інноваційного розвитку корпоративно-інтегрованих структур у системі активізації організаційного ресурсу маркетингового менеджменту та визначення шляхів їх вирішення. Для досягнення мети використано методи аналізу та синтезу, індукції та дедукції, порівняння, класифікації, системного підходу, статистичного аналізу, структурно-логічного узагальнення.

У статті досліджено та узагальнено світовий досвід корпоративного управління. Розглянуто польську практику успішного функціонування інтегрованих корпоративних структур. Проведено статистичний аналіз діяльності акціонерних товариств України. Розглянуто проблемний стан інноваційного розвитку корпоративних структур України та визначено шляхи його усунення. Досліджено особливості, фактори, організаційні форми, моделі, види науково-технічної та інноваційної діяльності корпоративних структур в Україні. Запропоновано організаційний дизайн компанії, який спрямований на залучення організаційних ресурсів. Визначено пріоритетні напрями інноваційного розвитку корпоративно-інтегрованих структур в Україні.

Ключові слова: *корпоративна інтеграція, корпоративні інтеграційні процеси, корпоративне управління, інтегровані корпоративні структури, інноваційний розвиток, інноваційна діяльність, маркетинговий менеджмент, організаційний ресурс, світовий досвід, польська практика.*

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Tetiana CHARKINA ©
D.Sc. in Economics, Professor *(Ukrainian State University of Science and Technologies),* Ukraine

Oleksii ZALESKYI ©
Post-graduate *(Ukrainian State University of Science and Technologies),* Ukraine

ORGANIZATION OF PROJECT MANAGEMENT OF RAILWAY TRANSPORT INFRASTRUCTURE MODERNIZATION IN THE CONTEXT OF DIGITALIZATION

Abstract. The organization of project management of the modernization of railway transport infrastructure in conditions of digitalization is an important aspect of the development of the transport industry, which requires a deep analysis and understanding of modern trends. The article is devoted to the study of approaches to projects in the modernization of railway transport infrastructure aimed at the implementation of digital innovative technologies. The authors consider railway transport as a key element of urban mobility, which is experiencing a

© Charkina T, 2024
ORCID iD: https://orcid.org/0000-0001-6202-0910
charkina@i.ua

© Zaleskyi O., 2024
ORCID iD: https://orcid.org/0009-0006-4737-3703
kafedraem@ukr.net

period of significant changes caused by modern trends towards digitalization and innovation.

The research substantiates the current challenges facing the industry, including the need to increase efficiency, reduce costs and improve the quality of services. Emphasis is placed on the importance of implementing the latest IT solutions, such as IoT, AI, machine learning and 5G technologies, which can provide greater security, reliability and optimization of resource management. The article defines various aspects of the modernization of railway transport, which includes not only technical innovations, but also the development of an organizational and economic project management mechanism.

The article develops an organizational and economic mechanism for managing infrastructure projects in railway transport. This mechanism includes a set of measures and structural relationships aimed at effective functioning and development of the project in the conditions of digital transformation. In particular, attention is focused on the need to implement information technologies for the automation of management processes, data analysis and strategic decision-making, as well as resource optimization and project effectiveness maximization.

The authors suggested the use of modern project management methods, such as Agile and Scrum, and the introduction of innovative approaches to the management process based on Big Data analysis and the use of artificial intelligence. Strategies for risk management and ensuring a high level of information protection in terms of digital security have been developed, which plays a key role in the successful implementation of transport infrastructure projects.

Keywords: *railway transport, digitalization, project management, infrastructure modernization, innovative technologies, organizational and economic mechanism, risk management strategies.*

Introduction. In the modern world, railway transport is going through a period of significant changes caused by global digitalization and innovation. These changes are transforming urban mobility, offering new challenges and opportunities for the development of transport infrastructure.

Digitalization of railway transport is a response to the growing needs of passengers and goods manufacturers to increase efficiency, reduce costs, and improve the quality of services. It includes the implementation of the latest IT solutions to optimize work processes, increase the transparency of activities and create new business models that will satisfy modern market demands.

