of infrastructure is represented by information and communication systems, such as radio, television, communication networks, the Internet, data management systems, etc. They facilitate the transmission of information, access to knowledge, and coordination of various areas of activity.

At the fourth level of infrastructure formations are waste management systems, such as landfills, waste processing plants, and waste recycling systems, which ensure environmental safety and sustainable development of the urban environment.

Infrastructure systems provide services to the population and businesses, and participate in the creation of tangible and intangible goods and values. They provide access to markets and all types of resources and information, and create favorable conditions (including institutional ones) for business and entrepreneurship development. Developed infrastructure systems influence economic performance by contributing, for example, to lower transaction costs, increased labor productivity, and faster capital turnover, thereby stimulating investment activity. In addition, infrastructure plays a vital role in ensuring social stability and improving the quality of life of the population by providing access to education, healthcare, and other social services.

Like any economic object (element), infrastructure systems possess characteristics and indicators that reflect their features, state, and dynamics of change, and which serve the purposes of management, planning, and development. One of the most important characteristics of infrastructure systems, which has not yet been sufficiently studied, is economic potential, reflecting their ability to sustain themselves and develop independently. Furthermore, the economic potential of the infrastructure system is considered as a combination of resources, opportunities, and factors capable of ensuring sustainable economic growth and improving the living standards of the population in a given territory. It includes not only the physical presence of infrastructure facilities, such as transport networks, energy systems, and communication lines, but also their qualitative characteristics, operational efficiency, and ability to adapt to the changing needs of the economy.

Assessing the economic potential of an infrastructure system requires a comprehensive approach that considers both quantitative and qualitative indicators. For example, it is important to consider not only the volume of investment in infrastructure, but also its effectiveness.

The economic potential of an infrastructure system is its ability to generate economic value by supporting production, exchange, and consumption. This potential is determined by characteristics such as productivity, efficiency, and sustainability.

Based on this definition of an infrastructure system, economic potential consists of the following key components:

Physical (tangible) assets, which include infrastructure facilities such as roads, canals, power supply networks, buildings, structures, as well as equipment, raw materials, etc.

Intangible assets mean the elements that do not have a physical form but generate economic profit (e.g., patents, service marks, trademarks, licenses, etc.).

Human resources, which is represented by qualified specialists involved in the creation of the infrastructure system, maintaining its operation, and managing it.

Financial resources include the investments and funding necessary to ensure the operation and development of the infrastructure.

Technological advancements are progressive technologies that improve the performance and productivity of infrastructure.

The combination of components and the structure of an infrastructure system determine the size and characteristics of its economic potential. Given the importance and influence of potential, it can be argued that economic potential also affects the composition of components and the structure of the infrastructure system.

For management and planning purposes, the economic potential of an infrastructure system (EPIS) can be represented by the following mathematical expression:

$$EPIS = \sum(TA + IA + HC + FR + TI) \times R \times EMS \times S, \quad (1)$$

where TA denotes tangible assets; IA – intangible assets; HC – human capital; FR – financial resources; TI – technological innovations; R – risk-based losses (value in the range 0-1); EMS – efficiency of the management system of infrastructure (value in the range 0-1); S – socio-economic situation in the region (value in the range 0-1).

To determine the volume (value) of the economic potential of an infrastructure system, relevant economic indicators (cost, prices, revenues, etc.), as well as expert assessments, can be used. The determination of expert assessment values can be illustrated using Table 1 as an example.

Table 1

Scale of expert assessment values (in scores)

Range of the assessment	Criteria	Description
0-0.2	Low level	Minimal influence
0.2-0.5	Average risk level	Insignificant influence
0.5-0.8	High level of risks	Significant impact
0.8-1	Critical level of risks	High impact

The management of the infrastructure system must ensure the creation of conditions and the application of such methods, in which the formation and use of economic potential, considering risk and the need to achieve the required level of competitiveness, should strive for maximum values in each period of time:

$$EPIS \rightarrow \max. \quad (2)$$

Infrastructure risks are the probability of events occurring that threaten the functioning of key infrastructure elements (transport, energy, water supply, communications, IT).

It is important to synchronize the management of infrastructure and the industries it serves. Infrastructure serves as the foundation for the successful functioning of these industries. Therefore, management should be aimed at maintaining operational efficiency, development, and adaptation to the needs of the industry, which is achieved through planning, design, construction, operation, and modernization.

