

# Economic assessment of the implementation of distributed data registry platforms in multimodal transport

Ilya Gulyi<sup>1,\*</sup>

Department of transport Economics, Emperor Alexander I Petersburg State Transport University 190031 9, Moskovskiy prospect, St. Petersburg, Russia

**Abstract.** Task: to develop a concept for implementing distributed Ledger technologies (blockchain) in passenger railway transport and to justify the approach to evaluating the effectiveness of these technologies. Methods: content analysis of special industry research, analysis of specialized statistical reporting on the use of digital systems and technologies, survey, mathematical modeling, and others. Result. The author analyzes the trends of the multimodal passenger transport market, in particular the European segment. It is established that due to the significant development of multimodality in passenger transport, transport organizations will be able to meet modern customer requests mainly when switching to network technologies, mainly to digital systems of distributed transaction data registry. The concept of passenger blockchain in transport is proposed: its functionality, platform composition, digital modules, additional services for passengers. The effects resulting from the introduction of blockchain in passenger transportation are systematized, the sources of their occurrence, and their quantitative assessment for the passenger railway complex of Russia is given. Practical significance: the results of the study deepen methodological developments in the field of economic evaluation of investment projects for the introduction of digitalization technologies. They are in demand by managers of transport companies, development specialists, and analysts who evaluate digital technologies.

## 1 Introduction

Due to the significant development of transport multimodality in passenger transport, transport organizations will be able to meet customer requests mainly when switching to digital network technologies. One of the key technologies is distributed Ledger technology (blockchain), a decentralized digital register of transaction data that is used by a distributed network of market participants to improve the efficiency and transparency of processes [2].

## 2 Materials and methods

The study uses basic methods, such as the results of a survey of carrier companies, and systematization of data from industry surveys [5].

## 3 Discussion

The research has shown that the growth of the multimodal passenger travel market in Europe by 2030 will be almost 60%. The main growing segments are: railway + aviation, railway + bus, aviation + bus transport (table 1).

**Table 1.** Trends in the development of the European passenger transport market (involving multimodality).

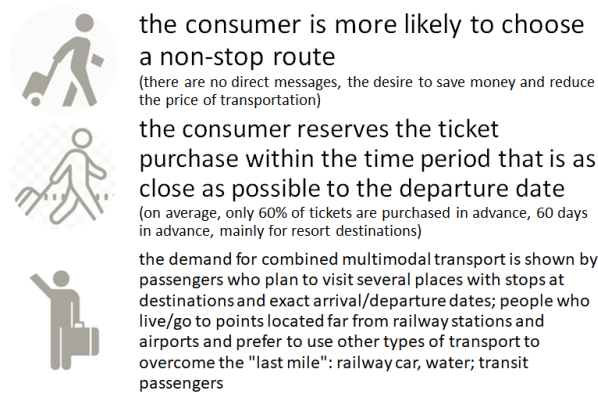
Segment	air + railway	air + bus	railway + bus	ferry and others	Total
Multimodal transport under a single contract, %	2.1	1.1	0.05	0.05	3.3
Multimodal transportation under different contracts and tickets, %	40.6	20.9	0.9	0	62.4
Total	42.7	22	0.95	0,05	65.7
The expected annual growth in the years 2019-2030, in %	2.9	2.8	0.8	0	2.8
Total expected in 2030	63.7	32.3	1.1	...	97

Source: the table was created by the author based on the source: <https://ec.europa.eu>.

The archetype of the modern passenger confirms the need to create a “blockchain platform” for organization of multi-modal [1]. So, the modern consumer increasingly prefers a non-stop route, and more often plans a trip in terms that are as close as possible to the date of the trip. Many passengers are demanding to continue the trip (overcoming the “last mile”), for many

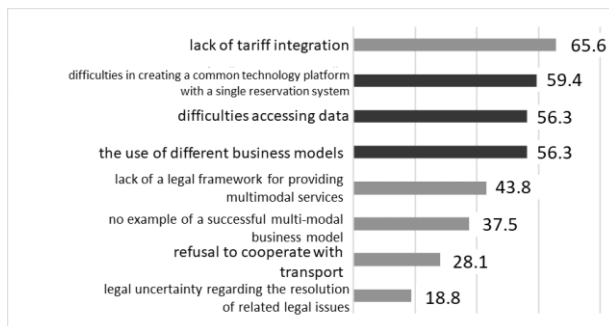
\* Corresponding author: [ilya.gulyi@mail.ru](mailto:ilya.gulyi@mail.ru)

it is necessary to visit several places at the destination [3] (Fig. 1).



