ECONOMY

SCENARIOS OF INCREASING THE ECONOMIC EFFICIENCY OF THE KALININGRAD REGIONAL TRANSPORT SYSTEM

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The development of the considerable transport and logistics potential of the Kaliningrad region is hampered by several factors. This problem, to which we will refer to as a transport deadlock effect, translates into the limited contribution of transport to the regional economy. Particularly, it manifests itself at the level of regional gross value added, where the contribution of transport is much smaller than one might expect given the significant role the industry plays in the economy of the region. In this study, we examine major ways of increasing the economic efficiency of the regional transport system from the value added perspective. We posit that the structure of cargo handled and the redistribution of value added in favour of regional actors have the dominant influence on economic efficiency. Using our own simulation model and the earlier developed system of transport tariffs and value added calculation for the Kaliningrad region, we produce scenarios and consider changes in value added in the case of selected cargoes carrying intermediate, investment, and consumer goods (as defined in the International Classification for Broad Economic Categories ICT BEC-4). Our calculations show that higher value added and greater economic efficiency of a regional transport system are associated with re-orientation towards investment and consumer goods. The most visible effect is associated with rail and road transport. As to sea transport, the decisive role is played by an increase in the physical volume of cargo handled. The results of this study and its modelling tools can be applied in the

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analysis of the current situation and in the assessment of the efficiency of transport systems in other regions. Another possible application is the identification of growth conditions for an industry, particularly, when developing projects and proposals for increasing the efficiency of transport services.

Keywords: transport system, regional economy, Kaliningrad region, value added, simulation modelling

Introduction

The economic and geographical location of some Russian regions has led to transport becoming an essential element of their economies. The Kaliningrad region falls into this category. John Friedmann's theoretical typology [1] classifies these territories as 'development corridors'. These regions handle the major international trade flows of their mother countries and ensure effective cooperation with neighbouring counties and macroregional economic associations. The Russian territories traditionally classified as 'development corridors' are the Primorsky and Khabarovsk regions (access to China and Asia Pacific), the Rostov and Krasnodar regions (Turkey and the other Black Sea states), the Leningrad region (the Baltic region and the EU), and the Kaliningrad region (the Baltic region).

The focus of our study is the Kaliningrad region, the geography of which translates into a high potential in transport and logistics. On the one hand, one of the manifestations of this potential is the capacity to handle Russia's international trade operations. On the other hand, it is the maintenance of global transit flows.

The typology of regions, which we use in this study, is one of many known approaches. However, in considering the Kaliningrad region as a 'development corridor', we can identify and describe the effect of the geopolitical and exclave factor on the development of the regional transport industry. The existing typologies of regional transport industries [2—4] do not provide a full account of their features. They are usually based on evaluating the development of regional transport industries. Taking into account various factors, transport industry typologies focus on the infrastructural and functional rather than economic components.

In comparison to other 'development corridors', the Kaliningrad region has rather low economic efficiency. At the systemic level, this is manifested in the macroeconomic indicator of regional gross value added. Over the past fifteen years, the contribution of transport and communications to the GRP of the Kaliningrad region has been the national average, which is well below the performance of other 'development corridors'. However, in view of the region's potential involvement in interna-

tional transport corridors and integration projects and initiatives in logistics, transport infrastructure, and intermodal traffic, this contribution should be much more substantial. This relates to agreements in the framework of the Eurasian Economic Space, the Commonwealth of Independent States, the Shanghai Cooperation Organisation, the Asia—Pacific Economic Cooperation, the Belt and Road Initiative, and projects to support the development of transport corridors in Asia—Pacific.

Earlier studies [5; 6] suggest that the factors and circumstances leading to the low efficiency of transport in the Kaliningrad region have geopolitical, institutional, and infrastructural components and nature. The regional transport system can develop along several different strands. The first one is an increase in cargo and passenger traffic. Extensive in its essence, this variant has an immediate bearing on unlocking the transit potential of the Kaliningrad region. The second, intensive, variant suggests creating extra value added by switching to high-paying freight and greater involvement of regional businesses in the supply chain (shipping, storage, customs clearance, insurance provision, etc.), alongside a reduction in prime costs, particularly, cargo and passenger shipping times.

The transport system of the Kaliningrad region should develop along either strand. However, in this study, we will focus on the necessary conditions for attaining greater economic efficiency of transport by increasing value added. We evaluate the influence of change in the cargo structure and greater involvement of regional companies and organisations in the growth in value added. As source materials, we used our findings on value chains in the Kaliningrad regional transport network obtained from a 2014—2016 project for the creation of a datadase for regional studies at the IKBFU. In this article, we present the output of a simulation of value added for several types of cargoes carrying intermediate, investment, and consumer goods following an increase in the involvement of regional companies and organisations in value chains. To perform the calculations, we employed our own simulation model and an earlier developed system of transport tariffs and value-added calculations for the Kaliningrad region (SOTTKO). Using the calculation results, we make proposals for improving the Kaliningrad region transport industry by increasing its economic efficiency and its contribution to the development of the regional economy.

