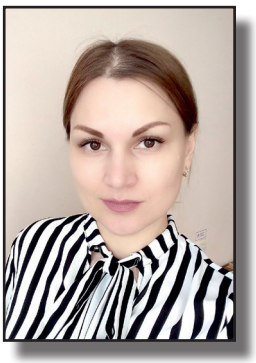
ORIGINAL ARTICLE
DOI: https://doi.org/10.30932/1992-3252-2022-20-3-8

World of Transport and Transportation, 2022,
Vol. 20, Iss. 3 (100), pp. 187–192

Diagnostics of Subsystems of Material and Equipment Supply Chain: Delivery by Rail in Orenburg Region



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ABSTRACT

The process of supply of enterprises with material and equipment is one of the most important conditions for uninterrupted and productive performance of economic entities. Therefore, it is important to pay attention not only to the number of transactions and purchases, and rational use of those resources but also to the time of delivery to enterprises, to the travel time. Delay in supply of necessary resources may cause reduction in production efficiency that further will result in losses for enterprises. This topic is relevant not only for individual business structures and organisations, or all over the national transport system, but from the regional aspect as well.

The article using an example of Orenburg region considers not only general issues of development of regional transport and logistics system but also the features of rail transportation.

The proposed classification of subsystems of supply chain management based on core activity indicators supposes further in-depth diagnostics to reveal the causes of occurrence of signs of inefficiency in rail transportation and their prompt elimination.

Keywords: transport, transportation, supply chains, staff, infrastructure, cargo owners, diagnostics, regional transport and logistics system.

Financial support: the article was prepared as part of the research activity plan of the Institute of Economics of the Ural Branch of the Russian Academy of Sciences for 2021–2023.

For citation: Tarasenko, E. A., Eliseev, V. N. Diagnostics of Subsystems of Material and Equipment Supply Chain: Delivery by Rail in Orenburg Region. World of Transport and Transportation, 2022, Vol. 20, Iss. 3 (100), pp. 187–192. DOI: https://doi.org/10.30932/1992-3252-2022-20-3-8.

The text of the article originally written in Russian is published in the first part of the issue.
Текст статьи на русском языке публикуется в первой части данного выпуска.

INTRODUCTION

Railway transport is deservedly popular all over the world not only among cargo owners and consignees, but also among passengers (see, e.g.: [1; 2]).

Therewith, in the modern world, in the framework of market relations, since the activity of business enterprises is aimed not so much at satisfying the value of consumers as at obtaining their own benefit, and regardless the great dependence of revenues on satisfying the demand of consumers, the risk that managers once will make decisions that can lead to a decrease in the quality of the transportation services provided can't be entirely eliminated.

This is a reason for the emergence of a problem of formation and development of supply chain management systems that use diagnostics of all its components concerning participants in the transportation process.

The solution of this problem requires careful preparation, collection of a huge number of documents and data. Sometimes this is quite difficult since the participants in the supply chain are economic entities of different legal and organisational status and the accessible data format and volume differ.

In the process of preparing the article, the authors set an *objective* to reveal the main causes of failure and delays in supply of material and technical resources, and also suggested a developed model of subsystems of transportation process management, allowing further diagnosing of all supply chain participants and levels.

RESEARCH METHODS

The main *methods* of research on the problems of railway transportation in Orenburg region comprised collection of data on quantitative and qualitative indicators of the work of this area and a comparative analysis of activity of various modes of transport to determine the position of railway transportation in the transport services market. A performed SWOT analysis of the features of Orenburg region referring to transport and logistics was intended to determine how they can influence the transportation activity by rail.

RESULTS

To identify the strengths and weaknesses of features of Orenburg region referring to transport and logistics, namely to rail transport, as well as to identify opportunities and threats, the authors conducted a SWOT analysis (Table 1).

Orenburg region has quite favourable conditions for transportation activities, including for the activities of railway transport.

