DEVELOPMENT OF BASIC PROJECT MANAGEMENT STRATEGIES FOR THE PRODUCTION AND USE OF TECHNICAL CAPABILITIES BY RAILWAY TRANSPORT UNITS DURING A FULL-SCALE INVASION OF UKRAINE

Abstract. This article aims to research and develop project management strategies that are reflected in the context of a full-scale invasion of Ukraine and affect the operation of railway transport units. The modern world is facing a variety of geopolitical challenges, and this article examines a specific case where the technical resources and infrastructure of rail transport can successfully influence the role of ensuring the security and functioning of a city during a crisis.

The article discusses key aspects of such project management strategies, including: threat and risk analysis. Assessment of potential threats and risks associated with the invasion of a neighbouring country and determination of their impact on railway transport and urban infrastructure.

Development of detailed action plans to ensure the safety and operation of railway transport in a crisis, including evacuation, public communication and other necessary measures.
Identification and readiness of the necessary technical resources and personnel to carry out the planned actions in response to the crisis situation.

Ensuring communications: developing a communications system for the effective exchange of information between railway departments, city authorities and other relevant structures.

Testing and exercising: conducting training and simulation exercises to test the effectiveness of strategies and staff preparedness.

This article aims to contribute to the understanding of the importance of rail emergency preparedness and to provide practical recommendations for developing project management strategies in such situations. The authors provide analysis and practical tools to improve preparation for and response to such crises, which can be useful for railway management, city authorities and other stakeholders.

Keywords: project management, production and technological potential, geopolitical threats, railway transport resources, evacuation, production process, international standard ISO 9000, railway transport, optimisation, strategy.

Кульбовський Іван Іванович кандидат технічних наук, доцент, кафедри автоматизації та комп’ютерно-інтегрованих технологій транспорту, Державний університет інфраструктури та технологій, вул. Кирилівська, 9, м. Київ, 040715, тел.: (050)832-21-81, https://orcid.org/0000-0002-5329-3842

Голуб Галина Михайлівна кандидат технічних наук, доцент, кафедри автоматизації та комп’ютерно-інтегрованих технологій транспорту, Державний університет інфраструктури та технологій, вул. Кирилівська, 9, м. Київ, 040715, тел.: (063)266-18-98, https://orcid.org/0000-0002-4028-1025

Козачук Олена Ігорівна аспірантка, кафедри автоматизації та комп’ютерно-інтегрованих технологій транспорту, Державний університет інфраструктури та технологій, вул. Кирилівська, 9, м. Київ, 040715, тел.: (099)273-84-53, https://orcid.org/0000-0002-3823-6057

РОЗРОБКА ОСНОВНИХ СТРАТЕГІЙ УПРАВЛІННЯ ПРОЕКТАМИ З ВИРОБНИЦТВА ТА ВИКОРИСТАННЯ ТЕХНІЧНИХ МОЖЛИВОСТЕЙ ПІДРОЗДІЛАМИ ЗАЛІЗНИЧНОГО ТРАНСПОРТУ ПІД ЧАС ПОВНОМАСШТАБНОГО ВТОРГНЕННЯ В УКРАЇНУ

Анотація. Ця стаття спрямована на дослідження та розробку стратегій управління проектами, які відображаються в умовах повномасштабного вторгнення в Україну та впливають на роботу підрозділів залізничного
транспорту. Сучасний світ стикається з різноманітними геополітичними викликами, і ця стаття розглядає конкретний випадок, коли технічні ресурси та інфраструктура залізничного транспорту можуть успішно вплинути на роль забезпечення безпеки та функціонування міста під час кризових ситуацій.

У статті обговорюються ключові аспекти таких стратегій управління проектами, включаючи: аналіз загроз та ризиків. Оцінка потенційних загроз та ризиків, пов'язаних із вторгненням сусідньої країни, і визначення їх впливу на залізничний транспорт та міську інфраструктуру.

Створення детальних планів дій для забезпечення безпеки та функціонування залізничного транспорту в умовах кризи, включаючи евакуацію, комунікацію з громадськістю та інші необхідні заходи.

Визначення та готовність необхідних технічних ресурсів та персоналу для виконання запланованих дій у відповідь на кризову ситуацію.

Забезпечення комунікацій: розробка системи комунікацій для ефективного обміну інформацією між підрозділами залізничного транспорту, міською владою та іншими відповідними структурами.

Тестування та навчання: проведення тренувань і симуляційних вправ для перевірки ефективності стратегій та готовності персоналу.

Ця стаття має на меті внести вклад у розуміння важливості готовності залізничного транспорту до надзвичайних ситуацій та надати практичні рекомендації для розробки стратегій управління проектами у подібних ситуаціях. Автори надають аналіз та практичні інструменти для вдосконалення підготовки та реагування на подібні кризи, що може бути корисним для керівництва залізничного транспорту, міських влад та інших зацікавлених сторін.

