Using Digital Solutions in Railway Logistics: The Experience of Medium-Sized Businesses

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Abstract. At present, the state policy in the field of digital technologies confirms the concern about the digitalization of all sectors of production and industry, including the transport and logistics complex. At the same time, the creation of an ecosystem of the digital economy in Russia implies that digital data is a key factor of production in all spheres of socio-economic activity. In the article, in order to achieve the goal of increasing the efficiency of organizing the business process of transportation activities, the need to expand the possibilities of introducing automated systems that support the adoption of effective management decisions is substantiated. As an example the article demonstrates of the use of digital solutions, that have proved their effectiveness based on THE experience of medium-sized businesses, their advantages and disadvantages are indicated, the article provides analytical data from the logistics company Liter-Trans (including the results of cooperation with the German company German Transport Engineering, which is engaged in multimodal transport design throughout the world), and also substantiates the need to create and use not only IT systems that are adequate to the realities, but also the implementation of "end-to-end" IT technologies, based on the principle of complementarity and unity of infrastructure, ensuring the network interaction of business processes and the creation of value chains for all participants in the transportation process, which will improve the quality of logistics services and the efficiency of the environment for doing a business.

Keywords: Digital economy · Digital logistics · Business processes · IT technologies · IT tools · Rail logistics · Freight · Medium-sized businesses

1 Introduction

The Russian state policy in the field of digitalization is defined in the National Program "Digital Economy of the Russian Federation", the implementation management system of which was approved by Decree of the Government of the Russian Federation on 2019/03/02 №234 (as amended on 2020/08/21). One of the goals of this program is to create an ecosystem of digital economy of the state, involving the consideration of digital data as a key factor of production in all spheres of socio-economic activity [1]

and, at the same time, effective interaction (including cross-border) between business, the scientific and educational community is ensured, state and citizens [2–4].

All branches of production and industry, including the transport and logistics complex, are puzzled by the issues of digitalization. For effective work in the freight market and building up the transit potential of Russia, the transport complex needs to constantly develop, to increase the speed, quality, and convenience of cargo transportation.

The previous reform of 2011–2012, which took place during the implementation of the "Structural Reform", caused significant changes in the transport services market: then the usual logistics chains that suited the shippers were cut off as a result of the transfer of the fleet to private operators. It was during this period that the transition of logistics to new conditions for the implementation of business processes began. Now the transport market participants experience instability approximately every 3 years, being in a pendulum regime between the "surplus" and "deficit" of the fleet, with a very short period of the equilibrium price. The state of market volatility for the period from January 2008 to October 2021 can be assessed by the dynamics of the indexation of tariffs for Russian Railways [5] (a subject of natural monopoly in the field of freight rail transportation in Russia) and rates of operators (rent of gondola cars [6]) (Fig. 1).
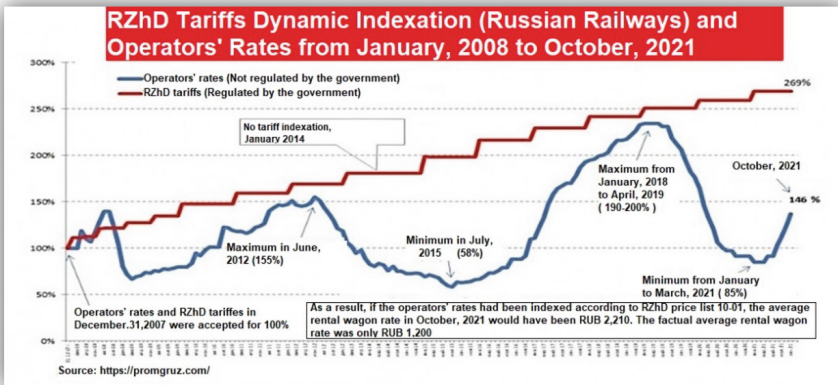

Fig. 1. Dynamics of indexation of Russian Railways tariffs and rates of operators (gondola car rental) from January 2008 to October 2021

It should be noted that the rates of operators in 2021 grew in the II quarter, in the III quarter the growth also continued (and even in those market segments where the high season was over [7]). The overall increase was about 30% compared to Q2 2021, while rates on the spot market exceed the rates for long-term contracts. During 2020 and 2021 Covid-19 has made its own changes in the management of a logistics business [8].

