Transformation of the multilevel system of transport infrastructure project management

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Abstract. The article is devoted to the development of theoretical and methodological provisions aimed at systemic transformation of the organization of a multi-level system of project management of transport infrastructure. The authors propose to use the method of multi-parametric assessment for groups of projects aimed at the development of transport infrastructure based on economic and environmental indicators, including determining the level of efficiency of the socio-innovative potential of transport, taking into account the degree of possible risks. The significance of the practical component of the study is to determine a set of conditions for the possible practical use of the methodology for managing groups of projects in the field of transport infrastructure considering the effectiveness of the implementation of the tasks and goals laid down in them. The method of organization of project management makes it possible to optimize the number of unrealized groups of projects in a multiple way, to carry out the procedure of ordering and multifactorial selection in the context of each hierarchical management level. The reliability of the results obtained was confirmed by the implementation of projects in the field of transport in Moscow, as well as the use of various mathematical methods.

1 Introduction

In the Russian Federation transport is a system-forming branch of the economy that fully ensures both the integral economic and territorial unity of the country, which creates the groundwork necessary for the development of conditions for the full implementation of a fundamentally new economic model of the country's growth, which is based on groups of tools that contribute to high-quality increasing the level of business activity of science-intensive groups of enterprises. A key place in the multi-level transport system is occupied by transport infrastructure, which has recently developed inconsistently and unbalanced, which was exacerbated by disproportionate investments, which ultimately led to a violation of the transport balance. To date, in regions with a developed level of infrastructure, there is a fairly high transport accessibility to groups of resources / markets of potential sales, which allows them to ensure a sustainable level of economic development. The range of certain restrictions imposed on transport accessibility in a number of regions is often associated with the fact that the transport infrastructure has developed unevenly and spasmodically. The restrictions imposed by Western countries led to an inevitable reduction in the volume of

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imported goods, which led to a certain reorientation of the Russian Federation towards the qualitative growth of groups of goods produced domestically, however, this also caused a number of difficulties, which are primarily related to the present need to fully ensure the development of transport functions. In the context of a new economic model, in conditions of high physical/obsolescence of the infrastructure components of the industry. New realities are transforming economic growth points and assigning one of the key places to transport infrastructure, so investments allocated by the state for the development of transport infrastructure are estimated at an average of 2.4-2.6% of the country's total GDP \[1\]. The national projects being implemented in the country until the end of 2024 provide for an increase in investments at the level of 0.36-0.45% of GDP every year, which is approximately 2.2 trillion soums. rubles. The article is devoted to the development of theoretical and methodological provisions aimed at systemic transformation of the organization of a multi-level system of project management of transport infrastructure. Achieving this goal requires solving the following tasks:

- to form criteria for assessing the level of development of innovation-oriented groups of projects aimed at transport infrastructure and to lay in their basis a group of indicators of economic, social and environmental efficiency;
- to propose a conceptual version of the presentation of the methodology for organizing the management of projects aimed at the development of transport infrastructure, taking into account the assessment of their prioritization and correlation with the tasks outlined in national projects.

2 Research methodology

The use of parametric assessment methods for groups of innovation-oriented projects related to transport is justified by the presence of a multidimensional system for organizing project management with the ability to regulate certain types of relations that arise during the direct implementation of projects, the variety of tasks for the development of a single transport complex both for the country as a whole and for individual regions, the presence of a certain degree of risk, and the need to fully ensure the effects of the practical implementation of tasks, which ultimately inevitably leads to the appearance of quite tangible differences in the analysis and evaluation of the procedure for choosing certain projects, the need to take into account the previously developed theoretical and methodological provisions of disparate parameters/criteria for selecting projects \[2\]. In the course of the study, the authors found that the priority groups of projects aimed at the development of transport infrastructure quite often show completely different indicators for assessing the parameters of economic, social and environmental security, while the degree of risk of project implementation is also excellent \[3\]. The parameters given in Table 1 can be recommended for successive stages of comparison of groups of project evaluations aimed at the development of transport infrastructure.

Table 1. Criteria indicators for evaluating innovation-oriented groups of land transport development projects.