The draft Development Strategy of the Orenburg Region for the period up to 2030 submitted for public discussion in June 2022 notes that the region is «one of the Russian regions most integrated with partners in Kazakhstan, including along technological chains». The draft emphasised the location of the region at the intersection of two major transport corridors: «Europe–Western China» and «North–South». In addition, it is crossed by the shortest route through Central Asia to Iran and further to India and the Persian Gulf countries. This is a prerequisite for the implementation of the transit potential of the region [1].

As far as rail transportation is concerned, since Orenburg region borders on Kazakhstan,

[1] Development Strategy of the Orenburg Region for the period up to 2030. Draft [Electronic resource]: https://www.economy.gov.ru/material/file/6a52661b0123d0507aef907cece7d894/proekt_strategii.pdf. Last accessed 06.07.2022.

Table 1

SWOT analysis of the core features of Orenburg region influencing the development of rail transportation [developed by the authors]

Strengths	Weaknesses
1. Favourable geographical location in proximity to the Republic of Kazakhstan. 2. Sufficiently developed agro-industrial complex. 3. Developed transport infrastructure, availability of access roads. 4. A large number of industrial enterprises.	1. Insufficient development of human resources. 2. Lack of a logistics distribution centres and warehouses in Orenburg region. 3. Insufficient financing of the region. 4. Features of climatic conditions.
Opportunities	**Threats**
1. Cooperation with the Republic of Kazakhstan and the PRC. 2. Extraction of minerals and their sale to other regions.	1. Threat of air pollution related to industrial activity. 2. The outflow of the population due to lack of employment. 3. Depletion of water resources.

and also has possibilities to organise transportation to China, it can be supposed that rail transportation is promising to provide transportation support for cooperation with these countries if the purchase of some resources is made there: e.g., of cheaper fuel from Kazakhstan, of a variety of consumer goods, e.g., stationery and office equipment, etc.

The presence of large industrial enterprises involves possible provision of other cities by rail with various types of resources: coal, coke, iron and manganese ore, ferrous metals. It is necessary to take into account that according to draft region development strategy the region manufactures almost 100 % of liquefied helium, odorant and electrolytic chromium in the country. Besides, the region has immense capacity to extend non-energy sector of the regional economy[1].

The features of the agro-industrial complex of Orenburg region make it possible to provide the need for transportation all the year round, there is «year-per-year growth of exportations of agricultural products abroad»[1]. At the same time, regional transportation is influenced by seasonal fluctuations. E.g., the delivery of seasonal harvest of watermelons from Sol-Iletsk increases volume of regional transportation, according to the Statistical Yearbook of Oren burg Region (2021), by 2 %[2].

At the same time, currently there is no single transport and logistics system efficiently operating within the territory of Orenburg region supposing the presence of logistics centre instead of several small enterprises providing logistics services.

The state program of Development of transport system in Orenburg region notes that «regardless favourable trends for development of modes of transport, transport system does not fully meet existing needs and prospects for development of the region»[3]. The reasons noted comprise unbalanced and uncoordinated development of some modes of transport and transport infrastructure.

So, the relevant task is to develop transport system, interregional logistics cluster. This

[2] Statistical Yearbook of Orenburg Region. 2021: Stat. coll. / Orenburgstat. Orenburg, 2021, 516 p. [Electronic resource]: https://orenstat.gks.ru/storage/document/document_statistic_collection/2021-12/30/Ежегодник_2021.pdf. Last accessed 06.07.2022.

[3] Decree of the Government of Orenburg region dated 29.12.2018 No. 916-pp on the adoption of the state program «development of transport system of Orenburg region» (as amended and supplemented). [Electronic resource]: http://pravo.gov.ru/proxy/ips/?docbody=&prevDoc=153108768&backlink=1&&nd=153123737. Last accessed 06.07.2022.