The main initiative for the development of transport and logistics services is the creation of an automated resource for maintaining a single catalog of services in the field of freight transportation, which provides consumers with access to the entire range of services, conditions, and parameters of cargo transportation.

The most popular technologies are the Internet of goods, big data, intelligent systems, blockchain, wireless communication technologies, virtual and augmented reality technologies.

The purpose of the article is to summarize the experience of medium-sized companies in terms of IT solutions that have proven their effectiveness in the practice of railway transportation during 2021, identify problems of their use and distribution, formulate proposals to improve their user capabilities, and justify the need to create and use adequate realities, not only IT systems, but also implementation of "end-to-end" IT technologies based on the principle of complementarity and unity of transport, logistics, production, and trade infrastructure, which ensures the network interaction of business processes and the creation of value chains for all participants in the cargo transportation process that can improve the quality of logistics services, the efficiency of the business environment.

2   Materials and Methods

The research methodology is based on the use of methods of system analysis, the substantiation of theoretical provisions was carried out on the basis of reasoned conclusions collected and generalized by the authors during the study using general scientific, general economic, economic-statistical and empirical methods. Theoretical and methodological basis consisted of modern achievements of domestic and foreign scientists and logistics practitioners in the use of digital solutions in railway logistics. The information and empirical base were made up of data from special scientific and periodical literature, information from the regulatory framework of Russian Railways, analytical reports of the logistics company Liter-Trans, a German company engaged in multimodal transport design around the world, German Transport Engineering, as well as open sources the Internet [9, 10].

3   Results

In the current technological revolution, all industries, including railway logistics, are moving to Industry 4.0, where data and analytics in digital form are central components and factors of production in all spheres of socio-economic activity, which increases the competitiveness of countries. Intelligent transportation [11], considered as an innovative product of digital logistics, contributing to the creation of innovative integrated transportation services.

The consumers of digital logistics products in the field of railway freight transportation are, first and foremost, small and medium-sized companies, which currently experience an acute need for information and analytical systems and technologies when managing business processes in conditions of incomplete and inconsistent information available to entrepreneurs.

The work within the target program of the Ministry of Transport of the Russian Federation "Development of small and medium enterprises in the sphere of transport" only partially solves the problems that need to be solved by business and which can be eliminated in the implementation of industry projects of this program, namely: "digital

transport" and "digital logistics" [12–16]. To achieve the goals of effective management of business processes in Russia and the formation of an appropriate business environment, it is necessary to develop and use IT systems that will not only be adequate to current conditions, but at the same time combine end-to-end IT technologies based on a unified transport, logistics and trade infrastructure, which will be able to ensure the integration of business processes and create consumer value.

One of the elements of the digital transformation strategy in railway transport is digital platforms for managing the transportation process. In the process of developing and implementing digital platforms, the rules of interaction are being revised and business processes are being optimized between departments. In order to implement the state program in 2019, the board of directors of Russian Railways approved the Strategy for the digital transformation of the company until 2025, which influenced the level of digitalization of all railway supply chains when interacting with other participants in the transport market.

Interaction in forecasting and planning cargo transportation is divided into several stages in the formation of cargo transportation volumes - for a year, a quarter and a month. Formation of the forecast parameters of loading the railway administrations of the CIS countries for transportation to Russia and in transit through Russia is carried out on the basis of the analysis of statistical data on the transportation of goods.

Various structural divisions are involved in the planning of freight traffic. For operational end-to-end production planning of freight traffic on railway transport and for other purposes, it is advisable to launch an electronic document management system (EDM). However, when implementing, for example, in the Russian logistics company Liter-Trans, it was difficult to convince counterparties to use EDI instead of the usual paper media, but the pandemic accelerated the transition to the digital era.

