Detailing the impact structure of the participants of the complex transport service

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Abstract. During the reforms underway in the railway industry, the consolidation of companies and vehicles, the formation of new models of transportation services is achieved through the creation and implementation of integrated high-tech information systems. In this case, a holistic approach to the effective management of the production system should determine the extent of their responsibility. The article illustrates the main aspects of quality management of customer service as one of the key factors of transportation company efficiency in the segment of freight transportation. The procedure of quality estimation of the transportation service is presented in the Target model of the complex transport service by each of its parties in the different transportation categories. Specification of the impact structure of the parties of the complex transport service on its quality level through calculation of a responsibility ratio has been made.

1. Introduction

Most transport production processes in the railway industry consist of multiple transport services, in many cases not interconnected and not interacting, which in itself complicates a single technological process and reduces its efficiency. Currently, in the current conditions for the consumer of transport services there is a problem of determining the zones of influence of the participants of transport - providing functions on the quality of service and determining the degree of their influence on the quality criteria. To solve these problems, the author of the article proposed a target model of integrated transport services in the freight market segment. It uses the principles of consolidated, consistent and preferential application of various transport services in a single transport system and in different categories of transportation. The use of this model allows one to achieve optimal planning and quality management of transport services, while providing maximum aggregate profit. This article represents a logical development of the early editions. Thus, in [1] the model of complex transport service is proposed, in [2] the stages of formation of the target model of complex transport service in the field of freight transportation are presented. To improve the production process, in terms of improving the quality of transport services and reducing costs, it is necessary to develop new approaches. In this article the method of evaluation of quality of transport service in the target model of the complex transport service by detailing the structure of influence of subjects of the complex transport service on the level of its quality in different categories of transportations [2,3] is presented. At present, the main
quality criteria in the market of transport services in the cargo transportation space are: the safety of the transported cargo and goods \(K_{\text{safe}}\), the safety of the transportation of finished products \(K_{\text{fp}}\), the speed of delivery of goods and goods \(K_{\text{sp}}\), constancy and mass transportation of products \(K_{\text{tr}}\), price availability and rationality of transport services \(K_{\text{price}}\) \[3,4\]. These criteria actually give an idea of the consumers' attitude towards observance and effective improvement of transport services quality by all participants of the transport process. In order to ensure the level of each quality criterion, it is necessary to develop and implement a set of measures aimed at increasing the quality of transport services, which in turn require large financial investments.

2. Materials and methods

In the existing model of transport services in the area of cargo transportation, the level of mandatory quality and its significance according to the requirements of federal laws of the Russian Federation is established in the legal field of responsibility for failure to meet the criteria of quality of services \[4,5\].

Figure 1 shows the subjects of services in a descending order of the level and competence of responsibility for compliance with the requirements of the main quality criteria.

![Spatial structure of the location of transport services subjects in a descending order by the level and competence of responsibility for compliance with the requirements of the main quality criteria](image)

**Figure 1.** Spatial structure of the location of transport services subjects in a descending order by the level and competence of responsibility for compliance with the requirements of the main quality criteria.

It can be seen that the carrier, the owner of infrastructure and the owner of the rolling stock \[5\] must meet five main quality criteria. Therefore, the quality factor \(K_{\text{qua}}\) is 1. The consignor, consignee and the owner of the track are responsible \[6\] for the 4 main quality criteria, resulting in a quality factor of 0.8. The rolling stock operator and freight forwarder \[6, 7\] actually fulfill two main quality criteria, respectively, the quality factor is 0.4. When organizing a single transportation process \[7\], each transport service subject is responsible for quality criteria in its area of influence. Coefficients of quality of transport services show full compliance with the conditions of transport service, but can not be part of a single quality compliance (as a result, do not give a total of 1 or
3. Results

Calculation of the quality factor provides an opportunity to assess the impact on compliance with the level of quality criteria by transport service providers, but does not provide a definition of their responsibility [7, 8]. For this purpose, it is necessary to detail the structure of the impact of the participants of the production transport process on the quality of services provided [8] by calculating the coefficient of maximum quality assurance by all subjects \(K_{\text{max,qua}}\). The coefficient of maximum quality assurance is defined as a sum of the coefficients of quality of the subjects of transport services participating in a single transport process [9]. The number of transport services subjects participating in a single process of goods-cargo movement may vary depending on the design of the transport services market:

\[
K_{\text{max,qua}} = \sum K_{\text{qua},i} = \sum K_{\text{qua},1} + K_{\text{qua},i},
\]

