

Problems of Decision-Making in Implementation of Technological Innovations in Transport Industry



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ABSTRACT

The article considers the features of transport as an object of technological innovation, due, on the one hand, to the service nature of the main activity and the specifics of innovative processes during provision of transport and logistics services, and, on the other hand, to the high capital intensity and technological complexity of the infrastructure transport complex, which is the focus point of technological innovation.

The objective of the article is to substantiate the initial prerequisites for developing an alternative approach to making strategic decisions on development of transport organisations based on technological innovations, which, besides the traditional justification of economic efficiency, considers several non-economic factors. The method of substantiation is a systemic strategic analysis, which allows to study the features of the transport complex in the context of the factors of external environment and their dynamics.

Regarding the Russian Federation, the scale of the national territory, natural and climatic diversity and uneven territorial distribution of the resource and production base determine the special role and place of transport in the national economy, which quite often leads to the need to make decisions on development of the transport complex based on predominantly non-economic factors (such as security, reliability, environmental friendliness, etc.)

and on scientific, technical, political and socio-economic forecasts. At the same time, private enterprises (with or without participation of the state) dominate currently almost all transport sectors where they operate on the principles of profitability, investment attractiveness and competitiveness, which leads to inconsistency of internal decision-making criteria in the field of technological strategies.

The ongoing change in the technological paradigm is an additional and significant factor determining trends in transport developments. It is based on the processes of digitalisation and digital transformation of the transport and logistics business. The problems of decision-making in implementation of technological innovations in transport industry, arising from its peculiarities, necessitate a revision of approaches since economic assessments of efficiency are not always able to reflect the real needs and feasibility of choosing mainstream trends in technological development of the transport system.

The analysis of the features of the transport and logistics industry based on universal experience and cases in Russian practices in the context of formation of a new technological paradigm makes it possible to substantiate the methodology for making strategic decisions on implementation of technological innovations.

Keywords: transport, transport services, technological innovation, digitalisation and digital transformation of transport, the process of making strategic decisions, trends in the technological development of the transport complex.

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INTRODUCTION

Improvement of approaches to substantiating the choice of a strategy for technological modernisation of the transport complex is among inherent aspects of the problem of making decisions on development of transport.

In the Russian Federation, transport plays an important role in ensuring sustainable economic development of the country and its national security due to the territorial scale, uneven distribution of the resource and production base, climatic and geographical differences between the regions of the country. The main task of transport is to ensure integrity, unity, and connectivity of the territory of the Russian Federation based on reliable circulation of freight and passenger flows as a condition for effective functioning of the country's economy [1]. Insufficient attention to the problems of transport development can lead to a threat to national security (in a broad sense): from the rupture of production and logistics chains and termination of trade and economic relations with other countries to destruction of connectivity and disruption of life support systems of individual regions and territories.

Even though currently the transport industry in Russia and other countries has developed and uses methodological provisions for assessing the effectiveness of innovative technological solutions, which serve as a rationale for development of technological strategies, practices show that the results of assessment do not always reflect real consequences of the implemented innovative projects since non-economic factors and decision-making criteria are not sufficiently considered. In this regard, it becomes necessary to clarify the approach to substantiating decisions on implementation of innovations in transport, considering a wider set of factors and criteria, as well as industry's specifics. For this, it is necessary to highlight key prerequisites for development of an alternative approach to making strategic decisions on development of transport organisations based on technological innovations, which is the *objective* of this study. This objective is achieved by *analysing* the specifics of transport as of an object of innovation through highlighting non-economic aspects of decisions made that then become separate research and analytical tasks.

RESULTS

Transport, being a complex organisational and technical system, has a characteristic specificity due to its belonging to the service sectors of the economy: the main result of functioning of transport is provision of transportation and logistics services. According to the classical approach developed within operations management [2], a feature of the technological process of providing services is that the client (consumer) is directly involved in the process of providing services, and the operator is in constant contact with the client, therefore, one of the main indicators of functioning of service-providing organisations is «customer focus» [1].

Based on the principle of customer focus, it is possible to clearly draw the boundary between main and auxiliary technological and business processes in the transport industry:

- *Main* processes include those technological and business processes that have value and are important (significant) for the client, serve as the basis for making decisions on obtaining a service and determine technological competitiveness of a transport organisation.