In 2021, the number of clients and partners who switched to EDM increased by 82% (Fig. 2), which made it possible to reduce printing costs, reduce the time for processing documents, increase the speed of refunds, and free employees from routine.

In addition to the digital corporate culture, there are a number of areas in the transport industry that are subject to priority digital transformation:

– development of transport and logistics systems in a single transport space based on customer orientation;
– development and implementation of dynamic transportation process control systems based on artificial intelligence;
– formation of clear requirements for the creation and operation of innovative railway rolling stock;
– introduction of innovations ensuring the automation and mechanization of station processes;
– development, approbation, debugging and use of innovation for railway logistics infrastructure, including for the development of high-speed and high-speed traffic and organization of heavy freight traffic;
– development of the railway transportation safety management system and risk management methods in logistics;
– introduction of advanced technologies to improve the energy efficiency of production operations, as well as technologies in the field of environmental protection;
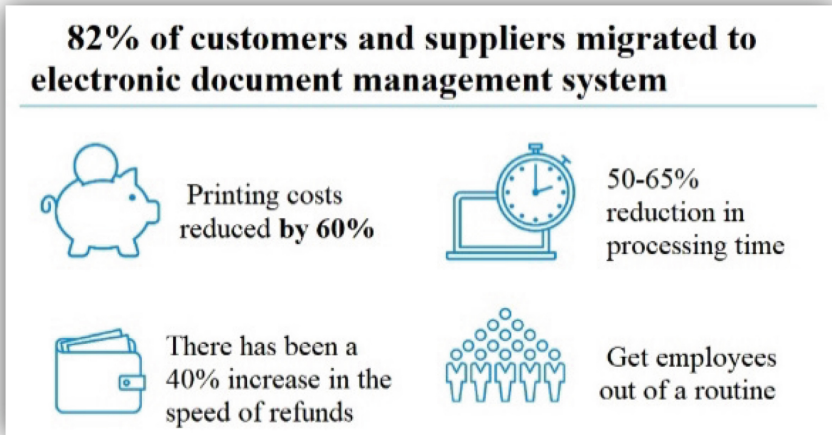– development of an appropriate quality management system.

82% of customers and suppliers migrated to electronic document management system

Printing costs reduced **by 60%**

50-65% reduction in processing time

There has been a 40% increase in the speed of refunds

Get employees out of a routine

Fig. 2. Results of implementation (where or where to?) EDF in 2021

To achieve the goal of increasing the efficiency of organizing the business process of transportation activities, this article substantiates the need for a transition to automated systems that are capable of supporting the adoption of effective management decisions for the possibility of competent management of production processes in real-time, modeling and forecasting the development of specific situations in the transport and logistics market services.

The process of digitalization of Russian transport is impossible without optimizing business processes, revising the regulatory framework, and taking into account the intermediate results of the implementation of the national program "Digital Economy of the Russian Federation". Despite the presence of the target program of the Ministry of Transport of the Russian Federation "Development of small and medium-sized businesses in the field of transport", there are a number of issues that need to be solved by business and which can be resolved, among other things, by means of the implementation of relevant industry projects on digital transport and digital logistics.

In this regard, the transformation entails the introduction of changes in the existing production processes and mechanisms of cross-functional interaction between departments, the creation of a project office for the implementation of the digital transformation strategy, the organization of interaction with the scientific industry complex to participate in the creation of digital platforms and the implementation of scientific expertise at all stages of product development.