(1)

To determine the amount of responsibility of the subjects of transport services, the responsibility coefficient is calculated by dividing the coefficient of quality of the subject of transport services \(K_{\text{qua},i}\) by the coefficient of maximum quality assurance \(K_{\text{max,qua}}\):

\[
K_{\text{con,trans}} = \frac{K_{\text{qua},i}}{K_{\text{max,qua}}},
\]

(2)

To determine the quality level of transport and logistics services, the coefficient of the quality level of service is calculated by the following formula:

\[
U_{\text{sub}} = \frac{K_{\text{qua},i} \times t_i \times K_u \times K_z \times M}{K_{\text{max,qua}} \times t_i \times Z},
\]

(3)

where:
- \(t_i\) - time for performing \(i\)-transport service;
- \(K_u\) - correlative coefficient of the transport service provider's liability;
- \(K_z\) - correlation coefficient of the Client's liability for transport services;
- \(M\) - number of calendar days in the reporting period;
- \(Z\) - rhythm of transport services provision is determined by the number of calendar days required to fulfill the transport services provision plan by the Provider.

The formula shows that the service quality level factor depends on the time of transport service performance, the correlation coefficients of responsibility of the Contractor and the Customer, the quality factor of the subject of transport services. It follows from this that the increase of responsibility of the subjects for compliance with the plan of transport services is the most important condition for improving the quality of service and reducing the cost of transport services. In the existing model, the coefficient of maximum quality assurance of transport services is 6.2. Provided that there is the impact of all participants of transport services allows providing functions on the quality of provided services in a single transportation process.

Figure 2 shows the dependence of the quality factor of the subjects of transport services on their responsibility factor.

In Figure 2, you can see that the dependency curve tends to decrease (curve 3) and increase (curve 1). Moreover, the higher the value of the responsibility factor is (curve 1, curve 2), the higher the value of the quality factor of the subject of transport services is, i.e., the more investments are made by the corresponding participants of the process to provide guaranteed transport services.

Thus, in the current model of transport services on the railway transport there are subjects, including those with a minimum share of responsibility for compliance with the main quality criteria, and therefore less effective in the development of transport services quality [10,11]. The possibility of effective and rational interaction with other modes of transport in a single transport system has been

100%).
eliminated [11,12], which ultimately leads to higher prices for finished products and non-competitive consumers of services.

1 - a curve of dependence of the quality factor of the owner of the infrastructure, the carrier, the owner of the rolling stock on the factor of their responsibility.
2 - a curve of dependence of the quality factor of the consignor, consignee, owner of the way of non-use on their liability factor.
3 - a curve of dependence of the rolling stock operator's and freight forwarder's coefficient on the coefficient of their responsibility.

**Figure 2.** Dependence of the quality factor of transport service subjects on their responsibility factor

In conditions of declining growth rate of the country's economy, it is necessary to search for new, alternative ways to improve the quality of the transport process in the market of transport services in various categories of transport using the potential of a unified transport system [12,13].

The author of the article suggests a new target model of complex transport service, which presents new subjects of transport services and defines the areas of their impact by categories of transportation [13,14].

Figure 3 presents new subjects of transport services and their impact areas in categories of transportation in the proposed target model of the integrated transport service.

**Figure 3.** Spatial structure of new subjects of transport services and areas of their influence in the categories of transportation in the proposed target model of the complex transport service
Figure 3 shows that a regional freight transport company in the category of transportation (regional), a large-scale freight transport company in the category of transportation (interregional) and an international freight transport company in the category of transportation (international) ensure the fulfillment of all eight main criteria of quality of a complex transport service. Consequently, the quality factor \( K^{\text{qua}} \) is 2. Division of the complex transport service in the category of transportation (domestic), the international freight transport company in the category of transportation (transit) ensures the fulfillment of seven main quality criteria. The quality coefficient \( K^{\text{qua}} \) is 1.75. The division of the complex transport service in the category of transportation (industrial) ensures the fulfillment of six main criteria, respectively, the quality coefficient \( K^{\text{qua}} \) is equal to 1.5.

