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Assessment of the Impact of the Transport and Logistics System on Resource Efficiency, Key Regional Economic Indicators and Economic Sustainability

Valery A. KHAITBAEV

Evgeny V. CHERNIAEV

Valery A. Khaitbaev [1], Evgeny V. Cherniaev [2]

[1] Samara State Transport University, Samara, Russia.
[2] Volsk Military Institute of Material Support, Volsk, Russia.
[1] ORCID 0000-0001-8244-8842; Scopus Author ID: 57207192153; Russian Science Citation Index SPIN-code: 6990-4788; Russian Science Citation Index Author ID: 50419860.
[2] ORCID 0009-0003-9646-5995; Russian Science Citation Index SPIN-code: 3339-3490; Russian Science Citation Index Author ID: 1197150.
✉ [1] *vhaitbaev21@mail.ru.*
✉ [2] *ki-la@mail.ru.*

ABSTRACT

The objective of the study is to determine the degree of dependence between the regional transport and logistics system and the main regional economic indicators and their impact on resource-saving and the level of economic sustainability.

The research methods are based on the use of a comparative analysis of approaches used to determine the characteristics of transport and logistics systems, retrospective, correlation and regression, morphological, abstract logical, theoretical and empirical, and structural analysis.

The study has resulted in the analysis of approaches to defining and assessing transport and logistics system from the position of the spatial location of transport and logistics infrastructure facilities in the context of their impact on spatial organisation of productive forces; a retrospective, comparative and correlation and regression analysis of indicators characterising the regional transport and logistics system, economic indicators of GRP and retail turnover; evaluation of the analytical dependence of the region's economic indicators on the state of the regional transport and logistics system; rationale of the dependence of the level of economic sustainability and resource-saving on the development of the transport and logistics infrastructure.

The results of the study may be used to determine the level of influence of the transport and logistics system on regional economic indicators of various industries, which are indicators of their economic sustainability within the framework of the adopted regional strategy for planning the spatial distribution of transport and logistics infrastructure facilities.

Keywords: transport and logistics system, infrastructure, region, economic indicators, economic sustainability, resource-saving, dependence.

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BACKGROUND

The task for Russia to enter an innovative path of socio-economic development cannot be considered beyond the context of regional economic policy. Long-term forecasts and strategies for socio-economic development of the Russian Federation, i.e., the Federal Law of 28.06.2014 N 172-FZ (as amended on 17.02.2023) «On Strategic Planning in the Russian Federation»[1], which was developed for the next six years, can obviously be implemented exclusively by means of breakthrough scientific and technological development of regional economies of the constituent entities of the Russian Federation. As part of drawing-up development strategies for the Russian Federation, coordination of activities includes matching the strategies for socio-economic development of the constituent entities of the Russian Federation and preparing a consolidated conclusion on them. In this context, are no less important the national projects «Balanced Regional Development» (implementation deadlines for the regions included in the project are until 2030) and «Safe and High-Quality Highways» (implementation deadlines for the regions included in the project are until 2026–2030).

The development of regional transport and logistics systems (TLS) is one of key factors in increasing the efficiency of regional economies. In view of the peculiarities of territorial distribution of productive forces, in which the economic distance between business entities significantly increases the cost of final goods and services, creation of a developed transport and logistics infrastructure is quite rationale, it can be considered one of the priorities of regional development.

Therefore, the spatial distribution of enterprises requires rationale choice of their location with the account of the capabilities of TLS. In this regard, the Strategy for Spatial Development of the Russian Federation for the period up to 2025, approved by the Order of the Government of the Russian Federation dated February 13, 2019 No. 207-r[2], shapes a system of criteria for placement of productive forces that ensure territorial development and economic growth and is a strategic planning document within the framework of goal-setting following a territorial principle. Since the period of implementation of the strategy is ending, it is highly probable to suppose that the similar strategy will be adopted that will be in the mainstream of the previous one, including the need to achieve previously set goals.

Those documents highlight resource-saving among most important principles of state development. Resource-saving for the economy of the Russian Federation and its constituent entities, along with other tasks, determines the basis for territorial development. In this regard, the impact of the cost of transport and logistics services sets the task of improving the transport and logistics infrastructure, and often of developing a new one.

The goal of the Russian Federation joining the leading economies of the world requires, among other things, development of optimal resource-saving mechanisms, and since the share of logistics costs in Russia is about 25–30 % of the gross domestic product [1], which is one of the highest values of this indicator among developed countries, the need is obvious to develop and modernise the logistics sector.

Moreover, introduction of resource-saving mechanisms affects the increase in economic sustainability of both the entire state and individual regions. Due to the high cost of transport and logistics services, their impact on the spatial connectivity of territories is undisputable, and the dependence between the resource-saving mechanism of the transport and logistics system and the level of economic sustainability is obvious.

LITERATURE AND RESEARCH REVIEW

The problem of developing a TLS resource-saving model in the context of the economy of not only an enterprise, but also of a region and a country is a cornerstone and requires scientific analysis, assessment and methodological techniques for its rationale and effective solution. Modern scientific literature comprises sufficiently many works that reveal this problem and offer a set of scientific tools and mechanisms for solving it. It is possible to outline several works that have undoubted advantages in terms of the level of analysis and detailing of resource-saving tasks, their evolution, and contain scientific and practical recommendations for solving them. It may refer, e.g., to the monograph by L. L. Kamenik «Resource-saving policy and the

[1] Federal Law dated 28.06.2014, N 172-FZ (as amended on 17.02.2023), «On Strategic Planning in the Russian Federation». [Electronic resource]: https: www.consultant.ru/document/ons_doc_LAW_164841. Last accessed 19.04.2024.