Today's technological landscape is characterized by rapid development and adoption of innovations such as IoT, AI, machine learning and 5G technologies, which are changing the face of public transport. These technologies make it possible to increase the efficiency of passenger service, ensure greater safety and reliability of vehicles, as well as optimize logistics and resource management.

Research in the field of digital transformation of railways emphasizes the importance of innovation to improve productivity and service quality. Various aspects are considered, from optimizing train schedules and routing to customizing services and improving logistics using blockchain.

Such approaches play a critical role in the renewal of railways, highlighting significant benefits for increased productivity, improved safety and improved customer service. The use of intelligent control systems and automated ticket reservation platforms allows not only more efficient management of resources, but also opens up new horizons for the development of the industry.

Analysis of recent research and publications. In the field of modernization of railway transport, there is an urgent need for in-depth analysis and elaboration of various aspects that have not been comprehensively covered in the scientific literature. This direction of research is actively developing thanks to the efforts of such scientists as V. Dykan', H. Ozerska, O. Kirdina,

H. Obruch, M. Korin', I. Tokmakova, T. Charkina, V. Zadoya, and others (Dykan' & Korin', 2020; Kirdina, Tokmakova et al., 2023; Tokmakova, Cherednychenko et al., 2019; Obruch, 2020; Zadoya, 2022; Charkina & Orlovs'ka, 2022; Galushko, 2017; Martseniuk, Dyomin & Galushko, 2021), which make a significant contribution to the development of the process of organizing the project management of the modernization of railway transport infrastructure in the context of the introduction of digital technologies, offering new ideas, solutions and approaches to solving modern challenges in this field. In their activities, they demonstrate how the integration of the latest processes can contribute to the creation of more efficient, safe, and customer-oriented transport systems.

At the same time, despite a significant amount of research, many issues require additional study in the context of the impact of external and internal changes on the industry, which create new challenges and prospects for its development.

The purpose of the article is to study the implementation of project management of the modernization of infrastructure facilities of railway transport in the conditions of digital technologies and innovation.

Formulation of the main material. Digital control systems make it possible to automate many processes that previously required manual intervention. For example, intelligent systems can optimize traffic schedules, detect delays or schedule conflicts, and automatically adjust routes in real time. This increases the efficiency of the staff and ensures smooth movement of trains.

Digital technologies in monitoring and diagnostic systems contribute to increasing the safety of railway transport and allow identifying and diagnosing potential problems with rolling stock or infrastructure before they lead to accidents. This helps reduce the risk of collisions, accidents and other incidents.

Digitalization also accumulates the experience of consumers, which in the future provides an opportunity to improve the quality of railway services. E-ticketing, online booking and mobile apps for controlling train schedules and tracking train movements make traveling more convenient and affordable. This contributes to the growth of customer satisfaction and their loyalty.

Digital transformation also helps railways become more energy efficient and environmentally sustainable. Intelligent control systems can optimize fuel and energy consumption, minimizing CO_2 emissions. Digitalization supports the integration of railways with other modes of transport, promoting the development of multimodal transport solutions and opening the way for innovations: the introduction of unmanned trains, the use of Big Data for demand forecasting and asset management.

The process of implementing digitalization of railway transport is a catalyst for the procedure of organizing projects of modernization and renovation of infrastructure facilities of railway transport, contributing not only to the increase of operational efficiency and safety, but also to the improvement of service for passengers, sustainable development of the system.

Implementation of infrastructure projects in the field of railway transport is an important tool for stimulating economic growth and recovery of the national economy in the post-war period. Scientific studies conducted earlier indicated the following areas of implementation of infrastructure projects (Zadoya, Charkina & Sytnik, 2024):

– Modernization of the railway infrastructure in order to increase the speed of rolling stock. This direction of development is critically important for increasing the average regional speed of warehouse movement, which directly affects the speed of movement of goods or passengers.