The coefficient of maximum quality assurance is defined as the sum of the coefficients of quality of the subjects of transport services participating in the complex transport service:

\[
K_{\text{max,qua}}^{\text{tr,s}} = \sum K_{\text{qua}}^{\text{tr,s}}.  \quad (4)
\]

The responsibility factor of the subjects in the model of the complex transport service is calculated as a partial division of the factor of quality of the complex transport service of the subject \( K_{\text{qua}}^{\text{tr,s}} \) by the factor of maximum quality assurance of the complex transport service \( K_{\text{max,qua}}^{\text{tr,s}} \):

\[
K_{\text{con,trans}}^{\text{tr,s}} = \frac{K_{\text{qua}}^{\text{tr,s}}}{K_{\text{max,qua}}^{\text{tr,s}}}. \quad (5)
\]

The quality level coefficient of transport and logistics services is calculated by the formula:

\[
U_{\text{sub}}^{\text{con,trans}} = \frac{K_{\text{qua}}^{\text{tr,s}} \times K_{\text{con,trans}}^{\text{tr,s}}}{K_{\text{max,qua}}^{\text{tr,s}}}. \quad (6)
\]

In the proposed model the coefficient of maximum quality assurance of the complex transport service is 11 under the conditions of the impact on the quality of services provided by all participants of the complex transport service and the use of two types of transport in the transport scheme, namely: road and rail. When used in the transport process [14,15] in more modes of transport, this coefficient increases.

As a result, the liability factor for an international freight transport company in the categories of transportation (international and transit) is calculated as follows:

\[
K_{\text{sub}}^{\text{con,trans}} = \frac{2 + 1.75}{11} = 0.34.
\]

For subdivision of the complex transport service in categories of transportation (internal and industrial) the coefficient of responsibility is calculated as follows:

\[
K_{\text{sub}}^{\text{con,trans}} = \frac{1.5 + 1.75}{11} = 0.3.
\]

For a regional freight transport company in the category of transportation (regional) and a large-scale freight transport company in the category of transportation (inter-regional) the calculation of the coefficient of responsibility looks like this:

\[
K_{\text{sub}}^{\text{con,trans}} = \frac{2}{11} = 0.18.
\]

Figure 4 shows the dependence of the quality coefficient of the subjects of transport services on the coefficient of their responsibility for the categories of transport in the target model of the complex transport service.
1 - Curve of dependence of the quality factor of an international freight transport company in the categories of transportation (international and transit) on the liability factor.

2 - Curve of dependence of the quality coefficient of the division of complex transport service in the categories of transportation (domestic and industrial) on the liability coefficient.

3 - Curves of dependence of the quality coefficient of a regional transport company in the category of transportation (regional) and a large-scale freight transport company in the category of transportation (interregional) on the liability coefficient.

**Figure 4.** Dependence of the quality factor of transport services subjects on the factor of their responsibility by transport categories in the target model of the complex transport service

Figure 4 shows that the curve of dependence between $K_{qua}^{tr.s.}$ and $K_{sub}^{con.tr.s.}$ has the desire to fill, and the higher the value of $K_{qua}^{tr.s.}$, this filling occurs earlier (curve 1,2). In its turn, the coefficient of responsibility of transport service subjects depends on the coefficient of maximum quality assurance.

As a result, the parameters of conducted calculations show [15] that the processes of rendering transport services in the New Target Model have been formed effectively. The data on responsibility coefficients show that investment in ensuring the main criteria of quality by the subjects of transport services will be maximum. In practice, there may be cases in the process of rendering transport services in which a certain subject could not provide on the proper level those quality criteria that must be met. This leads to incomplete compliance with the quality index of complex transport services. It should be noted that this provision leads to failure to meet the requirements of transport and logistics services, and, therefore, compensation of losses to the consumer, the subject of the service because of which occurred failure to meet one of the quality indicators.

**4. Conclusion**

The presented in the article technique of transport service quality estimation in the Task model of the complex transport service allows one to trace and accordingly estimate influence of each subject on quality assurance of services with the help of maximum values of quality coefficients.

On the basis of the detailed structure of influence of participants of the complex transport service on improvement of the quality of service, coefficients of their responsibility for observance of the plan of transport services, calculated for each category of transportations, are defined.

By calculating the coefficients of the quality service, it is possible to assess the value of the contribution to the compliance with the requirements of transport and logistics services not only by the Executor, but also by the Customer of these services.

The presented Task Model of Integrated Transport Services excludes subjects of transport services with a minimum share of responsibility for compliance with the main quality criteria, and therefore
less effective in the development of the quality of transport services. In this model we formed an effective and rational mutualization of different types of transport in a single transport system, which as a result reduces the rate of growth of value added of finished products and increases the competitiveness of consumers of integrated transport services.

The responsibility coefficients should be used rationally when determining the size of obstacles to the subjects of transport services, as well as when calculating the cost of transport services and income rate.

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