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**ABSTRACT**

The transformation of the global environment, accompanied by a change in the operating environment of enterprises under the influence of digitalization processes, has a significant impact on the activities of railway transport enterprises. For more than a dozen years now, they have been operating under the conditions of the implementation of reforms and systematic underfunding of the processes of updating the technical and technological base. Due to the lack of investment and the low level of innovative activity, the enterprises of the industry are currently experiencing a state of technological crisis, which is manifested in the critical state of technological objects and rolling stock that are key to the transport process [1]. According to experts' estimates, the annual investment need of railway transport enterprises is about 35 billion UAH. Currently, the industry's capital investment needs are met by 25–30 % [2]. Due to a systemic violation of the reproduction mechanism of the technological base, the latter is being exploited at the critical limit. Such a situation with the state of the technological base of railway transport enterprises indicates that the mechanism of innovation reproduction of funds is currently broken in the industry and the priorities of the innovation policy have not been chosen correctly [3]. In the conditions of the digital revolution, which leads to a significant increase in competition in the market of transport and logistics services, in the coming years, railway transport enterprises must implement radical changes in all the main technological and business processes through the systematic introduction of technological and organizational innovations.

**KEYWORDS**

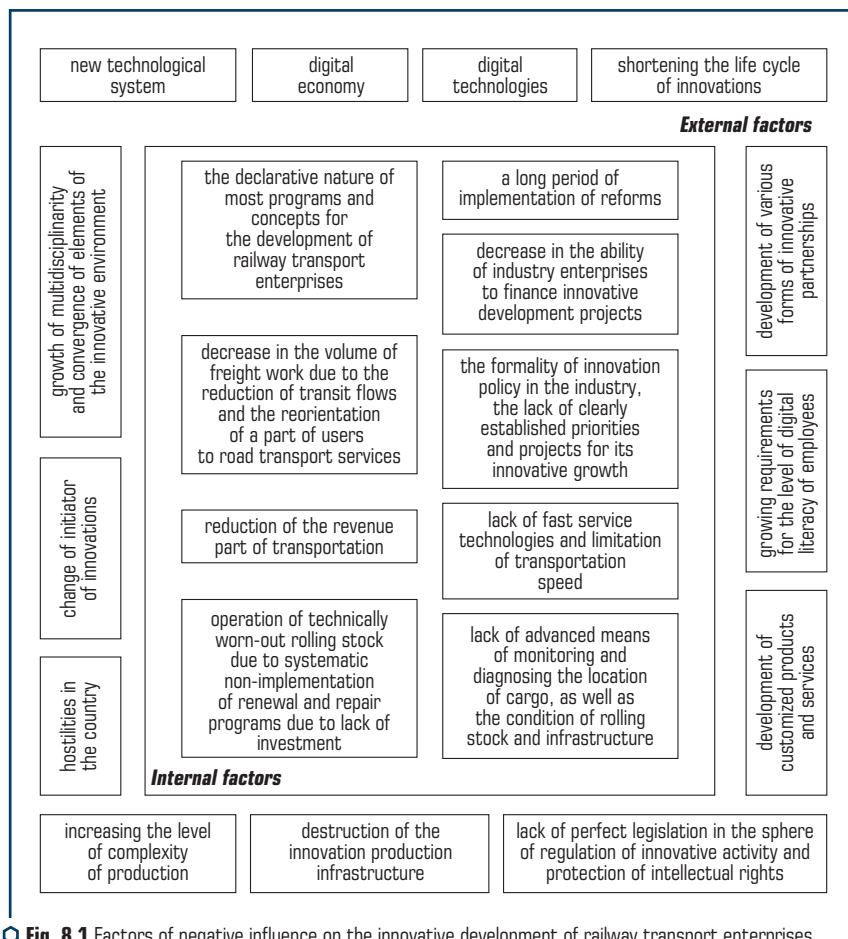
Goal setting, innovative development strategy, transport infrastructure, strategic goals, foresight, public administration.

**8.1 ENVIRONMENT FOR INNOVATIVE DEVELOPMENT OF RAILWAY TRANSPORT ENTERPRISES**

Taking into account the fact that railway transport enterprises function as an open system and have established connections with the external environment, let's focus primarily on its research (**Fig. 8.1**).