The transport industry of the region: its development and an increase in its economic efficiency

Academic evaluations of the development of transport industries and proposals on increasing its efficiency at a regional level can be divided

into two groups. The first one analyses the role of individual elements of a regional transport system: port facilities [7], railway transport [8], and aviation [9]. The second considers transport as a territorial system component and links the possibilities for its development to an increase in the efficiency of its selected functional elements [10—14]. Researchers often reduce their proposals to the need for developing or modernising regional transport infrastructures. Much less often they provide a rationale for the introduction of new forms of organising and managing transport processes (for instance, cluster forms [15]) or elements of intelligent or information communications-based transport industries [16].

Few studies have focused on the practical and theoretical problems of economic efficiency and value added creation in a regional transport industry. In most cases, these issues are examined within the concept of logistics, supply chain management (see, for instance, [17—19]), and in the context of the involvement of countries, clusters, sectors, and manufacturing businesses in global value chains [20—22]. At the same time, value chain formation in a regional transport industry should be studied in view of the following. Firstly, transport chains are becoming increasingly integrated into production systems: cargo carriers offer a whole range of services meeting costs, time, and reliability priorities. Thus, transport chains are playing a growing role in value chains. The geography of value chains is merging with the geography of transport industries [23]. Secondly, the highest profits along the value chain, which is represented by a smiling curve [24], are concentrated in its final segments (logistics, sales and after-sales services) [25]. This provides additional arguments in favour of an increase in value added by the regional transport industry through switching to high-paying freight and end products. Thirdly, an increase in value added by the regional transport industries suggests a search for optimal proportions in the process of its creation. This will make it possible to estimate what percentage of value added can be created at the level of regional transport companies and organisations in the course of cargo transport, and what percentage can be accounted for by national and international transport companies and organisations.

Studies into the economic efficiency and development problems of the Kaliningrad regional transport industry remain a priority for both public authorities dealing with regional matters and the academic community [26—28]. The reason for this is the persistent transport deadlock effect: the situation when a regional transport industry is affected by various internal and external factors. In our case, the dominant ones are the federal policy of supporting the other ports of North-West Russia, the exclave position of the region, small volume of potential cargoes, and limited involvement in transboundary transport industries. Taken individually, each of these factors has a negative yet not critical impact.

However, the cumulative effect of all these factors prevents the unlocking of the considerable transport potential of the region, which owes it to its geographical location. Thus, the region is becoming another 'transport deadlock' in the structure of modern national and global transport corridors.

At first glance, the Kaliningrad regional transport industry is improving its economic performance. In 2007—2018, the proportion of transport companies increased from 5.9 to 8.2% of all the regional companies. The contribution of the industry to the regional value added was 28.7% of the total capital investment in the regional economy. However, as it was mentioned above, the Kaliningrad regional transport industry is outstripped by its counterparts in other Russian development corridors in terms of their contribution to, and involvement in, the creation of value added (table 1). Although Kaliningrad has employment and capital investment rates comparable to other regions and the proportion of transport companies and organisations higher than in other regions, the industry accounted for a mere 10.6% of the gross regional product. A leading sector of the Kaliningrad regional economy, transport creates value added at a rate slightly above the national average. At the same time, in other development corridor regions (with the exception of the Rostov region), its contribution is much more substantial. Our analysis shows that the performance of the region in 2005—2016 followed a similar pattern. All other things being equal, this testifies to the low economic efficiency of the industry.

The economic efficiency of the regional transport complex requires the following [29]:

— the construction and modernisation of the regional transport infrastructure;

— procedural, legal, and institutional support for the transport industry, aimed to ensure equal opportunities in competition with other regional transport industries for Russian exports and imports;

— more effective integration of the region in transnational and interregional transport systems, primarily, those in the Baltic region;

— new methods for organising and managing the regional transport industry, expecially those using modern digital and intelligent systems.

Today the problem of increasing the economic efficiency of the Kaliningrad regional transport industry can be solved by targeting selected aspects of growth in value added. To this end, it is necessary to attain the following research objectives:

— to identify the conditions for increasing value added by changing the volume and makeup of cargoes by classes of goods in favour of high-paying freight and end products and by redistribution of value added by favour of regional companies and organisations;

— to develop mechanisms and to select measures and projects contributing to an increase in the cargo traffic and thus to ensure value-added growth in the industry. Moreover, the region can benefit from its transit function, whereas extra value added can be created by changing the structure and increasing the volume of transit cargoes. This aspect deserves particular attention;

— constructing extensive and intensive scenarios of the development of the regional transport industry from the perspective of an increase in economic efficiency, i. e. the creation of value added.