There is a close relationship between the economic potential of infrastructure and the industry it serves. Infrastructure creates the conditions for the efficient operation of the industry, reducing costs and ensuring reliable access to resources. In turn, the growth of the industry stimulates the development of infrastructure.

It is important to distinguish between strategic, tactical, and operational management of the economic potential of infrastructure, considering the impact of risks. Strategic management focuses on long-term goals and risk prevention, while tactical and operational management address short-term tasks. Strategic management defines the mission and direction of development, tactical management develops specific measures, and operational management ensures uninterrupted operation. Risk management is an integral part of strategic management, while tactical and operational management consider risks in the context of current tasks.

Let's consider the key aspects of the goals and objectives associated with managing the economic potential of the infrastructure system, considering the impact of risks. The main goal in this context is to maximize the socio-economic impact of the infrastructure system while ensuring its high resilience in the face of various risk situations.

Achieving this overall goal requires fulfilling a number of conditions:

1) the staff of the infrastructure system must ensure the effective attraction, allocation, and rational use of resources aimed at maintaining current operations and development;

2) an essential condition is the consideration of risks and the development of measures to eliminate negative consequences following the adoption of management decisions;

3) realizing economic potential involves implementing innovations, including in the technological sphere. This makes it possible to increase the efficiency and quality of services through modernization;

4) it is very important to use a variety of tools and methods to improve efficiency in the field of management, such as diversifying sources of funding or establishing partnerships between the state and the private sector;

5) the coordination of measures undertaken by all participants in infrastructure complexes and the transparency of the entire process are absolutely essential for realizing human resource potential in various areas of the economy and for effective risk management.

The results obtained highlight the importance of developing a strategy in the field of infrastructure potential management. This includes analyzing and preventing threats, minimizing risks, and ensuring the rationality of financial investments. This study presents a framework that considers the diversity of risks and their potential consequences for economic growth.

Conclusion

1. Infrastructure complexes play a key role in economic progress, but they are subjected to serious risks.
2. Effective management involves applying a strategic model that combines risk analysis and cost-effective solutions.
3. The proposed model for managing the economic potential of infrastructure, which considers the impact of risks, provides valuable insights for industry stakeholders.