The external environment for the implementation of projects of innovative development of railway transport enterprises is currently extremely turbulent. First, dynamic changes are caused by the transition to a new technological system and the development of the digital economy.

Digital technologies have significantly accelerated economic processes and led to confrontation between market entities. Digital technologies caused extremely significant transformations in the field of innovative activity, leading to a significant reduction of the life cycle of innovation due to the optimization of the procedure for creating, modeling and developing a prototype.



**Fig. 8.1** Factors of negative influence on the innovative development of railway transport enterprises  
Source: author's development (formed on the basis of [1–4])

Features of the digital transformation of domestic enterprises are studied in detail in the works of Volodymyr Dykan, Myroslava Korin, Hanna Obruch, Iryna Tokmakova, Viktoriia Ovchynnikova, Serhii Pankratov, Pavlo Denysenko, Oleksandr Kubatko, Olena Shkarupa, Anton Yaremenko [4–9].

The analysis of the results obtained by scientists allowed to come to the conclusion that under the influence of digitalization, the innovative activity of railway transport enterprises has also undergone changes: technological solutions have appeared that significantly optimize technological processes in the industry.

In addition, digital technologies allowed railway transport enterprises to become a full participant in the process of creating innovations due to the formation of effective communication channels within the framework of the creation of innovative and technological cooperation mechanisms. Today, in the world of railway enterprises, they are active participants in the innovation process, not only dictating to manufacturers the needs for innovations, but also independently developing innovations for the needs of railway transport.

Secondly, the transformation of the innovation environment that is taking place today is caused not only by the increase in the number of scientific developments and research, the emergence of digital technologies, but also by a change in the initiator of innovations. As research will allow, a significant part of innovative developments today have the status of "consumer" because they arose from the initiative not of the manufacturer, but of the consumer of its products.

Thirdly, the modern innovation environment is characterized by the growth of various types of innovative partnerships based on the combination of the potential of innovative companies and individual industries. Strategic partnerships between railway transport operators and large manufacturers of products for the needs of railways are developing quite actively in Europe and are used as a strategic tool to support industry development projects.

Fourthly, due to the growing level of use of digital technologies in the activities of economic entities, including railway transport enterprises, systematic training of employees in the field of using digital innovations is carried out to support the efficiency of the innovation process. In fact, as in other areas, in the field of innovation there is also an increase in requirements for the level of digital literacy of employees, which led to the transformation of the system of their education and training.

Fifth, the rapid development of customized products and services led to an increase in the level of complexity of production, and also caused an increase in multidisciplinary and the convergence of all elements of the innovation environment.

In addition to the fact that the external innovative environment of the enterprises of the industry is transformed, the nature and strength of the influence of external factors are also changing. In particular, projects of innovative development of railway transport enterprises are blocked by the processes currently taking place in the country. This is, first of all, military actions, which entail the destruction of not only the railway infrastructure, but also the infrastructure for the production of innovations, destabilize economic processes, causing a mass stoppage of production, and, accordingly, a decrease in the resource provision of economic stability in the country.

The lack of perfect legislation in the sphere of regulation of innovative activity and protection of intellectual rights inhibits innovation processes at railway transport enterprises. Also, the activity of the existing innovative infrastructure in the country should be recognized as not entirely effective, most of which functions according to the residual principle, without creating significant

developments and innovations for the country. The state policy in the field of innovation support has an equally negative impact on the state of the innovation environment of railway transport enterprises: despite the determination of state innovation priorities, most innovative projects are currently financed according to the residual principle [10].

The internal environment of ensuring the innovative development of railway transport enterprises is characterized by the presence of a number of disincentive factors that indirectly affect the effectiveness of the innovative activities of the enterprises of the industry. These factors are represented by the key issues that have become the cornerstone for enterprises in the industry, namely:

- the declarative nature of most programs and concepts for the development of railway transport enterprises, including those that establish industry priorities in the field of innovative activity;
- the long term of implementation of reforms, which have been of a formal nature for many years, and currently remain unfinished;
- a drop in the volume of freight work due to the reduction of transit flows and the reorientation of some users to road transport services;
- a reduction in the revenue part of transportation and, as a result, a decrease in the ability of industry enterprises to finance innovative development projects;
- uncertainty and formality of innovation policy in the industry, lack of clearly established priorities and projects for its innovative growth;
- operation of technically worn-out rolling stock due to systematic non-implementation of renewal and repair programs due to lack of investment;
- lack of fast service technologies and limitation of transportation speed in a significant part of service areas due to the timely failure to carry out scheduled and preventive repairs of infrastructure facilities and signaling;
- lack of advanced means of monitoring and diagnosing the location of cargo, as well as the state of rolling stock and infrastructure, etc. [11].