- *Auxiliary* technological and business processes meet only the needs of the service-providing organisation itself, while remaining outside the customer value system and having significance, first of all, either for the transport organisation itself, or for creating conditions and the possibility for sustainable implementation of the main technological and business processes.

But for transport, which is a high-tech industry, it is the auxiliary components and processes of transport systems that are the most resource-intensive and complex (infrastructure, vehicles or rolling stock, etc). As a result, the bulk of innovations in transport are implemented precisely in auxiliary components and processes, almost imperceptibly for the client, which forms negative customer assessment of the level of innovative activity of transport organisations. For example, the transition to automated train driving, which is a breakthrough technological innovation, is almost invisible to the passenger of an unmanned train. At the same time, marketing innovation, such as changes in design of the train, is obvious, but not always positively perceived as a necessary and useful innovation.

Another consequence of dominance of auxiliary processes and components in innovations in transport systems is low



productivity of one of the traditional methods of initiating innovations based on new or projected market needs (*market pull*), which are not always associated with auxiliary or supporting processes. Moreover, in the main activities of transport organisations, new services that can become innovations appear quite rarely: transportation of goods and passengers, as well as cargo handling services or services before travel and along the route have changed little in their essence over the past 100–200 years. Mainly the technologies of their provision were subject to changes: the level of mechanisation and automation was growing, new transport equipment was mastered, the transport infrastructure was modernised, etc. [3]. Therefore, the innovative activity of transport is mainly concentrated in the field of technological process innovations. Consequently, the problems of making strategic decisions in the field of technological process innovations acquire special significance for transport.

If we study the example of Russia, it is necessary to consider other factors as well. The territorial and geographical position of Russia and, consequently, of its transport system are a prerequisite for creation of international transport corridors and organisation of transit of passenger and freight traffic along Europe-Asia axis [4]. The growth in the volume of transit traffic by land transport requires not only modernisation of the track infrastructure, but also expansion of the range of additional services that ensure competitiveness of Russian transit in the global transportation market. However, it should be noted that most of the innovations in this field of transportation, despite their scale and high resource intensity, are also out of sight of customers: passengers and shippers/consignees. Thus, straightening of curved sections in the eastern mountainous part of Trans-Siberian Railway to ensure heavy and faster train traffic [5], most likely, will be invisible to passengers and shippers, although we are talking not only about new technologies for construction of railways, but also about fundamentally new technical solutions for traffic organisation and control, including the unmanned driving of trains.

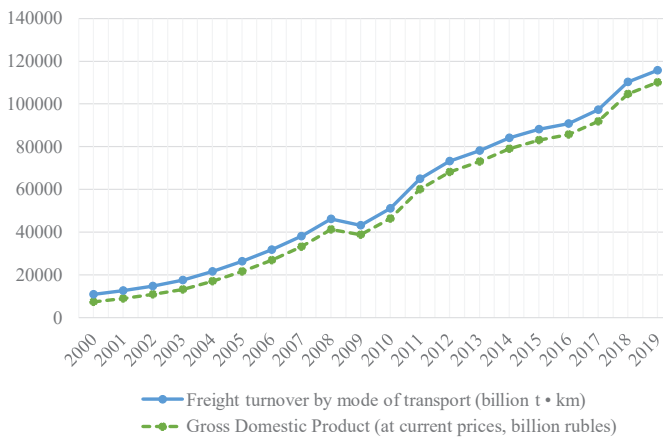
The high capital intensity of the transport business inevitably leads to an increase in the size of companies up to formation or maintenance of natural monopolies or formation of oligopolies. In Russia, e.g., this feature is typical for all modes of transport: in civil aviation, there are

practically no medium and small airlines left with unconditional dominance of Aeroflot PJSC, small private taxi fleets are forced to merge on the platforms of the aggregators *Uber*, *Gett* and *Yandex*, the natural monopoly of JSC Russian Railways remains on the railways. Similar trends can be traced abroad. Due to the monopoly on the market, transport companies have a lower propensity to innovate, they are more conservative in their decisions on implementation of atypical technologies and technical solutions that differ significantly from the used technologies. When deciding on the purchase of new transport equipment, large companies prefer established technological solutions with minimal risks for operational activities, therefore, as a rule, they buy not innovative, but mass-produced products, that is, those products which are no longer innovative for their manufacturer. At the same time, transport organisations themselves turn out to be «innovatively active», or «carrying out innovative activities», since, according to the definitions of statistical bodies¹², we can talk about the first three years of implementation of new equipment and technology in an organisation, regardless of the innovativeness of the latter¹.