REFERENCES

- Aven, T., & Zio, E. (2021). Globalization and global risk: How risk analysis needs to be enhanced to be effective in confronting current threats. *Reliability Engineering & System Safety*, 205, Article 107270. <https://doi.org/10.1016/j.res.2020.107270>
- Charykova, O.G., & Markova, E. S. (2019). Regional clustering in the digital economy. *Economy of Region*, 15(2), 409–419. <https://cyberleninka.ru/article/n/regionalnaya-klasterizatsiya-v-tsifrovoy-ekonomike>
- Dzobelova, V. B., Dovtaev, S.-A.S., Kuzina, A.F., Shadieva, M.Y., & Elgaitarova, N.T. (2020). Analytical support of the management accounting system in an unstable economy conditions. *International Review*, (3–4), 130–136.
- Fonotov, A.G., & Bergal, O.E. (2019). Territorial clusters as a mechanism for spatial development of Russian economy. *Russian Journal of Economic Theory*, 16(4), 673–687. <https://doi.org/10.31063/2073-6517/2019.16-4.6>
- Hollnagel, E., Woods, D.D., & Leveson, N.G. (Eds.). (2006). *Resilience engineering: Concepts and precepts*. Ashgate. <https://erikhollnagel.com/books/resilience-engineering-2006>
- Hong, L., Ouyang, M., Xu, M., & Hu, P. (2020). Time-varied accessibility and vulnerability analysis of integrated metro and high-speed rail systems. *Reliability Engineering & System Safety*, 193, Article 106622.
- Jafarov, S. (2024). Internationalisation and cultural aspects of online learning, training, and research. *Pakistan Journal of Life and Social Sciences*, 22(2), 6437–6452. <https://doi.org/10.57239/PJLSS-2024-22.2.00486>
- Jafarov, S., Babashova, S., Dadashov, T., & Garibov, S. (2024). The influence of intonation on the interpretation of parenthetical clauses. *Pakistan Journal of Life and Social Sciences*, 22(2). <https://doi.org/10.57239/pjlss-2024-22.2.00810>
- Kirilchuk, S.P., Ergin, S.M., Nalivaychenko, E.V., & Artuhova, I.V. (2022). Methodology for assessing the development of regional production infrastructure (on the example of the Republic of Crimea). *MIR (Modernization. Innovation. Research)*, 13(4), 720–736. <https://doi.org/10.18184/2079-4665.2022.13.4.720-736>
- Mammadova, B., Iskender, E., Jafarzadeh, S., Mustafayeva, L., & Mesimzade, G. (2026). Characteristics of forest phytocoenoses established by the biogroup method in the eastern Zangezur region. *Acta Botanica Caucasica*, 5(1), 52–58. <https://doi.org/10.30546/abc.2026.1146>
- Mirzaev, N.A., Marinova, A.P., Mammadov, Kh.F., Temerbulatova, N.T., Kozempel, J., & Filosofov, D.V. (2020). Sorption of metal ions on an anion-exchange resin in an ammonium acetate solution. *Russian Journal of Physical Chemistry A*, 94, 1190–1194. <https://doi.org/10.1134/S0036024420060175>
- Nosonov, A.M. (2023). Formation of innovative territorial clusters in the regions of Russia. *Russian Journal of Regional Studies*, 31(3), 498–513. <https://doi.org/10.15507/2413-1407.124.031.202303.498-513>
- Radoushinsky, D.A., Radushinskaya, A.I., & Khaykin, M.M. (2023). Improving the quality of implementation of the container transportation project along the NSR based on the environmental and energy transition agenda. *Polar Science*, 35, Article 100923. <https://doi.org/10.1016/j.polar.2022.100923>
- Trofimov, E.A., & Trofimova, T.I. (2021). Economic and theoretical aspects of the structure of the modern economy. *Baikal Research Journal*, 12(2), Article 2. [https://doi.org/10.17150/2411-6262.2021.12\(2\).2](https://doi.org/10.17150/2411-6262.2021.12(2).2)
- Yagolnitsr, M.A., Kolobova, E.A., & Buruk, A.F. (2020). Evaluating the impact of cluster development on the region's economy. *Region: Economics and Sociology*, (3[107]), 218–241. <https://doi.org/10.15372/REG20200309>

УПРАВЛЕНИЕ ФИНАНСОВЫМИ РЕСУРСАМИ ИНФРАСТРУКТУРНЫХ ОБЪЕКТОВ С УЧЁТОМ АНАЛИЗА РИСКОВ

Байгузина Л.З.^{1*}, Багратуни К.Ю.², Федюнин Д.В.³, Агакишиева Г.Р.⁴,
Аллахверенов М.Ш.⁵, Строков А.И.², Михайлова А.Е.⁶, Дзобелова В.Б.⁷

¹Уфимский университет науки и технологий, Россия
450076, Уфа, ул. Заки Валиди, 32

²Финансовый университет при Правительстве Российской Федерации, Россия
125167, Москва, Ленинградский пр., 49/2

³Российский экономический университет имени Г. В. Плеханова, Россия
117997, Москва, Стремянный пер., 36

⁴Институт географии Министерства науки и образования Азербайджанской Республики, Азербайджан
AZ1073, Баку, пр. Г. Джавида, 117

⁵Мингячевирский государственный университет, Азербайджан
AZ4500, Мингячевир, ул. Д. Алиевой, 21

⁶Санкт-Петербургский государственный лесотехнический университет имени С. М. Кирова, Россия
194021, Санкт-Петербург, Институтский пер., 5

⁷Северо-Осетинский государственный университет имени К. Л. Хетагурова, Россия
362025, Владикавказ, ул. Ватутина, 44–46

*Автор, отвечающий за переписку: lyuzab@mail.ru

Резюме. Целью данного исследования является изучение методов регулирования экономических ресурсов инфраструктурных комплексов с учётом воздействия факторов риска. Инфраструктурные комплексы играют важную роль в развитии

экономике, однако подвержены различным угрозам, включая финансовые, экологические и операционные трудности. В исследовании определяются основные компоненты инфраструктурных комплексов, их экономический потенциал и риски, связанные с их регулированием. На основе анализа существующих научных подходов и соответствующих публикаций предлагается единая концептуальная основа регулирования инфраструктурных комплексов с акцентом на снижение угроз и обеспечение экономической эффективности. Результаты включают математическую модель экономического ресурса, систематизацию инфраструктурных комплексов и подробный анализ принципов управления рисками. В исследовании обосновывается, что эффективное регулирование инфраструктурных комплексов требует стратегического подхода, объединяющего оценку угроз, экономический анализ и адаптивное управление. Данная работа вносит вклад в развитие рассматриваемой области, обеспечивая комплексное понимание регулирования инфраструктуры и предлагая практические рекомендации всем заинтересованным сторонам.