So, summarizing in general, it is worth pointing out that currently the environment for the implementation of projects of innovative development of railway transport enterprises is characterized by a high level of instability, which is caused by high external dangers and risks, primarily those that exist at the state level, as well as the presence of systemic functioning problems railway transport enterprises.

## 8.2 STRATEGIC DIRECTIONS OF IMPLEMENTATION OF INNOVATIVE PROJECTS AT RAILWAY TRANSPORT ENTERPRISES

Based on the above, it is worth pointing out that in the near future, in order to maintain their own competitiveness and preserve the existing potential, railway transport enterprises must fundamentally change all technological and business processes by replacing rolling stock with

more modern models, and introducing progressive technological complexes, intelligent systems traffic management and other organizational and technological innovations. At the same time, as the experience of European railways proves, without reforming approaches to the organization of railway transport management with an orientation towards the growth of innovative activity of industry enterprises, without the formation of conditions that ensure the creation and use of effective innovations, the national security of the country appears to be under threat. In accordance with this, strategic directions for the implementation of innovative projects at railway transport enterprises should be identified, which correspond to the global trend of the transformation of railways and will ensure innovative modernization of domestic enterprises of the railway industry (**Table 8.1**).

The key direction of the implementation of innovative projects should be the direction of ensuring digital modernization and the introduction of digital technologies. Most of the innovative projects in this direction should relate to the development of such modern digital technologies as the Internet of Things, "big data", distributed registers (blockchain), artificial intelligence technologies, virtual and augmented reality technologies, new data transmission technologies. A platform approach to the formation of new services for consumers should also be applied, which is based on the creation of digital platforms in the key areas of activity of enterprises in the industry, including the field of development and use of innovations [12].

The priorities of infrastructure development should include the creation of intelligent stations, which provide for the introduction of innovative systems of automation and mechanization of station processes, as well as infrastructure for means of robotization of warehouse processing processes at sorting stations, which will allow the transition to unmanned technologies, increase the throughput of sorting stations due to robotics maintenance processes in the reception park, reduce the impact of the human factor on the technological process, speed up the processing of warehouses.

For the practical implementation of the projects listed above to ensure the innovative development of railway transport enterprises, it is expedient to organize the cooperation of industry enterprises with specialized enterprises by forming an engineering center. The latter should specialize in the development of innovations for the enterprises of the industry due to the combination of their innovation and production potential with the country's leading manufacturers, namely:

- creation of high-speed rolling stock for the transportation of passengers and cargo;
  - development of electric trains with the 4th level of automation;
  - creating a line of low-complexity hybrid electric trains serving mixed passenger services;
  - creation of hybrid models of diesel locomotives for work on shunting and removal work;
  - implementation of systems for collecting, processing, and storing coordinate information about infrastructure objects and rolling stock of railway transport, including a high-precision coordinate system and a spatial data base of digital track models;
  - development of other new types of rolling stock;
  - development of passenger information and entertainment systems, etc.
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**INNOVATIVE DEVELOPMENT OF THE ROAD AND TRANSPORT COMPLEX:  
PROBLEMS AND PROSPECTS**

● **Table 8.1** Priority projects of innovative development of railway transport enterprises

