ASSESSMENT OF THE RELIABILITY OF MULTICRITERIAL CHOOSING THE OPTIMAL ROUTE OF CARGO TRANSPORTATION IN THE MULTIMODAL TRANSPORT NETWORK

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Abstract

The article proposes a method for assessing the reliability of the choice of the optimal route of transportation in a multimodal transport network. The method is based on the presentation of the problem in a multicriteria form. The development of a decision on the optimal route is implemented by reducing the indicators of alternative routes to an integrated assessment of a nonlinear scheme of trade-offs. The assessment of the reliability of the optimal route is carried out by an integrated assessment in the form of a linguistic category "good-bad". The use of a fundamental rating scale allows to establish a comparative establishing of the optimal route and alternative routes.

Keywords: multimodal transportation, multicriterial optimization, indicator, criterion.

Introduction

The components of the unified transport system are determined by the Law of Ukraine "On Transport". The Law states that the unified transport system of Ukraine consists of: public transport (rail, sea, river, road, and air, as well as urban electric transport, including the subway); industrial railway transport; departmental transport; pipeline transport; public roads. The unified transport system must meet the requirements of social production and national security, have an extensive infrastructure to provide the full range of transport services, including for warehousing and technological preparation of goods for transportation, to provide foreign economic relations of Ukraine.

Multimodal transportation of goods is carried out with the participation of two or more modes of transport involved in one transportation process and is an integral part of a single transport system of Ukraine. The points of interaction of modes of transport and segments of freight routes form a multimodal network, which by its nature is an undirected graph, the vertices of which are the points of interaction, and the edges – the paths. Roads and other infrastructure facilities (port, station, station, etc.) of multimodal transportation are a limited resource that can pass a certain number of rolling stock units per unit time. Therefore, when determining all alternative delivery routes, it is important to choose the optimal route according to certain optimality criteria.

The assessment of the reliability of the multicriteria choice of the optimal route will be considered on the example of freight routes in the System of Rail Freight Transportation, which is indicative, as the plying of passenger and freight railway rolling stock is carried out by common tracks. This organization of traffic overloads railway infrastructure facilities and causes deviations in train schedules and subsequent successive reloading of cargo on other modes of transport. Therefore, for effective organization and management of freight flows in a multimodal transport network, the solution requires the applied problem of increasing the reliability of the choice of the optimal route of transportation of goods.

Methods for solving multicriteria problems are considered in the works of G.I. Ankudinov, G.S. Antushev, A.N. Voronin, et al., [1 – 4]. Methods of parametric synthesis and design of the structure of complex systems have been studied by scientists V.V. Baranov, P.G. Kuchuk, Yu. K. Ziatdinov, et al., [5 – 9]. Theoretical and practical problems related to the strategy of international integration of the transport and road complex of Ukraine in the processes of integration into the world and European transport systems are considered by scientists Yu.Ye. Pashchenko, O.I. Nikiforuk in [10]. Comprehensive assessment of the reliability of transport systems, analysis of the availability of optimal trips, rational schemes of distribution of train flows is considered [11 – 20]. However, the traditional formalization of the optimization problem in a single-criteria form does not provide a solution to the complex problem of selecting and assessing the reliability of the optimal route in a multimodal transport network. Progressive in this sense are the methods of multicriteria (vector) selection, evaluation, and optimization [21 – 25]. Analysis of the methods used in solving multicriteria problems shows that the most effective are the methods of multicriteria optimization, which consist of reducing problems to a single-criterion form according to a certain criterion and finding its extremum. Therefore, it is necessary to solve the problem of assessing the reliability of the optimal route of transportation using multicriteria approaches.

In connection with the above, the task of developing a methodology for assessing the reliability of the choice of the optimal route of transportation in a multimodal transport network.

The main idea of the problem solution

The specificity of the problem of decision-making with the choice of a single option from a variety of alternatives is the need to analyze the factors that determine this choice. As a rule, these factors form a vector that is transformed into a vector of criteria when formalizing the problem of choice as an optimization problem. And, therefore, multifactorial and multicriteria analysis for the problems of choosing alternatives is a priori adequate and corresponds to the natural essence of such problems. Therefore, the article considers the problem of assessing the reliability of the choice of the optimal route as a problem of multicriteria choice. For this purpose, alternative routes are built on the graph of the transport network. Alternative routes are described by a graph with a vector of indicators and criteria for each specific route variant. The route is selected based on the analysis of the integrated efficiency criterion of each graph bypass option. The integrated indicator (aggregation stage) is formed according to the nonlinear scheme of compromises of prof. Voronina A.M. The assessment of the reliability of the choice of the optimal route is based on the linguistic category of efficiency on a fundamental scale.