[2] Strategy for Spatial Development of the Russian Federation for the period up to 2025, approved by the Order of the Government of the Russian Federation dated February 13, 2019, No. 207-r.[Electronic resource]: https: www.consultant.ru/document/cons_doc_LAW_318094/. Last accessed 19.04.2024.

resource of its implementation in the format of evolutionary development» [2]. The author proposes three models of resource-saving. The first two, which the author calls technocratic, provide for a decrease in the resource intensity of technologies and obtaining a resource-saving effect at the enterprise level. The third model provides for obtaining a resource-saving effect within the space of a region and a country, that is, it scales the system of production relations in the space between enterprises in the production and logistics chain. The author substantiates the cause-and-effect relationship between resource provision and resource-saving. However, the main attention in the work is paid to resource-saving models regarding the natural resource potential of Russia.

At the same time, the author pays less attention to the organisational mechanisms of resource-saving, which is a key factor in management and functioning of a resource-saving transport and logistics model. The works [3–5] are more focused on the problems of resource-saving in production, construction, waste management, energy conservation, etc. However, organisational and managerial technologies of resource-saving, the tasks of saving resources during delivery of goods using TLS are not considered in detail.

In the context of resource-saving within TLS, several areas can be identified. Firstly, this is improvement of the organisational and managerial mechanism; secondly, the rational choice of the location of enterprises considering minimisation of costs for transportation, consolidation and distribution of cargo flows; thirdly, development of a network of transport and logistics centres (TLC); fourthly, development of the road network of transport modes and, finally, widespread introduction of information technologies.

TLS consisting of TLCs and a network of transportation routes deserve a more detailed analysis. Since placement of production sites requires considering the basic conditions and prerequisites that imply an acceptable level of enterprise efficiency, spatial management through TLS modelling is designed to ensure the integration of enterprises into the chains of «supply – production – sales – distribution – consumption» and a reduction in increasing logistics costs.

The topic of developing and implementing transport and logistics models is quite trivial and is presented in detail in the scientific literature. Thus, the works [1; 6–9], substantiate the need to develop transport and logistics clusters (TLCL) following various models, including structural and logical ones. The indicated works present methods for assessing the economic potential of territories to determine the feasibility of developing TLCL, and also clarify the definitions and concepts regarding TLCL.

The analysis of publications devoted to TLCL shows the scientific and practical value of this method of organising economic activity for implementation of socio-economic development objectives. On the webpage of the electronic resource of the project «Map of Clusters of Russia», developed by specialists of the Russian Cluster Observatory of the ISSEK HSE [Institute for Statistics Studies and Knowledge Economics of Higher School of Economics][3], it is reported that 120 clusters have been created in the Russian Federation in 28 industries, and the influence of the distribution of clusters by Federal Districts on the GDP (GRP) values is shown. The work [10] analyses the structure of TLCL, highlighting the main components: transport, terminal and warehouse complexes, transit potential and logistics operators. To determine the impact of TLCL on the economy, including the regional economy, two works [10; 11] were also studied, summarised and analysed, in which the concepts and definitions of TLCL and their structural elements are clarified.

At the same time, the analysis shows that the problems of creating TLCL in the Russian Federation arise, among other things, due to the lack of a generally accepted understanding of components of a cluster, its participants and functional relationships by the scientific community, business and government bodies [1].

The analysis of scientific publications that reveal the content of the industry approach shows its insufficient effectiveness, while the task of achieving the goals of an industry requires going beyond its boundaries and attracting the technological, technical and resource potential of other industries. Thus, the work [11] points to a predominantly industry approach to managing economic activity, which limits the development of enterprises with the boundaries of the industry. The work provides

[3] Map of Clusters of Russia. HSE. [Electronic resource]: https://map.cluster.hse.ru/.

a comparative analysis of the industry and cluster approaches, where the advantage of the cluster approach is highlighted.

However, the works that determine the influence of the cluster and industry approaches on economic indicators, sustainability of regional economies and resource conservation have not received due development.

Nevertheless, this relationship is obvious, and the impact on the level of economic sustainability is determined through a system of resulting groups of indicators. It is recommended to include the following indicators in these groups: indicators of production sustainability of regional enterprises; indicators of resource and technical sustainability; indicators of investment sustainability; indicators of financial sustainability; indicators of organisational and managerial sustainability.

The definition of «economic sustainability of an economic entity» is analysed in a few scientific publications, for example, in [12; 13], and does not have an established definition. The difficulty in shaping this definition is that it consists of two words – «sustainability» and «development», which are, according to some authors, mutually exclusive: «sustainable development simply cannot exist, since with development (dynamics) there will be no stability (constancy)» [14].

In international scientific literature, the term «Sustainable development» became widely known after the report «Our Common Future» in 1987, completed under the leadership of Gro Harlem Brundtland[4], and was translated into Russian. The term «sustainable development» originally introduced by G. H. Brundtland concerned the global development of the entire world community and meant harmonious, balanced development of economic, social and environmental spheres of human existence. Later, this term became so popular that it began to be applied not only to the macro level, but also to the micro level, being scaled to the phrase «economic sustainability of the enterprise», which expanded the scope of its application and led to even greater complexity of its use [10].

The analysis of scientific publications on economic sustainability of business entities, conducted according using the database of the Scientific Electronic Library eLibrary.Ru showed that there are about 470 of them (as of March 2024), and most of the works on this problem relate to industrial enterprises and other areas of economic activity. For example, in this context the works [16–22] do not analyse the activity of transport enterprises, TLC and transport and logistics systems.