<b>A group of projects</b>	<b>Content</b>	<b>Type of innovations created</b>	<b>Effect</b>
Digital modernization and implementation of digital technologies	Mastering digital technologies, creating digital platforms in key areas of activity	Procedural	Ensuring innovative development, transformation of the business model and industry processes
Automatic control of rolling stock	Automation of management processes and diagnostics of the technical condition of rolling stock	Process, organizational	Increasing the efficiency of operational activity, optimizing costs for the main activity, increasing labor productivity
Renewal of rolling stock	Introduction of modern models of locomotives operating on alternative types of fuel, creation of "smart locomotives" with the use of intelligent control systems, locomotives with increased average daily productivity, increased mileage between repairs, structures, creation of digital models of rolling stock with functions of predictive forecasting of technical condition	Procedural	Improvement of operational characteristics of rolling stock, reduction of life cycle costs, improvement of safety, reliability and environmental friendliness of transportation, growth of indicators of transportation activity
Development of high-speed traffic	Construction of separate high-speed tracks designed for passenger traffic, introduction of modern electric trains and systems for automatic monitoring of traffic parameters, construction of an effective data exchange system between various participants in the transportation process	Grocery	Increasing the level of customer loyalty, attracting additional passenger traffic
Development of services for consumers of transport services	Expanding sales tools, improving application functionality, creating digital relationship management platforms	Food, advertising	Improving the quality of services, customer orientation, provision of new digital services
Modernization of railway infrastructure	Creation of a digital model with functions of predictive analytics of implementation technologies of interval regulation of train movement, "virtual clutch" technology, innovative track designs, technologies and technical means of major track repairs, rail grinding and milling technologies, creation of intelligent stations	Process, organizational	Reduction of costs related to repairs and maintenance (including indirect costs from downtime), reducing the number of unscheduled repairs, improving transportation safety and labor productivity
Development of strategic partnerships	Organization of cooperation between industry enterprises and specialized enterprises through the creation of an engineering center	Organizational	To reduce the import dependence of industry enterprises, to organize the localization of production of innovative rolling stock and its components

Its creation will make it possible to reduce the import dependence of enterprises in the industry, organize the localization of the production of innovative rolling stock and its components, reduce the duration of work on the development of the concept, development of technical documentation, R&D, creation of prototypes, conducting all kinds of tests of new equipment, and also ensure the accelerated implementation of progressive projects and solutions and, accordingly, additional efficiency due to life cycle cost savings implemented by innovations.

Therefore, the need to transform railway transport enterprises into an innovative European-level company is recognized today both at the highest level of state management and at the level of individual structural divisions. This manifests itself not only in the form of political declarations and heated discussions, but already in certain, not always consistent and often unsubstantiated decisions made at the industry level. Despite the fact that currently the state does not invest enough funds in the implementation of projects of innovative development of railway transport enterprises, quite often the decisions made at the level of the management of the railway industry and aimed at the implementation of innovative achievements are not effective enough. In any case, management actions in the field of innovation activity would be more effective, which would be based on scientific studies of patterns and institutional forms of innovation activity management [13]. Until now, the theory and best practices of innovation management have accumulated enough arguments in favor of the fact that the technological and production component in innovative development is far from the most important. The real transformation of railway transport enterprises into an innovative company is impossible without increasing the efficiency of management of innovative projects without increasing innovativeness. After all, the currently existing practice of implementing innovation policy at railway transport enterprises clearly demonstrates that the effectiveness of innovative activity is restrained, or better said – undermined, by a chronic disease – not a successful choice of management tools for innovative development projects of enterprises in the industry.

### 8.3 CONSIDERATIONS REGARDING THE IMPROVEMENT OF THE MANAGEMENT PROCEDURE OF PROJECTS OF INNOVATIVE DEVELOPMENT OF RAILWAY TRANSPORT ENTERPRISES