Ключові слова: управління проектами, виробничо-технологічний потенціал, геополітичні загрози, ресурси залізничного транспорту, евакуація, виробничий процес, міжнародний стандарт серії ISO 9000, залізничний транспорт, оптимізація, стратегія.

Statement of the problem. The topic of the article involves a study of the effective use of the production and technological potential of railway transport units during full-scale implementation in Ukraine. However, in modern conditions, structural subdivisions of railway transport do not sufficiently use their technical resources and capabilities to ensure the safety of the city and effective management in emergency situations. The main problem is the development of appropriate strategies aimed at the optimal use of production and technological potential.

In this context, the article aims to develop project management strategies that allow to effectively mobilise and use the technical resources and capabilities of railway transport units to ensure safety and implement certain management actions.
during emergencies. An important aspect is the solution of scientific and applied management tasks and the development of specific strategies for using the technical capabilities of railway transport in a crisis.

**Summary of the main material.** Managing the production processes of structural units is one of the main tasks of improving the efficiency of using its production and technological potential [1]. From the standpoint of cybernetics, production processes can be considered as controlled processes with feedback.

In this case, the principle of combined control is implemented, which takes into account deviation, disturbance and state control. This approach, as studies have shown, ensures the most rational use of the production and technological potential of railway transport in accordance with international standards ISO 9000 [2].

The main task of managing the production processes of railway transport units is multifaceted and includes the solution of various strategies for using their production and technological potential. In the context of the article, when railway transport faces an emergency, organisational and technical measures become key to effectively addressing the practical challenges of ensuring the safety and operation of railway transport.

This article emphasises the need to use an assessment of the competitiveness of services provided by railway transport units in the process of implementing organisational and technical measures. Assessment of competitiveness is important for ensuring effective management and setting priorities in the use of the production and technological potential of railway transport units.

In addition, the management of production processes and strategies for using the technical capabilities of railway transport should be comprehensive and aimed at achieving the systemic goal of functioning of railway transport units in crisis situations that may arise during the war [2] (Fig. 1). This is done through marketing analysis based on the widespread use of information. Marketing analysis is an integral part of system analysis and includes the commercial activities of a structural unit. Depending on the volume of production and marketing activities, the goal set and many other factors, systemic marketing requirements are formed. Marketing activities should provide [3]:

Marketing activity in modern conditions should solve a number of strategic tasks. First of all, it should be aimed at the formation of works and services that increase the changing requirements of the market. This requires not only responding to the current needs of consumers, but also actively forecasting their future needs and identifying what new services or improvements may be of interest to customers.

At the same time, marketing should influence consumers and create demand, which ensures maximum control over the sales area. This means not only reactive measures, but also active marketing strategies aimed at creating demand, developing and introducing new products or services.
In addition, marketing should provide information about the state of the market, due to the structure and dynamics of demand for railway transport services and other aspects of the external environment. This information will allow to make informed strategic decisions and adapt the offer to changes in market conditions. Thus, marketing is a key tool for managing and adapting railway transport to the needs of market interests.

In times of war, marketing analysis becomes especially important and performs several key functions[4]:

- assessment of the performance of structural units, constant monitoring and evaluation of the effectiveness of railway transport units in war conditions is required. It is important to find out how they affect the overall problem and the consequences of the conflict and develop proposals for their improvement;
- Developing a strategy for assessing demand, in wartime the demand for railway transport services can change significantly due to population movements, evacuations, changes in transport needs, etc. Therefore, it is important to develop strategies to assess these changes and adapt railway transport services to the new demand;
- mechanisms to stimulate the implementation of services, in times of war it can be difficult to implement rail transport services due to access restrictions and risks for citizens. Marketing incentives may include advertising the importance of safe and fast transportation in emergency situations, as well as measures that help preserve the life and health of the population.

The main organisational tasks of marketing can be divided into external and internal. External tasks include

- analysing the volume of demand in terms of certain indicators that characterise it, market segmentation; researching competitors and the quality of their work.
- studying patterns and trends in changes in key performance indicators and market conditions;
- assessment of the impact of scientific and technological progress on the performance of railway transport, taking into account the actual state and options for the development of its production and technological potential.
Fig. 1 Basic principles of formation of production and technological potential of railway transport units

Internal tasks include:
- assessing the volume of potential orders that have not been realised by structural units;
- researching the range of services and assessing the level of customer satisfaction;
- formation of a logical structure of goals, functions, tasks and methods for their solution, which ensures their systematic connection in the process of implementation in real conditions;
- analysing the causes of defects, disruptions to the normal operation of railway transport and failures of devices and equipment;
- assessment of the level of risk in relation to the effectiveness of the implementation of the tasks and planned organisational and technical measures;
- study of possible profits from new types of repair services provided by railway transport units;
- assessment of the investments required to address new challenges to improve the efficiency of the use of the production and technological potential of railway transport.