Table 1

Evaluation of the transport industry performance in development corridors

Region	Contribution of transport and communications to the economic performance of the region,%											
	Average annual employment			Gross value added			Capital investment			Number of companies and organisations		
	2005	2010	2016	2005	2010	2016	2005	2010	2016	2005	2010	2016
National total	7.1	7.9	7.3	10.6	10.5	9.5	25.9	26.7	18.6	3.9	5.5	5.6
Kaliningrad region	10.5	8.7	8.3	11.6	10.7	10.6	21.0	29.3	22.6	5.9	7.9	8.2
Leningrad region	6.9	7.1	8.3	17.0	12.8	14.3	41.2	56.3	27.0	5.4	6.1	5.4
Rostov region	7.4	7.5	7.4	10.2	10.1	8.3	25.6	20.0	30.5	3.8	5.6	5.6
Krasnodar region	8.7	8.2	7.8	19.3	15.5	17.9	35.5	47.7	45.2	4.4	5.8	5.4
Primorsky region	10.9	11.6	10.2	22.0	21.1	24.1	40.3	46.3	23.2	9.2	10.9	11.6
Khabarovsk region	10.3	9.7	9.0	19.1	16.7	20.2	41.0	64.5	45.5	6.5	8.7	8.3

Calculated by the authors based on: Rosstat. *Regiony Rossii. Sotsiaklno-ekonomicheskie pokazatekli, 2018: stat. sb.* [*Russian regions. Socio-economic performance, 2018: statistical digest*]. Moscow, 2018; Rosstat. *Investitsii v Rossii. 2017: stat. sb.* [*Investment in Russia, 2017: statistical digest*]. Moscow, 2017; Rosstat. *Regiony Rossii. Sotsiaklno-ekonomicheskie pokazatekli, 2011: stat. sb.* [*Russian regions. Socio-economic performance, 2011: statistical digest*]. Moscow, 2011; Rosstat. *Regiony Rossii. Sotsiaklno-ekonomicheskie pokazatekli, 2006: stat. sb.* [*Russian regions. Socio-economic performance, 2006: statistical digest*]. Moscow, 2006.

In this study, we will focus on the first and partly the second objective. Alongside the discussion of earlier proposals, we will provide a rationale for increasing the economic efficiency of the regional transport industry by redistributing the value added, which is created along the chain, in favour of regional companies and organisations, depending on the structure and types of cargoes, i.e. the class of goods. In analysing these scenarios, we examine possible measures and projects contributing to an increase in the regional cargo traffic and thus the creation of extra value added.

A regional transport industry simulation: methodology and data

We used simulation modelling as a major method for evaluating changes in value added that is created by Kaliningrad regional transport companies and organisations. We employed the simulation model for the Kaliningrad region transport industry, which we developed and tested as a part of the family of regional industry-specific models within a 2014—2016 project for the creation of a database for regional studies at the IKBFU. Simulation models were built of the agricultural industry, transport, manufacturing, and tourism and recreation [30]. Industry-specific simulation models help to estimate the influence of various regulatory and control impacts on changes in value added across industries and companies and in the regional economy as a whole. Using our simulation model, we measure changes in value added brought about by an increase in the proportion of cargoes carrying intermediate, investment, or consumer goods identified according to the International classification by broad economic categories (BEC rev. 4).[1]

This way, we solve the problem of calculated value added by transport services against the background of increased involvement of regional companies in the chain. Their operating costs relating to cargo transport are taken into account. The model makes it possible to estimate value added at different stages of its creation in the industry: legal services, insurance, storage (both emergency and contract-based), loading and packaging, transport rental and shipping. Simulation modelling of value added reveals the factors behind its growth. We rely on the traditional concept of value chain [31] and more recent studies into the phenomenon [33—38].

[1] United Nations. *Classification by Broad Economic Categories (Rev. 4).* New York, 2002. Available from: https://unstats.un.org/unsd/ publication/SeriesM/SeriesM_53rev4r.pdf (accessed 13.03.2019).