Table 2

Parameters of supply chain management subsystems in railway transport [newly developed by the authors based on [3, pp. 140–141]]

Type of sustainability	Clients	Business processes	Finance	Personnel
Economic	- volume of transportation; - number of services provided; - the number of clients; - level of logistics service	- implementation of the transportation plan; - availability of warehouses and access roads - speed of fulfilment of orders for transportation	- profit from transportation; - marginal profit; - level of receivables	- number of employees; - mean wages; - labour productivity
Environmental	- compliance of services with environmental standards; - number of delays in delivery	- environmentally harmful substances emission; - the impact of noise, vibration, radiation; - the state of sanitation in the workplace	- environmental protection costs; - payment for cases of incapacity of personnel for environmental reasons; - fines and payments for non-compliance with environmental protection requirements	- compliance with labour safety requirements; - number of cases of occupational diseases; - availability of personal protective devices; - training in behaviour in emergency situations
Social	- number of loyal clients; - number of new clients; - share of clients leaving; - trust level	- number of suppliers and intermediaries; - errors in order picking; - losses due to poor management; - smart use of human capacity	- the amount of social payments; - losses from downtime and overtime work; - hiring, dismissal and training costs	- psychological climate; - number of labour accidents; - the state of labour discipline; - staff turnover

opportunity is highlighted among key opportunities in the draft regional development strategy. It foresees, namely, that the construction of a new road infrastructure in the framework of New Silk Road project will allow to create an important multimodal hub in the region. For this, it is necessary to continuously eliminate key «bottlenecks» in regional road network and to improve the infrastructure of border checkpoints. It will facilitate the creation of conditions for «redistribution of cargo flows in favour of the region, attracting of freight transportation and freight carriers into the region»[1].

Development of single transport and logistics system will contribute to further growth in attractiveness of Orenburg region in the national market, positioning it as «large trade, educational, cultural, administrative and business centre» [3]. Besides, transport and logistics system can potentially become a key sector of regional economy and will allow the region to act an important transport hub at the intersection of transport corridors «Europe–Western China» and «North–South»[1].

It is necessary to account for some other factors also.

Namely, the regional transport system is influenced by «continuing outflow of population, particularly from the eastern part of the region»[1] followed by losing of key competences in different sectors and increased load on «maintenance costs for social and transport infrastructure»[1].

The risks in the sphere of staffing of railways relate to probability of lack of employees with required qualifications and to recruitment of young employees [3, pp. 115–116].

The decrease in the time of rail delivery of material and technical equipment is most influenced by general time of transporting that includes the idle time of cars and locomotives at stations for loading and unloading, repair, shunting and maintenance operations.

One of the main problems of transport infrastructure is associated with high degree of wear of main productive assets. Referring, e.g., to road transport in Orenburg region, the wear of «some groups [of assets] attain 50–80 %» that influences throughput capacity of roads and demands continuous investment on repair and modernisation works[3] [4]. The problems of wear, including of rolling stock, are to different extent inherent also to some rail enterprises of Orenburg region. The important issues also comprise current maintenance of infrastructure and rolling stock

(see, e.g.: [5]), and keeping them in good state of operability

It is also extremely important to pay constant attention to improving safety of railway crossings, since the non-respect of the rules implies risks of interruption of rail traffic.

It is also necessary to highlight a topical factor. Transport and logistics system requires the fastest introduction of digital technology. It is important for regional development[1], entire transport industry[4] and rail transport[5], nation-wide as well as at regional level.

The above allows drawing a conclusion that optimisation of the existing supply chain management system should consider the totality of mentioned factors.

Some other factors also merit attention as those determining the efficiency of supply. They englobe issues of cargo safety, including legal aspect there-of (e.g.: [7–9]), combined transport (e.g.: [10]), tariffication and pricing (e.g.: [11]).

Recommendations on Improving Rail Transportation

Most important are suggestions referring to rail transportation since rail transport of Orenburg region is among the top regions in Volga federal district per rates of loading and fright turnover, is on the list of top-10 of largest regional structures, and the share of goods transported by rail constitutes 67 % in general volume of cargo transported in the region, and 95,3 % in regional cargo turnover[6].