<table>
<thead>
<tr>
<th>Parameter used for evaluation (par)</th>
<th>Indicator (Ind)</th>
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<tbody>
<tr>
<td>( \text{par} \rightarrow [E,CE,E_{ce},LIR] )</td>
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<tr>
<td>1. Economic efficiency assessment:</td>
<td></td>
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<tr>
<td>( E = \sum_{\theta=1}^{\rho} \text{Ind } E'<em>{\theta} \times w E</em>{\rho} )</td>
<td></td>
</tr>
<tr>
<td>( \text{Ind } E_1 )</td>
<td>discounted period during which the project will pay off</td>
</tr>
<tr>
<td>( \text{Ind } E_2 )</td>
<td>index indicator of profitability of investments invested in the project</td>
</tr>
<tr>
<td>( \text{Ind } E_3 )</td>
<td>internal rate of return</td>
</tr>
</tbody>
</table>
2. Definition of social efficiency:

\[ CE = \sum_{\Phi=1}^{n} \text{Ind} CE_{\Phi} \times wCE_{\Phi} \]

Ind \( CE_1 \) the effect of reducing the level of social burden

Ind \( CE_2 \) the degree of change in the level of business / travel correspondence

Ind \( CE_3 \) level of change in the use of passenger (ground) transport

Ind \( CE_4 \) rate of change in accident rate

Ind \( CE_5 \) the degree of infrastructure development in the areas adjacent to the roads

3. Calculation of the value of the level of environmental safety:

\[ E_{co} = \sum_{\nu=1}^{e} \text{Ind} E_{co_{\nu}} \times wE_{co_{\nu}} \]

Ind \( E_{co_1} \) the total value of the potential damage that can be caused to the environment during the implementation of transport projects

Ind \( E_{co_2} \) calculation of the share of vehicles running on alternative energy sources

Ind \( E_{co_3} \) determination of the degree of impact on the ecology/environment after the implementation of priority transport projects

4. Determination of the potential effect from the implementation of innovations:

\[ P_{I} = \sum_{\eta=1}^{\gamma} P_{I_{\eta}} \times wP_{I_{\eta}} \]

\( P_{I_1} \) the range of costs associated with the integration of various groups of innovations in the overall structural outline of the cost of implementing a transport project

\( P_{I_2} \) assessment of the level of potential inherent in the framework of innovations in the implementation of the transport project

\( P_{I_3} \) calculation of the index of return on investments invested in the project (public / commercial)

5. Determining the degree of inherent risk:

\[ LIR = lir_1 + lir_2 + lir_3 + lir_4 + lir_5 \]

\( LIR \) determination of the range of risks (embedded) and groups of potentially possible ones that will not allow to fully implement and/or cancel the transport infrastructure development project

Ind \( E'_{\Phi} \), Ind \( CE'_{\Phi} \), Ind \( E'_{co_{\nu}} \), \( P_{I_1} \), \( P_{I_2} \), \( P_{I_3} \), \( E, CE, E_{co}, P_{I} \), \( LIR \), \( wE_{\Phi}, wCE_{\Phi}, wE_{co_{\nu}}, wP_{I_{\eta}} \) – standardized indicators/values for parameter groups;

\( E, CE, E_{co}, P_{I}, LIR, wE_{\Phi}, wCE_{\Phi}, wE_{co_{\nu}}, wP_{I_{\eta}} \) – weight value of indicators included in separate groups of parameters (from 1 to 5)

\[ EIE = \sqrt{\frac{1}{e} (E \times W_e) \times (CE \times W_c) \times (E_{co} \times W_{eco}) \times (P_{I} \times W_{imm}) \times ((1 - LIR) \times W_{ek})} \]  

where, \( W_e, W_c, W_{eco}, W_{imm} \) – parameter weights \( E, CE, E_{co}, P_{I}, LIR \) (Fishburn formula); \( v_k \) – total number of parameter groups considered.
3 Results and discussion

It is necessary to carry out a selection procedure for groups of projects related to the development of infrastructure components of the transport industry in order to ensure a consistent increase in the level of efficiency from ongoing transformation processes in the structural contour of the transport complex, improve the quality of the range of services provided and, of course, to create a sustainable basis for production and economic growth as separate regions and the country as a whole [6].

**First stage. Initiation of a complex of multilevel procedures aimed at conducting pre-project studies**

- Organization and implementation of a set of procedures in the areas of strategic / long-term planning. Formation of a complex of solutions bearing a point character
- Determining the level of need for the implementation of transport infrastructure development priorities
- Obtaining confirmation of the practical implementation of the groups of priorities identified in the framework of the projects. Certain changes can be made to the current regulatory framework, for example, related to the procedure for purchasing new rolling stock or traffic organization schemes

**Second stage. Organization of the TP selection procedure**

- Refinement of the generated range of tasks
- Formation of projects based on their intended purpose
- Formation of a list of requirements related to the procedure for accepting applications for projects related to the development of transport

- Compilation of many projects: \( M = \{\Pi p_1, \ldots, \Pi p_n\}, n = 1,2,3, \ldots, n \) followed by prioritization of goals: \( \Pi III_y, y = 1,2,3, \ldots, y \). Compilation of project groups: \( K_i, i = 1,2,3, \ldots, I = A, B, C \) (project group). Defining tasks by group: \( M^k_i, i = 1,2,3, \ldots, M^k \). Calculation of indicators of each individual group: \( R^k_d, d = 1,2,3, \ldots, R^k \)