Due to high capital intensity, the period of transition to a new technological basis in transport organisations turns out to be quite long and can reach several decades, going beyond the normative definition of the innovation period up to three years¹. From this point of view, the decision to introduce new technological solutions in transport industry should be made taking into account the long period of operation of equipment and the use of technologies, where an erroneous decision will have a negative impact on efficiency of the transport business for many years. Thus, the decision to electrify railways turns out to be effective only with cheap electricity, while a change in the price ratio between electricity and hydrocarbon fuel can lead to permanent

¹ Instructions for filling out the federal statistical observation form N 4-innovation. Information about the organisation's innovative activity. ConsultantPlus website, 1997–2021. [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_359374/. Last accessed 20.01.2021.

² OECD/Eurostat, Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg, 2018. [Electronic resource]: <https://www.oecd-ilibrary.org/docserver/9789264304604-en.pdf?expires=1604869291&id=id&accname=guest&checksum=B2ED06AD817A6F8922255CA9BF2A9D34>. Last accessed 28.01.2021. DOI: <https://doi.org/10.1787/9789264304604-en>.



Pic. 1. Dynamics (accumulated) of GDP and freight turnover per modes of transport in the Russian Federation (accumulated), 2000–2020 [built by the authors based on Rosstat [Federal State Statistics Service] data]^{3, 4, 5}.

losses during transportation due to the use of more expensive energy resources. As a result, when making decisions on technological modernisation, it is necessary to consider the long-term and difficult-to-predict context of the decisions made.

Another features are that the service could not be «stored up» to reduce peak loads in future, and that there is a high dependence on the economic activity of other sectors of the economy. In fact, the economic activity of transport is a derivative of the situation prevailing in a country's economy: in case of a general economic downturn, the demand for transportation and logistics operations decreases proportionally, regardless of the level of technological readiness of transport, its capacity and special marketing measures (Pic. 1).

Hence, innovations in transport industry should be more resistant to unfavourable economic situation. At the same time, for making innovative decisions and setting targets for transport development, the use of indicators related to freight and passenger turnover (for example, the amount of revenue or operating profit) or calculated on their basis (for example, labour productivity) turns out to be unproductive.

Real indicators can significantly differ from the calculated ones for reasons beyond the control of a transport organisation. For the same reasons, such indicators should not be considered when deciding on implementation of innovations in transport organisations. Nevertheless, such indicators as «labour productivity» and «revenue growth rates» are set as targets and are planned by the government when developing and implementing innovative development programs for such large Russian transport organisations [with public capital] as PJSC Aeroflot⁶ and JSC Russian Railways⁷.

Also, a feature of service-providing industries, in general, and of transport, in particular, is their special role in the high-tech market, where they must act as consumers or customers, creating a demand for innovation. At the same time, transport organisations should not independently develop new generation transport equipment, since they are not manufacturers, but operators. In this regard, the innovative activity of transport organisations is determined by technological capabilities of manufacturers of this equipment. Of course, a transport company can actively participate in design of technical specifications, but when purchasing new equipment, it will be limited in choosing between only those solutions

³ Federal State Statistics Service (Rosstat). Gross Domestic Product, annual data (at current prices). [Electronic resource]: [https://www.gks.ru/storage/mediabank/tab1\(2\).htm](https://www.gks.ru/storage/mediabank/tab1(2).htm). Last accessed 20.01.2021.

⁴ Federal State Statistics Service (Rosstat). Freight turnover by mode of transport in the Russian Federation. [Electronic resource]: <https://www.gks.ru/folder/23455>. Last accessed 20.01.2021.

⁵ Federal State Statistics Service (Rosstat). Information on the socio-economic situation in Russia, 2019. [Electronic resource]: <https://gks.ru/storage/mediabank/oper-12-2019.pdf>. Last accessed 20.01.2021.

⁶ Passport of the Innovative Development Program of Aeroflot Group 2020. Aeroflot Airlines 2008–2021. [Electronic resource]: https://www.aeroflot.ru/media/affiles/media/strategy/pasport_programmy_innovatsionnogo_razvitiia.pdf. Last accessed 23.01.2021.