See the results of the studies, it can be assumed that risks of negative impact on railway transportation are predetermined by several factors that may hinder development of transportation activities and continuous functioning of supply chains due to insufficient sustainability. This assumption is based on series of authors' research, referring to classification of the objects of supply chain management, integrated resource flows, classification of processes accompanying separate flows and their sustainability [12], management of logistics processes [13], management of supply chains at the level of territorial entities of railways [3; 14], other researchers' works in the field of supply chain management (e.g.: [15]).

The issues of efficiency of the entire supply chains without focusing on the transport links are developed by the foreign companies specialised in that field[7]; many researchers consider issues of organisation and optimisation of supply chains regarding selected industrial sectors or enterprises as well as in the context of management there-of; works (e.g.: [16]) are dedicated to selected functional aspects of diagnostics, namely, to application of IT-technology.

Based on this, it seems appropriate to suggest a system of indicators for further detailed diagnosing supply chains in railway transport based on the sustainability criterion by economic, social and environmental types within «Clients», «Business processes», «Finance», «Personnel» subsystems.

Table 2 shows possible problems in each of the identified subsystems of supply chains, which allows further diagnostics of them to detect «bottlenecks» and promptly eliminate those that cause problems in the supply of material and technical resources by rail in Orenburg region [3].

Diagnostics could result in identification of critical deviations of the parameters of logistics systems, which if there is insufficient quality of concentration and distribution as activities of the logistics system, and under the influence of external and internal environmental factors may have an impact on transportation services provided by rail transport in Orenburg region, increasing time and reducing quality of delivery.

CONCLUSIONS

The research has resulted in identification of factors affecting the activities of railway transport, including timeliness of cargo deliveries. Diagnostics of supply chain subsystems being implemented based on the array of the required data, it will allow executives of a rail company, in the considered case of Russian Railways, to promptly eliminate emerging problems.

The supply chain management is the most important task for the management of transport

[4] Transport Strategy of the Russian Federation till 2030 with a forecast for the period up to 2035. Approved by the decree of the Government of the Russian Federation dated 27.11.2021 No. 3363-r. [Electronic resource]: http://static.government.ru/media/files/7enYF2uL5kFZlOOpQhLl0nUT91RjCbeR.pdf/. Last accessed 06.07.2022.

[5] The board of directors of the JSC Russian Railways has approved the strategy of digital transformation. [Electronic resource]: https://company.rzd.ru/ru/9397/page/104069?id=184629. Last accessed 06.07.2022.

[6] The website of the Government of Orenburg region. Transport. [Electronic resource]: https://orenburg-gov.ru/activity/1651/. Last accessed 06.07.2022.

[7] E.g.: Supply chain diagnostic: improving processes. [Electronic resource]: https://www.mecalux.com/blog/supply-chain-diagnostic. Last accessed 06.07.2022.

and logistics companies, since insufficiently efficient supply chain management may cause loss of active customers, intermediaries, suppliers, lost profits, growing employee turnover, etc., which in turn will lead to loss of beneficial cooperation and will consequently inevitably cause decrease in profit of the enterprises that position rail transportation as main activity.

Hence, to reveal the causes of emergence of signs of inefficiency in rail transportation in the most accurate way, it is necessary to develop the detailed parameters of all the subsystems of supply chain followed by further diagnosing of each of the parameters.

Once relevantly adapted, the suggested matrix approach to diagnostics of the supply chain management subsystems, in the authors' opinion, may be scaled up to Russian Railways (in case of rail transport), and the companies of other modes of transport at regional, as well as at the national level. Further research on the issue will contribute to create best conditions for the implementation.

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Article received 06.06.2022, updated 06.07.2022, approved 07.07.2022, accepted 11.07.2022.