The purpose of the methodology is to increase the reliability of the choice of the optimal route of delivery of goods in a multimodal transport network.

Presentation of the main material of the study

The methodology of multicriteria distribution of traffic flows in a multimodal transport network includes three generalized stages: formation of indicators and criteria of route optimality; determination of values that characterize the change of the established indicators and criteria of route optimality; deciding on the optimal route. The essence of the method is explained by the structural and logical scheme of Figure 1.

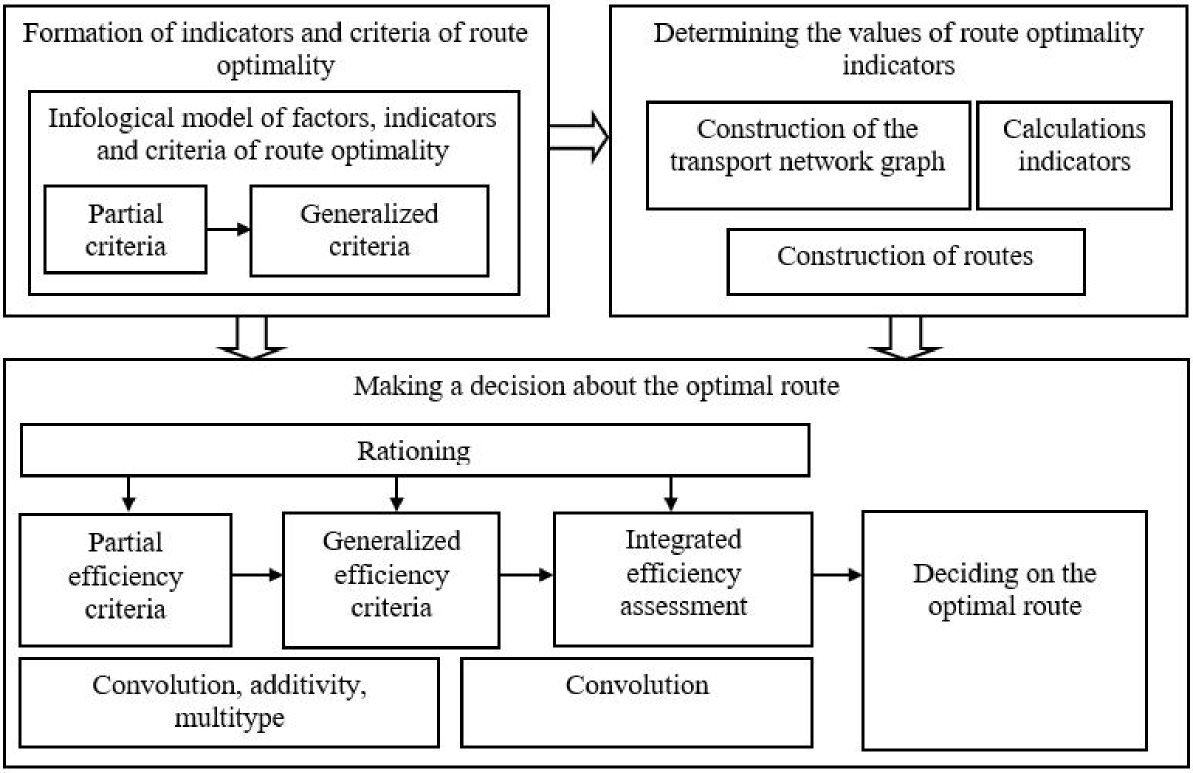

Figure 1. Structural and logical scheme of the method of multicriteria selection of the optimal route

The developed methodology is based on the presentation of the problem by a multicriteria model and the development of a single multicriteria estimate using a nonlinear scheme of compromises. However, the final decision on the optimality of the route is formed in the form of a linguistic category of quality. The assessment of the reliability of the determined optimal route is established by a comparative assessment.