The main criteria for evaluating marketing may include:
- reduction in the cost of work performed;
- growth in the range of orders;
- increase in profits from the sale of services, etc.

In a market environment, the operation of railway transport largely depends on the market for its services. It is necessary to study the demand and, on this basis, to formulate the commercial, technical and technological behaviour of railway transport units, including the pricing policy.

The price for railway transport services is formed depending on the demand for it and the production and technological potential of its units, i.e. \[ U_{ij} = F\left( N_{1ij}, N_{2ij} \right), \quad i = 1,2,...,m; \quad j = 1,2,...,n, \] (1)

where \( F \) is the price of repairing the \( i \)-th object by the \( j \)-th technological process;

\( N_{1ij}, N_{2ij} \) - respectively, the demand for the \( i \)-th object by the \( j \)-th technological process and the production and technological potential of the unit for repairing the \( i \)-th object using the \( j \)-th technological process.

For the corresponding nomenclature of repair objects, we can write \[ U_{ij} N_{1ij} = U_{ij} N_{2ij}, \] (2)

Expression (2) indicates that the demand for the services of an enterprise should be equal to its real potential in a given period of time (equality condition).

The production and technological potential of subway divisions is found using the expression:
where $F_{Di jp}$ is the effective annual time fund of equipment of the p-th item when repaired by the j-th technological process of the i-th repair object; 

$$F_{Di jp} = \left[ (365 - BD - CL) \times 8.2 - PCD \times 1 \right] \times Z_{ij p} \times K_{p},$$

where $BD$ – number of days off per year; $CD$ – number of holidays per year; $PCD$ – the number of pre-holiday days in a year (the working day is shorter by one hour); $Z_{ij p}$ is the number of shifts of the process equipment of the p-th name during the repair of the j-th process of the i-th repair object; $K_{p}$ is a coefficient that takes into account the time spent by the pth equipment in repair; $K_{3ijp}$ is the load factor of the pth equipment during repair by the j-th technological process of the i-th repair object; $C_{Oijp}$ is the number of equipment of the p-th name required for repair by the j-th technological process of the i-th repair object; $t_{ij p}$ is the labour intensity of the work performed on the p-th equipment during the repair of the j-th technological process of the i-th object; $\alpha_{ij p}$ is the coefficient of permissible losses for re-adjustment of the p-th equipment during the repair of the j-th process of the i-th object in excess of the preparatory and final time.

The price of an enterprise's services is formed depending on the demand for them and the units' Gross Turnover (supply). To form the mechanism of price changes, let's introduce the value of

$$Z_{ij} = N_{ij} - N_{2ij}.$$  

If $Z_{ij} > 0$, the demand for railway transport products exceeds its TOT, $Z_{ij} < 0$, the supply exceeds demand.

Under the actual conditions of railway transport operation, the following pricing strategies can be used[6]:

- the price change is proportional to excessive demand;
- price change is proportional to excessive supply;
- price changes are in line with supply and demand.

Price stability means that the demand for the company's products and services is met.

Let us consider the main strategies of using the production and technological potential of the structural units of the railway transport in the post-war period. Taking
into account the peculiarities of the functioning of the production processes of the railway transport and the level of use of its production and technological potential, three alternative strategies for the use of its production and technological potential can be distinguished (Table 1)[7].

**Table 1**

<table>
<thead>
<tr>
<th>Name strategies</th>
<th>Designation</th>
<th>The ratio between supply and supply</th>
<th>Criteria values</th>
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<tr>
<td>1st strategy</td>
<td>S&lt;sub&gt;1&lt;/sub&gt;</td>
<td>N&lt;sub&gt;1ij&lt;/sub&gt; = N&lt;sub&gt;2ij&lt;/sub&gt;</td>
<td>Є&lt;sub&gt;f&lt;/sub&gt; = 1, e&lt;sub&gt;f&lt;/sub&gt; = 1</td>
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<tr>
<td>2nd strategy</td>
<td>S&lt;sub&gt;2&lt;/sub&gt;</td>
<td>N&lt;sub&gt;1ij&lt;/sub&gt; &lt; N&lt;sub&gt;2ij&lt;/sub&gt;</td>
<td>Є&lt;sub&gt;f&lt;/sub&gt; &lt; 1, e&lt;sub&gt;f&lt;/sub&gt; &lt; 1</td>
</tr>
<tr>
<td>3rd strategy</td>
<td>S&lt;sub&gt;3&lt;/sub&gt;</td>
<td>N&lt;sub&gt;1ij&lt;/sub&gt; &gt; N&lt;sub&gt;2ij&lt;/sub&gt;</td>
<td>Є&lt;sub&gt;f&lt;/sub&gt; = 1, e&lt;sub&gt;f&lt;/sub&gt; = 1</td>
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The strategies for using the production and technological potential of railway transport differ from each other in the correlation between the demand for the company's products N<sub>1ij</sub> and supply (production and technological potential) – N<sub>2ij</sub> and indicators of the quality and efficiency of production process management, which are respectively determined from the expressions:[8]