⁷ Long-term development program of JSC Russian Railways until 2025, approved by the order of the Government of the Russian Federation of 19.03.2019, No. 466-r. ConsultantPlus, 1997–2021 [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_320741/. Last accessed 21.01.2021.





Source: Russian Railways: <https://company.rzd.ru/ru/9407/page/686507d-20454>.

that are on the market. And the possibilities of its development can be limited by the technological backwardness of suppliers. For example, the metallurgical industry may not have existing new technologies and production facilities for production of advanced grades of steel and its products. As a result, modernisation of the track can be based only on those materials and components of the track superstructure that are available on the market, which leads to a decrease in the innovative potential and in the organisational and technical level of technological processes ensuring transportation.

On the other hand, due to the scale of the railway infrastructure and the associated large volumes of purchases of railway equipment, railways are among main players in the innovation market, shaping the demand and trends in technological development of the industry, that, in case of Russia, is confirmed by the data of the investment program of JSC Russian Railways, which during the period from 2015 for 2019 ranged from 365,5 to 690,0 billion rubles⁸, or on average about 3 % of the total budget of the Russian Federation. Russian transport organisations annually acquire new equipment, not only stimulating its production, but also taking an active part in its development and modernisation, which is not typical for transport organisations in some other countries, where transport companies can choose equipment from a sufficiently large number of really competing

suppliers seeking to bypass each other in terms of the technological characteristics of new equipment. Abroad, transport companies and the state only determine the requirements and adopt technical regulations for operation of new equipment (for example, noise level, energy efficiency class, railway track width, runway length, etc.), and the whole R&D process is carried out by companies manufacturing transport equipment. This is largely due to the closed nature of the Russian market of transport equipment since manufacturers focus on the internal needs of Russian transport companies as the export or expansion of new players to the market is associated with complex procedures of certification of products and production, confirmation of qualifications, and possession of competencies and technologies necessary to participate in electronic trading, and many other constraints in this area. Constraints linked to entering the domestic Russian market of transport equipment, on the one hand, allow to rule out unscrupulous suppliers, but, on the other hand, prevent the emergence of innovatively active players developing alternative competitive and technologically promising solutions. As a result, the inflow of new technological solutions to the transport equipment market is significantly depleted, and the quality of supply decreases.

An additional factor affecting quality of transport equipment offered by suppliers is alienation in favour of the customer of intellectual property rights arising from creation of new transport equipment ordered by a transport organisation. The requirement to transfer all

⁸ JSC Russian Railways. Investment activity. [Electronic resource]: https://old-ir.rzd.ru/static/public/ru?STRUCTURE_ID=35. Last accessed 21.01.2021.

rights to the result of intellectual activity⁹ to the customer which is a transport organisation, clearly turns out to be illogical and ineffective from all points of view: transport organisations pay the cost of creating IP, increasing their research and development costs and at the same time having neither the capabilities nor the intention to further commercialise those results outside their own business, since they are not manufacturers of railway equipment. At the same time, organisations that have performed R&D resulted in creation of objects of intellectual property (OIP) lose the possibility of using OIP in other developments, which reduces the interest of developers in a high scientific and technical level of the obtained results of intellectual activity¹⁰.

At the same time, the experience of international companies shows that even in the conditions of a monopoly or an oligopoly of transport organisations, the developed technologies and samples of equipment can be successfully promoted outside the national markets, and competition in world markets encourages developers and manufacturers of transport equipment to increase the level of developments brought to the market. For comparison: Deutsche Bahn, the largest German railway carrier, has only a few patents on its balance sheet: for logos and branding, while their suppliers, in particular, Siemens AG, owns intellectual property rights and promotes their transport equipment not only in Germany, but around the world.

Nevertheless, at present, making decisions on implementation of innovations in large transport companies with state participation, according to the established requirements, should be built considering how many intellectual property objects will be on the balance sheet. The number of patents and licenses that a transport organisation possesses, becomes one of the key development indicators. Reporting on innovative development programs includes indicators of obtained patents.

A feature of transport is the strong influence of regulators on the main and auxiliary

technological processes: from tariff regulation to requirements for safety and environmental performance, which leads to a high share of economically ineffective innovations. Thus, the requirement established by the legislator to enter passport data in travel tickets and their obligatory checking during embarkation and disembarkation of passengers, led to an increase in complexity of processing travel documents and increased the time required to service passengers at stops. This, on the one hand, reduced the customer satisfaction index, and on the other, led to an increase in costs for transport organisations. Nevertheless, this economically ineffective innovation has been implemented in almost all modes of long-distance passenger transport. Innovations in the field of ecology and safety are not characterised by a real (reflected in the financial and economic indicators of transport organisations) economic effect, but nevertheless they are invariably included in the programs of innovative development of transport organisations^{11, 12, 13}.