This article summarizes the experience of medium-sized companies in terms of IT solutions that have proven their effectiveness in the practice of railway transportation during 2021, identify problems of their use and distribution, formulate proposals to improve their user capabilities, and justify the need to create and use adequate realities, not only IT systems, but also implementation of "end-to-end" IT technologies based on the principle of complementarity and unity of transport, logistics, production, and trade infrastructure, which ensures the network interaction of business processes and the

creation of value chains for all participants in the cargo transportation process that can improve the quality of logistics services, the efficiency of the business environment. It is worth noting that logistics companies have to use and analyze large volumes of Excel files, manually summarizing information from different sources in order to assess the fulfillment of the set shipping plan. So, there are tasks of reducing the time for generating reports, simplifying the process of transferring information between participants in the business process, and visualizing data for clarity when making management decisions. For this, reliable and scalable solutions were developed in the form of reports in MS Power BI depicting business processes, creating graphs, and customizing dashboards, which allow you to speed up iteration and implementation of solutions (Fig. 3).
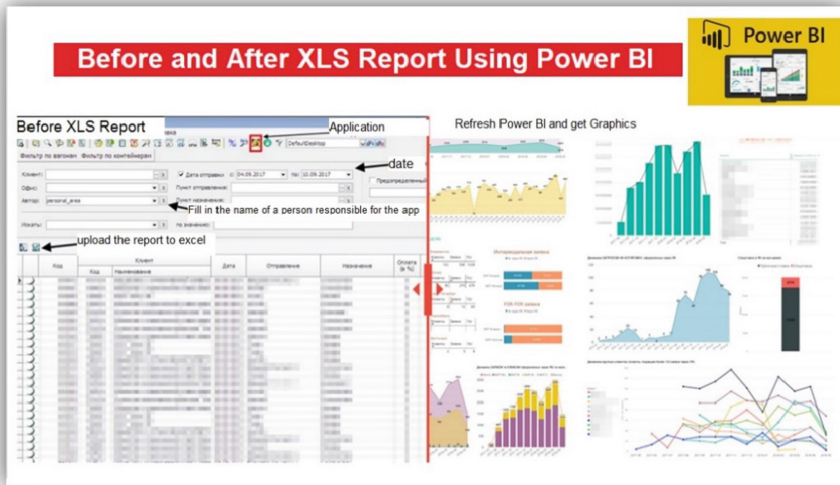

Fig. 3. Visual display of the result of using Power BI

So, data automation provides visualization of a number of parameters of shipment and the entire transportation of goods when making management decisions. Auxiliary filters display data on the required specific parameters (Fig. 4).

It is important to note that Power BI is a self-service BI and resident computing BI class. This Microsoft business intelligence software is comprehensive and integrates several software products that share a common technological and visual design, connectors, and web services.

Evaluating a number of digital solutions used in railway logistics based on the experience of Russian and German medium-sized businesses, it can be concluded that the programs and the tasks performed in them are fragmented, which complicates not only the process itself but also complicates the adaptation of new employees, reduces work efficiency by several times. To achieve the goal of increasing the efficiency of organizing the business process of transportation activities, it is necessary to switch to automated
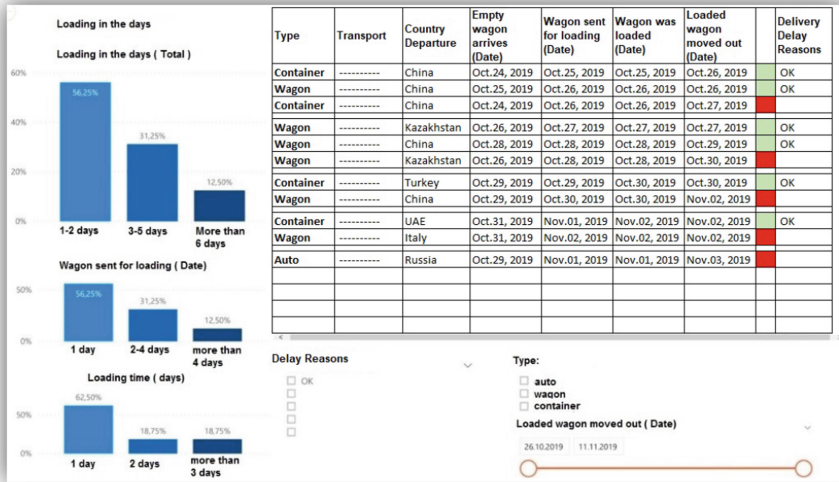
Fig. 4. Visualization of loading waiting parameters based on Power BI

systems that are capable of comprehensively supporting the adoption of effective management decisions for the possibility of competent management of production processes in real-time, modeling and forecasting the development of situations.