The factors affecting the cost of shipping operations are included in the model as dimensionless coefficients. Most of these factors relate to the quality of services rendered. In their turn, the costs incorporated in the model are based on actual independent dimensionless components and can be considered as fixed. This means that factors affecting the costs are external to the system studied. Our model helps to identify what proportion of value added by shipping remains in the region (i. e. is created by regional transport organisation) and what proportion leaves the region (i. e. is created by Russian and international transport organisations). Based on the practices characteristic of the Kaliningrad transport industry, we made the following assumptions: 1) a single transport company covers the whole range of shipping and auxiliary operations at all stages of freight transport; 2) within freight transport operations, one can identify values describing costs and value added created during freight transport; 3) factors affecting the cost of transport operations, which is expressed as dimensionless coefficients, are known.

Without specific features of different modes of transport taken into account, our model is as follows:[2]

$$V = (V_o^j \prod_{n=1}^{N_o^j} \varepsilon_n + V_a^j \prod_{n=1}^{N_a^j} \varepsilon_n) + (V_o^i \prod_{n=1}^{N_o^i} \varepsilon_n + V_a^i \prod_{n=1}^{N_a^i} \varepsilon_n) + (V_o^k \prod_{n=1}^{N_o^k} \varepsilon_n + V_a^k \prod_{n=1}^{N_a^k} \varepsilon_n) +$$

$$+ (V_o^{l+p} \prod_{n=1}^{N_o^{l+p}} \varepsilon_n + V_a^{l+p} \prod_{n=1}^{N_a^{l+p}} \varepsilon_n) + (V_o^{r+t} \prod_{n=1}^{N_o^{r+t}} \varepsilon_n + V_a^{r+t} \prod_{n=1}^{N_a^{r+t}} \varepsilon_n),$$

where V is the total cost across all shipping stages;

V_o is the costs a transport company bears in rendering the service;

V_a is value added at a certain transport stage;

Index values:

j is legal services;

i is insurance;

k is storage (both emergency and contract-based);

l + p is loading and packaging;

r + t is rental and transport;

[2] D.A. Malyi, an analyst of the IKBFU's Centre for Modelling Regional Socio-Eonomic Development, contributed to the development of a model of the Kaliningrad regional transport network within a project for creating an information and analytical system for regional studies support. The IKBFU was running the project tin 2014–2016.

n is the number of the factors affecting the cost element of the transport process;

N_a is the maximum number of the factors affecting value added at the selected stage;

N_o is the maximum number of the factors affecting the costs borne at the selected stage;

ε_n is the indicators of factors affecting value added at a certain stage of the transport process.

In constructing value-added scenarios for certain modes of transport, we calibrate the model to incorporate auxiliary operations.

The model takes into account the structure of freight transport. We evaluate opportunities for creating extra value added by 1) an increase in the contribution of local companies and organisations to cargo traffic through performing a larger number of operations along the chain; 2) an increase in the number of small companies and organisations providing full-cycle transport services; 3) performing more complicated operations along the chain to increase value added by local companies and organisations.

When solving the problem of increasing the proportion of value added by the Kaliningrad regional transport sectors, we take into account two possible ways to create extra value added:

a) an increase in the number of transport services provided by regional companies and organisations (cargo transport services proper, storage, customs clearance, insurance, etc.). This translates into higher transport costs and, thus, the proportion of value added by the region;

b) a reduction in the costs borne by regional transport companies and organisations, whereas the transport costs borne by the consignor remain the same. In this case, extra value added is created by optimising various types of costs.

The analysis of data from Kaliningrad demonstrated that there are opportunities to increase value added along both strands. However, in view of the current state of affairs in the regional transport industry, the first variant has a greater potential for attaining the desired result.

We used customs and regional statistics and the results of in-depth interviewing and surveying representatives of transport and logistics companies as source materials. Qualitative methods were used to construct and evaluate value chains. We identified possible variants of creating extra value added by the transport and logistics industry of the Kaliningrad region (fig. 1).

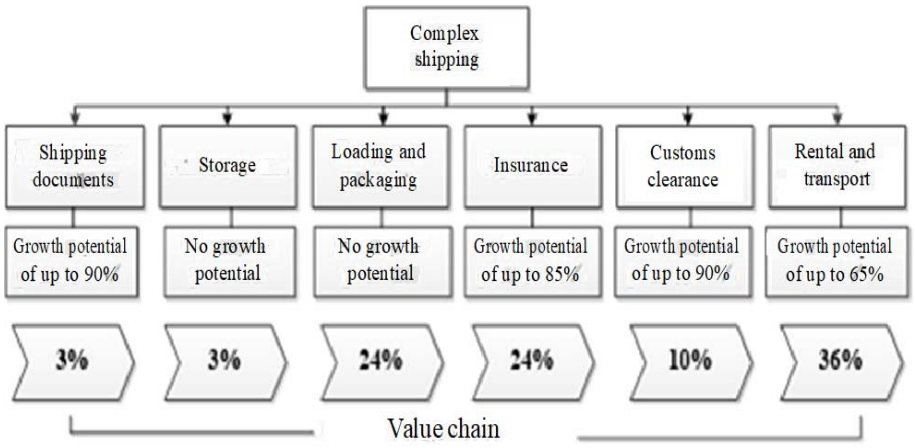


Fig 1. Value chain scenarios

Prepared by the authors based on interviews with representatives of transport companies.

