Digitalization of freight rail transportation as a factor in improving their efficiency

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Abstract. The economy is currently undergoing significant changes and fluctuations, requiring the transport industry to adapt and improve its services in a timely manner. The most relevant now is the issue of digitalization of transport services, which entails both an increase in the speed of transportation and a gradual departure from a large amount of paper workflow. These changes are taking place, in particular, in the field of railway transport, the role of which in the strategic development of the eastern range is the most important, demonstrating an increase in traffic volumes, minimization of delays in transit, as well as stability and regularity of shipments. The purpose of this article is to substantiate the feasibility of digitalizing the process of transporting goods by rail through the introduction of a specialized digital platform. The authors put forward and prove the assumption that the use of such a platform can reduce the loss of time at all stages of cargo transportation, reduce the costs associated with the transportation process, and also provide more flexible access to infrastructure. It also confirms the increase in the efficiency of interaction between all participants in the transportation process: from the carrier company to the supervisory authorities. The article proposes a regulation for processing documentation using electronic document management, which includes the use of mobile workstations; the importance of the spread of digital services to the process of intermodal transportation of goods and, as a result, the increase in the reliability of such transportation is argued. The results obtained are of an applied nature, since they propose and justify a number of measures aimed at enhancing the electronic interaction of participants in the process of cargo transportation.

1 Introduction

In 2022, the change in the networks of routes and locations for the transportation of goods is taking place at a pace exceeding the record indicators of the pandemic crisis [1]. At the same time, it should be taken into account that fluctuations in economic activity lead to comparable fluctuations in demand for transport and logistics services. One can observe an extremely difficult situation in the maritime transportation market, where the shortage of container equipment due to unprecedented demand, as well as various force majeure circumstances,
led to a jump in the cost of transportation and a decrease in the level of reliability of supplies. In turn, air cargo transportation, judging by the main metrics, managed to recover almost to pre-crisis levels by the beginning of 2022, but the long-term growth momentum was lost due to the sanctions imposed. In total, at the moment only rail transport demonstrates qualitative development to the market with a reorientation of the geography of services, which attracts the attention of shippers [2]. Russian railways play an important strategic role in the development of the eastern polygon, offering exactly what shippers need: regular shipments, the shortest possible time and stable prices [3].

2 Materials and Methods

The purpose of this study is to determine the relationship between the expansion of the use of digital technology and the effectiveness of the development of intermodal transport. Our task is to prove that the «Intertran» project allows railway companies, seaports and regulatory authorities to interact effectively.

It is necessary to take into account the advantages of cargo transportation by rail, namely:

- **speed**
  - today, for some companies, the proposed speed of delivery by rail is the only way to ensure mobility and speed of transportation [4];

- **regularity**
  - thanks to the uninterrupted and regular dispatch of trains, it is much more reliable to plan the loading of production with raw materials or the delivery of goods to retail [5];

- **safety**
  - ensuring the highest level of cargo safety, which is confirmed by the absence of similar indicators in alternative delivery methods;

- **environmental friendliness**
  - statistics confirm that, taking into account the global trend towards the transition of companies to ESG approaches, the prospects for railway companies, infrastructure and transportation proper are quite optimistic.

**Fig. 1.** Advantages of cargo transportation by rail. *Source: author*

The research materials were reports of Asian and European railway companies – members of the International Union of Railways (UIC), Russian and foreign forwarding companies, as well as data from the Federal Customs Service of Russia (FCS) and foreign customs authorities.

The basis of the developed information technology "Intertran" is the determination of the order of electronic interaction between seaports and railways in the process of intermodal transportation of goods through seaports using electronic documents and data (Fig. 2).
It is necessary to note the preliminary trend of Russian railways in compliance with the principles of environmental protection and compliance with safety measures, which is enshrined in the Environmental Strategy of the Holding until 2020 and for the future until 2030 [7]. Currently, the company's share in atmospheric emissions, wastewater pollution and the creation of waste substances is no more than 1% compared to all organizations operating on the territory of the Russian Federation. At the same time, in 2019 in accordance with the corporate Program of measures to increase environmental responsibility, there is a reduction in atmospheric emissions, wastewater discharges and water consumption in the range of 3-4% compared to the previous period.

