MANAGEMENT, CONTROL AND ECONOMICS

# Building Flexible Systems of Digital Interaction between Transport Process Participants in a Changing Environment

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## ABSTRACT

*The transport industry is currently undergoing profound changes. They are related both to overcoming the consequences of the pandemic, and – in the longer term – to the fundamental transformation due to the ongoing process of digitalisation.*

*Services created for intelligent traffic flow management, monitoring of infrastructure facilities, rolling stock, customer relations, digital platforms will most probably remain drivers of the ongoing digital transformation of the transport industry in the near future. From the point of view of digital technologies, the main ones include artificial intelligence, blockchain, the Internet of things, big data.*

*Considering the vastness of the topic, the paper highlights the key, from the point of view of the authors, issues of experience and tasks of creating systemic, end-to-end digital platform solutions in the Russian transport industry, as well as on the example of railway transport (including at the corporate level), classification of already implemented solutions and promising areas of digital change in the transport and logistics industry.*

*Keywords: transport, digitalisation, transport infrastructure, digital technologies, economic development, railway transport.*

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## INTRODUCTION

The transport and logistics industry despite the significant success in introduction of new technologies has a significant potential of adaptation and development in the context of digitalisation; it is to a certain extent still at the stage of digital transformation. The implementation of this concept is complicated by a large amount of data that needs to be reconstructed, and by a significant number of operations that can be digitised, especially given the integration of transportation processes within a single supply chain involving suppliers, shippers, consignees, and end customers. «The transport sector must connect to a new ecosystem in which the boundaries between the stages of production, transportation, and consumption are practically seamless. Data flows are the basis of digital logistics» [1].

The *objective* of the research is to study trends and directions of digital transformation in the field of transport, considering the impact of the fourth industrial revolution, the speed of change and creation of digital platform solutions that ensure effective interaction between the participants in the transportation process and the entire supply chain.

The *methods* of analysis, synthesis and classification helped to generalise the existing empirical experience in creating end-to-end digital platform solutions in the transport industry of Russia, at the level of the largest companies (using the example of JSC Russian Railways) and for modes of transport (using the example of railway transport), is generalized, and to suggest a basic classification of directions of digital changes in the transport and logistics industry and to present examples of their implementation.

## RESULTS
### Industry Integrated Digital Platform Solutions

One of the most important tasks of the transport system is to ensure the maximum efficiency of functioning of the transport and road complex by improving quality of meeting the needs of the economy and the population in safe and efficient transport services.

The solution of these tasks should be achieved «due to two mutually complementary areas of activity: development of transport infrastructure and introduction of technologies» [2] of the organisational management of transport systems using modern information, telecommunication and telematic technologies.

The industry has made significant systemic efforts towards digitalisation.

The Transport Strategy of the Russian Federation until 2030 with a forecast for the period up to 2035[1] contains special sections devoted to the areas of digital transformation of transport (including main directions of digitalisation of the transport complex, creation and development of integrated transport services, digitalisation of vehicles, digitalisation of transport infrastructure, digitalisation of activity of authorities in the field of the transport industry), the main stages of the digital transformation of transport. They contain a comprehensive description of directions, tasks, mechanisms for the digital transformation of the transport and logistics industry.

The priorities, goals, and objectives of digitalisation of transport and logistics are based on the national program «Digital Economy of the Russian Federation until 2024»[2], which includes several federal projects.

In 2019, the departmental project of the Ministry of Transport of the Russian Federation «Digital Transport and Logistics» was approved[3], closely integrated with implementation of the Comprehensive Plan for Modernisation and Expansion of the Trunk Infrastructure for the period up to 2024[4]. The project included 35

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[1] Transport Strategy of the Russian Federation until 2030 with a forecast for the period until 2035. Approved by the Order of the Government of the Russian Federation of November 27, 2021, No. 3363-r. [Electronic resource]: http://static.government.ru/media/files/7enYF2uL5kFZlOOpQhLl0nUT91RjCbeR.pdf. Last accessed 19.12.2022.