Since 2011, Liter-Trans has been a user of AS ETRAN (electronic bill of lading [17]) - an automated system for preparing and processing shipping documents for railroad transportation of Russian Railways across the territory of the Russian Federation. In 90% of the traffic volume, Liter-Trans LLC acts as a cargo owner, while not being a participant in the transportation process for Russian Railways JSC (the scheme of interaction between the participants in the transportation process is shown in Fig. 5).

Because of this, a company representing a medium-sized business cannot promptly receive information about the delay of a carriage at "loading/unloading" stations, although operators impose fines for the idle time of a carriage at stations for just such a company.

In 100% of cases, after the completion of the shipment (information about fines may come in the range from 1 to 6 months). For the client, this is a direct loss, since the transportation cycle has already been completed by that time. The most difficult thing is to collect the evidence base and supporting documents if the downtime was not the fault of the client himself. This process is very difficult and has a negative impact on customer relationships.

In this regard, it is expedient to implement, through AS ETRAN, the possibility for the cargo owner to receive operational information about the reasons for the downtime with supporting documents.
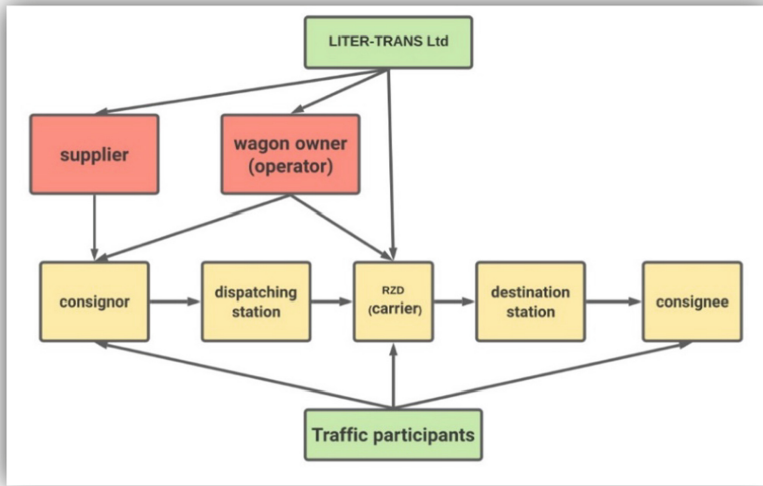
Fig. 5. Scheme of the interaction of participants in the transportation process (for example, LLC "Liter-Trans").

The lack of developed software for solving at least half of business processes in one space remains a significant gap for medium-sized businesses. This, of course, requires integrated industry standards and a willingness to exchange information (on balances in warehouses, applications for planned transportation, start getting access to supporting documents, etc.).

It is also worth noting the difficulty in the availability of a number of information solutions for medium-sized companies, such as an ERP system, VR, and Big data. However, the digital transformation of the transport industry is a dramatic increase in operational efficiency thanks to the use, in addition to traditional tools, of digital technologies and the integration of data from various lines of business. To maintain competitiveness, increase customer focus, and economic growth, the transport industry must be evenly transformed in all areas of activity.

Another project for the digitalization of railway transport is the creation of a digital freight transport platform. From our point of view, digital logistics should be based on comprehensive IT support of coordinated systems of production, trade and economic processes for the movement of goods, material flows in "value chains". Applied objectives in business processes of digital logistics: reducing time, labor and financial losses associated with data retrieval; using advanced information technology to form optimal interaction schemes (based on effective modeling of horizontal production, economic and trade relations) between the participants of the cargo transportation process, as well as production and economic relations between partner companies.