In order to reduce the negative impact of railway transport on the environment, the Holding actively uses "green" technologies for the electrification of track lines intended for passenger transportation. The economic effect of the implementation of energy-efficient projects amounted to more than 2 billion rubles in 2019, which indicates the leading positions held by JSC "Russian Railways" among international freight and passenger rail carriers in terms of energy and environmental efficiency.

If we consider the chronology of the Intertran project, we can note the key stages of its implementation. In 2016, the Economic and Social Commission for Asia and the Pacific (ESCAP) The UN publishes the results of a study aimed at optimizing intermodal rail services in Northeast and Central Asia. In 2017, Intertran was identified as a priority project for 2018 with the support of UIC APRA and international organizations such as ESCAP, OSZhD, CCTT. In 2018, the vector of further development of the project in terms of its practical implementation has been established. In 2019 Information technologies have been developed and implemented for the Intertran project, as well as pilot transportation on the Yokohama – Vladivostok – Silicate route (Fig. 3).
Determining the relationship between the expansion of the use of digital technology and the effectiveness of the development of intermodal transportation, the results of the study of the expert group for 2020 on the topic "Legal regulation of multimodal transportation in the Asia-Pacific region" were taken into account, which made it possible to expand the scope of paperless technologies in terms of freight transportation by rail and identify priority areas for further work in this area, which is also reflected in our research.

3 Results

1) The participation of Russian railways in the development of innovations and the digital market environment is justified

The pandemic crisis, shifting markets, and economic fluctuations as a result of the sanctions imposed accelerated the general trend of digitalization of cargo transportation and logistics activities. In the context of a sharp increase in the importance of the railway in international communication, the development of integration processes in the field of digitalization in the space of Asian economic cooperation is one of the most important areas of development. Digitalization of processes can provide a reduction in the cost of transportation, as well as an increase in speed and reliability, which will allow to induce a significant share of additional volumes [6]. In this situation, a practical solution may be an additional expansion of the digital market environment through the active implementation of the Intertran project as an integrator of the transport and logistics space in order to unite the changing geography of transportation [7].

2) The procedure for processing documents in electronic form within the framework of the Project using mobile workstations has been established

An additional factor in the growth of digitalization of technological processes of cargo transportation in JSC "Russian Railways" is the development and implementation of a domestic IT solution that allows processing documents in electronic form at ports when receiving cargo for departure and its delivery (Fig. 4).
3) The effects of the organization of pilot cargo transportation within the framework of the Intertran project are determined. The creation of the Intertran information technology and the development of a consistent project implementation plan were carried out by the working group of JSC "Russian Railways" and TG "FESCO" on the development of intermodal transportation using electronic document management. The work carried out made it possible to carry out a pilot shipment of containers from the Japanese Port of Yokohama, through the Port of Vladivostok to the Silicate station of the Moscow Railway.

The pilot cargo transportation scenario within the framework of the Intertran project provides for the implementation of practical measures for the introduction of electronic document management in intermodal transportation, as well as the creation of a unified environment for information exchange in order to ensure the automation of business processes in railway transport. This is an additional incentive that increases the attractiveness of through intermodal rail transport for shippers and freight forwarders (Fig. 5).
Fig. 5. Sequence of document processing in electronic form. Source: author

Thus, the main positive effects of the Project implementation include a reduction in the total cargo handling time by 4 days and a reduction in total costs for participants in the cargo transportation process.

4) The necessity of expanding the digital environment of trust between participants in transport and logistics processes has been established. It should be noted that the jump in cargo transportation volumes during the pandemic crisis showed the limited capabilities of the railway infrastructure – the bottleneck, first of all, is the capacity of checkpoints [8].

Undoubtedly, the speed of transportation is significantly reduced as a result of downtime at the customs border. At the same time, one of the strategic goals of the development of JSC "Russian Railways" is to accelerate the movement of trains with a reduction in transportation time. But achieving this goal is difficult if the train will stand at the border, despite the introduction of digital technologies into the work of the Federal Customs Service of Russia, for example, electronic customs transit [9].