In modelling value added and performing scenario calculations, we used the system of transport tariffs and value-added calculations for the Kaliningrad region (SOTTKO), which was developed by A. A. Novikova, one of the authors of this research. Based on the simulation model described above, the system was created to suit the conditions of the Kaliningrad region.

The system makes it possible to calculate both the transport cost and the complex shipping cost. The transport cost is the cost of moving cargoes with the shipping distance, the cargo weight, the mode of transport, the class of hazard, and the type of cargo taken into account. The complex shipping cost includes the transport cost and the cost of additional services provided during shipping. Additional services are cargo storage in the warehouse of the carrier, crating, palletising, picking up the cargo, delivering the cargo to the final destination, legal services, and the preparation of shipping and customs documents.

The system for calculating the transport cost and the complex shipping cost by types of cargo and by modes of transport in view of changes in regulatory impacts makes it possible:

— to select the optimum shipping variant based on the transport cost or the complex shipping cost;

— to evaluate the influences of additional transport services on the transport cost or the complex shipping cost;

— to select the mode of transport in view of the cargo transport parameters: the transport cost and the complex shipping cost;

— to evaluate the influence of external factors on the transport cost for each mode of transport (these factors include exchange rates and transit tariffs).

The system helps to analyse the conditions of switching between different modes of transport and examine the created value added for selected types of cargoes.

We used the simulation model and SOTTKO to construct scenarios relying on different configurations of factors and to simulate changes in value added for cargoes carrying intermediate, investment, and consumer goods.

Scenarios of the transport industry development

We consider three major scenarios of an increase in value added by the transport industry of the Kaliningrad region. The number of scenarios can be greater if the aims and objectives of a study require it. However, in this study, the number of scenarios is limited to variants that differ in the essence of central processes affecting the development of the Kaliningrad regional transport industry.

The extensive scenario. It suggests heavier cargo traffic. This may be attained in the future by an increase in the volume of transit cargoes. We assume that the basic conditions of the creation of value added (the contribution of regional companies and organisations to the chain and the number of operations within complex shipping) would remain the same. Transit increases by 150—200 % above the current level. According to our estimates obtained using customs statistics and the software package for situation forecasting and strategy development for the socioeconomic development of the Kaliningrad region',[3] the cost of transit cargoes reached USD 3.831 billion in 2018 (2.691 in 2017; 1.708 in 2016; 5.256 in 2015; 9.746 in 2014), or 23 % of the total cargo handled in the region (exports, imports, and interregional operations taken into account). The extensive scenario can be considered as the baseline scenario of the creation of value added by cargo shipping in the region.

[3] Software registration certificate No. 2016617454 of July 6, 2016 'Software package for situation forecasting and strategy development for the socioeconomic development of the Kaliningrad region'. Authors: K.Yu. Voloshenko, V.A. Tsybatov, L.P. Pavlov. Copyright holder: IKBFU.

The target scenario. It suggests an increase in value added by the industry through greater involvement of regional transport companies and organisations in the chains. In this case, most value added remains in the region and only a small part, which is created by national and international companies, leaves its territory. The scenario takes into account the current situation, the potential of the regional transport industry, limitations to capacities expansion, the effect of geopolitical factors, and the involvement of the Kaliningrad region in the integration initiatives for the development of international transport corridors.

The intensive scenario. Complex shipping translates into the maximum increase in value added (see fig. 1, p. c.59) at the link level. Although this scenario is unlikely, it demonstrates possibilities for creating extra value added.

In our study, complex shipping costs are modelled, whereas transport costs are calculated. This is explained by the lack of reliable data on the structure of transport costs, which can be obtained only by surveying major carriers working with each mode of transport. In constructing scenarios of value added by complex shipping, we rely on its difference from the baseline computed using the results of interviewing regional transport companies and studying value chains [30]. According to our calculations, it reaches 43—45 % across the region for all modes of transport. The resultant values were verified using regional statistics on the transport and communication industry. We obtained acceptable convergence between expert evaluation and calculations. The error did not exceed 5 %. At the same time, regional companies and organisations account for a mere 40 % of the total value added by cargo transport. The rest is created by national and international companies. Our scenarios take into account the following initial ratios between 'regional' and 'external' value added: 40 and 60 % in the extensive scenario, 60 and 40 % in the target scenario, and 65 and 35 % in the intensive scenario.