[2] Passport of the national project «National Program «Digital Economy of the Russian Federation», approved by the minutes of the meeting of the Presidium of the Council under the President of the Russian Federation for Strategic Development and National Projects dated June 4, 2019, No. 7. [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_328854/. Last accessed 19.12.2022.

[3] The government commission approved the project of the Ministry of Transport of Russia ««Digital transport and logistics» [Electronic resource]: https://www.dtla.ru/news/pravitelstvennaya-komissiya-odobrila-proekt-mintransa-rossii-tsifrovoy-transport-i-logistika/. Last accessed 19.12.2022.

[4] Approved by the Decree of the Government of the Russian Federation No. 2101-r dated September 30, 2018 (as amended by Decrees of the Government of the Russian Federation No. 1844-r dated August 17, 2019, No. 610-r dated March 13, 2020, No. 1747-r dated July 4, 2020, dated 02/20/2021 No. 430-r, dated 12/28/2021 No. 3896-r, dated 04/13/2022 No. 855-r, dated 12/09/2022 No. 3867-r). [Electronic resource]: http://government.ru/docs/all/118785/. Last accessed 19/.12.2022.

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activities divided into 7 main areas: transformation of cargo transportation; cross-border interaction; passenger transportation with a variety of digital services and a single electronic ticket; digital transport infrastructure; safety; ecology and meteorology; unmanned vehicles[2].

From January 1, 2020, within the framework of the state program of the Russian Federation «Development of the transport system», the direction (subprogram) «Digital transport and logistics»[5] has been implemented. Being one of 9 directions of the state program, it includes the following structural elements[6]: the federal project «Transport and logistics centres», the departmental project «Formation of a network of transport and logistics centres», the departmental target program «Digital platform of the transport complex of the Russian Federation»[7].

In 2021, the industry Strategy for digital transformation of the transport industry of the Russian Federation was approved[8]. The document was approved by the protocol of the Presidium of the Government Commission for Digital Development and was discussed at the Federation Council. The strategy includes six key initiatives of the Ministry: «UAVs for Passengers and Cargo», «Green Digital Passenger Corridor», «Seamless Cargo Logistics», «Digital Management of the Transport System of the Russian Federation», «Digitalisation for Transport Security», «Digital Twins of Transport Infrastructure Objects». The implementation of the strategy is based on the priority use of domestic software and the massive use of artificial intelligence technology[9]. The leaders and experts of more than 200 enterprises of various industries were involved in development of the strategy. To prepare the document, a steering committee was formed with the Digital Transport and Logistics Association[7], which continued to work on implementation of the projects within the strategy.

The Digital Transport and Logistics Association (DTL) was established in 2019 with the support of the Ministry of Transport of the Russian Federation by JSC Russian Railways, Aeroflot-Russian Airlines, RT-Invest Transport Systems, ZashchitaInfoTrans, GLOSAV and Aviatelecominvest. The same year, the State Corporation for Air Traffic Management in the Russian Federation and Azimuth (part of Rostec State Corporation) joined the Association, in 2020 it was joined by TransTeleCom Company and the State Company Russian Highways (Avtodor), in 2021 by OZON, MegaFon, Rosmorport, JSC GLONASS, Centre for organising traffic unmanned vehicles (COM UV is a joint venture with Rostec, Diginavis and Project 7), Datapax and United Transport and Logistics Company – Eurasian Railway Alliance (UTLC ERA). The strategic partners of DTL are the State Transport Leasing Company (STLC) and the SMARTS company. Partners comprise, in particular, ANO Tsifrovaya ekonomika, the Association of Commercial Sea Ports (ASOP), Innopolis University and others[10]. The goal of DTL is «to create and develop a single multimodal digital transport and logistics space on the territory of the Russian Federation in the interests of participants in the transport and logistics market based on development and implementation of new digital technologies, as well as combining efforts and integrating programs of industry companies and the state»[8].