Besides, while highly appreciating contribution of domestic scientists to the study of spatial distribution of productive forces, we note that this scientific research does not sufficiently consider the experience of other economically developed countries, for example, development of a network of freight villages in the European Union.

At the same time, it is worth noting the Russian experience of creating freight villages and TLC, such as «Freight Village Vorsino», TLC Bely Rast and others. Attention may be drawn to the practices of building «dry» ports by JSC Russian Railways, which, among other things, are regional hubs for certain vectors of external exports routes.

Thus, the priorities of regional economic development dictate the directions of substantive modernisation of transport and logistics infrastructure, which focus on the need not just to adapt to the needs of cargo owners and carriers, but to forecast their changes associated with global and country's economic conditions, obviously influencing the requirements for transport and logistics services.

Regional spatial features form the prerequisites for functioning and development of the transport and logistics system as a spatial one, integrated into the regional production and technological system, since only in this form can it act as a «growth pole».

The list of the authors who developed classical theories of spatial distribution of productive forces includes I. G. von Thunen, A. Weber, A. Lösch, E. Hoover and others [23–25]. The works of N. N. Kolosovsky, N. N. Baransky, M. K. Bandman, J. Ottaviano, P. Martin, J. R. Thisse and others are devoted to

[4] Gro Harlem Brundtland. Statement at the 42nd session of the General Assembly of the United Nations. October 19, 1987. Presentation of the unanimous report of the World Commission on Environment and Development – «Our Common Future». P. 4. [Electronic resource]: https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/20579/WCED_v42_doc1–36.pdf. Last accessed 19.04.2024.

approaches to the systemic spatial organisation of the economy[5] [26–29]. The methodology of the territorial organisation of productive forces in the study of growth poles in economic space was developed in the works of P. Krugman, M. Porter, B. Asheim, A. Isachsen, J. Humphrey, H. Schmitz and others [30–36], as well as in publications of Russian researchers, e. g. in [37–38].

The integral criterion in the works of the listed authors refers to the level of development of TLS as a necessary condition for development of territories.

Consequently, the spatial integration of business entities based on effective transport and logistics models orients the economic system toward a significant increase in its contribution to socio-economic development of Russian regions. Therefore, the spatial development of territories, due to many unresolved problems, remains the subject of scientific analysis and practical solutions presented in strategic, forecast, and program documents of the Russian Federation and its constituent entities.

MATERIALS AND METHODS

The analysis of approaches to the definition, structure, form of ownership, functional purpose and place of TLS in the economy of the constituent entities of the Russian Federation is quite diverse.

In this list, the most well-known and discussed are the cluster approach to the definition and functional purpose of TLS, industry and spatial approaches, which have their own specifics.

Features of the cluster approach distinguish transport and logistics systems into a single organisational and economic unit that consolidates resources and is linked by a common ultimate goal: providing customers, enterprises and organisations with an effective transport and logistics service. The possibility of providing a low-cost and high-quality service depends on the level of cooperation and interconnectedness of organisations of the transport and logistics cluster located in a certain territory. That is, it is a specific resource that ensures connectivity and availability of economic participants in the production and logistics chain. From the standpoint of the cluster approach, the transport and logistics system is one of the elements of an economic system of a higher order, for example, the economy of a constituent entity of the Russian Federation. The analysis of the cluster approach allows us to identify, for example, an industrial cluster (by industry type), i. e., an aviation cluster, a petrochemical cluster, an automotive cluster, an agricultural cluster, etc.

From the point of view of the industry approach, TLS is a specific economic activity concentrated in the industry of providing services for transportation and distribution of goods, where the grouping of enterprises occurs according to industry characteristics. In an industry, in contrast to a cluster, the boundaries of which may extend beyond the industry, there is a unification of enterprises according to a technological or product characteristic. A cluster, on the other hand, provides for going beyond the industry and for unification of enterprises from different industries, which is typical, among other things, for a transport and logistics cluster.

The use of a spatial approach to development of transport and logistics systems in the analysis of economic processes determines the impact on the economy of an enterprise or of a region of transport tariffs, time and speed of cargo delivery, availability of transport, the possibility of transporting large volumes of cargo and other basic parameters that affect the spatial dislocation of infrastructure facilities.

Thus, the analysis of the listed approaches to assessing TLS in the economy of regions showed both their similarities and differences (see Table 1). The analysis of the contents of Table 1 shows obvious advantages of the cluster approach, but the spatial approach has no administrative restrictions. Therefore, it is possible to go beyond not only the industry, but also the cluster and involve a larger number of clusters and industries in the common economic space, provided that the price for the transport and logistics service is competitive and satisfies both suppliers and customers.

In this regard, special attention should be paid, for example, to the experience of the EU governing bodies and its member countries in forming the TLS and their impact on the economy of the entire EU, including regions and countries. European countries have gone through more than forty years of creating TLS and have

[5] Baransky, N. N. Short Course in Economic Geography. Part 2. Economic Geography of the USSR. General Overview of the Entire USSR. Overview by Economic Regions. Moscow, Leningrad, 1928, 455 p. [Electronic resource]: https://elib.rgo.ru/safe-view/123456789/229245/1/MzM2MjRfQmFyYW5za2lpLCBOLiBOLiBLcmF0a2lpIGt1cnMgZWtvbm9taWNoZXNrb2kgZ2VvZ3IucGRm. Last accessed 19.04.2024.