We performed calculations for three categories of cargoes: 1) construction materials; 2) machines and equipment; 3) furniture and its components. According to the international classification by broad economic categories (BEC rev. 4), these are intermediate, investment, and customer goods. Cargo categories correlating to classes of goods make it possible to evaluate possibilities for an increase in value added and to analyse their features. To simplify our calculations, we assumed that each cargo is carried a distance of 1,600 km and its weight is 17,000 kg. It is kept in the warehouse of the carrier for one day due to emergency and for three days within a contract. Table 2 shows the calculation results.

Table 2

Calculations of cargo shipping costs, thousand roubles

Indicator	Type and values		
Type of goods	Intermediate	Investment	Customer
Cargo	Construction materials	Machines and equipment	Furniture and components
Transport costs by:			
Road	64.3	67.1	69.8
Rail	72.4	157.0	125.1
Sea[4]	74.4	75.1	73.6

As to investment and customer goods, the lowest costs are associated with shipping by road and the highest — with railway transport.

The cost of shipping by rail is almost twice as high as that by road and sea. Overall, it exceeds the cost of shipping intermediate goods. This is explained by the fact that railways charge different classes of cargoes differently.

Table 3 shows scenario calculations of value added for complex shipping. Figure 2 shows the structure of value added by providing additional services.

Table 3

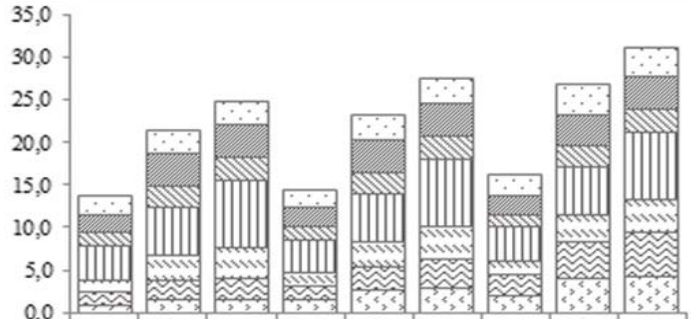
Value added by cargo transport under the three scenarios, thousand roubles

Mode of transport	Scenario								
	Extensive			Target			Intensive		
	m	k	c	m	k	c	m	k	c
Road									
Cargo shipping	34.2	39.4	40.2	35.5	42.8	43.7	36.8	44.8	45.8
Additional services	13.6	21.5	24.8	14.5	23.3	27.5	16.2	26.9	31.2
Rail									
Cargo shipping	17.2	47.1	35.4	17.7	54.2	38.2	18.6	57.4	39.7
Additional services	10.2	16.4	13.7	10.6	17.3	14.3	11.3	19.4	15.4
Sea									
Cargo shipping	32.6	35.2	34.6	34.5	39.0	37.5	35.9	41.2	39.2
Additional services	20.8	27.7	17.5	21.9	29.1	18.2	24.7	33.4	20.4

Comment: m is construction materials (intermediate goods), k is machines and equipment (investment goods), and c is furniture and components (customer goods).

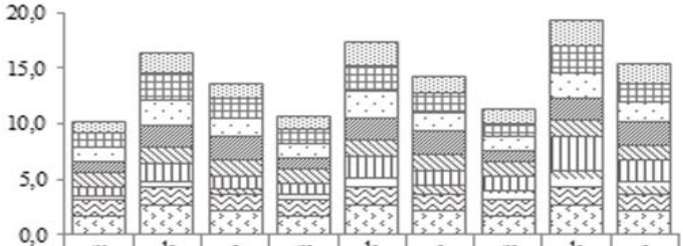
[4] As to maritime transport, we used hypothetical rates for the Baltiysk–Ust-Luga route.

For maritime transport, loading and unloading require intra-port movements and cargo aggregation following the ‘vehicle — warehouse — vehicle’ pattern.