## The Main Directions of Digitalisation of the Transport and Logistics Industry

Digitalisation of transport and logistics is a complex process that involves integration of individual solutions into intelligent systems. As the researchers note, «the largest transport companies that create separate intelligent digital systems for themselves integrate them into the smart city, digital railway, etc. ecosystems; they include «smart roads» with digital solutions for collecting and processing data on vehicles and

[5] Decree of the Government of the Russian Federation of March 30, 2021, N 483 «On amendments to the state program of the Russian Federation «Development of the transport system»». [Electronic resource]: https://docs.cntd.ru/document/603366910. Last accessed 19.12.2022.
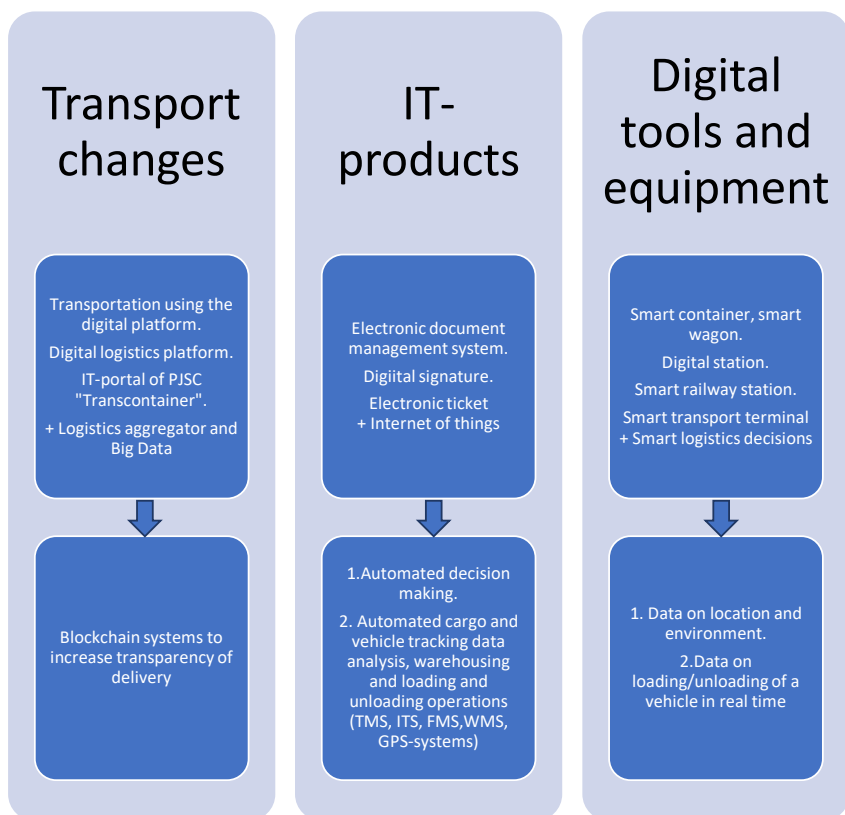
[6] Portal of the state programs of the Russian Federation. [Electronic resource]: https://programs.gov.ru/Portal/pilot_program/24/elements/179e46eb-04d9–43ad-8f07–62107c8220bd. Last accessed 19.12.2022.

[7] Departmental target program of the Ministry of Transport of the Russian Federation «Digital platform of the transport complex of the Russian Federation». [Electronic resource]: https://mintrans.gov.ru/file/435210. Last accessed 19.12.2022.

[8] Passport of the strategy for digital transformation of the transport industry of the Russian Federation. [Electronic resource]: https://mintrans.gov.ru/documents/8/11374. Last accessed 19.12.2022.

[9] The Ministry of Transport of Russia has developed the departmental Strategy for digital transformation. [Electronic resource]: https://mintrans.gov.ru/press-center/news/9985. Last accessed 19.12.2022.

[10] ANO DTL website. [Electronic resource]: https://dtla.ru/company/. Last accessed 19.12.2022.