Table 1

Comparative analysis of approaches to assessing TLS [developed by the authors]

Indicator	Cluster approach	Industry approach	Spatial approach
Production, technological and organisational boundaries	A group of enterprises from various industries that complement each other	A set of enterprises united by logistic features within the boundaries of one industry	There are no clear boundaries, signs of territorial allocation: location; economic distance; elements of cluster and industry approaches
Regulation of economic activity	Based on private-public partnership	Executive authorities, government	Focus on indicative parameters for decision-making on placement of facilities (Strategy for spatial development of the Russian Federation)
Competitiveness indicator	High	The indicator decreases with direct regulation of economic activity	Highest competitiveness indicator, no direct regulation
Degree of interaction with the external environment	Combination of competition and cooperation	No interaction is provided, processes are limited to intra-industry technology	Maximum level of interaction
Barriers/growth points	High bureaucracy, lobbying, corruption risks / high potential for resource concentration	Divergence of interests with other industries and clusters / rapid response to changes in the external environment	The need to complete the development of part of the infrastructure of the transport and logistics system / scale of activity, low level of legislative restrictions
Economic growth	Strengthening based on synergies and scale economy	Limited by industry boundaries	Depends on the efficiency of location of TLS facilities

ensured that these systems reduce logistics costs and cover maximum delivery territories. The created European system has a strengthening role in the EU economy.

According to Europlatforms EEIG[6], whose members are the largest associations and individual TLC and freight villages of Europe, in 2015 there were 240 TLC in 28 EU countries with a total area of 25 891 hectares (the average area of one TLC was 108 hectares)[7].

The experience of the European Union shows a gradual transformation in the creation of a TLC network from an industry-based to a cluster-based approach and, finally, to a spatial approach, which is confirmed by the coverage of almost the entire EU and access to transport and logistics services for the maximum number of customers.

Thus, the analysis of approaches to determining the role and place of TLS in the economic space shows that most scientific papers, although they reveal the influence of TLS as a cluster or industry on the economy of regions, do not focus on how these links affect, for example, economic sustainability.

Consequently, further research will be rationale with the *objective* to determine the degree of dependence of the main regional economic indicators on the regional transport and logistics system and its impact on the level of economic sustainability and resource-saving practices.

RESULTS

The conducted analysis of the of the immanent regional economic indicators proposed for assessment and determination of the degree of their dependence on the existing regional TLS allows us to assume the presence of a significant correlation between them.

Samara region was chosen for the study. The analysis and assessment were carried out based on the following sectoral indicators of the regional economy: gross regional product with indices of its physical volume; statistical indicators of industries (construction, transport and storage, wholesale and retail trade); investments in fixed capital and their cost by type of activity (construction, transport and storage, wholesale and retail trade); commissioning and degree of depreciation of fixed assets for construction, transport and storage, wholesale and retail trade; financial results of activities; transportation of goods and cargo turnover of motor transport. The study covered the period of 2017–2022.

At the same time, an important reservation is necessary. The task in the context of the study

[6] [Electronic resource]: https://www.europlatforms.eu

[7] The concept of formation and functioning of transport and logistics centres adopted in the EU. [Electronic resource]: https://mintrans.org/ru/o-nih/transportno-logisticheskie-centry/evrosojuz/. Last accessed 19.04.2024.

Table 2

Aggregated regional economic indicators of Samara region

Indicators	Years					
	2017	2018	2019	2020	2021	2022
Gross regional product (in current basic prices), million rubles	1449005,7	1625558,7	1689575,4	1625461,8	2157662,0	2378451,0
Index of physical volume of gross regional product (% of the previous year)	100,8	100,2	101,4	94,1	105,3	97,8
Construction (compared to the previous year %)	104,5	80,7	116,2	86,8	121,8	102,1
Transportation and storage (compared to the previous year %)	104,0	103,0	100,8	92,1	104,2	105,2

Source: developed by the authors using data of the Federal State Statistics Service [8].

Table 3

Dynamics of interdependent regional economic indicators

Indicators	Years					
	2005	2010	2015	2020	2021	2022
Retail trade turnover (in current prices; million roubles)	225858	423534	589988	674641	757583	835385
Indices of physical volume of retail trade turnover (in comparable prices; as a percentage of the previous year)	113,7	103,3	80,9	94,5	103,1	94,5
Cargo transportation, million tons	77,8	60,1	40,6	28,3	32,5	30,7
Cargo turnover, million t-km	3393	5596	4442	3881	3393	3703

Source: developed by the authors using data of the Federal State Statistics Service [8].

was to identify fundamental patterns and develop methodological approaches, but not to analyse the exact reasons for changes in the dynamics of the indicators under consideration in a particular region. In this regard, the study focused on the indicated period for which sufficient information was available at the time of publication. In 2023, there was a significant improvement in regional indicators, but according to preliminary analysis, the positive dynamics confirmed the conclusions made in the study regarding the identified patterns.

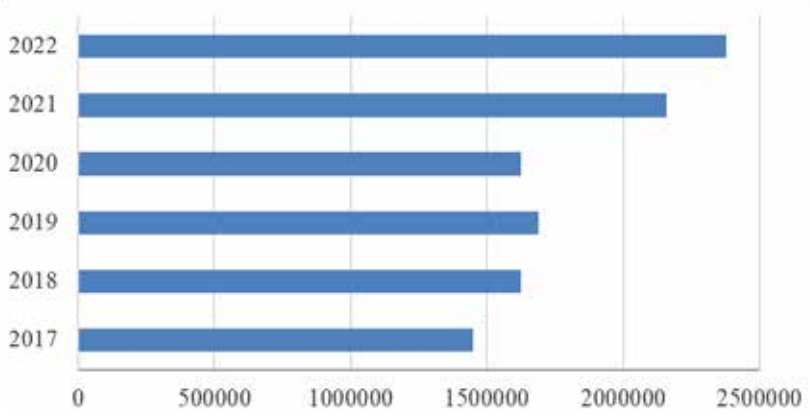
Table 2 and Pics. 1 and 2 demonstrate the main aggregated regional economic indicators[8].