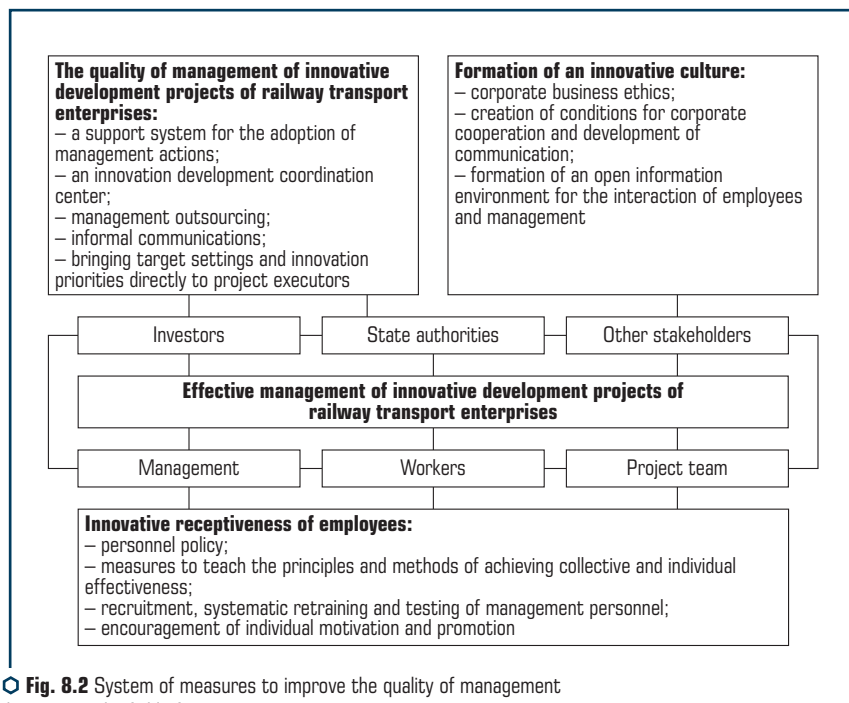
The main goal of innovative transformations at railway transport enterprises is to ensure their proactive development as the basis of financial stability and competitiveness in the market of transport and logistics services. Undoubtedly, innovative development should be based on the structural restructuring of the management system of innovative activities at railway transport enterprises, as well as technological updating of their production base due to the introduction of modern innovative technologies.

That is why today it is extremely important to take measures to improve the management procedure of innovative development projects of railway enterprises, since the stable future of the industry depends on their effectiveness.

Taking into account the fact that currently there is a low efficiency of the current innovation policy and the effectiveness of the projects selected for the implementation of innovation development,

a comprehensive system of management of innovation projects should be formed at the enterprises of the industry, taking into account industry transformations and innovation priorities within the framework of the next stages:

1. Establishment of bottlenecks, obstacles and directions for improvement of the management system of projects of innovative development of railway transport enterprises. Studies prove that to increase the efficiency of the management system of innovative projects at railway transport enterprises, it is necessary to implement measures to improve the quality of management decisions in the field of innovative activity. These measures should be directed not only to the development of the competencies of the management personnel, but also to the formation in the minds of employees of the importance of innovative changes for the enterprises of the industry, the development of innovative partnerships, and the formation of an innovative culture (**Fig. 8.2**).



**Fig. 8.2** System of measures to improve the quality of management decisions in the field of innovative activity

Source: author's development

In particular, in order to improve the coordination and quality of management actions in the process of implementing innovative development projects of railway transport enterprises, it is advisable to implement a support system for the adoption of management actions, to create



innovation development coordination centers, which will allow a clear demarcation of powers and responsibilities between project group participants, as well as to ensure a balance of interests all stakeholders. It will also allow to implement management outsourcing, develop informal communications, and ensure delivery of target attitudes and innovation priorities directly to project executors. The formation of an innovative culture should take place through the support of corporate business ethics, the creation of conditions for corporate cooperation and the development of communication, the formation of an open information environment for the interaction of employees and management (**Fig. 8.2**).

For the development of innovative receptivity of employees, namely employees' awareness of the importance of innovative changes, an appropriate personnel policy should be implemented, which would include measures to teach the principles and methods of achieving collective and individual effectiveness, recruitment, systematic retraining and testing of management personnel, encouragement of individual motivations and promotion by service Transformation of innovation policy and development of a program of priority projects of innovative development of railway transport enterprises.

2. Formation of industry standards and requirements for projects of innovative development of railway transport enterprises.

3. Organization of control over the effectiveness of the program of priority projects of innovative development of railway transport enterprises by creating standard forms of reports and developing a system of indicators for assessing the degree of their implementation.

It is possible and necessary to ensure the innovative development of railway transport enterprises based on the implementation of progressive innovative projects through the formation of an integrated management system for the innovative development of the industry, which will ensure the full cycle of the implementation of innovative projects – from the definition of strategic directions and target parameters of development to obtaining new services and assessing their effectiveness.

In addition, it is also important to observe the following conditions in the process of managing innovative development projects of railway transport enterprises.

First, since innovative projects are a creative process that is characterized by a high level of uncertainty and risk, a revision of traditional project management principles is necessary, it is advisable to apply only the best practices in the field of project management and combine them with new approaches and tools to achieve an optimal result.