\[
\eta_\phi = 1 - \left( \frac{\int_0^t |A(t) - \overline{A}(t)| dt}{\int_0^t \overline{A}(t) dt} \right), \quad (6)
\]

\[
e_\phi = 1 - \left( \frac{\int_0^t |\Pi_1(t) - \overline{\Pi}_1(t)| dt + \int_0^t |\Pi_2(t) - \overline{\Pi}_2(t)| dt}{\int_0^t \overline{\Pi}_1(t) dt + \int_0^t \overline{\Pi}_2(t) dt} \right), \quad (7)
\]

Improvement of the level of use of the production and technological potential of railway transport in the implementation of the strategies provided for in Table 1 can be achieved by solving a set of relevant tasks.

The first strategy - S<sub>1</sub> = S<sub>1</sub> \{N<sub>1ij</sub> = N<sub>2ij</sub> ^ Є<sub>f</sub> = 1 ^ e<sub>f</sub> = 1 ^ Є<sub>f</sub> = 0\} involves the full use of the production and technical potential of a structural unit. This strategy is
the most rational (optimal) one that can take place in the real conditions of railway transport operation. When implementing strategy S1, the set of all tasks included in the system model of railway transport functioning is fully resolved, which ensures maximisation of quality and efficiency indicators of the structural unit’s production process management (\(a_f = 1, \ e_f = 1\)).

Due to the fact that the optimisation of the management of railway transport production processes and the use of its production and technological potential is reduced to the creation of external and internal conditions that would lead to the implementation of the first strategy \(S_1\).

The second strategy of using the production and technological potential involves exceeding supply over demand

\[S_2 = S_2 \{ N_{1ij} < N_{2ij} \land a_f < 1 \land Z_{jk} = Z_{jk} \},\]

which leads to underutilisation of the production and technological potential of road repairs and, accordingly, a decrease in the quality and efficiency of management (\(a_f < 1, \ e_f < 1\)). To balance supply and demand, prices for the company's products and services can be reduced in accordance with the previously mentioned recommendations. In addition, in order to ensure the required level of utilisation of the production and technological potential of railway transport, it is necessary to solve a number of problems by optimising the technical level of production. The search for effective financial mechanisms and interaction between enterprises and structural units that use their services and products will significantly improve the use of production and technical potential and, as a result, the financial condition of the structural unit.

The third strategy of using the production and technological potential involves unmet market demand

\[S_3 = S_3 \{ N_{1ij} > N_{2ij} \land a_f = 1 \land e_f = 1 \land Z_{jk} = Z_{jk} \}\].

Demand exceeding supply (\(N_{1ij} > N_{2ij}\)) enables stable operation. However, in order to meet the demand of the reserve, the following tasks need to be addressed:

- providing the metro with modern technological processes;
- optimisation of technological processes for the repair of rolling stock and engineering structures;
- optimisation of the use of technological equipment and tooling, etc.

The effective solution of a set of these and other technical, technological, economic and organisational tasks ensures an increase in the level of utilisation of production and technological potential and makes it possible to meet demand that exceeds supply (the existing production and technological potential of subway divisions). In real conditions at this stage, this strategy is less common than the \(S_2\), due to the general decline in production.[9]

Thus, by choosing the appropriate strategies, it is possible to manage the production processes of railway transport units, ensuring the most efficient use of its production and technological potential. Thus, by choosing the appropriate strategies, it is possible to manage the production processes of railway transport units, ensuring the most efficient use of its production and technological potential.
Conclusion. The article proposes appropriate strategies for the effective formation and implementation of managerial actions aimed at ensuring the required level of use of the production and technological potential of railway transport structural units, especially in war or emergency situations.

An important aspect is that, given the unique challenges faced by the railway industry in wartime, these strategies allow railway transport units to rationally use their technical and production resources to ensure safety and a reliable system of operation.

Focused on analysing, assessing and stimulating demand, and continuously improving the operations of structural units, these strategies ensure the highest level of service and efficiency even in difficult situations. Thus, they are an essential tool for ensuring the safety and stability of railway transport during military conflicts and other crisis situations.

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