The analysis of the Table 2 and data shown in the diagrams in Pics. 1, 2 shows that the dynamics of the gross regional product (GRP) indicators in absolute and relative values generally had a negative trend during the considered period. The growth of values in rubles reflects inflationary processes, and the index of physical volume of GRP confirms a decrease in the value of this indicator. The exception is 2021, which is associated with post-COVID growth, and this recovery does not exceed the 2017 level.

The indicators of the types of economic activity «construction», «transportation and storage» in general also have a downward trend, except for 2021, which is similar to the dynamics of GRP. The «construction» indicator in 2021 increased due to the growth rate of housing construction and does not reflect the commissioned transport and logistics infrastructure facilities. The share of commissioned TLS facilities in the total volume of commissioned buildings and structures on average does not exceed 5–7 % and in 2020–2023, no significant facilities were commissioned.

The indicator of the «transportation and storage» type of economic activity (in accordance with OKVED / Russian classifier of types of economic activity) shows the dependence on the GRP indicators, and it is obvious that the less is produced, the less is transported. Also, a negative impact on these indicators was exerted by a decrease in the volume of transit cargo, both interregional and international. The increased indicator in 2022 shows a post-COVID revival of transportation, but this value is less, in absolute values, than the level of 2017.

[8] Federal State Statistics Service. Regions of Russia. Socio-economic indicators 2023. [Electronic resource]: https://rosstat.gov.ru/storage/mediabank/Reg_Rus_Pokaz_2023.htm. Last accessed 19.04.2024.



Pic. 1. Dynamics of changes in gross regional product [developed by the authors using data of the Federal State Statistics Service[8]].

Table 3 and Pics. 3 and 4 show the dynamics of regional economic indicators, which to a greater extent reflect the impact of TLS on the regional economy[8].

The indicators of retail trade and cargo transportation, like the GRP indicator, also had in 2022 negative dynamics. The main clearly visible reasons are the decrease in the money supply in the retail trade sector, in the number of commercial contracts, which led to a decrease in the volume of trade and transportation, as well as a decrease in the income of the main consumer groups, mainly households.

The second reason, which does not appear immediately, as a rule, but over a long period of time, is the decrease in transport, cargo handling and warehouse capacities.

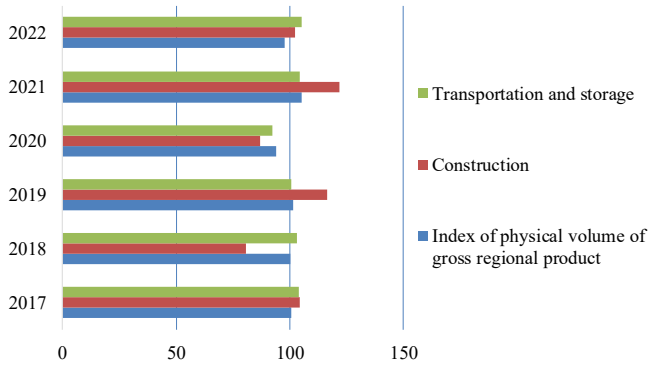
It is fair to note that a decrease in trade volumes forces participants in logistics chains to reduce their capacities. The analysis of such a reduction shows a higher rate of withdrawal of transport and logistics facilities from their production and logistics activities than the rate of reduction in retail trade volumes.

Since, due to its high inertia, the introduction of logistics facilities into production activities will lag the faster recovery of retail turnover and, accordingly, the deficit of transport and logistics services, a negative effect arises that restrains the growth of retail turnover.

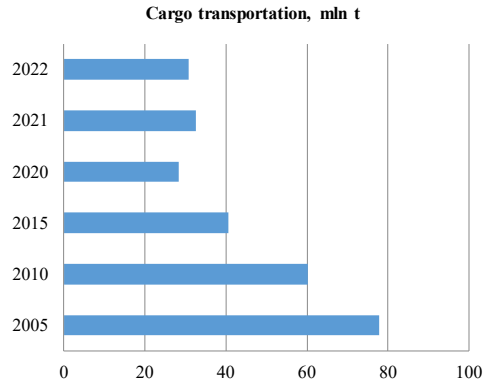
Consequently, the impact of the state of the TLS on retail trade indicators and GRP shows an obvious dependence and, accordingly, can be one of the factors determining the economic stability of the region.

At the same time, the analysis of the «construction», «wholesale and retail trade», «transportation and storage» activities correlates in general with the indicators shown in Tables 2 and 3, and more relevantly indicates the impact of the level of development of the regional TLS on the listed industries (see Table 4)[8].

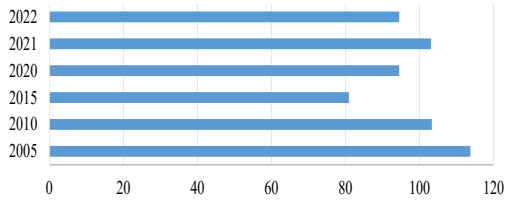
For example, the indicator «industry structure of gross value added» shows that the final function of the supply chain, i.e. «retail and wholesale trade», demonstrates the processes of expansion and contraction of entrepreneurial activity, manifested in the previous industries.