**Transport changes**

Transportation using the digital platform.
Digital logistics platform.
IT-portal of PJSC "Transcontainer".
+ Logistics aggregator and Big Data

Blockchain systems to increase transparency of delivery

**IT-products**

Electronic document management system.
Digiital signature.
Electronic ticket
+ Internet of things

1.Automated decision making.
2. Automated cargo and vehicle tracking data analysis, warehousing and loading and unloading operations (TMS, ITS, FMS,WMS, GPS-systems)

**Digital tools and equipment**

Smart container, smart wagon.
Digital station.
Smart railway station.
Smart transport terminal + Smart logistics decisions

1. Data on location and environment.
2.Data on loading/unloading of a vehicle in real time

*Pic. 1. Vectors of transport digitalization [compiled by the authors].*

road infrastructure, such as «smart traffic lights», parking meters, video surveillance and warning systems [3], etc. Also, transport changes cannot bypass the use of drones, which «allows solving the problem of the «last mile», that is, the stage of delivery to the end consumer, including to hard-to-reach regions, they are in demand even now in the absence of ground infrastructure» [4].

Intelligent Transport System (ITS) can be defined as a management system that «integrates modern information and telematic technologies. ITS is designed for automated search and acceptance for implementation of the most effective scenarios for managing the transport and road complex of the region, a specific vehicle or group of vehicles in order to ensure a given mobility of the population, maximize the use of the road network, improve safety and efficiency of the transport process, comfort for drivers and transport users»[11].

The Transport Strategy of the Russian Federation[1] introduces the concept of a «national

network of intelligent transport systems on public roads», which is understood as a «territorially distributed system consisting of interrelated elements of information technology, organisational, methodological, personnel, legal and regulatory nature, uniting existing and created in compliance with uniform rules intelligent transport systems into a single network with an optimised topology and a single development plan»[10].

Intelligent transport systems, besides solving immediate technological industry problems, serve as an important tool for achieving the goals of a broader economic and social order (for example: [5]): reducing accidents, increasing the efficiency of public transport and cargo transportation, ensuring overall transport safety and security, and improving environmental performance.

The Transport Strategy defines it as follows: «Intelligent transport systems make it possible to increase safety of transportation, optimise routes, increase the transit capacity of the transport system, reduce the costs of maintaining, repairing infrastructure and transportation in general, as well as planning the integrated

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[11] GOST [Russian state standard] R 56294-2014. National standard of the Russian Federation «Intelligent transport systems. Requirements for functional and physical architectures of intelligent transport systems». [Electronic resource]: https://docs.cntd.ru/document/1200115739. Last accessed 19.12.2022.

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development of transport infrastructure, including the infrastructure for managing highly automated and autonomous transport, charging and refuelling infrastructure of «green» transport – transport that has a minimal impact on the environment»[1].

In technical, technological, and organisational terms, at the present stage, three main directions (vectors) of transport digitalisation can be distinguished (Pic. 1):

1. Transport changes.
2. IT products.
3. Digital tools and equipment.

The first vector is creation of transport exchanges in the format of a logistics aggregator. As the researchers note, «the objective of creating digital platforms is interaction between customers and contractors» [6].

The second vector is creation of personalised IT products. In the current realities, customers absolutely do not need numerous software products, the interaction between which is difficult, and sometimes impossible, to be organised without significant distortions. A single multifunctional application is the most convenient tool for the user. The solution of any problem, including making managerial decisions within a single service, is a promising outlook for personalised IT products.

Gradually, digital platforms and Internet platforms are replacing traditional services due to formation of a single information space, creation of a user-friendly interface and operational flexibility. «Digital platforms based on distributed ledger technologies are widely in demand for transactions and cargo transportation, and the Internet of Things integrates data and devices into a single environment everywhere in logistics, allowing tracking movement of goods at all stages of the supply chain, as well as combining different modes of transport depending on the type of product, traffic situation, etc.» [7].

The third vector is digitalisation of machinery and equipment for smooth operation of goods at all stages of the supply chain (for example, «smart terminal»). In the future, there is an opportunity to develop a system of «vehicle dispatcher – vehicle user» and similar ones.

## Main Trends in Digitalisation of Railway Transport

Digitalisation is the reason for major changes in railway transport. Global trends refer to improvement of rolling stock, modernisation and unification of signalling and control systems, traffic management, automating the processes of maintaining infrastructure and repairing rolling stock, introducing intelligent systems for predicting the need for repairs, and many others. All these directions are developed successfully in Russia [for example, [8]]. One of the key results of successful digitalisation should become the increase in transit capacity without increasing the physical infrastructure.