Secondly, depending on the type of innovative project, it is advisable to change the approach to its implementation. It is advisable to choose an approach to project management depending on the technological features of the project, the conditions of the external and internal environment. If the innovative project is technological in nature, it is rational to choose a systemic or structural approach. If the project has a research nature and is related to the search for new ways of developing high technologies, then a situational approach should be used in relation to them. In projects related to the introduction of new technology, it is rational to use a marketing or process approach.

Thirdly, the key factor in the success of the implementation of an innovative project is a correctly selected toolkit of strategic management. The management of the industry needs to find

a balance between strict adherence to the chosen strategy of innovative development of railway transport enterprises and flexible response to the changing conditions of the external and internal environment, which will lead to lower costs, increased economic efficiency and reduced risks.

Fourthly, in order to increase the effectiveness of the management of projects of innovative development of railway transport enterprises, it is necessary to ensure the introduction of progressive information, communication and digital technologies. When managing innovative projects, it is advisable to use the latest digital technologies (for example, big data analysis, Internet of Things technology). Big data science technologies will allow to increase the competitiveness of projects because they allow to perform big data analysis in the following areas: analysis of existing research and development (including patent search); analysis of technological Internet sites; simulation of launching complex algorithms of new ideas. An actual solution for increasing the effectiveness of innovative projects at railway transport enterprises is the use of technologies based on IoT (Internet of things). IoT technologies involve the use of a global network of devices interconnected with each other and are used for project communications, data collection, advanced data analytics, and dynamic planning, which leads to a significant reduction in project completion times.

The complexity of managing innovative projects has increased significantly over the last decade, which is caused by an increase in the level of uncertainty of project parameters, high dynamism of the internal and external environment of the project, a large amount of data for project management and management, the need to attract highly qualified specialists for the creation and application of intellectual property objects, using modern technologies and material resources.

Considering the fact that the management of innovative projects at railway transport enterprises involves, first of all, the adoption of such decisions that will ensure the technological renewal of the industry and the growth of its competitiveness in the transport market, it is advisable to use effective information technologies to support management decision-making in order to select effective projects of innovative development to innovate and to reduce the uncertainty and risks associated with them.

To date, the practice of management has developed a significant number of decision support systems that allow management to make progressive decisions using data, knowledge, objective and subjective models to analyze and solve poorly structured and unstructured problems.

In fact, a decision support system is a computer system that provides information support to a decision maker and provides it with easy access to models and information used for the development and implementation of innovative projects. The decision-making support system allows to track information on existing innovative projects, obtain comparative characteristics of similar innovative projects in terms of direction, forecast income from the implementation of a certain innovative project, consider all possible alternative options for projects, conduct training and personnel training; implement monitoring and control over the implementation of innovative projects; organize effective communications between project team members, customers and other stakeholders.

Based on the above, let's propose the creation of a decision-making support system for managing projects of innovative development of railway transport enterprises, which is a complex of

functional blocks-tasks and is based on the use of dynamic fuzzy cognitive maps as a tool for modeling, analysis, development and monitoring of the implementation of innovative projects of the development of enterprises in the industry (Fig. 8.3).