**Fig. 1.** The profile of the consumer of passenger transportation services.

Barriers that hinder the development of passenger multimodality: difficulties in creating a common technology platform with a single reservation system, difficulties with data access, and the use of various business models of interaction with the client (Fig. 2).

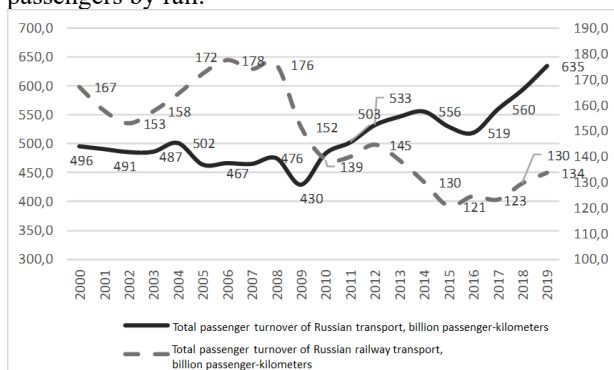


**Fig. 2.** The profile of the consumer of passenger transportation services (based on a survey of European carriers).

Source: the figure was created by the author based on the source: <https://ec.europa.eu>.

## 4 Results

In the course of research, the author analyzes the results of the activities of transport organizations that transport passengers by rail.

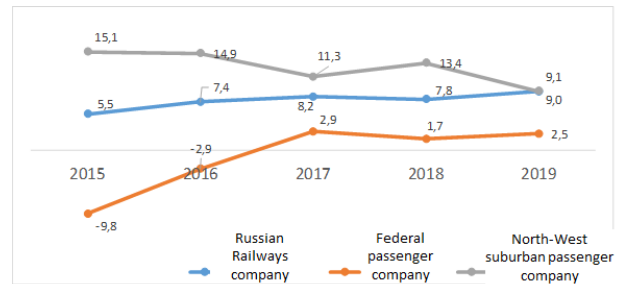


**Fig. 3.** Industry trends-dynamics of Russian passenger traffic in transport, including railway transport.

Revenue growth from long-distance passenger transportation from 2015 to 2019 was +31%. On the example of the North-West suburban passenger company – revenue growth from suburban transportation +28%. In some periods, passenger transport operations were unprofitable (for the Federal passenger company-2015-2016). the Return on sales for the Russian Railways holding is relatively stable. But for Russian Railways company, it tends to decrease by 2019.

Main conclusion:

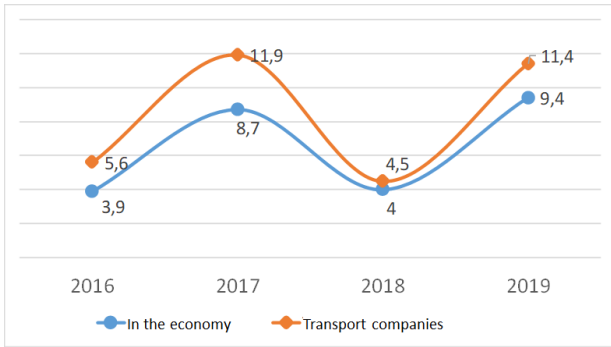
- significant loss of market share in the passenger segment since 2010 (fig. 3);
- low profitability (2-3%), loss in some periods (fig. 4);
- the lag in the growth rate of value added in comparison with the overall macroeconomic growth in the country.



