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Innovative Development of Transport System using Magnetic Levitation Technology

Anatoly A. ZAITSEV **Yana V. SOKOLOVA** **Tatyana A. PANTINA**

Zaitsev, Anatoly A., *Emperor Alexander I St. Petersburg State Transport University, St. Petersburg, Russia.*
Sokolova, Yana V., *Emperor Alexander I St. Petersburg State Transport University, St. Petersburg, Russia.*
Pantina, Tatyana A.*, Admiral Makarov State University of Maritime and Inland Shipping, St. Petersburg, Russia*.*

ABSTRACT

Digital transformations in various sectors of the national economy of many countries lead to an increase in demand for not only information, but also innovative technologies in general. Those current trends are fully manifested in large-scale technological changes in the field of transport.

At the same time, the contents of tasks reflecting the trend for innovation, the priority of their formulation, as well as implementation mechanisms are determined in the context of socio-economic systems and development strategies of each state, taking into account its geopolitical position, participation in regional associations and organizations, many other factors affecting the nature of decisions made, formation of the strategic management of the innovative development of transport systems.

In Russia, the current public policy in the field of transport is focused on realizing the transit potential, improving the efficiency of transport services, and the level of economic connectivity of the territory through modernization and expansion of transport infrastructure. The solution of such problems, including, inter alia, increasing efficiency and safety of transport, requires introduction of fundamentally new technological solutions using the latest achievements of world science and technology.

The objective of the article is to propose a conceptual approach to inclusion of magnetic levitation in the set of technologies that contribute to strategic development of the transportation system in Russia.

In the context of an actively developing digital economy, the launch of a qualitatively new product on the domestic market, which is magnetic levitation transport systems (MLTS), will be a breakthrough solution in development of the country's transport system, taking into account a number of key tasks it solves.

Keywords: *transport, strategic management, national projects, trunk infrastructure, magnetic levitation transport.*

*Information about the authors:
Zaitsev, Anatoly A. – D.Sc. (Economics), professor, head of the scientific and educational center for innovative development of passenger railway transportation of Emperor Alexander I St. Petersburg State Transport University, St. Petersburg, Russia, nozpgups@gmail.com.
Sokolova, Yana V. – Ph.D. (Eng), deputy head of the scientific and educational center for innovative development of passenger railway transportation of Emperor Alexander I St. Petersburg State Transport University, St. Petersburg, Russia, nozpgups@gmail.com.
Pantina, Tatyana A. – D.Sc. (Economics), professor, vice-rector for scientific work of Admiral Makarov State University of Maritime and Inland Shipping, St. Petersburg, Russia, PantinaTA@gumrf.ru.

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Background. The state of the transport industry is one of the indicators reflecting the level of economic development of each country.

In the context of digitalization of various sectors of the national economies of many countries, there is a rapid increase in the number of fundamentally new technologies being developed and introduced. This trend is also characteristic of transport.

At the same time, innovative development of each country due to the specifics of socio-economic systems, the existing and planned configuration of the transport network, geographical location, availability of resources, and the degree of inclusion in the global transport system is developing along its own path, which determines formation and conditions for implementation of the respective strategies.

The key tasks of the public policy in the field of transport in Russia comprise implementation of the transit potential of Russia, increasing the efficiency of transport services and the level of economic connectivity of the territory, modernization and enhancement of transport infrastructure.

With a steady trend of dynamic changes taking place in the political and socio-economic environments, strategic management of innovative development of transport systems is of great importance.

The *objectives* of the article are to overview and briefly analyze the documents, determining public strategy in the transport field, and to put forward some suggestions, particularly regarding importance of integration of magnetic levitation transport systems (MLTS) into the list of technologies contributing to the strategic development of the transportation system.

The authors use general scientific *methods*, contents and comparative analysis, evaluation approach.

Results.

Plan for modernization and development of mainline infrastructure in Russia

Decree of the President of the Russian Federation dated 05.07.2018 No. 204 (hereinafter referred to as the Decree) defines the national goals and strategic objectives of the country's development until 2024 [1]. Pursuant to the Decree, national projects have been developed in 12 priority areas of socio-economic development.

