

## **INTEGRAL APPROACHES TO MANAGING TRANSPORT SYSTEM DEVELOPMENT PROJECTS**

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In the context of sustainable development, transport systems must be integrated with environmental, social, and economic objectives, as defined in the United Nations Sustainable Development Goals. This includes emission reduction, optimization of freight delivery systems, and risk management. The contemporary transport sector is undergoing a period of intensive transformation driven by the rapid advancement of digital technologies and the necessity to adapt to the evolving demands of society. In this context, project management in the transport industry faces new challenges that require a revision of traditional approaches to planning and implementing solutions aimed at improving the efficiency of freight delivery systems.

Integrated project management methods, which combine elements of traditional and agile methodologies, represent a promising solution for the transport sector. They enable the preservation of the required level of structural rigor while simultaneously ensuring flexibility and adaptability to change. Traditional project management approaches, focused on detailed upfront planning, often prove inadequate in conditions of rapid technological change in the transport sector, unpredictable regulatory shifts, the need to integrate new digital solutions, increasing sustainability requirements, and the involvement of diverse stakeholders.

Mathematical models for sustainable development in freight forwarding and logistics activities include risk-based models, such as multimodal transport risk models with stochastic parameters [1, 2]. Bifurcation analysis in traffic flow models demonstrates transitions to instability induced by risk parameters [3, 4].

Recent studies in the field of integrated project management in transport emphasize the integration of strategic and project management. For instance, study [5] on integration in transport enterprises highlights the necessity of strategic planning for sustainable operational development.

Integrated project management methods represent a combination of elements from various methodologies adapted to the specific characteristics of a given project or organization. The main types of integrated approaches in managing transport development projects include: phased integration, which involves the application of different methodologies at different project stages, for example, employing a traditional approach for planning freight delivery systems and Agile methods for implementing transport development projects; functional integration, which implies the allocation of methodologies across functional domains of a transport project, such as traditional methods for managing transport infrastructure and Agile approaches for IT components of freight delivery systems; system integration, which focuses on the development of a unified methodology combining elements of various approaches across all aspects of managing freight delivery system development projects.

The integration of transport systems into sustainable development requires a multimodal approach, in which transport is aligned with economic, social, and environmental objectives.

Within the framework of forming an integrated model for transport system development, it is proposed to apply technical criteria (level of compliance with technical requirements, efficiency of technical solutions, degree of innovation adoption in transport system development projects), economic criteria (degree of adherence to the project budget, return on investment in transport system development projects, efficiency of resource utilization), process criteria (level of compliance with project implementation schedules, responsiveness and flexibility to changes, level of information interaction), and project stakeholder criteria (customer satisfaction level, project team engagement level, and the social impact of the project).

The conceptual model of sustainable development in implementing transport system development projects within a risk-oriented approach constitutes an integrated system of interrelated components ensuring a balanced achievement of economic, environmental, and social objectives while minimizing project risks. The model is based on the Triple Bottom Line concept of sustainable development, adapted to the specific characteristics of transport projects, with the integration of risk-oriented management principles across economic, environmental, and social dimensions.

First, optimization of the life cycle of transport system development projects is performed, ensuring the financial sustainability of transport systems, improving resource efficiency, and establishing stable funding sources while accounting for financial risks. Second, the model focuses on minimizing negative environmental impacts, implementing environmentally friendly technologies, reducing greenhouse gas emissions, and managing environmental risks in accordance with the principles of the circular economy within the operation of transport systems. Third, accessibility of transport services is ensured, quality of life is improved, employment opportunities are created, and social risks, including impacts on local communities, are effectively managed.

**References:** 1. Bifurcation Theory in Transport Systems: Mathematical Models / ed. by R.K. Smith, J.L. Anderson. Cambridge University Press, 2021. 324 p. 2. Transportation Research Board. Digital Transformation in Transportation: Strategic Implementation Guide. National Academies Press, 2022. 145 p. 3. O. Kyryllova, V. Piterska, V. Kyryllova, V. Shakhov, «Implementation Framework for a Maritime Transport Navigation Safety Information System: Project Development Approach», Proceedings of the 6th International Workshop IT Project Management (ITPM 2025), Dortmund, May 2025, CEUR Workshop Proceedings, 2025. 4. Piterska, V. (2025). Development of a cargo delivery risk management system based on the HAZOP method and the XGBOOST model. Herald of the Odessa National Maritime University, (75), 161-175. <https://doi.org/10.47049/2226-1893-2025-1-161-175>. 5. V. Samoilovska, O. Kyryllova, V. Piterska, «Model for Evaluating the Efficiency of Seaports Development Projects Based on the Quality 4.0 Information and Analytical System,» Proceedings of the 4th International Workshop IT Project Management (ITPM 2023), Warsaw, Poland, May 19, 2023, CEUR Workshop Proceedings, 2023, vol. 3453, pp. 1-12.