**Fig. 4.** Profitability of sales (Russian railway companies), %.

Investments in digital technologies of Russian railway companies. Investment in digital technologies has increased significantly in recent years. From 2005 to 2019, the volume of investment in real terms increased 4 times.

There is no data on “blockchain usage” in the statistical reports of Russian companies. But at the same time, there is an indicator in the reporting “the number and share of the total number of organizations that used cloud and distributed computing, virtualization and storage systems”. Based on this indicator, we can judge that approximately 11% of transport companies were working in this direction (this is higher than the average for the Russian economy) (Fig. 5).



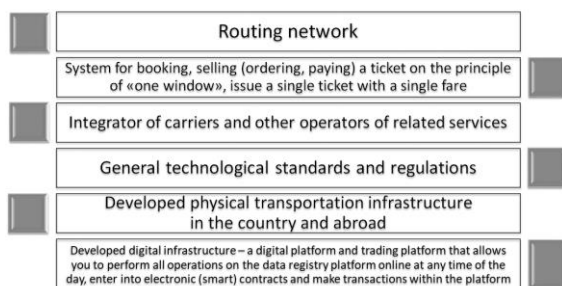
**Fig. 5.** Percentage of Russian organizations that used cloud and distributed computing, virtualization, and storage solutions, %.

The Russian Railways holding company is already engaged in the organization of multimodal passenger transportation [4]. The Innovative mobility company acts as an operator of an IT platform that is designed to distribute and sell e-tickets for all types of transport. Passengers have the opportunity to plan and arrange a door-to-door trip, taking into account all types of transport and additional services.

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The creation of digital platforms for multi-modal passenger transport is predetermined by the indicators reflected by the Russian Ministry of transport and the Russian Railways company in the strategic planning documents. In terms of transport, the number of passengers transported in mixed mode should increase by 30 times.

In the study, the author proposed the functionality of the passenger transportation blockchain. This will be a system that provides door-to-door passenger transportation via a digital platform, the formation and payment of a single electronic ticket, and the provision of additional services. Moreover, the organization of all these processes is carried out without the participation of intermediaries and operators.



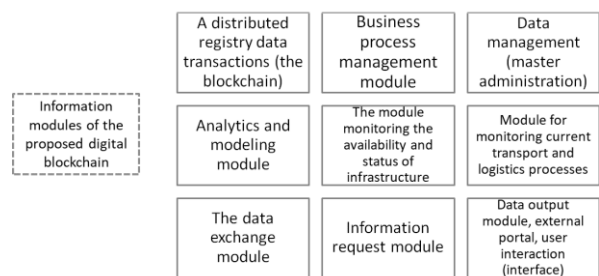
**Fig. 6.** Conceptual structure of the digital platform for blockchain passenger transport involving railway transport.

Source: author's development.

Among the additional services purchased on the same platform, we will separately highlight the following: food, accommodation, Luggage delivery, excursions, purchase on credit, insurance.

The IT system itself is developed by an IT company. Program blocks: route network, full set of data (database) on transport infrastructure, integrator of carriers and other suppliers, system of booking, payment and registration of a single ticket (Fig. 6).

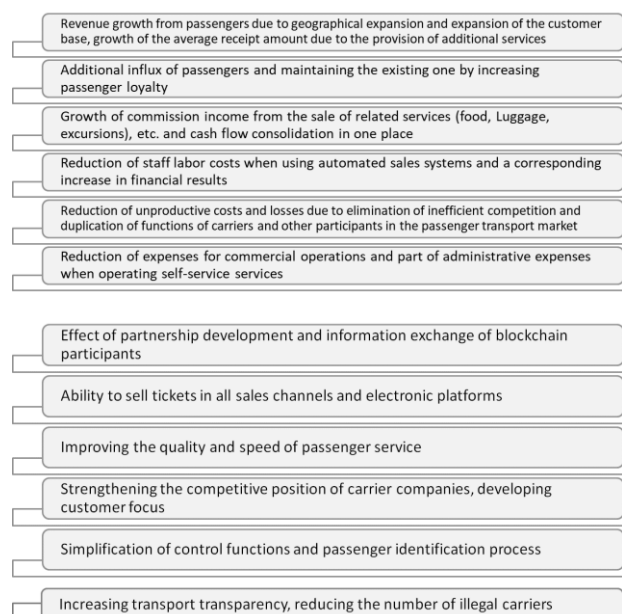
In addition to the blockchain itself, it should include modules: analysis and modeling, current monitoring of transport availability and infrastructure status, a query module, a data exchange module, and a data exchange module with other platforms (Fig. 7).