1. Formation of indicators and criteria of route optimality

To assess the reliability of the choice of the optimal route, indicators and criteria of optimality are formed, which are a measure of the positive effect of the functioning System of Rail Freight Transportation (SRFT).

The structure of SRFT can be represented by the following components – transport work, material and technical base, operational work, economic efficiency. These components of the structure of SRFT, following the main purpose of the system, are determined by a set of factors that affect its effectiveness as a whole and form a system of indicators and criteria of optimality.

The main categories of factors influencing the choice of the route of transportation of goods by rail rolling stock: organizational (technological), technical (operational) and economic.

The category of organizational (technological) factors includes those that characterize the participants in the transportation process, namely the number of modes of transport involved in the transportation process, available rolling stock, responsibility and professionalism of persons planning operations, routes, documentation and directly transportation.

The category of technical (operational) factors should include those determined by the technical component of the system, the capabilities of technical devices. The following groups of factors are included in this category: rolling stock and equipment, infrastructure, cargo, cargo handling point.

The category of economic factors that affect the efficiency of the functions performed by the system reflects the cost of operations, including the cost of transportation of passengers and goods, the cost of achieving high productivity, deductions for system maintenance and more.

To achieve a positive effect from the functioning of the system when considering both organizational (technological) and technical (operational) factors, there is a need to increase certain costs. This resource is limited, so it is natural to try to reduce costs in the system. Thus, the category of economic factors affects the efficiency of the system, and the reduction of economic costs often leads to a deterioration of its properties.

Each factor influencing the choice of the optimal route of transportation is reflected by one or more indicators and criteria. Therefore, indicators and criteria can be unitary or combinatorial, ie those that are generalized for a particular decomposition link and are formed from partial indicators and criteria. For the case of combinatorial indicators and criteria, a hierarchy is built for each of them, from which a system of efficiency criteria is formed. The generalized hierarchy of partial and generalized criteria for organizational (technological), technical, operational, and economic categories can take the form of structural schemes (Figure 2).

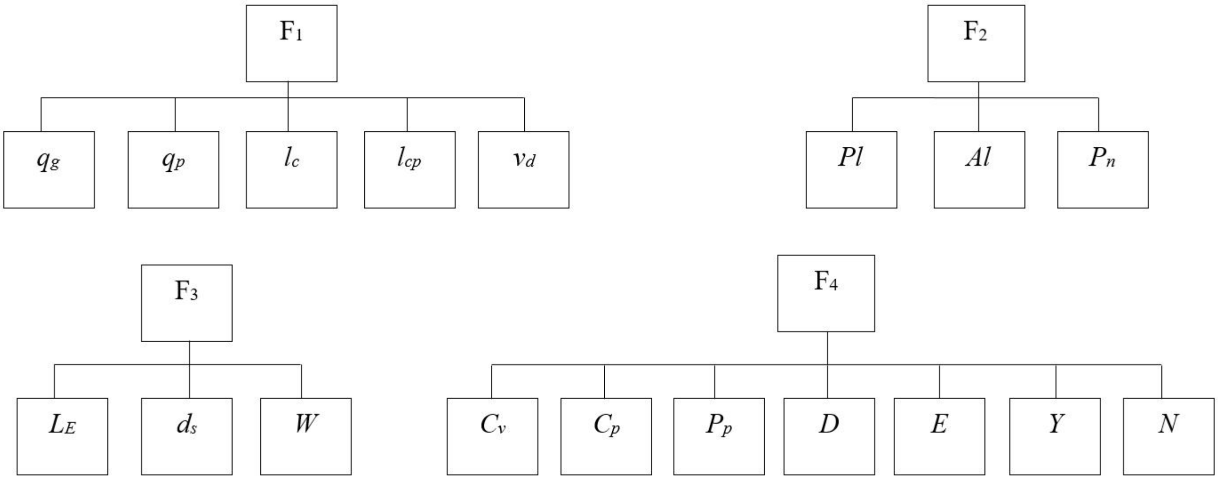

Figure 2. Hierarchy of partial and generalized criteria

These categories are organized in the form of an infographic model of factors, indicators, and criteria for the optimality of the route of transportation of goods by rail rolling stock, Figure 3.