	Extensive scenario			Target scenario			Intensive scenario		
	m	k	c	m	k	c	m	k	c
Other	2,1	2,9	2,8	2,2	3,0	3,0	2,5	3,6	3,5
Delivery to destination	2,2	3,8	3,8	2,2	3,8	3,8	2,2	3,8	3,8
Picking up	1,5	2,5	2,7	1,5	2,5	2,7	1,5	2,5	2,7
Crating	4,0	5,6	8,0	4,0	5,6	8,0	4,0	5,6	8,0
Palletising	1,5	3,1	3,7	1,5	3,1	3,7	1,5	3,1	3,7
Customs clearance	1,4	2,1	2,3	1,7	2,7	3,4	2,5	4,4	5,2
Insurance	1,0	1,6	1,6	1,5	2,6	3,0	2,1	4,0	4,3

a



	Extensive scenario			Target scenario			Intensive scenario		
	m	k	c	m	k	c	m	k	c
Other	1,1	1,8	1,4	1,2	2,1	1,6	1,2	2,4	1,7
Delivery to the final destination	1,3	2,3	1,7	1,3	2,3	1,7	1,3	2,3	1,7
Picking up	1,3	2,3	1,7	1,3	2,3	1,7	1,3	2,3	1,7
Robust packaging	1,0	2,0	2,1	1,0	2,0	2,1	1,0	2,0	2,1
Loading and unloading	1,3	1,5	1,4	1,3	1,5	1,4	1,3	1,5	1,4
Customs clearance fee	0,8	1,5	1,1	1,0	1,9	1,4	1,3	3,1	2,0
Insurance	0,4	0,5	0,4	0,6	0,9	0,7	0,8	1,4	1,0
Reconsignment fee	1,5	1,6	1,5	1,5	1,6	1,5	1,5	1,6	1,5
Cargo escorting	1,7	2,7	2,2	1,7	2,7	2,2	1,7	2,7	2,2

b

	m	k	c	m	k	c	m	k	c
	Extensive scenario			Target scenario			Intensive scenario		
Other	3,3	3,6	2,4	3,3	3,6	2,4	3,3	3,6	2,4
Delivery to the final destination	3,2	3,5	1,6	3,2	3,5	1,6	3,2	3,5	1,6
Picking up	2,3	2,5	1,1	2,3	2,5	1,1	2,3	2,5	1,1
Survey services	2,3	2,8	2,8	2,5	3,0	2,8	3,2	4,1	3,5
Crating	4,1	8,2	4,9	4,1	8,2	4,9	4,1	8,2	4,9
Customs clearance fee	1,7	2,4	1,4	2,2	3,1	1,7	3,5	5,4	2,7
Insurance	0,8	0,8	0,7	1,2	1,4	1,0	1,9	2,2	1,5
Loading and unloading	3,3	4,0	2,7	3,3	4,0	2,7	3,3	4,0	2,7

c

Fig. 2. The structure of value added according to additional services provided, thousand roubles

a — transport by road; *b* — transport by rail; *c* — transport by sea

In figure 2, the ‘other’ costs include: a) legal support, machine loading, emergency and contractual storage in the warehouse of the carrier (transport by road); b) contractual and emergency storage in the warehouse of the carrier, weighing fees (transport by rail); c) emergency and contractual storage in the warehouse of the carrier (transport by sea).

The transport cost accounts for most of the complex shipping cost. Thus, changes in the value added by the transport cost have the most considerable effect on the calculation results. Greater involvement of regional companies and organisations in value chains and the most significant increase in the latter are associated with investment and customer goods transported by road and rail. Investment goods transported by rail ac-

count for the most dramatic change. Value added increases by 15 % and 20 % under the target and intensive scenarios respectively, as compared to the extensive variant. Slower growth is observed when this type of goods is carried by sea (10 % and 17 %). A significant effect on value added by railway transport is attributed to differences in railway rates for different classes of cargoes. Construction materials are class 1 cargoes, whereas machines and furniture are class 3 cargoes. The rates for the latter are higher, which explains the significant increase in the cost of shipping investment goods. The higher rates for class 3 cargoes are accounted for by the need to reduce the contribution of the transport component to the final cost of the 'cheapest' cargoes (class 1). An increase in the transport cost does not have a significant effect on the final cost of 'expensive' cargoes [39; 40]. This way, the carrier is compensated for missed earnings.

Our scenario calculations show that the mode of transport has little effect on consumer goods: value added increases almost uniformly. Ate the same time, the rate of changes in the indicator is lower than it is in the case of investment goods, reaching 8 % under the target and 12—14 % under the intensive scenario. As to intermediate goods, value added by shipping also increases rather uniformly for all the modes of transport. However, it is significantly below the performance of the other categories of goods. As compared to the extensive scenario, it grows by 4—6 % under the target scenario, and by 8—10 % under the intensive one.

Our scenario calculation of value added by additional services shows the following:

— under all the scenarios, the most significant increase in value added is associated with road transport. Higher growth rates are observed in the case of investment and customer goods (within 20—25 % under the target and intensive scenario);

— as to maritime transport, the most dramatic increase in value added by additional services is accounted for by intermediate and investment goods (within 18—20 %);

— as to railway transport, investment goods ensure growth by 18 % and intermediate and customer goods by 10—12 %.