– Development of multimodal terminal and logistics centers. The development of these centers can increase the convenience of using the railway infrastructure, both for passengers and for senders and receivers of goods. In addition, strengthening the multimodal infrastructure will help to increase the level of integration of railway transport into logistics chains, reduce the mileage and generally increase its attractiveness compared to road and sea transport.

– Development of transport interchanges. This direction in railway infrastructure development projects is one of the main ones for achieving positive agglomeration effects, such as increasing employment of the population, wages, etc.

– Modernization of the infrastructure of border crossings. The movement of warehouses often slows down when crossing the border. This is due to many factors, starting from the differences in the diameter of the railway track and parameters of the electrification of the railway network and ending with the inefficiency of the customs document flow at the border crossing.

– Implementation of digital platform solutions. The digitalization of railways can not only increase the efficiency of the transport system, the throughput capacity of nodes, but will also contribute to all market participants, as it will significantly increase the convenience of use for passengers and shippers of goods and will allow more efficient integration of rail transport into logistics chains.

For example, in the context of infrastructure projects aimed at organizing passenger traffic, it is possible to obtain various socio-economic effects:

1. Saving time on the road.
2. Improvement of transportation safety.
3. Reduction of emissions of harmful substances and noise level (when choosing alternative options).
4. Positive impact of public transport due to increased physical activity.
5. Social integration and creation of a barrier-free environment.
6. Subjective well-being – perception of the environment or level of happiness (Danylchenko, 2016).

Infrastructure modernization projects are extremely capital intensive and often cannot be fully implemented due to funding constraints. This factor plays a particularly significant role in wartime conditions and forces one to evaluate not only potential effects, but also to carry out comprehensive risk management when deciding on the implementation of an infrastructure project on railway transport.

Another problem of infrastructure modernization projects lies in the principles of cost and risk distribution among its participants. Transport infrastructure projects (TIP) are usually accompanied by a number of risks. Some of them are specific and characteristic only for transport projects.

In the study (Painvin, n.d.), the authors single out three main groups of risks:

– *political*, characterized by threats: long duration of project coordination processes, high probability of intervention by state authorities, deliberate

overestimation of benefits from project implementation in order to obtain political dividends, incorrect assessment of the quality of the institutional environment and legal framework, etc.

– *complex*, due to the uniqueness of transport infrastructure projects. For example, the length of the project's life cycle can lead to difficulties in estimating the costs of implementation and achieving the planned social or commercial effects within the contractual terms and within the allocated budgets due to deliberate "strategic distortions" or errors – the difference between the expected and actual passenger traffic can be within 25 % to 85 % (Dehornoy, n.d.). It is also possible to include here the suboptimal distribution of risks, rights and obligations between the participants in accordance with the concession agreement, etc.

– *commercial*, may arise due to financial, organizational, technical, legal or other factors.

One of the features of infrastructure project management in general is that the project is usually divided into several sub-projects (for example, planning, design, construction, operation).

However, the transport infrastructure is an extensive network with a complex technological process, and each of its links has certain features and limitations that affect the implementation of the project. It is characterized by a linear-nodal type of location, which distinguishes it from industrial (point type) and agricultural (areal type) objects. These aspects are important for project stakeholders, as they must be confident that all factors necessary for the launch or implementation, including technical, financial and logistical, are carefully considered and taken into account in the project planning process.

One of the most important aspects of the successful implementation of any project is the ability to adapt to changes in the internal and external dynamic environment. The factors of the project's internal environment traditionally include: infrastructure, personnel, financial sphere, sales and production sphere, resource provision, management methods, communication channels, technologies (CRM), etc. The external environment includes - political, economic, social, legal, technical and technological, natural and other factors that can affect the project.

Modern infrastructure project management methodologies distinguish general and special factors (Reznikova, 2022).

General factors of external influence include: institutional (level of development of the institutional environment, level of integration of project participants, etc.), organizational (level of knowledge, competence and creativity of management, level of motivation, efficiency and functionality of the organizational management structure, etc.), economic, political, social, natural and other factors.