Another feature of transport is its heterogeneity. The transport system of Russia is formed by various modes of transport. At the same time, railway transport plays a system-forming role in the country's economy: its share in freight turnover in 2018 reached almost half (46 %) of cargo transportation by all modes of transport and over 87 % excluding pipelines. The volume of freight turnover of railway transport in 2018 amounted to 2 598 billion tkm¹⁴. The importance of railways as the main component of the Russian transport system is emphasised in the Transport Strategy of the Russian Federation until 2030: «Railway transport is one of the key

¹¹ A comprehensive program for innovative development of Russian Railways holding company for the period up to 2025, approved by the Board of Directors of JSC Russian Railways on February 26, 2020. Single window of innovation. [Electronic resource]: <https://eoi.rzd.ru/front/media/1022/266-%D1%80-%D0%BE%D1%82-11022021.pdf>. Last accessed 20.01.2021.

¹² The strategy for development of innovative activities of the Federal Road Agency for the period 2016–2020, approved by the order of Rosavtodor dated 28.03.2016, No. 461-r. Accounts Chamber of the Russian Federation. [Electronic resource]: <https://ach.gov.ru/upload/iblock/67d/ap67p4spuhjz179h0jbnjtb66pvlptlc.pdf>. Last accessed 21.01.2021.

¹³ Passport of the Innovative Development Program of Aeroflot Group 2020. Aeroflot Airlines 2008–2021. [Electronic resource]: https://www.aeroflot.ru/media/affiles/media/strategy/pasport_programmy_innovatsionnogo_razvitiia.pdf. Last accessed 23.01.2021.

¹⁴ Russia in figures. 2019: Brief statistical collection of Rosstat. Federal State Statistics Service, Moscow, 2019, P. 371. [Electronic resource]: https://www.gks.ru/free_doc/doc_2019/rusfig/rus19.pdf. Last accessed 25.01.2021.

⁹ The term RIA in Russian laws is generally equal to intellectual property protected in law. – *Translator's note*.

¹⁰ Standard STO RZD 08.014–2011 «Innovation activities in JSC Russian Railways. Requirements for procurement of innovative technical products». [Electronic resource]: <https://files.stroyinf.ru/Data2/1/4293731/4293731375.pdf>. Last accessed 21.01.2021.





Source: Russian Railways: <https://company.rzd.ru/9407/page/68650?id=23436>.

components of the single transport system in Russia, it is called to timely and efficiently meet the needs of the population, business and the state in transportation, to help create conditions for development of the economy and ensure the connectivity of territories and a single economic space»¹⁵.

According to experts' forecasts [7–10], railway transport in the long term will remain the main mode of transport in Russia. This is due to the fact that among land modes of transport, the railway transport is most easily transferred to the remote-control mode, and subsequently to automatic (unmanned) control, since the train trajectory is linear with a limited number of degrees of freedom. For example, in many international airports and in some foreign metro systems trains run without drivers [11], and traffic control is carried out through a single remote-control centre.

In addition, for several regions of the country (for example, Western Siberia), railways remain the only means of transportation throughout the year due to wetlands and undeveloped territory.

In the context of formation of a new technological paradigm (Industry 4.0), railway transport is characterised by a higher readiness to integrate new intelligent control technologies, being one of the most ready for automation of

operational activities and adoption of unmanned technologies, which was especially pronounced in the context of the COVID-19 pandemic. The volume of traffic during the period of quarantine measures in most countries fell sharply, and at the peak of the epidemic, the drop in passenger traffic was from 70 to 100 %¹⁶. The pandemic almost completely paralyzed air traffic around the world, the largest international hub airports, which provided links between regions and continents, were closed.