Pic. 2. Aggregated regional economic indicators [developed by the authors using data of the Federal State Statistics Service [8]].



Pic. 3. Dynamics of cargo transportation indicators [developed by the authors using data of the Federal State Statistics Service[8]].



Pic. 4. Dynamics of physical volume of retail trade turnover indices [developed by the authors using data of the Federal State Statistics Service[8]].

The analysis of the «transportation and storage» sector for 2020–2022 shows the worst value in 2020 (coronavirus pandemic) and a slight rise in 2021 and a slight fall in 2022. That is, the possibility of expanding the functions of consolidation, cargo handling and distribution is reduced, partly due to the reduction of «wholesale and retail trade». Similarly, there is a reduction in the volume of «construction».

On the other hand, a decrease in the number of warehouse real estate objects commissioned and, accordingly, a decrease in the «transportation and storage» indicators reduce trade volumes.

Thus, an effect arises in which the maximum value of transportation and storage in 2018 ensured an increase in the trade indicator in the same year. In 2019, the value of «transportation and storage» decreased, but the trade indicator, due to low inertia, remained almost at the same level and showed a significant decrease only in 2020 (partly due to the coronavirus pandemic).

At the same time, the growth in trade volumes in 2021 was by 2,6 % of gross value added compared to 2020 and ensured a slight increase in «transportation and storage» over the same period by 0,4 %. Such inertia of the process may be due to a significant time lag in the expansion of the volumes of «construction», «transportation and storage» and a smaller lag for an increase in the trade indicator.

There is a discrepancy between the decline in trade volumes and a slower (due to low inertia) decline in the «construction», «transportation and storage» indicators, and vice versa, an intensive increase in the trade indicator leads to a slower recovery of the «construction», «transportation and storage» indicators. In other words, the growth of trade at the beginning of the year

Pic. 5. Planned TLC of Samara Region [developed by the authors based on the Resolution of the Government of Samara Region No. 422 of September 23, 2010].

Table 4

Dynamics of industry indicators relevant to the level of development of TLS

№	Indicator	Industry											
		Construction				Transportation and storage				Wholesale and retail trade			
		2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
1	Average annual number of employed by type of economic activity (thousand people)	134,8	129,1	140,2	131,1	144,2	121,7	141,7	1138	283,1	267,9	231,7	278,1
2	Sectoral structure of gross value added (%)	5,3	4,9	5,6	5,1	5,9	5,7	6,1	6,0	10,5	7,8	10,2	9,8
3	Investments in fixed capital by type of economic activity (million rubles)	3657,5	2989,6	3958,1	3451,7	98546	87548	99754	97800	7854	6987	7198	7321
5	Commissioning of fixed assets by type of economic activity (million rubles/ share)	6112/ 2,1 %	5675 /1,4 %	6325/ 2,4 %	6037/ 2,0 %	11989/ 3,8 %	8562/ 3,1 %	12389/ 4,0 %	11454/ 3,7 %	41983/ 15,3 %	31085/ 9,9 %	43287/ 16,2 %	37715/ 12,2 %
6	Degree of depreciation of fixed assets by type of economic activity (%)	57,6	47,1	60,3	56,4	74,2	62,9	79,7	73,3	59,1	47,9	61,7	56,3
7	Distribution of the number of organisations by types of economic activity (at the end of the year)	9525	7564	12589	9454	22079	18698	23849	21878	6115	5569	6138	6040
8	Turnover of organisations by type of economic activity (billion rubles)	97,7	79,9	99,9	94,5	641,1	603,5	617,8	620,7	432,2	350,8	420,9	390,3
9	Balanced financial result of the organisation for individual types of economic activity (million rubles)	6865	5987	6954	6804	30158	27856	34565	29362	5798	5107	5898	5505

Source: developed by the authors using data of the Federal State Statistics Service[8].

Table 5

Correlation coefficients of the values of TLS and economic indicators of Samara region

Economic indicators of the region / Indicators of TLS of Samara region	Construction of TLS facilities, units	Transportation and storage, million tons of cargo	Cargo transportation, million tons.	Cargo turnover, million t-km.	Average annual number of employed, thousand people	Number of TLS organisations by type of economic activity, units.	Cargo rolling stock (trucks), units	Passenger flow of public buses, million passenger-km	Operational length of Motorwys, km.	Operational length of railway tracks, km
GRP, million rubles	0,59	0,84	0,86	0,80	– 0,45	0,53	0,39	0,82	0,92	0,47
Retail trade turnover, million rubles.	0,76	0,79	0,91	0,82	0,34	0,76	0,81	–0,29	0,79	0,52

Source: developed by the authors.

ensures the growth of «construction», «transportation and storage» by the beginning of the next year, where the time lag is approximately one year (see Table 4).

Obviously, the specified areas of activity related to transport and logistics services, which are provided by the corresponding infrastructure facilities, are correlated with regional indicators of economic activity. Therefore, undoubtedly, development of regional TLS affects the economy of the region and its sustainability.

Assessing the development of the regional TLS, it should be noted that several legislative initiatives have been developed at the regional level to develop a regional network of TLC.

Among them are the Resolution of the Government of Samara Region dated September 23, 2010, No. 422, «On the Concept of Development of the Regional Transport and Logistics System of Samara Region for 2011–2015» and the Program of the Government of Samara Region in accordance with Resolution No. 441 dated July 12, 2017 «On the Strategy for Socio-Economic Development of Samara Region for the Period up to 2030 (as amended on September 17, 2019)».