Special factors have a direct impact on the efficiency and effectiveness of a specific project and include: technical-technological, organizational-legal, organizational-economic, financial, etc. aspects

General and special factors collectively determine the principles of managing transport infrastructure projects, which from the point of view of a systemic approach include: decentralization of works; cooperation with the private sector; principle of subsidiarity; mobility and adaptability; the principle of allocated competence; compliance of powers and responsibilities;

systematicity of the developed solutions and assessment of their effectiveness; principle of scientific validity, life cycle and other aspects.

There are a number of methodological approaches to the management of large infrastructure projects, each of which has its own definition and regulates the process of their development and implementation (Hertogh, Baker et al., 2008):

– PMBOK project management standard (PMBOK Guide, 2008);

– national requirements for the competence of project management specialists;

– methodological developments of Ukrainian and foreign consulting companies.

Acquaintance with the tools that exist in the methodological recommendations of different countries can be key to the successful management of infrastructure projects, to ensure their effective planning and implementation.

In the modern economy, project management processes are characterized by the following features (Table 1): creation of a complex of interconnected projects, selection and regulation of project quality, project implementation planning, project implementation management (monitoring). An important part of the project is the process of structuring (decomposition), that is, dividing it into hierarchical subsystems and components.

Table 1

Groups of project management processes in railway transport in conditions of digitalization

PROCESS GROUPS ACCORDING TO *PMBOK*	**GROUPS OF INFRASTRUCTURE PROJECT MANAGEMENT PROCESSES IN RAILWAY TRANSPORT IN THE CONDITIONS OF DIGITALIZATION**
1. Group of initiation processes:	– Identification of the needs and possibilities of digitalization of railway transport infrastructure. – Determination of the priority areas of digital development of the railway. – Selection of a model for the implementation of digital technologies in an infrastructure object, taking into account the specifics of the project and the customer's requirements.
2. Group of planning processes:	– Comprehensive examination of the existing infrastructure and justification of the necessary changes for digitalization. – Development of a detailed plan for the implementation of digital technologies in the infrastructure object, including technical, time, financial and resource aspects. – Determination of key stages and milestones of the project.
3. Group of execution processes:	– Conducting a tender process for the selection of suppliers of digital solutions and services. – Awarding of contracts for the development and implementation of digital technologies in the infrastructure of railway transport.

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PROCESS GROUPS ACCORDING TO *PMBOK*	GROUPS OF INFRASTRUCTURE PROJECT MANAGEMENT PROCESSES IN RAILWAY TRANSPORT IN THE CONDITIONS OF DIGITALIZATION
4. Group of management monitoring processes:	– Control of construction works and implementation of digital solutions. – Evaluation of the project's effectiveness, taking into account the achieved results and compliance with the goals.
5. Group of completion processes:	– Management of contracts and closing contractual relations with suppliers. – Project monitoring at the completion stage to ensure compliance with customer requirements and expectations.

Source: developed by O. Zaleskyi

The systematic use of these principles will allow to ensure the concentration of synergy, which can act as the initiator of the project, to form an objective fundamental basis for the development of an organizational and economic mechanism for managing the infrastructure project on railway transport in conditions of digitalization.

The organizational and economic mechanism of managing the infrastructure project on the railway in the conditions of digitalization is a set of measures and structural relationships aimed at ensuring the effective functioning and development of the project in the conditions of digital transformation (Fig. 1). It includes the implementation of information technologies for the automation of management processes, data analysis and strategic decision-making, as well as the optimization of resources and the maximization of project effectiveness.

The organizational and economic mechanism involves the use of modern methods of project management, such as Agile or Scrum, and the introduction of innovative approaches to the management process based on the analysis of Big Data and the use of artificial intelligence, the development of risk management strategies and ensuring a high level of information protection in conditions of digital security Its purpose is to ensure the successful implementation of the transport infrastructure project, the achievement of the set goals and the maximization of the socio-economic impact.

