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ALGORITHM FOR MANAGING THE NON-TRANSPORT EFFECT AT RAILWAY TRANSPORT ENTERPRISES

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Abstract

The main goal of transport companies is to improve work efficiency while ensuring public safety and taking into account the non-transport effect. This type of effect is most closely related to the quality of transport services, which, in the face of increased competition between transport companies, is becoming one of the main factors in the sustainability of carrier enterprises and terminal service facilities. It is advisable to take into account the non-transport effect when comparing competing modes of transport, as well as when substantiating the mechanism of state regulation of the transportation market at the municipal and regional levels. The article discusses the concept of the “non-transport effect” in railway transport and describes the causes and cases of its occurrence. Classification of types of non-transport effects is given, and its components are considered. Formulas for calculating the overall non-transport effect are presented, which allow for saving material and labor resources in the process of transportation. The methodological bases for developing a system of criteria for the non-transport effect of the development of railway transport have been formed. The measures that bring the greatest non-transport effect on railway transport enterprises are described. The types of effects that need to be calculated using the direct counting method and based on economic and statistical models are analyzed. A matrix of paired correlation coefficients between indicators characterizing the regions' socio-economic level of development is given.

Keywords: Assessment, non-transport effect, quality, safety, transport

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1. Introduction

Modern society needs a constant increase in the volume of transport services and an improvement in the reliability, safety, and quality of transportation of people and goods. Transport issues are complex and spread across various areas of regulation and management. Therefore, the modeling in managing the non-transport effect is significant for developing a strategy for the development of transport companies (Razvadovskaya et al., 2016).

Transport is an intersectoral complex that ensures the material exchange of goods and services between economic entities of the market and interpersonal relations of the population (Tereshina et al., 2002). Railway transport has an impact on almost all branches of material production with which it interacts since it carries out the transportation process and is a tool for creating favorable conditions for the development of the country's economy, as well as for improving the quality of life of the population (Zabnenkov & Moysievich, 2012). To assess the economic efficiency of investments in railway transport, it is also necessary to evaluate the accompanying and associated effects, that is, the non-transport effect.

2. Problem Statement

The non-transport effect is managed at the level of administrative-territorial entities, which allows, on the one hand, to establish clear territorial boundaries for the formation of non-transport effects, and, on the other hand, to take into account multiplier effects. In turn, the transformation of these effects makes it possible to increase the objectivity of their feasibility studies due to more complete consideration of all factors that determine the national economic significance of these projects. The problem of assessing the non-transport effect was reflected in the works of scientists A.P. Abramov, V.N. Obraztsov, I.V. Belov, V.A. Persianov, M.F. Trikhunkov, V.N. Livshits, Yu.I. Sokolov, V.G. Galaburda, I.M. Lavrov, N.P. Tereshina, V.A. Podsorin, A.V. Ryshkov and P.V. Kurenkov.

3. Research Questions

According to Sokolov Yu.I., Galaburda V.G., Lavrov I.M., Anikeeva-Naumenko L.O., and Averyanova O.A.: “The non-transport effect is defined as benefits, associated effects or losses obtained in various areas of the socio-economic life of society as a result of the use of a particular mode of transport and various transport technologies, but not reflected in the financial performance of transport enterprises” (Sokolov, Galaburda et al., 2018).

The non-transport effect contributes to the preservation of the life and health of the population, the production of additional products, the reduction of production costs, the saving of passenger travel time, and other results in various areas of human life and society (Sokolov, Lavrov et al., 2018).

The classification of the types of non-transport effects arising from the improvement of transport is diverse (Table 01).

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Table 1. Influence of types of non-transport effect on the development of transport

Types of non-transport effect	Measurements for the development and improvement of transport
Development of communications	The use of natural resources and the creation of products in the newly-developed regions.
Increasing the safety of cargo	Accelerating the turnover of funds and reducing costs from the immobilization of material resources.
Acceleration of cargo delivery	Savings by reducing the cost of maintaining labor, machinery, and storage facilities.
Increasing the transport security of production	Improvement of inter-district communications accelerated the development of hinterlands. Alignment of the level of economic and social development of the regions.
Improving the uniformity, regularity, and reliability of transport operation	Saving transport costs by switching cargo to a cheaper mode of transport.
Improving the interaction of modes of transport, and the consistency of work with the clientele	Increasing the production, reducing losses due to insufficient supplies of raw materials.
Rolling stock specialization, development of container and package transportation	Reducing qualitative and quantitative losses of transported goods. Saving costs for the creation and storage of current and insurance supply.
Environmental measures	Reducing environmental pollution, the impact of pollution, noise, and vibration on human health, flora, and fauna. Preventing the depletion of natural resources. Alienation of land and other natural resources.
Improving transport safety	Reducing the number and severity of traffic accidents, emergencies, and the damage they cause to the environment (natural environment and non-transport property). Reducing the damage from loss, and damage to the transported cargo; Reducing damage to human health; Reducing damage from delays of goods and passengers in transit.