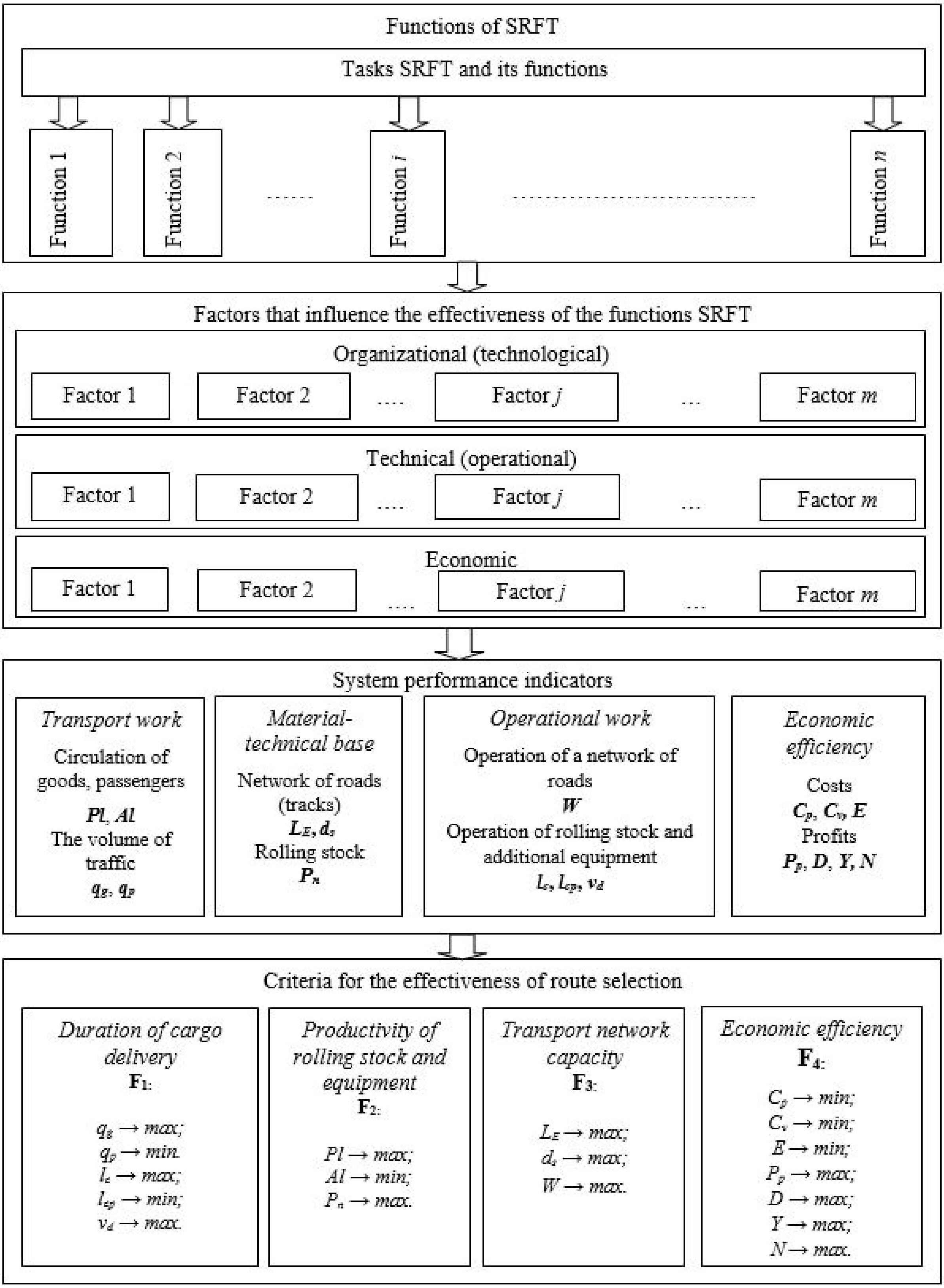

Figure 3. Infological model of factors, indicators, and criteria for the optimality of the route of transportation of goods by rail rolling stock