The maximum increase in value added by complex shipping is associated with investment goods. The indicator increases by over 120 % when carried by rail, about 119 % when carried by sea, and by 118 % when carried by road (customer goods demonstrate a similar performance in this case) (fig. 4).

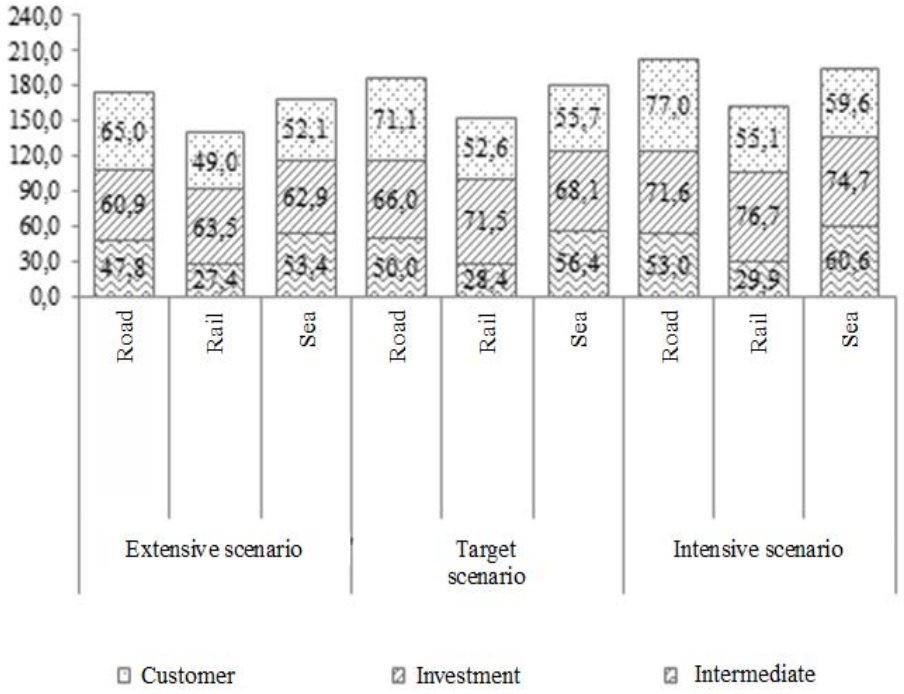


Fig. 4. Value added by complex shipping under the three scenarios, thousand roubles

Our calculations prove that, in a mid-term perspective, the regional transport industry should seek a change in the structure of cargoes to ensure an increase in the proportion of investment and customer goods. This will have the most considerable influence on the efficiency of railway and road transport, whereas an increase in the physical volume of cargoes handled is of major significance to maritime transport.

Conclusion

In our article, we presented the results of modelling the scenario of enhancing the economic efficiency of the Kaliningrad regional transport industry, measured using value added. We evaluated how changes in the structure of cargo traffic and redistribution of value added along the chain in favour of regional companies and organisations affect an increase in value added in the transport industry. The simulation modelling was performed using our simulation model and the SOTTKO software package. To take into account how value added is created in the production of intermediate, investment, and customer goods, we selected three corre-

sponding cargo categories: construction materials, machines and equipment, and furniture and components. Our calculations showed that, in a mid-term perspective, the most considerable potential for increasing the economic efficiency of the Kaliningrad regional transport complex is associated with the transport of investment and customer goods. Change in the structure of cargo traffic by classes of goods has the greatest effect on railway and road transport, whereas, for maritime transport, a major factor is an increase in the volume of cargoes. Thus, change in the structure of cargoes does not translate in greater economic efficiency as long as maritime transport is considered. Of more importance are the testing of measures and the creation of conditions for ensuring greater volumes of cargoes handled. For all the modes of transport, the most promising avenue is to incorporate the interest of the Kaliningrad region into international integration initiatives and to redirect national export and import flows to the region.

A major limitation of this study results from the need to verify and re-evaluate the efficiency of the transport industry if the necessary measures are approved and new investment projects and initiatives are launched.

A promising line for future research is to study the effect of transit on the development of the regional economy and thus the creation of extra value added. The problems of value added creation within the transport rather than the complex shipping cost merits special attention. This research objective requires surveys of key players in the regional transport services market.

Our findings and approach to simulating and evaluating conditions for attaining greater efficiency of the transport industry can be extrapolated to other regions, particularly, those classified as development corridors. This can be done, firstly, to evaluate the current efficiency and the potential for an increase in value added and, secondly, to develop projects, measures, and proposals aimed at the intensification of transport services by expanding the contribution of regional companies and ensuring growth in the volumes of cargoes handled.

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