The non-transport effect of the functioning and development of transport in the region includes the savings in social costs for the production and transportation of products, as well as other types of economic, social, or other effects that occur in transport or beyond (Nunes et al., 2019). The non-transport effect consists of two groups of interrelated components (Table 02).

Table 2. The relationship of the components of the non-transport effect

Economic	Social
Changes in the income of third-party organizations and the population as a result of the projects.	Changing the number of jobs in the region.
Change in budget spending to create an equivalent number of jobs.	Changing working conditions.
Change in tax revenues to the budgets of all levels.	Changing the structure of production personnel.
An increase in the value of companies as a result of the development of transport infrastructure and the growth of the economy, and investment attractiveness of the hinterland.	Changing the security of supplying regions with certain goods.
Reducing losses from road accidents.	Saving people's free time.
Reducing costs in non-productive sectors (health care, public education, and public services for the population in rural areas)	Improving the quality and safety of transport services.

The economic components of the non-transport effect include the results of the implementation of innovative and investment projects and are taken into account when conducting a comprehensive assessment of efficiency (Kuzina, 2012). However, the unreliable operation of transport and the lack of

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convenient transport support can lead to losses, which are a lost non-transport effect; it can only be implemented with the optimal development of the country's transport system (Drozdov et al., 2021).

4. Purpose of the Study

The purpose of the article is to calculate the algorithm for managing the non-transport effect based on economic and statistical models in relation to railway transport enterprises.

5. Research Methods

In the study process, the scientific method of multi-step regression analysis, direct calculation, system analysis, and technical and economic calculations were used.

6. Findings

The calculation of the total non-transport effect as a result of transport measures can be made using formula (1), which most fully characterizes the effects and damages arising outside the transport sector as a result of transport measures:

$$\Delta E_{non\text{-}transp} = \Delta I_{workcap} + \Delta C_{transpcost} + \Delta S_{acc} + \Delta S_{stock} + \Delta S_{loss} + \Delta I_{prop} + \Delta E_{soc} - D_{transp} \quad (1)$$

where $\Delta I_{workcap}$ is savings of working capital of enterprises;

$\Delta C_{transpcost}$ is the reduction in the share of transport costs in the price of sales of products;

ΔS_{acc} is the savings in production current costs caused by the acceleration of production, capital turnover, and the development of natural resources;

ΔS_{stock} is the cost savings on storage of stocks of material resources;

ΔS_{loss} is the cost savings associated with the reduction of cargo losses, the introduction of specialized rolling stock, container, and package transportation;

ΔI_{prop} is an increase in profits of property owners due to the development of transport infrastructure;

ΔE_{soc} is the social effect received by passengers from improving the operation of transport and the quality of their service;

D_{transp} is the cost associated with the elimination of damage from the measures of transport.

The effect of improving the quality of life and management in the region (non-transport effect) is calculated using formula 2 (Makeev & Mamaev, 2006):

$$\Delta E(in) = \Delta E(G) + \Delta E(T) + \Delta E(I) + \Delta E(P), \quad (2)$$

where ΔE (G) is the effect of the growth of the gross regional product;

ΔE (T) is the effect of improved transport accessibility;

ΔE (I) is the effect of increasing the area of the territory;

ΔE (P) is the effect of population increase.

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The non-transport effect can be calculated in the current conditions of transport operation when justifying the effect of introducing new transportation technologies, switching to new modes of transport, introducing high-speed traffic, and improving the quality of customer transport services (Vakulenko et al., 2021). The quality of transport provision criteria is higher, the better all other things being equal, the road and rail links are developed (Mavrin et al., 2018). The methodological foundations for developing a strategy of criteria for assessing the quality of transport provision in railway transport are shown in Figure 01.