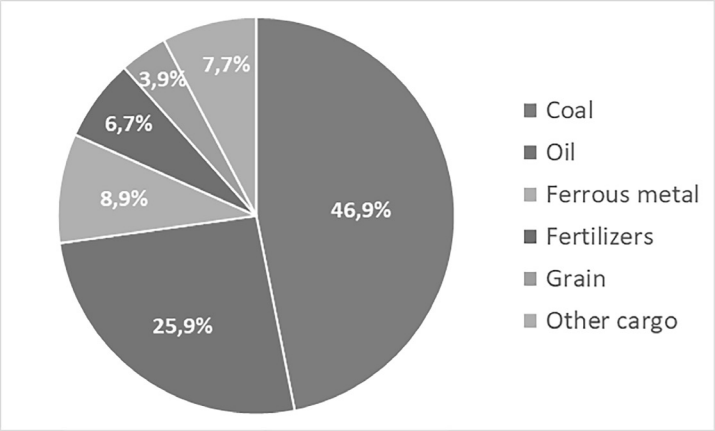
«The Comprehensive plan for modernization and expansion of mainline infrastructure for the period until 2024 (hereinafter referred to as the Comprehensive plan)», approved on September 30, 2018, which includes two parts: transport and energy power», «envisages development of West–East and North–South transport corridors for transportation of goods», railway, aviation, road, sea and river infrastructure in order to ensure economic connectivity of the country [2].

The development of the West–East and North–South transport corridors will be carried out, in particular, through construction and modernization of roads connecting Europe with Western China. Large-scale measures are envisaged to develop the Northern Sea Route, the capacity of Baikal-Amur Mainline and Trans-Siberian Railway. The expected results of development of transport corridors provide for a decrease in the transit time of container transportation, an increase in the average commercial speed of cargo transportation by rail, the grown capacity of multimodal transport and logistics centers put into operation, and an increase in the volume of export of transportation comprehensive services. For example, in the field of railway transport, 104 projects are envisaged [3].

Assessment of railway transport capabilities' conformity to the country's needs

The national transport sector faces today many challenges, including the need to develop infrastructure, attract private investment, insufficient maturity of companies participating in the market, which creates additional difficulties for functioning of the transport system [4]. At the same time, Russia operates the railway infrastructure much more intensively than many other countries: 29 million tons of cargo were transported per 1 km of tracks in 2017, while this figure is a lower by quarter in China and twofold lower in the United States. According to the assessment made by The Global Competitiveness Report, Russia ranks third in the world (86 thousand km) in terms of railway length and 23rd in terms of quality of railway infrastructure [5].

Today, the railway network cannot cope with the increasing flow of export cargo. The loading on the entire railway network of Russia in the direction of seaports from January to September 2018 increased to 229 million tons (+6,1 %



Pic. 1. Structure of export cargo (January–September 2018).

compared to the level of January–September 2017) [6].

The share of raw materials in the volume of export of certain goods (Pic. 1) is of 92,3 %, while other goods, including finished products of the industrial complex, account for 7,7 % [6]. In fact, the so-called high-margin cargoes, perishable products that are transported by road are excluded from the range of railway cargo transported.

At the same time, the volume of exports of hydrocarbons and, above all, coal, by rail is increasing. The railway network today is unable to fully meet the needs of business and the state by quantitative and qualitative indicators. Due to the large number of bottlenecks, Trans-Siberian Railway cannot take the additional load.

The solution of those problems requires taking a set of measures to attract resources, use innovative technological capacity, and create conditions for a stable balanced development of the transport system.

Given the increasing complexity and uncertainty of the external environment, the natural capabilities of the market mechanism are not enough to coordinate investment activity, and under those conditions the importance of state investment policy in Russia, which should develop and acquire the features of strategic management, is growing.

The role of strategic management of national projects

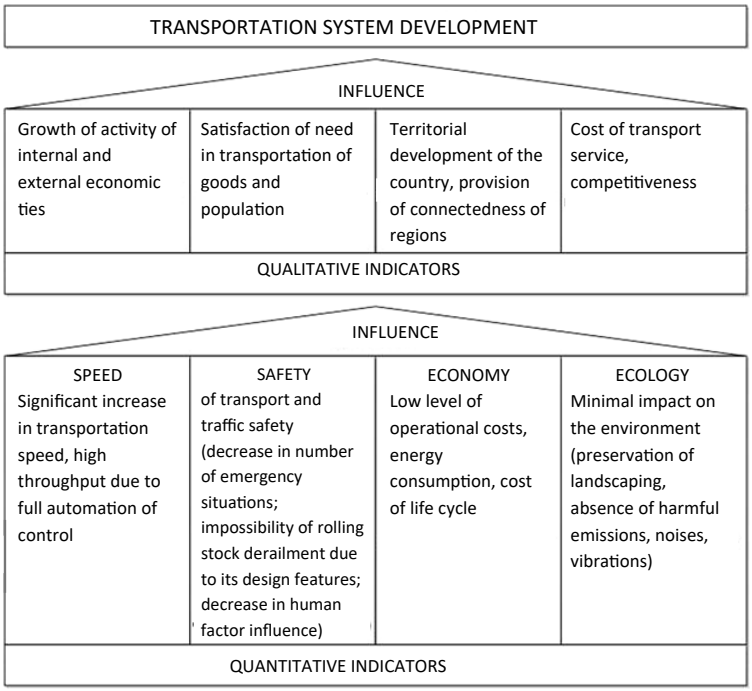
The features of strategic management are the ability to take into account forecasts of development of the internal and external economic situation in the world, the degree of their influence on implementation of the development program, use of innovative technologies in a unique layout, flexible timely response to constant changes, involvement of the country's intellectual elite in developing practicable methods and optimal choice of managed facilities.