Following, we obtain a system of criteria that will characterize the optimal choice of the route of transportation of goods by rail rolling stock F_M for indicators of the unitary type in the form:

$$F_M = \begin{cases} F_1 \to \min; \\ F_2 \to \min; \\ F_3 \to \min; \\ F_4 \to \min. \end{cases} \quad (1)$$

$$F_1 = \begin{cases} q_g \to \max; \\ q_p \to \min; \\ l_c \to \max; \\ l_{cp} \to \min; \\ v_d \to \max. \end{cases} \quad F_2 = \begin{cases} Pl \to \max; \\ Al \to \max; \\ Pn \to \max. \end{cases} \quad F_3 = \begin{cases} L_E \to \max; \\ d_s \to \max; \\ W \to \max. \end{cases} \quad F_4 = \begin{cases} C_v \to \min; \\ C_p \to \min; \\ P_p \to \max; \\ D \to \max; \\ E \to \min; \\ Y \to \max; \\ N \to \max. \end{cases} \quad (2)$$

Combinatorial indicators of the optimal route will be characterized by the expansion of the system of criteria (1) following the model subsystems of partial criteria (Figure 3).

Thus, partial criteria of efficiency of the process of choosing the route of cargo transportation by rail rolling stock in the form of unitary (1) and combinatorial systems of partial criteria (2) are formed.

The explanation of the physical essence of the established indicators and optimality criteria following the notations and explanations of the order of determination, describing the change of partial criteria, are given in Table 1.

The main criteria for the effectiveness of the choice of the route of transportation of goods by rail rolling stock are the following:

F_1 – duration of cargo delivery;

F_2 – productivity of rolling stock and equipment;

F_3 – capacity of the transport network (infrastructure facilities, track facilities);

F_4 – economic efficiency.

The model shown in Figure 3 allows to form a system of contradictory partial criteria of route optimality, which indicates the receipt of a multicriteria optimization problem for determining the optimal route of transportation:

$$\delta = \begin{cases} q_p \to \max; q_p \to \min; l_c \to \max; l_{cp} \to \min; \\ v_d - \max; Pl \to \max; Al \to \min; \\ P_n \to \max; L_E \to \max; d_s \to \max; \\ W \to \max; C_p \to \min; C_v \to \min; P_p \to \max; \\ D \to \max; E \to \min; Y \to \max; N \to \max. \end{cases} \quad (3)$$

The formed system of partial criteria is contradictory, which follows from such considerations. The simultaneous increase in freight and passenger traffic on one line will negatively affect the capacity and carrying capacity of the elements of the transport network. Thus, the set of contradictory partial criteria of route optimality indicates the reduction of the synthesis problem to a multicriteria form. Then the formation of the mathematical model of SRFT will consist in establishing the relationship between the partial criteria of system optimality by solving a multicriteria optimization problem.

Table 1.

Generalized table of indicators and criteria of optimality
of the route of cargo transportation by railway rolling stock

Generalized indicator	Partial indicator	Extreme direction	Physical essence	The order of determination
F_1	q_g	max	Volume of cargo transportation	Calculation
	q_p	min	Volume of passenger traffic	Calculation
	l_c	max	Average distance of cargo transportation	Calculation
	l_{cp}	min	Average distance of passenger transportation	Calculation
	v_d	max	Speed of cargo delivery	Calculation
F_2	Pl	max	Turnover of goods	Calculation
	Al	min	Turnover of passengers	Calculation
	P_n	max	Load capacity of a rolling stock unit	Calculation
F_3	L_E	max	Operating length of tracks between stations	Calculation
	d_s	max	Network density	Calculation
	W	max	Traffic intensity	Calculation
F_4	C_p	min	The cost of transporting passengers	Calculation
	C_v	min	The cost of transportation of goods	Calculation
	P_p	max	Productivity of work	Calculation
	D	max	Revenues	Calculation
	E	min	Costs	Calculation
	Y	max	Profit	Calculation
	N	max	Cargo transportation fee	Calculation

Table 3 data are the starting point for further calculations of alternative routes.

2. Construction of the transport network graph

To construction a graph of the transport network, the nodal stations Odessa-Zastava 1, Ternopil, Lviv, Stryy, Batyovo, Chop, Uzhhorod of the current route of the passenger train №108 Odessa-Holovna-Uzhhorod (through Chop station) were chosen, which is indicative, as transportation on the route is carried out by freight and passenger tracks rolling stock, and supplemented by nodal railway stations of the Western region of Ukraine with heavy traffic of passenger and freight rolling stock.