Ключевые слова: инфраструктурные системы, экономическая эффективность, экономический потенциал и риски, стратегическое управление, устойчивость, управление

RİSKLƏRİN TƏHLİLİ NƏZƏRƏ ALINMAQLA İNFRASTRUKTUR OBYEKTlərİNİN MALİYYƏ RESURLARININ İDARƏ EDİLMƏSİ

Bayguzina L. Z.^{1*}, Bagratuni K. Y.², Fedyunin D. V.³, Ağakışiyeva G. R.⁴, Allahverənov M. Ş.⁵, Strokov A. İ.², Mixaylova A. Y.⁶, Dzobelova V. B.⁷

¹Ufa Elm və Texnologiyalar Universiteti, Rusiya
450076, Ufa, Zəki Vəlidü küç. 32

²Rusiya Federasiyası Hökuməti yanında Maliyyə Universiteti, Rusiya
125167, Moskva, Leninqrad pr. 49/2

³G. V. Plexanov adına Rusiya İqtisad Universiteti, Rusiya
117997, Moskva, Stremyannı döngəsi, 36

⁴Azərbaycan Respublikası Elm və Təhsil Nazirliyi, Coğrafiya İnstitutu, Azərbaycan
AZ1073, Bakı, H. Cavid pr. 117

⁵Mingəçevir Dövlət Universiteti, Azərbaycan
AZ4500, Mingəçevir, D. Əliyeva küç. 21

⁶S. M. Kirov adına Sankt-Peterburq Dövlət Meşəçilik Texniki Universiteti, Rusiya
194021, Sankt-Peterburq, İnstitutski döngəsi, 5

⁷K. L. Xetaqurov adına Şimali Osetiya Dövlət Universiteti, Rusiya
362025, Vladıqafqaz, Vatutin küç. 44–46

*Məsul müəllif: lyuzab@mail.ru

Xülasə. Tədqiqatın məqsədi risk amillərinin təsirini nəzərə almaqla infrastruktur komplekslərinin iqtisadi resurslarının tənzimlənməsi üsullarını araşdırmaqdır. İnfrastruktur kompleksləri iqtisadiyyatın inkişafında mühüm rol oynayır, lakin maliyyə, ekoloji və əməliyyat çətinlikləri kimi müxtəlif təhlükələrə məruz qalır. Tədqiqatda infrastruktur komplekslərinin əsas komponentləri, onların iqtisadi potensialı və tənzimlənməsi ilə bağlı risklər müəyyən edilmişdir. Mövcud elmi yanaşmaların və müvafiq nəşrlərin təhlili əsasında təhlükələrin azaldılmasına və iqtisadi səmərəliliyə xüsusi diqqət yetirilməklə infrastruktur komplekslərinin tənzimlənməsi üçün vahid konseptual çərçivə təklif olunur. Nəticələr iqtisadi resursun riyazi modelini, infrastruktur komplekslərinin sistemləşdirilməsini və risklərin idarə edilməsi prinsiplərinin ətraflı təhlilini əhatə edir. Tədqiqatda əsaslandırılır ki, infrastruktur komplekslərinin səmərəli tənzimlənməsi təhlükələrin qiymətləndirilməsini, iqtisadi təhlili və adaptiv idarəetməni birləşdirən strateji yanaşma tələb edir. Bu tədqiqat infrastrukturun tənzimlənməsinin hərtərəfli anlaşılmasını təmin etməklə və bütün maraqlı tərəflərə praktiki tövsiyələr təqdim etməklə müvafiq sahəyə töhfə verir.

Açar sözlər: infrastruktur sistemləri, iqtisadi səmərəlilik, iqtisadi potensial və risklər, strateji idarəetmə, dayanıqlıq, idarəetmə