It is important to note that intelligent tools in all areas of transport digitalisation are customer-oriented and ready to adaptation to increased interaction of all participants in the transportation process.

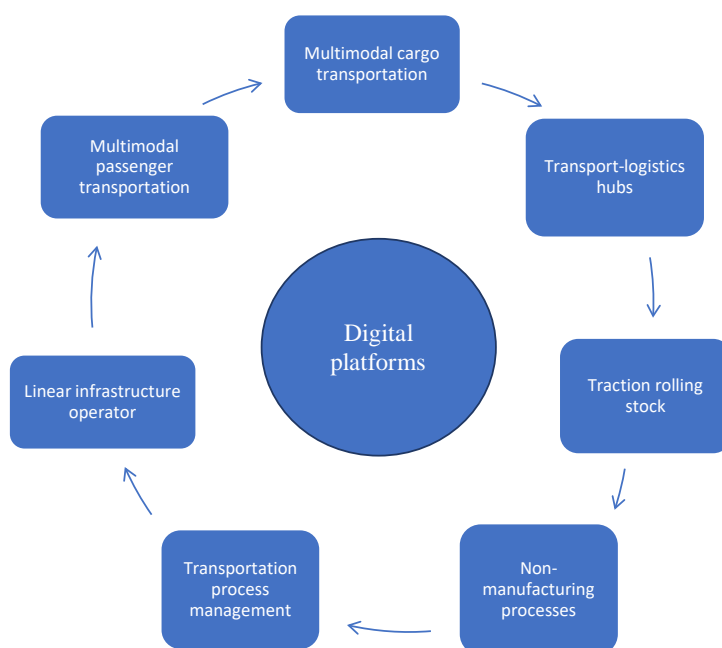## Directions of Digital Transformation of JSC Russian Railways

Russian Railways Holding Company is the largest transport company in the Russian Federation and on the European continent. The significance of the company is manifested not only in the size of the business, determined by the amount of cargo transported and passenger traffic, but also in high social responsibility.

The platform approach became the basis for implementation of the company's digital transformation strategy. The main advantage of the platform approach is the full coverage of all existing areas of the company's activities. These segments are the foundation for development of services that provide the economic effect that was originally included in the strategy (Pic. 2):

JSC Russian Railways, as well as the entire Russian Railways Holding Company, was actively engaged in development of electronic trading platforms both for interaction with passengers (electronic ticketing) and for working with partners (cargo transportation). A fault detection system was implemented using neural network technologies and machine learning. Besides, an information service for monitoring fulfillment of obligations under contracts (based on smart contracts) was introduced.

Russian Railways Holding Company sets itself ambitious goals. Among other development strategies, digitalisation has one very important advantage: the maximum avoidance of human influence as a factor in making erroneous decisions. Digitalisation of business processes and applied technologies is a contribution to the future of the company, its competitive advantage.

*Pic. 2. Platforms for digital transformation of Russian Railways holding company. Compiled based on the information of the Website rzddigital. [Electronic resource]: https://rzddigital.ru/platforms/. Last accessed 19.12.2022.*

## CONCLUSION

### Main Promising Areas of Digitalisation of the Transport and Logistics Industry

Digitalisation is a successful basis for modifying and modernising conventional technological processes, increasing the efficiency of transportation activities. This is noted by most researchers [for example: [9–12]], including when conducting an in-depth analysis of the prospects for development of certain modes of transport, for example, maritime transport [13]. The promising and potentially successful areas of digital transformation of the transport and logistics industry include:

1) Active development of information services and products with parallel digitalisation of all the equipment and machines.

2) Widespread use of the Internet of Things, blockchain and artificial intelligence to directly ensure the safety of transportation and build seamless supply chains [14–16].

3) Using Big Data to improve data processing speed.

4) Implementation of digital simulation adapted to the requirements of each client, in the format of digital platforms and intelligent interaction.

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5) Using the possibilities of digitalisation to increase customer focus, include users of transport services into the digital ecosystem of transport [17–18].

Using the possibilities of digitalisation makes it possible to build flexible systems of interaction between participants in the transportation process in a changing external environment to improve interaction with customers, develop new business models and achieve the goals of transport and logistics companies.

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