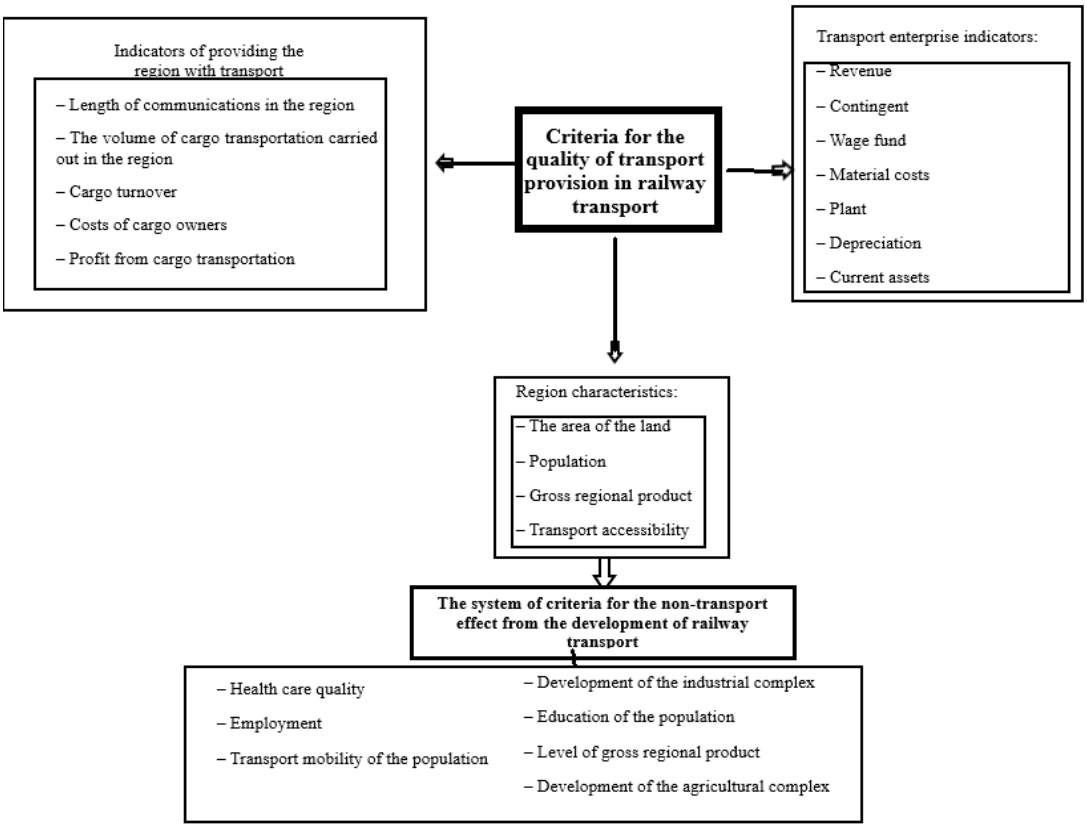

Figure 1. Methodological bases for developing a strategy of criteria for assessing the quality of transport provision in railway transport

The measures that bring the greatest non-transport effect on railway transport enterprises are shown in Figure 02.

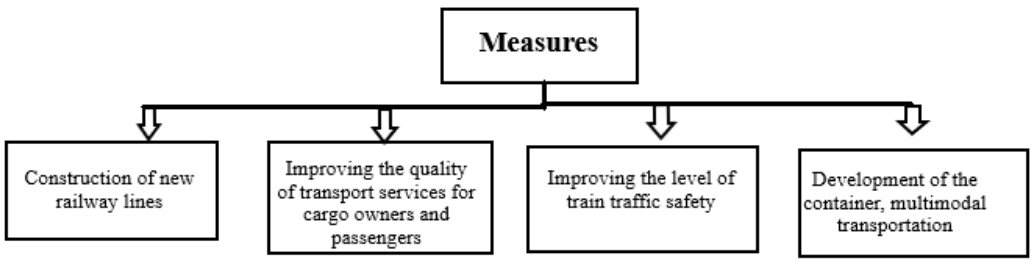

Figure 2. The measures that bring the greatest non-transport effect at railway transport enterprises.

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At present, the following indicators characterizing the socio-economic level of their development can be used to assess the non-transport effect:

i. Y1 is the volume of the gross regional product, million rubles;
ii. Y2 is the cost of core funds of all industries, million rubles;
iii. Y3 is the volume of agricultural production, million rubles;
iv. Y4 is the volume of products, works, or services of small enterprises, million rubles;
v. Y5 is wholesale trade, million rubles;
vi. Y6 is retail trade, million rubles;
vii. Y7 is the volume of paid services to the population, million rubles;
viii. Y8 is fixed investments, million rubles;
ix. Y9 is fixed investments with the participation of foreign capital, million rubles;
x. Y10 is the foreign trade volume, million dollars;
xi. Y11 is traffic accidents per 100 thousand people;
xii. Y12 is the number of road accident victims per 100 thousand people;
xiii. Y13 is incidence per 1000 people;
xiv. Y14 is per capita monthly incomes, rubles;
xv. Y15 is the number of vehicles per 1000 people.