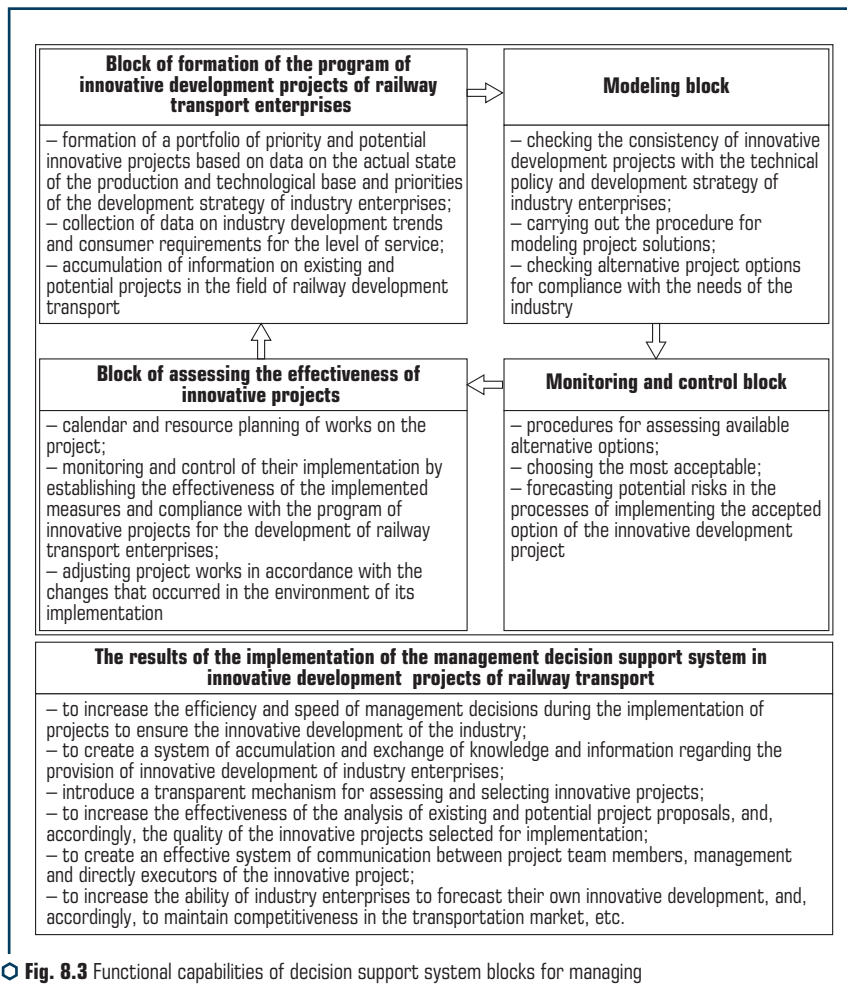


Fig. 8.3 Functional capabilities of decision support system blocks for managing projects of innovative development of railway transport enterprises

Source: author's development

Key blocks of this dynamic decision-making support system for the management of projects of innovative development of railway transport enterprises are defined as the block of forming

the program for the implementation of projects of innovative development of enterprises of the industry, the block of modeling, the block of assessing the effectiveness of innovative projects, the block of monitoring and control. Let's reveal in more detail the functionality of these task blocks.

The block for forming a program of innovative development projects of railway transport enterprises is intended for the formation of a portfolio of priority and potential innovative projects based on data on the actual state of the production and technological base and the priorities of the development strategy of the enterprises of the industry. Also, within this block, data collection will be carried out regarding trends in the development of the industry and consumer requirements for the level of service, as well as the accumulation of information on existing and potential projects in the field of railway transport development.

The modeling unit checks the consistency of innovative development projects with the technical policy and development strategy of industry enterprises, and also provides for the procedure of modeling project solutions, checking alternative versions of projects for compliance with the needs of the industry.

The unit for assessing the effectiveness of innovative projects includes procedures for assessing the available alternative options, choosing the most acceptable one, and forecasting potential risks in the processes of implementing the accepted option of the innovative development project.

The monitoring and control unit carries out calendar and resource planning of works on the project, as well as monitoring and control of their implementation by establishing the effectiveness of the implemented measures and compliance with the program of innovative projects for the development of railway transport enterprises. As a result of the assessment within this block, it is assumed that the project works will be adjusted in accordance with the changes that occurred in the environment of its implementation.

#### **8.4 DISCUSSION OF THE RESULTS OF THE FORMATION OF A DECISION-MAKING SUPPORT SYSTEM REGARDING THE INNOVATIVE DEVELOPMENT OF RAILWAY TRANSPORT ENTERPRISES**

Taking into account the functional capabilities of the blocks of the decision-making support system for managing innovative development projects of railway transport enterprises, it is worth noting that its implementation will allow:

- increase the efficiency and speed of management decisions during the implementation of projects to ensure the innovative development of the industry;
- create a system of accumulation and exchange of knowledge and information regarding the provision of innovative development of industry enterprises;
- introduce a transparent mechanism for assessing and selecting innovative projects;
- increase the effectiveness of the analysis of existing and potential project proposals, and, accordingly, the quality of the innovative projects selected for implementation;

- create an effective system of communication between project team members, management and directly implementers of the innovation project;
- increase the ability of industry enterprises to forecast their own innovative development, and accordingly to maintain competitiveness in the transportation market, etc.

Since Chapters 7 and 8 lay the foundation for the development of railway transport enterprises, in Chapter 9 let's proceed to the development of conceptual provisions for their development in particular and the industry as a whole.

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