In accordance with the Resolution of the Government of Samara Region No. 422 dated September 23, 2010, it was planned to create six TLC in the region by the end of 2015 (see Pic. 5).

The developed model of the regional TLC system was supposed to enhance the transit potential of the region and stimulate the economic growth of the regional industry by providing integrated transport and logistics services. However, given the favourable geographical location, the availability of transportation routes of all modes of transport, developed industry and science, the concept was not fully implemented. At the end of 2023, Samara region did not have a single TLC system and this sector of the economy is represented, in addition to a large number of small and medium-sized warehouses, by several large enterprises, for example, Srednevolzhskaya Logistics Company (80 thousand square meters of warehouse space), SOYUZ Company (24 thousand square meters), Volgatransterminal (10 thousand square meters), Pridorozhny Logistics Complex (48 thousand square meters).

The region's TLC system is mainly represented by corporate warehouses of large companies that service their cargo flows. The most famous include FSUE Russian Post, JSC Samaraagroprompererabotka, LLC Ozon, JSC «Novokuibyshevskaya neftekhimicheskaya kompaniya», X5 Retail Group NV and others.

The analysis of TLC of the listed companies in the region confirms that the facilities they create are intended for consolidation and distribution of their own cargo, so it is not correct to consider them in the context of a single regional TLC system.

However, in accordance with the decision of the Government of the Samara Region (Resolution No. 441 of July 12, 2017 «On the Strategy for Socioeconomic Development of Samara Region

until 2030 (as amended on September 17, 2019)», it is envisaged to create a transport and logistics system of Samara Region based on TLCL, which, according to the plan of the regional authorities, will ensure the spatial development of productive forces and increase the economic sustainability of Samara Region. This decision of the Government of the region, in terms of development of the transport and logistics system, is essentially intended to implement not completely implemented Resolution of the Government of Samara Region No. 422 of September 23, 2010 in the form of creating a logistics cluster.

The idea of TLCL is to ensure the interaction of all enterprises and organisations of the region, create equal access to transport and logistics services, and increase the economic efficiency of interregional and international cooperation. Obviously, the possibility of implementing this program will ensure the spatial development of the region in accordance with the Strategy for Spatial Development of the Russian Federation for the period up to 2025.

Thus, formation and development of a regional TLCL, which is similar in content and purpose to the term TLS, involves creation of conditions for increasing the economic efficiency of the regional industry. The mutual influence between the level of development of the regional TLS and industries is obvious, but it is necessary to determine to what extent this relationship affects their target indicators and the level of economic sustainability.

For econometric rationale of the mutual influence of TLS and the regional economy, the method of correlation and regression analysis was used, which allows us to determine the closeness of the relationship between TLS indicators and the economic indicators of the region. The statistical basis for the analysis was the data of the Federal State Statistics Service for 2017–2022 [8]. Table 5 shows the results of the correlation and regression analysis.

The results of the correlation and regression analysis confirm the assumption about the influence of TLS indicators on GRP indicators and retail turnover. Each TLS indicator (x_i) has a relationship with at least one regional economic indicator (y_j). For the computational experiment and in accordance with the methodology of correlation-regression analysis, we will assume that the value of the coefficient above 0,7 shows a strong relationship.

The significance of the calculated relationships is determined by multiple regression. Gross regional product (y_1) and retail turnover (y_2) were selected as variables. The variables, GRP and retail turnover, were selected in accordance with their significance for TLS. The following variables were selected for the calculations: construction of TLS facilities (x_1); transportation and storage (x_2); cargo transportation (x_3); cargo turnover (x_4); average annual number of employees (x_5); the number of TLS organisations by type of economic activity (x_6); cargo rolling stock (trucks) (x_7); passenger turnover of public buses (x_8); operational length of motorways (x_9); operational length of railways (x_{10}). To calculate the regression dependence of TLS and retail turnover, the following variables were selected: (x_1); (x_2); (x_3); (x_7). The computational experiment showed the following regression dependencies:

$$y_1 = 19246{,}03 + 56{,}947x_1 + 410{,}124x_2 + 620{,}521x_3 + 308{,}231x_4 - 15{,}329x_5 + 27{,}329x_6 + 547{,}872x_7 + 28{,}453x_8 + 479{,}295x_9 + 19{,}787x_{10}; \quad (1)$$

$$y_2 = 9273{,}729 + 3{,}143x1 + 349{,}274x2 + 474{,}839x3 + 624{,}472x7. \quad (2)$$

The calculations showed that the coefficients of determination greater than 0,75 are significant and equal to $R^2_1 = 0{,}987$ and $R^2_2 = 0{,}991$, respectively. This confirms the strong influence of the variables selected for the calculation on the GRP and retail turnover in Samara Region.

For the first model, the most significant indicators are: transportation and storage (x_2); cargo transportation (x_3); cargo rolling stock (trucks) (x_7); operational length of motorways (x_9). For the second model – cargo rolling stock (trucks) (x_7); cargo transportation (x_3).

Consequently, transportation and storage, cargo transportation, cargo rolling stock (trucks), operational length of roads have the strongest influence on the regional GRP, and cargo transportation and operational length of motorways – on the retail turnover.

CONCLUSIONS

The conducted correlation and regression analysis shows the influence of TLS indicators of Samara region on the regional GRP and retail turnover, therefore the initial assumption about the presence of the identified relationship is confirmed.