Scientists and practitioners in the field of transport logistics and transportation technology understand the real situation and its consequences for the country and comprehensively justify the need for large-scale projects to strengthen the main transport infrastructure.

The Russian Federation should find the opportunity to effectively use its territory to create West–East and North–South interstate transport corridors, focusing on technical, organizational and economic indicators that correspond to the new technological structure.

Magnetic levitation technology for innovative development of the transport industry

Magnetic levitation technology is constantly being improved and has great potential to become the core of the new transport revolution, both from the standpoint of accelerating movement and from the standpoint of traffic safety and environmental safety, which is reflected in the works of recognized world experts in this field from the USA, South Korea, Germany [10]. The evolution of high-speed rail transport has clearly demonstrated the achievement of the physical limit of the «wheel–rail» technology, so development of the transport system using innovative magnetic levitation technology is becoming a global trend [11].



Pic. 2. Key indicators of innovative development of the transport system using magnetic levitation technology.

The prospects for its use to date are not fully disclosed. However, the key issues of economic efficiency, the ability of a new technology to meet the needs of society and the economy more efficiently than existing technologies are proven and are obvious.

In their work «Energy Consumption of Track-Based High-Speed Transportation Systems: Maglev Technologies in Comparison with Steel-Wheel-Rail», the authors, members of the international steering committee, provide convincing proves and a number of comparative energy efficiency parameters for two, magnetic and classic high-speed «wheel–rail», systems [12]. The advantages of magnetic levitation transport vehicles are explained by the absence of friction in the system of moving elements.

For several decades, the international scientific community has been discussing the problem of using the unique properties of superconductors to improve the quality characteristics of magnetic levitation transport vehicles [13; 14; 15], while their widespread use is constrained by the cost, which tends to decrease, but has not yet reached a level acceptable for implementation in transport technologies.

The results of the 24th Maglev 2018 International Conference, held in St. Petersburg at Emperor Alexander I St. Petersburg State Transport University in September 2018, show that there is an increase in the number of countries in which strategies and programs for introduction of magnetic levitation transport technologies have been developed and are operational, as well as of countries in which magnetic levitation transport projects are either implemented or are being prepared for implementation. In China, Japan, South Korea, Germany, the USA and other countries, production of high-tech components is growing, the process of training specialists for future implementation programs is being developed.

The results of ongoing global studies will allow in the near future to qualitatively improve the technical and economic indicators of the magnetic levitation transport system, the key characteristics of which already confirm its effectiveness for innovative development of the transport system (Pic. 2).

For innovative development of the transport system, strong-willed decisions by the leadership of the country and the industry are needed, as well as system and focused work to test and develop initiative achievements of

Russian engineers. State support is becoming a decisive factor in bringing patented developments to the stage of implementation in real economic and technological conditions in order to safely and quickly move a large number of people and goods at any distance.

Conclusions.

Strategic management is an effective tool of achieving the goals of innovative development, allowing to obtain the planned results. In this regard, it is necessary to consider Magnetic Levitation Transport System (MLTS) as a technology that is strategic in nature and deserves development as an element of implementation of Russia's transport strategy.

A set of interconnected actions and activities aimed at ensuring an effective solution of the task of creating MLTS will ensure achievement of the strategic goals of innovative development of the transport industry.

Magnetic levitation transport technology, despite its uniqueness and effectiveness, confirmed by research and the results of commercial use in different countries of the world (Japan, China, South Korea), is an innovative product whose implementation experience is not available in Russia. The tools of strategic management and planning are able to minimize to a large extent the risks of project implementation at all stages of its implementation.

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