**Fig. 7.** Basic and additional modules of the digital blockchain.

Source: author's development.

About the effects of the blockchain platform for carriers: revenue growth due to increased passenger traffic; an increase in the average receipt, an increase in Commission income from additional services, reduction of administrative, commercial expenses, unproductive expenses due to inefficient competition and duplication of routes, improvement of quality and speed, and others (Fig. 8).



**Fig. 8.** The planned effects for carriers from the use of blockchain.

Source: author's development.

Passengers will also get certain useful effects. These are the following: growth of transport mobility and citizens' mobility; ease of planning and scheduling; individual offer; regular trips on the multimodal transport system.

When evaluating the effectiveness of investing in blockchain, the main principle was taken into account: long-term operational effects should significantly cover the development and implementation costs.

**Table 2.** Evaluating the effects and effectiveness of digital blockchain passenger transport.

Effect sources	Reporting data for 2019 (railway passenger complex)	The prognosis for implementation of the project (year)	Effect, billion rubles*
Transport mobility of the population (railway transport)	8.18 trips per 1 resident	10 trips per 1 resident	1.85
Number of passengers transported by Russian Railways infrastructure	1201 mln. people	1261 mln. people	0.42
Commission income	9 bln. rubles	14 bln. rubles	0.4
Wastage	9.7 bln. rubles	8.6 bln. rubles	1.1
Sales and administrative expenses	30.2 bln. rubles	28.9 bln. rubles	1.3
Labor costs	90 bln. rubles	89.2 bln. rubles	0.8
Network interaction			0.6
Information communications, unified access to the digital platform			0.4
<b>TOTAL</b>			<b>6.9</b>

\* The effect is to increase operating profit and reduce costs.

Source: the author's assessment.

In the research, we tried to evaluate the effects of blockchain implementation using an expert method. The sources of the effect and dynamics of indicators are formulated using data from industry publications, interviews with IT top managers of the Russian Railways company.

## 5 Conclusion

Our calculations allowed us to conclude the following. The blockchain will bring an additional 7 billion rubles in annual profit growth to the passenger complex of

Russian Railways. According to our calculations, with a minimum life cycle of IT technology (5 years), the effect will be 34 billion rubles. The payback period is approximately 2.5-3 years.

## References

1. N.A. Zhuravleva, I.M. Gulyi I.M, M. Polyanichko, Mathematical description and modelling of transportation of cargoes on the base digital railway, Environment Technology Resources Proceedings of the International Scientific and Practical Conference **2**, 175 (2019).
2. N.A. Zhuravleva, V.M. Shavshukov, The analysis of digital investment market and assessment of prospects for their use in the development of marine intelligent technologies, Marine Intellectual technologies, **4-2(46)**, 161-167 (2019).
3. N.A. Zhuravleva, A. Siekelova, K.F. Michalikova, Industrial Artificial Intelligence, Business Process Optimization, and Big Data-driven Decision-Making Processes in Cyber-Physical System-based Smart Factories, Addleton Academic Publishers. Journal of Self-Governance and Management Economics **8(2)**, 28-34 (2020).
4. M. Lyakina, W. Heaphy, V. Konecny, T. Kliestik, Algorithmic governance and technological guidance of connected and autonomous vehicle use: Regulatory policies, traffic liability rules, and ethical dilemmas, Contemporary Readings in Law and Social Justice, **11(2)**, 15-21 (2019).
5. Time to trust. Trillions of dollars worth of reasons to look at blockchain in a new way: a study by PricewaterhouseCoopers (PwC) (2020) 23 p. [Network source]. URL: <https://pwc.ru>.