- Determination of priorities for the development of transport infrastructure \((\rightarrow \max)\) within each individual group based on the application of the method of hierarchical synthesis. Organization of the procedure for selecting priority projects for the development of TI based on the method of parametric assessment

**Third stage. Calculation of the generated integral indicator:**

\[
E_{1E} = \sqrt[\varepsilon]{(E \times W_e) \times (CE \times W_c) \times (E_{eco} \times W_{eco}) \times (PFL \times W_{lmm}) \times ((1 - LIR) \times W_{rt})}
\]

Fig. 1. Conceptual version of the presentation of the methodology for organizing project management aimed at the development of transport infrastructure.
The selection of transport projects should be carried out on the basis of a procedure that is based on the application of a set of effective methods for their assessment, according to various groups of parameters and, of course, taking into account criteria that can show current problems and specific features associated with the practical implementation of the projects under consideration, which as a result should contribute increasing the level of literacy and efficiency in the field of project management within the transport sector [7].

Figure 1 presents a conceptual author's version of the structure of the methodology for organizing project management aimed at developing the transport infrastructure of the region. The use of the proposed methodology for organizing project management will significantly improve the efficiency of the transport infrastructure based on taking into account key dominant landmarks, including a wide range of parameters indicated in the project. The implementation of the methodology makes it possible to fully make a balanced selection of priority transport infrastructure projects, and then implement only relevant and critical projects through prioritization. The methodology was created with the aim of applying it in various organizations whose activities are related to the processes of regulation of the transport industry at various hierarchical levels [8]. The subject area of the work of the methodology is related to groups of transport infrastructure projects, its development, but which, in turn, do not have targeted funding, which are not projects related to the image and implemented on the direct orders of the authorities of the Russian Federation.

As a rule, the implementation of such projects is directly associated with obtaining permission from the top leadership of the country, while in these projects it lays not only a strategic, but also a political aspect [9]. The organization of the mechanism of project management in the context of the transformation of transport infrastructure is inextricably linked with a set of actions that take place before the final decision is made on the feasibility of the practical implementation of projects in the field of transport, and includes a certain sequence of procedures within the boundaries of the technology for evaluating/ selecting various projects based on a variety of parameters and criterion indicators [10]. Detailed planning of stages even at the stage of drawing up project implementation plans will make it possible to significantly increase the number of projects that have come to practical implementation, and will also increase the level of project management within this area.

4 Conclusion

The current level of dynamics in the development of the external environment forces the identification of problems in the transport industry on an ongoing basis, with its subsequent adjustment within the framework of the formed development tasks, which in turn certainly requires the development and decision-making on a systematic basis. Taking into account this circumstance, the methodology proposed by the authors for organizing the management of infrastructure transport makes it possible to carry out a range of procedures for analyzing, evaluating and subsequently selecting the most profitable and effective from different points of view of groups of projects for the development of transport infrastructure, taking into account the fact that new (target) projects can be added from the side of the state. Building an effective model for managing transport projects is associated with the development of multi-level interaction between various departments and involves the implementation of a number of functions in the management of related industries (energy/construction/engineering), which means that it will be necessary to develop a general organizational and technical regulation, including a number of provisions for structural divisions, who are able to competently and effectively perform the ambivalent function of accelerating and systematizing the work of the elements of the mechanism for developing consolidated solutions related to the development of transport projects. The regulation should be fully adopted in the context of various levels of project management (municipal/regional and
The structure of the organizational regulations includes a description of the work of the procedures for analyzing and selecting groups of priority transport projects, consolidating applications for new projects in the context of solving the existing wide range of problems in the field of transport infrastructure in a particular territory with the search for the most effective projects, followed by the creation of a schedule for them detailed implementation. The development of the transport infrastructure can be consistently and evenly carried out through the application of the principle of goal-setting, i.e. groups of goals that are related to the development of transport are formed on the basis of the already existing goal setting in projects of the national / federal level, as well as specialized industry programs, which in turn allows us to analyze the range of current problems in the field of transport and make the necessary adjustments to the formed goals. The study identified the most problematic and bottlenecks associated with the development of transport infrastructure:

- unsatisfactory level of technical and technological state of the industry. The problem can be partially solved through the ongoing digital transformation in the economy, the formation of programs and target projects for the development of the production and technical base, taking into account the reduction in the level of import dependence;
- a high degree of depreciation of objects, taking into account the high capital intensity of the transport infrastructure;
- discrepancy between the transport infrastructure and indicators of normative values. The solution of this problem is possible due to the development of the formed infrastructural potential;
- the need for a significant update of existing standards, including in matters relating to the investment mechanism, taking into account the packages of sanctions restrictions currently being introduced.

References