Obviously, the identified relationship between TLS and the economic indicators of the region can be interpreted as a factor determining the level of economic sustainability of the region.

The complex of analysed regional economic indicators, including the state of TLS, determines the level of economic sustainability through a system of resulting groups of indicators [9–12]. For example, these are indicators of production sustainability, indicators of investment sustainability and others.

At the same time, regional economic sustainability cannot be considered as a set of static, constant and unchanging groups of indicators, while the external economic environment is in a state of constant change. The sustainability of the regional economy is continuous socio-economic, as well as production-technical, logistical changes that bring the regional economy to a state of new equilibrium, which involves achieving the required, better economic indicators.

Consequently, the ability of the regional economy to adapt to new conditions of economic activity, to return to a state of equilibrium, which is characterised by better values of target economic indicators, should be understood as economic sustainability. The same is proved by the preliminary assessment of the correctness of the conclusions made regarding the positive dynamics of the indicators for the considered region in 2023, not included in the study since data for in-depth analysis missed when preparing the paper for publication.

The analysis of the dynamics of TLS indicators shows the impact on the regional economic indicators identified in the work, and the regression analysis confirms the high level of correlation and, obviously, characterises economic sustainability. In the context of the study, the state of TLS may be considered as an external factor influencing the indicators of GRP and retail turnover. This is also confirmed by other research, dedicated to complex assessment of the efficiency of regional transport and logistics systems [39].

Besides, the study confirmed the assumption about the influence of external factors on regional economic sustainability.

GRP can be used as an indicator of the dynamics of changes in regional economic sustainability. The analysis of regional economic indicators (Tables 2–4) shows this influence. Thus, the index of physical volume of the gross regional product (Table 2) shows a slight increase in this indicator from 100,8 % in 2017 to 101,4 % in 2019. In 2020, there was a decrease to 94,1 %, a recovery in 2021 to 105,3 % relative to the fall in 2020 and a decrease in 2022 to 97,8 %. That is, under the influence of endogenous factors, if we consider the entire regional economy, the GRP indicator decreases, then recovers to the previous or higher values. The endogenous factors studied in the work include transport and storage, wholesale and retail trade turnover, construction, cargo transportation and cargo turnover, which affect the volumes of goods and services produced and form the GRP. The dynamics of the listed factors correlate with the dynamics of GRP, which confirms their impact on economic sustainability. The most stable state in terms of GRP, if we consider 2017–2022, is observed in 2019 and 2021, which repeats the dynamics of aggregated endogenous factors and, accordingly, confirms not only the results of the performed correlation and regression analysis, but also the impact of these factors on regional economic sustainability.

Obviously, the decrease in GRP and retail turnover and, accordingly, economic sustainability indirectly occurs due to a decrease in transport and storage indicators, transportation volumes, investments in fixed assets, and commissioning of fixed assets. Therefore, a return to positive growth in the analysed trend, which corresponds to an increase in economic sustainability, depends on the elimination of barriers that impede the improvement of the listed indicators.

The study provides a comparative analysis of approaches to determining TLS from industry to spatial one. It should be noted that with a variety of forms of economic activity, all three approaches remain in demand. However, regardless of the great popularity and economic demand for the cluster approach, it has not been widely implemented at the regional level. The approach requires a more structured and resourced formulation of the task of developing transport and logistics systems that would correspond to the minimum necessary economic infrastructure and, first of all, to transport and logistics infrastructure, as well as more effective interaction and coordination between enterprises and authorities, enshrined in legislative documents. Therefore, the sectoral approach remains dominant.

On the other hand, the spatial approach partially solves the problem of spatial connectivity of economic entities in the absence of economic administration based on the interest of economic entities in the results of their activities.

Based on the analysis of statistical regional economic indicators for 2017–2022, the key components of regional TLS were identified. Correlation and regression analysis showed a high level of influence and relationship between regional TLS and key regional economic indicators. The obtained dependencies confirm the influence of individual TLS factors on GRP and retail turnover. The most significant factors influencing GRP are transportation and storage, cargo transportation; cargo rolling stock; factors influencing retail turnover are cargo rolling stock (trucks); cargo transportation. In addition, the study substantiates the assumption about the influence of TLS factors on regional economic sustainability, where sustainability is understood as the ability to restore previous regional economic indicators in accordance with the planned target values.

Thus, the conducted study allows us to conclude that TLS is not only one of the key systems of the regional economy, but also one of the factors ensuring economic sustainability. Consequently, planning of target economic indicators and the level of economic sustainability should be planned together with the target indicators of the elements of regional TLS. In this regard, e. g., the Program of the Government of Samara region «On the Strategy for Socio-Economic Development of Samara region for the Period up to 2030» probably requires revision in terms of including the section «Formation and Development of Regional TLS» and defining interrelated target indicators of TLS with key regional economic indicators.

Generally, the level of development of regional economies, their interaction and interdependence, economic sustainability and resource-saving practices, a priori, ensures sustainable growth of macroeconomic indicators, and, therefore, the comprehensive socio-economic development of the constituent entities of the Russian Federation, and is one of the key tasks of government bodies at all levels of governance.

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Information about the authors:

Khaitbaev, Valery A., *D.Sc. (Economics), Professor at the Department of Transport Economics and Logistics of Samara State Transport University, Samara, Russia, vhaitbaev21@mail.ru.*

Cherniaev, Evgeny V., *Ph.D. (Economics), D.Sc. candidate at Volsk Military Institute of Material Support, Volsk, Russia; ki-la@mail.ru.*

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