The direct calculation method is recommended to be applied primarily to those types of economic and social effects, the formation of which is directly related to specific transport and operational parameters of the road structure being designed.

These should include reducing the need of enterprises and organizations for working capital, the loss of time spent by passengers on the road, and the losses from road accidents.

Based on economic and statistical models, provided that the region where the projected road object is located is included in the set for which these models were built, it is necessary to calculate the following types of effects:

i. multiplier (from the increase in the gross regional product);
ii. in agriculture;
iii. in trade;
iv. in the improving the investment climate;
v. in the healthcare system;
vi. in the process of improving the welfare of the population.

At the same time, it was found that the types of non-transport effects presented in Table 03 can be set to a potentially possible change in each of the above indicators.

Table 3. Types of non-transport effects in transport

Effect types	**Y_1**	**Y_2**	**Y_3**	**Y_4**	**Y_5**	**Y_6**	**Y_7**	**Y_8**	**Y_9**	**Y_{10}**	**Y_{11}**	**Y_{12}**	**Y_{13}**	**Y_{14}**	**Y_{15}**
economic effect															
multiplier	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–
in agriculture	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–

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in small business	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
in domestic trade	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–
in foreign trade	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
in the improving the investment climate	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
social effect															
in the process of improving the welfare of the population	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
in the healthcare system	–	–	–	–	–	–	–	+	–	–	–	–	+	–	–
in the security situation	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–
in the recreation services	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–

Some of the indicators characterizing these effects may turn out to be interdependent, i. e., be very closely related to each other. The pair correlation coefficients between them were calculated to test them for multicollinearity, the matrix of which is given in Table 04 (Rosavtodor, 2018).

Table 4. Matrix of paired correlation coefficients between indicators characterizing the socio-economic level of development of regions

K_{ij}	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	Y_{10}	Y_{11}	Y_{12}	Y_{13}	Y_{14}	Y_{15}
Y_1	**1**	0.941	0.378	0.491	0.415	0.533	0.506	0.649	0.243	0.950	0.334	0.050	0.234	0.559	0.418
Y_2	0.941	**1**	0.616	0.666	0.578	0.749	0.711	0.713	0.337	0.831	0.343	0.070	0.202	0.481	0.304
Y_3	0.378	0.616	**1**	0.568	0.559	0.742	0.767	0.345	0.559	0.242	0.273	0.069	–	–	0.287
Y_4	0.491	0.666	0.568	**1**	0.505	0.906	0.871	0.599	0.461	0.261	0.390	0.210	0.084	0.200	0.398
Y_5	0.415	0.578	0.559	0.505	**1**	0.667	0.597	0.266	0.193	0.336	0.317	–	0.166	0.062	0.245
Y_6	0.533	0.749	0.742	0.906	0.667	**1**	0.919	0.538	0.438	0.342	0.330	0.094	0.070	0.125	0.392
Y_7	0.506	0.711	0.767	0.871	0.597	0.919	**1**	0.555	0.631	0.276	0.385	0.107	–	0.107	0.378
Y_8	0.649	0.713	0.345	0.599	0.266	0.538	0.555	**1**	0.473	0.335	0.280	0.059	0.057	0.630	0.406
Y_9	0.243	0.337	0.559	0.461	0.193	0.438	0.631	0.473	**1**	0.058	0.335	0.205	–	0.067	0.249
Y_{10}	0.950	0.831	0.242	0.261	0.336	0.342	0.276	0.335	0.058	**1**	0.270	0.069	0.255	0.613	0.267
Y_{11}	0.334	0.343	0.273	0.390	0.317	0.330	0.385	0.280	0.335	0.270	**1**	0.515	0.116	0.066	0.600
Y_{12}	0.050	0.070	0.069	0.210	–	0.094	0.107	0.059	0.205	0.069	0.515	**1**	–	–	0.231
Y_{13}	0.234	0.202	–	0.084	0.166	0.070	–	0.057	–	0.255	0.116	–	**1**	0.408	0.019
Y_{14}	0.559	0.481	–	0.200	0.062	0.125	0.107	0.630	0.067	0.613	0.066	–	0.408	**1**	0.236
Y_{15}	0.418	0.304	0.287	0.398	0.245	0.392	0.378	0.406	0.249	0.267	0.600	0.231	0.019	0.236	**1**

As can be seen from Table 4, between indicators Y1 (volume of the gross regional product) and Y2 (cost of core funds of all industries), Y1 and Y10 (foreign trade volume), Y2 and Y10, Y4 (volume of products, works or services of small enterprises) and Y6 (retail trade), Y4 and Y7 (volume of paid services to the population), Y 6 and Y7 have strong correlations (correlation coefficient over 0.8). This

indicates the inexpediency of their joint consideration as possible measures of the varieties of the non-transport effect (highlighted in Table 04).