In a pandemic, railway transport has proven to be the most flexible and adaptable to new realities. Several strategic decisions were made to improve transport safety. For example, in long-distance passenger trains, it is possible to provide an isolated passage of passengers by installing additional filters in the compartment ventilation system, ensuring embarkation and disembarkation of passengers at a safe distance with an increase in the parking time at intermediate stations, a decrease in the occupancy rate¹⁷ of a compartment to a single passenger or to

¹⁵ Transport strategy of the Russian Federation for the period up to 2030. Order of the Government of the Russian Federation of November 22, 2008 No. 1734-r. [Electronic resource]: <http://static.government.ru/media/files/41d4e8c21a5c70008ae9.pdf>. Last accessed 20.01.2021.

¹⁶ Report of the Analytical Center for the Government of the Russian Federation. Countering the impact of the COVID-19 pandemic on railway transport in the world. Russian Railways. Working reports, Iss. 24, p. 5. [Electronic resource]: https://ac.gov.ru/uploads/2-Publications/RZD_june2020.pdf. Last accessed 23.01.2021.

¹⁷ Regulatory documents on countering the spread of coronavirus infection in the Russian Federation: electronic operational collection (as of June 25, 2020) in 3 parts. Moscow, NMITS FPI, 2020, Part 1. [Electronic resource]: https://edu.rosminzdrav.ru/fileadmin/user_upload/specialists/COVID-19/dop-materials/250620/Sbornik_CH.2_25_ijunja.pdf. Last accessed 30.01.2021.

a family with an increase in length of trains, which is significantly cheaper in comparison with re-equipment of the aircraft cabin, where a complete rearrangement of the cabin must be carried out with creation of autonomous passenger seats.

In several cases, freight railway transport remains uncontested: for example, transportation of coal and ensuring its export, i.e., from Russia to China, is possible only by rail, since all other modes of transport are unable to provide reliable and relatively cheap transportation of such significant volumes of cargo. With the permafrost melting, operation of pipelines in the Arctic is becoming unreliable and carries risks of environmental disasters, like the catastrophic diesel spill in 2020 in the Arctic. Transportation of produced hydrocarbons in railway tanks, on the one hand, allows monitoring the condition of the track and rolling stock, and, on the other hand, allows reducing the likelihood of a spill and localising possible leaks.

However, at present, the trend of development of transport as of a multimodal system has emerged and is strengthening, which is the result of development of information and communication technologies, which make it possible to unite management of various modes of transport within a single technological platform. Initially, multimodal transportation emerged in transnational companies, global operators of transport services for transportation of goods, based on the integration (mergers and acquisitions) of companies (for example, Maersk Seeland) related to various modes of transport. However, at present, alliances and partnerships of various transport companies are increasingly spread, together with the emergence of independent logistics operators that form multimodal transport chains. Also, at present, multimodal transportation is increasingly being developed at the domestic national or regional level, primarily in the segment of passenger transportation [10].

The transition from a multi-agent model of transportation, in which a shipper or a consignee had to conclude several contracts with carriers related to different modes of transport, to multimodal transportation which is provision of services for transportation of goods with a single contract with at least two different modes of transport under the control of a single carrier, as a model of a multimodal transport network and its elements is confirmed by domestic research

[11; 12]. When deciding on introduction of multimodal cargo transportation, as a rule, the main attention is focused on cost indicators or time of delivery of goods or passenger travel. In addition, it is necessary to consider the total travel time, the risks of loss of goods by various modes of transport, the costs of concluding contracts, taxes, etc.

In passenger transport, multimodal transportation is often due to social reasons. For example, multimodal commuter train-bus service initiated by JSC Russian Railways carrier company makes it possible to reduce the costs of transportation on ineffective routes while maintaining transport mobility of the population, as well as unload highways at the exits from large settlements and megacities.

In development of multimodal freight transportation, railways also dominate, as they are capable of providing transportation of large volumes of goods with minimal costs and have ready-made points for sorting and transshipment of goods, including for further transportation by other modes of transport. Therefore, as a rule, namely railways become the initiators of multimodal transportation.

An example demonstrating the leading role of railway transport in development of multimodal freight and passenger transportation refers to organisation of piggyback transportation with participation of JSC Russian Railways on Yekaterinburg–Moscow route: in February 2020, a new piggyback platform was serially manufactured and launched onto the line¹⁸, allowing to minimise time parameters of loading and unloading operations and to organise seamless shipment and delivery of goods to customers located far from railways.

Nevertheless, development of multimodal transportation requires modernisation of the transport infrastructure. The expansion of the volume of multimodal transportation leads to the need to create hubs, large logistics complexes that provide a seamless connection of various modes of transport within the optimal route. And the very first task in this area faces the need to determine the optimal location for a multimodal transport hub, its capacity, technological equipment, etc.