In general, the authors of the study believe that the key aspects for the successful implementation of projects of infrastructural facilities on railway transport in the conditions of digitalization are the following.

First, it is recommended to consider the possibility of dividing the main project into smaller sub-projects, each of which will be responsible for specific functions and can be transferred to private partners. For example, the conclusion of life cycle contracts (Chukaeva, 2019) taking into account the technical risks and peculiarities of the technological cycle of this or that infrastructure object.

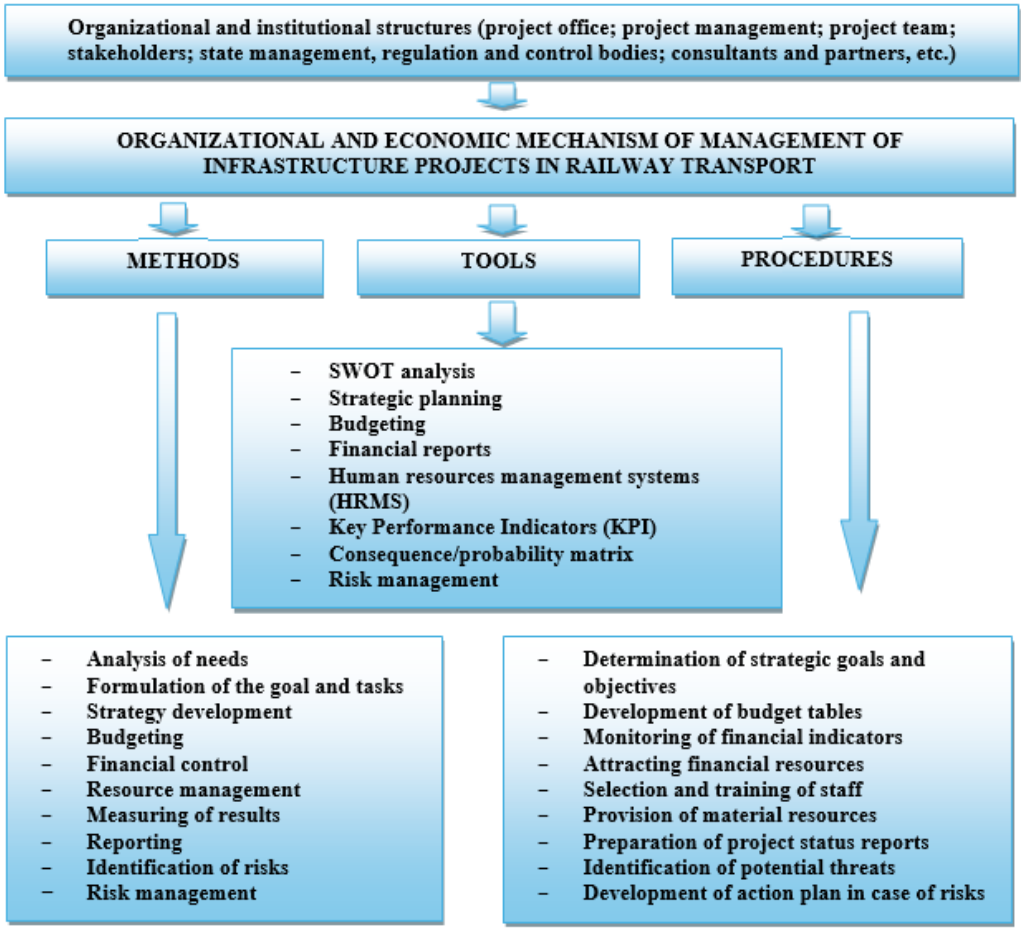

Fig. 1. – Constituent elements of the organizational and economic mechanism of managing infrastructure projects in railway transport in conditions of digitalization

Source: developed by O. Zaleskyi

The second important step is the standardization of all subprojects according to the technological requirements defined at the pre-project stage. This will help to avoid conflicts and risks associated with inconsistency of standards between different elements of the project. However, it should be noted that the responsibility for this process should be transferred to the structural body of the railway to ensure its effectiveness and compliance.