7. Conclusion

The given economic and statistical dependencies are made by a method of multistage regression analysis. Indicators that determine the socio-economic level of region development (Y1, Y3, Y5, Y6, Y8, Y9, Y11, Y12, Y13, Y14, Y15) were taken alternately as dependent variables. The major problem with the non-transport effect is that not all indicators can be thought of in terms of cost, and the effect size can only be estimated. It can be concluded that a complete transition to economic and statistical modeling of socio-economic indicators of regional development can be carried out only if there are sufficiently reliable regression relationships. Such dependencies must be established using dynamic models.

References

Drozdov, N. A., Vasilenko, M. A., Kuzina, E. L., Tagiltseva, Ju. A., Prokopova, A. M., & Korenyakina, N. N. (2021). Modeling as transport service quality and efficiency increase. *European Proceedings of Social and Behavioural Sciences (EpSBS), Vol. 117. International Conference on Social and Cultural Transformations in the Context of Modern Globalism (SCTCMG 2021). 219*, (pp. 1659–1667). https://doi.org/10.15405/epsbs.2021.11.219

Kuzina, E. L. (2012). Assessment of ensuring the country's environmental and economic security under the influence of transport factors. Economy. Entrepreneurship. *Environment (EPOS), 1*, 162–169.

Makeev, V. A., & Mamaev, E. A. (2006). Morphological approach and matrix models in solving economic problems of business. *Bulletin of the Rostov State University of Communications, 3*, 12–21.

Mavrin, V. G., Makarova, I. V., & Prikhodko, A. (2018). Assessment of the influence of the noise level of road transport on the state of the environment. *Transportation Research Procedia, 36*, 514–519. https://doi.org/10.1016/j.trpro.2018.12.138

Nunes, P., Pinheiro, F., & Brito, M.C. (2019). The effects of environmental transport policies on the environment, economy, and employment in Portugal. *Journal of Cleaner Production*, *213*, 428–439. https://doi.org/10.1016/j.jclepro.2018.12.166

Razvadovskaya, Y. V., Shevchenko, I. K., Bogdanov, D., & Koretsky, A. A. (2016). Modeling of parameters of cluster's economic efficiency. *Mediterranean Journal of Social Sciences, 6*(3), 173–179. https://doi.org/10.5901/mjss.2015.v6n3s4p173

Rosavtodor. (2018). *Guidelines for assessing the effectiveness of construction, reconstruction, overhaul, and repair of highways*. Moscow.

Sokolov, Yu. I., Galaburda, V. G., Lavrov, I. M., Anikeeva-Naumenko, L. O., & Averyanova, O. A. (2018). Non-transport effect in quality management in railway transport. *Transport business in Russia, 6*, 33–36.

Sokolov, Yu. I., Lavrov, I. M., Anikeeva-Naumenko, L. O., & Galaburda, V. G. (2018). *Evaluation of the non-transport effect of improving the quality of freight traffic*. https://cyberleninka.ru/article/n/otsenka-vnetransportnogo-effekta-ot-povysheniya-kachestva-gruzovyh-perevozok

Tereshina, N. P., Abramov, A. P., Galaburda, V. G., & Ryshkov, A. V. (2002). Methods for assessing the competitiveness of transport products, taking into account the non-transport effect. *Railway economics, 4*, 23–33.

Vakulenko, S. P., Kurenkov, P. V., Chebotareva, E., Solop, I. A., Kuzina, E. L., Vasilenko, M. A., Barashyan, V. Y., Astafiev A. V., Nadolinsky, P. V., & Gašparíki, J. (2021). Influence of innovative elements of railway infrastructure complex on the technology of the transportation

process. *Transportation Research Procedia, 55*, 342–347. https://doi.org/10.1016/j.trpro.2021.06.040

Zabnenkov, V. S., & Moysievich, N. V. (2012). The integrated system of indicators of the competitiveness of transport modes. *River transport (XXI Century), 2*(56), 60–67.