The reasons for this problem lie in the presence of a direct connection between the introduction of paperless technologies and document management, since the current paper technology is actually digitized and albums of electronic document formats are created for each participant in cargo transportation. In this regard, it is proposed to create a unified digital environment of trust between participants in transport and logistics processes with the possibility of exchanging meaningful data within paperless technologies for all participants, including state bodies that operate exclusively with the necessary data to ensure control functions. Since the issue of the development of multimodal transportation has recently become particularly relevant, the approach of exchanging significant data significantly simplifies the transportation process and increases its mobility.

4 Discussion

Currently, the issues of digitalization and the analysis of its impact on the functioning of enterprises, including in the field of railway transport, are an important area for research. The authors considered [10] promising directions for the development of rail transportation, which are prerequisites for achieving sustainable development indicators in this area.
Moreover, the areas under consideration are significant not only for the national, but also for the global economy on the way to cooperation and integration through the implementation of sustainable development goals.

The model for monitoring the digitalization process of a corporation, as well as the ways for the development of digitalization, are proposed by the authors [11], taking into account the trends in the digital transformation of traditional business models towards the introduction of automation, new information services that improve the activities of the corporation.

Digital technologies allow innovation in traffic management through various types of software that allow testing experimental models in the existing road network. Thus, the authors of [12] put forward an assumption about achieving a positive effect from the introduction of an agent-based model on the intellectualization of traffic. It is also proved that the implementation of this model will reduce the average waiting time by more than 2 times.

The methodology for the economic evaluation of the implementation of distributed data registry platforms in multimodal transportation is presented in [13]. An analysis of trends in the multimodal transportation market, in particular in the European segment, made it possible to systematize the effects arising from the implementation of blockchain in transportation on the railway network, indicating the sources of their occurrence and quantitative assessment for the railway network complex, given the global integration of the account. The results obtained are in demand by the heads of transport companies, development specialists and analysts who evaluate digital technologies in transport.

An important topic in the framework of research in the direction of technologies of automated vehicles is the analysis and evaluation of the algorithmic control of such vehicles. The authors of [14] analyse the assessment of these technologies, as well as their impact on future mobility and its benefits to society; the structure of this technological process is also formulated in the form of a model suitable for further research.

5 Conclusion

A new vision for the subsequent development of digitalization through the introduction of paperless technologies with a focus on intermodal transport appeared in 2016 as part of the UNESCAP project “Development of seamless intermodal transport with a railway element in Northeast and Central Asia to strengthen Euro-Asian transport links”. This situation can be considered as the primary "pilot" of the concept for the development of paperless technologies.

For Russian Railways, participation in the implementation of the Intertran project is not only a project aimed at developing the Company's digital services, but also a contribution to the implementation of the national development goals of the Russian Federation, approved by the Decree of the President of the Russian Federation. of the Russian Federation dated July 20, 2020 in the context of digital transformation.

The study confirms that the basis for the effective development of the Intertran project and the interaction of railway companies, sea ports and regulatory authorities is a set of actions aimed at:

- electronic interaction with customs authorities in the port when declaring goods and using electronic transit declarations;
- use of electronic bills of lading (paperless technology) in the preparation of railway transport documents;
- optimization of processing of technological operations at the station using mobile workstations;
- implementation by the customs authorities of the destination on the territory of the Russian Federation of the customs transit procedure in electronic form without the
Submission of paper documents.

Undoubtedly, the shift in stereotypes of digital development will lead to the transformation of production and consumption technologies, which, in turn, will affect the emergence of new business models for transport companies and a change in the cost structure for transport services [15-17].

References

1. Data from the SPARK news agency. https://spark.ru/startup/mlt-group/blog/88824/mirovaya-logistika-v-2022g-uzhe-zamedlila-svoyo-razvitie (last accessed 08.08.2023)

2. I. Gulyi, Analysis and evaluation of the cost and effective indicators of the digital transformation of Russian Railways. Lecture Notes in Networks and Systems 402 LNNS, 945-954 (2022)