The third stage is the implementation of the project implementation monitoring system, which will be based on a constant analysis of risks and cost effectiveness. The important indicators of such monitoring should include the assessment of cost effectiveness (Value For Money) and the distribution of risks between project participants.

Fourth – management decisions should be based on the mechanisms of clear definition of contract specifications, centralized responsibility, insurance and guarantee provision.

Conclusions. The article proposes an organizational and economic mechanism for managing infrastructure projects in railway transport, which will help the effective functioning and development of projects in the conditions of digital transformation.

The research determined that the key aspect for the successful

implementation of infrastructure projects is the division of the main project into smaller sub-projects with a clear division of responsibilities and risks, standardization of technological processes and effective monitoring of project implementation with an emphasis on cost effectiveness analysis and risk management.

Thus, the authors emphasize the need to ensure the successful implementation of transport infrastructure projects that can stimulate economic growth and contribute to the recovery of the national economy, especially in the post-war period. This will make it possible to carry out the optimal distribution of risks and provide projects with the appropriate level of financial acceptability and viability. The implementation of these measures will contribute to the increase in the efficiency of the process of managing railway infrastructure development projects and will ensure their financial stability.

Conflict of Interest and other Ethics Statements
The authors declare no conflict of interest.

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Тетяна ЧАРКІНА, Олексій ЗАЛЕСЬКИЙ

ОРГАНІЗАЦІЯ ПРОЄКТНОГО УПРАВЛІННЯ МОДЕРНІЗАЦІЄЮ ІНФРАСТРУКТУРИ ЗАЛІЗНИЧНОГО ТРАНСПОРТУ В УМОВАХ ЦИФРОВІЗАЦІЇ

Анотація. Організація проєктного управління модернізацією інфраструктури залізничного транспорту в умовах цифровізації є важливим аспектом розвитку транспортної галузі, яка вимагає глибокого аналізу та розуміння сучасних тенденцій. Стаття присвячена дослідженню підходів до проєктів при модернізації інфраструктури залізничного транспорту спрямованих на впровадження цифрових інноваційних технологій. Автори розглядають залізничний транспорт, як ключовий елемент урбаністичної мобільності, що переживає період значних змін, спричинених сучасними тенденціями до цифровізації та інноватики.

В дослідженні обґрунтовано сучасні виклики, з якими стикається галузь, включно з потребою в підвищенні ефективності, зниженні витрат та удосконалення якості послуг. Акцентується увага на важливості впровадження новітніх IT-рішень, таких як IoT, AI, машинне навчання та 5G технології, які можуть забезпечити більшу безпеку, надійність та оптимізацію управління ресурсами. В роботі визначені різноманітні аспекти модернізації залізничного транспорту, що включає в себе не тільки технічні нововведення, але й розробку організаційно-економічного механізму управління проєктами. В статті розроблено організаційно-економічний механізм управління інфраструктурними проєктами на залізничному транспорті. Цей механізм включає в себе комплекс заходів і структурних взаємозв'язків, спрямованих на ефективне функціонування та розвиток проєкту в умовах цифрової трансформації. Зокрема, акцентується увага на необхідності впровадження інформаційних технологій для автоматизації управлінських процесів, аналізу даних і прийняття стратегічних рішень, а також оптимізації ресурсів й максимізації результативності проєкту.

Авторами запропоновано використання сучасних методів управління проєктами, таких як Agile і Scrum, і впровадження інноваційних підходів до процесу управління, що ґрунтуються на аналізі Big Data та використанні штучного інтелекту. Розроблено стратегії ризик-менеджменту й забезпечення високого рівня захисту інформації в умовах цифрової безпеки, що відіграє ключову роль в успішній реалізації транспортних інфраструктурних проєктів.

Ключові слова: *залізничний транспорт, цифровізація, проєктне управління, модернізація інфраструктури, інноваційні технології, організаційно-економічний механізм, стратегії ризик-менеджменту.*