In order to prevent and minimize potential losses, as well as improve service for customers, the STZh-Complex AS was introduced, the software of which allows:

– increase customer awareness of the location of the car, (online);
– automatically notify customers about the emerging excess idle time of the car;
– take into account and calculate the final cost of the goods with delivery.

Calculation of the preliminary cost of delivery of cargo for the client can be made in such systems as: "ERAN", "Rail-Tariff" and "Success". Today the Rail-tariff program is the most convenient, but it should be noted that working with a large number of different software is very laborious.

Open-source data indicate that 2021 is breaking the record for a local fleet deficit. The company "Liter-Trans" operates both its own fleet of gondola cars and additionally rented. Starting from February to October 2021, through tenders, it was possible to successfully use the capabilities of the Digital Platform of the ETP GP. Federal Freight Company JSC has allocated more than 70,000 gondola cars to support small and medium-sized businesses, of which the company has shipped 2,200 gondola cars in deficient directions.

In the present conditions, it seems necessary to create and use not only adequate realities of IT-systems, but also implementation of "end-to-end" IT-technologies based on the principle of complementarity (additionality) of a single infrastructure that provides networking of related business processes and the creation of value chains for all participants in the transportation process, which will improve the quality of logistics services and the efficiency of the environment for doing such a business.

The creation of a mechanism based on the digital transformation of railway logistics will contribute to improving the efficiency of transport and logistics systems and complexes. This will simultaneously provide a platform for cooperation and coordinated development of Euro-Asian transport links (corridors).

Thus, the formation of chains (SCM - digital SCM using the Internet of Things technology) will ensure the optimization of information flows between all participants in railway supply chains, which will allow:

– reduce delays, downtime and, as a consequence, related costs;
– increase customer loyalty;
– increase profitability (due to improved quality of service, shorter transportation times, etc.).

The name of the process is also changing, Supply Chain 2.0 is replacing the Supply Chain, as well as the optimization criterion [18]. The benchmark for a minimum of costs and expenses is replaced by a maximum of economic effect and benefit. The basis for operational and strategic decisions is a model of complementary knowledge (competencies). Given these requirements, we can say that the total cost of an integrated management system built on the principles of digital logistics along the entire value chain will be minimal. At the same time, the total return on investment in its development will increase more than the sum of the effects of similar investments in the development of each of the individual subsystems. From our point of view, the use of advanced digital innovations in railway logistics can be considered a vector for the development of transport and logistics systems and complexes. This determines the relevance of defining the competence of personnel in the field of digital logistics.

4   Discussion

Following a digital transformation strategy [19], assets, services, and a management model for the transport industry are subject to digitalization. Thus, digital transformation implies not only a technological [20] but also, mainly, a managerial task. The key processes for such a transition involve:

– updating the regulatory framework, developing industry standards, and integrating with the National program for the digital economy in Russia;
– attraction and implementation of innovative technologies in logistics;
– automation of processes and their transformation in the creation of digital services (development of new technological processes and expanding the possibilities for the implementation of automated systems that support the adoption of effective management decisions);
– creation of a new corporate culture and development of human resources.

5   Conclusion

To implement the proposed mechanism, from our point of view, you need:

– development of a methodology for identifying points of "value" for the formation of harmonized value chains and transparency of logistics business processes aimed at achieving a common result;
– creation of a new architecture of business systems with seamless integration, the introduction of "end-to-end" IT technologies that ensure the network interaction of business processes and the creation of cross-industry cooperation;
– unification and standardization of advanced digital technologies, architectures and business models to solve problems of the transport and logistics complex and supply chain management in general;
– improvement of IT solutions used by transport and logistics SMEs, and cross-sector dissemination of international business best practices used in this area;
– revision of the rules of interaction and optimization of business processes between divisions within transport and logistics companies;
– determination of the operator of the unified digital logistics platform in cooperation with the scientific industry complex;
– training of professional personnel to work in the field of digital logistics, who will have a set of key competencies for creating effective information flows in the digital economy and developing analytical applications to optimize business processes at various levels of economic management.

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