It should be borne in mind that decision-making in this area is based on forecast data on

¹⁸ Heavyweight piggyback. *Gudok*, Iss. 32 (26881) 25.02.2020. [Electronic resource]: <https://www.gudok.ru/newspaper/?ID=1494810&archive=2020.02.25>. Last accessed 29.01.2021.



freight and passenger traffic for many years to come, which does not guarantee either accuracy or even the minimum adequacy of the forecasts. Regarding strategic perspective, in recent years, more and more people are talking about «strategic surprises» («black swans» [13]), which are not considered by any forecast.

Change in the technological paradigm, which not only changes the structure of technologies and equipment, but also significantly alters traffic flows adds additional complexity to decision-making in development of infrastructure and construction of hubs, as well as in their design. So, according to one of the forecasts [14], development of additive technologies and full automation of production will lead to the phenomenon that instead of production and subsequent transportation to the place of consumption of technological products, with emergence of automated factories, instead, only information about the technological process of manufacturing «on site» and «from local resources» will be transmitted, that is, the pre-existing need for transportation will disappear or at least decrease. In these conditions, a new, just laid railway line or an expensive and high-performance hub may turn out to be unclaimed, and the costs of their creation may be irrational.

Preserving and strengthening the role of transport in the country's economy requires a significant increase in innovative activity, aimed primarily at modernising and significantly renewing vehicles and infrastructure. However, in accordance with F. Janszen's TAMO¹⁹ model [15], the success of innovations is achieved only with an integrated, balanced approach that considers all aspects of the organisation's activities. Therefore, along with technological process innovations in accordance with Oslo Manual 2018, organisational, marketing, technological product innovations and innovations in business processes are no less important for transport organisations, and when designing technological changes, it is necessary to make changes along the entire chain of innovation activity.

Decisions on development of transport are currently based mainly on economic assessments, which are based on a comparison of expected effects and costs of modernisation and

reconstruction of both transport equipment and transport infrastructure. It has already been shown above that, as a rule, transport forecasts, which often represent an extrapolation of the current situation into the future, in certain situations turns out to be incorrect, and, therefore, the result of purely economic estimates turns out to be incorrect. Besides, the above-described features of transport as a capital-intensive service-providing sector of the economy with long-term fixed assets are not sufficiently considered. From an economic point of view, wear of these assets is reflected in depreciation, however, obsolescence of equipment remains currently outside the scope of economic assessments and feasibility studies. However, acceleration of the technological process, a change in the technological paradigm, require considering obsolescence when making decisions on the development of transport infrastructure, and ignoring it inevitably leads to errors and losses. In this regard, it is necessary to change the approach to making strategic decisions on development of transport, complementing economic assessments by considering technological trends both in the field of transport technology and in the transport services market.

CONCLUSIONS

When making decisions on implementation of innovations in transport industry, it is necessary to use an alternative approach to existing methodologies, based mainly on traditional economic models.

The prerequisites for this are the provisions that have been substantiated above and now are summarised below.

When making decisions on technological development of transport, one should focus on non-economic factors, which primarily include the need to ensure sustainable development of the country and national security in a broad sense.

Decisions made in the field of technological development are not always justified by market needs, but at the same time, for transport, as a service-providing industry, customer focus is becoming one of the most important factors of competitiveness, that is, a conflict arises that requires its resolution in the decision-making methodology.

When making decisions, it is necessary to take into account heterogeneity of transport both by modes and by the operated technological components (vehicles, infrastructure, etc.).

¹⁹ Technology, Applications, Markets or customers groups, Organisation.

However, at the same time, multimodal transportation, digitalisation, and digital transformation processes, as well as global natural, economic, socio-demographic and political processes are widely spread, which gives rise to a large number of options for implementation of transport and logistics services and increases the level of uncertainty in decision-making.

Development of the transport complex is characterised by high capital intensity and long service life, which, on the one hand, leads to an increase in the cost of an error in decision-making and, on the other hand, increases uncertainty in predicting functioning of the industry as a whole and of individual transport organisations in particular.

Based on these prerequisites, it becomes obvious that there is the need to develop an alternative approach to substantiating decisions on implementation of innovations in transport industry, based on the methods of multi-criteria parametric optimisation and considering non-economic criteria and indicators.

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