Node and border stations are the vertices of the graph. Total vertices – 13. The characteristics of the edges of the graph are the real distances between the vertices, total edges 16, Figure 4. The total length of the edges of the graph is 1625 km.

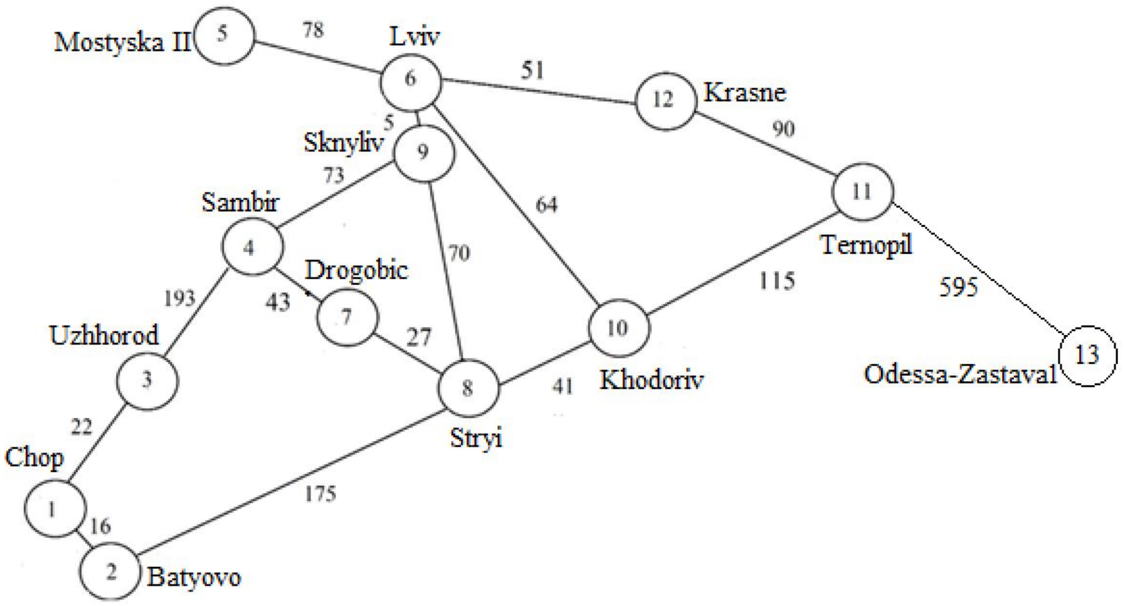

Figure 4. Graph of the railway transport network with interstation distances

Construction of routes on the graph of the transport network is carried out from the top 13 (Odessa-Zastava1 station) to the top 1 (Chop station). A total of 14 alternative routes have been built. Partial indicators of stations of the laid routes are generalized in Table 2.

Table 2.

Generalized table of indicators of transportation routes

Indicator / Route		M1				…	M14			
Generalized indicator	Partial indicator	Vertice i_1	…	Vertice j_1	Σ_1	…	Vertice i_{14}	…	Vertice j_{14}	Σ_{14}
F1	q_g	q_g^{i1}	…	q_g^{j1}	Σq_g^{ij1}	…	q_g^{i14}	…	q_g^{j14}	Σq_g^{ij14}
	q_p	q_p^{i1}	…	q_p^{j1}	Σq_p^{ij1}	…	q_p^{i14}	…	q_p^{j14}	Σq_p^{ij14}
	l_c	l_c^{i1}	…	l_c^{j1}	Σl_c^{ij1}	…	l_c^{i14}	…	l_c^{j14}	Σl_c^{ij14}
	l_{cp}	l_{cp}^{i1}	…	l_{cp}^{j1}	Σl_{cp}^{ij1}	…	l_{cp}^{i14}	…	l_{cp}^{j14}	Σl_{cp}^{ij14}
	v_d	v_d^{i1}	…	v_d^{j1}	Σv_d^{ij1}	…	v_d^{i14}	…	v_d^{j14}	Σv_d^{ij14}
F2	Pl	Pl^{i1}	…	Pl^{j1}	ΣPl^{ij1}	…	Pl^{i14}	…	Pl^{j14}	ΣPl^{ij14}
	Al	Al^{i1}	…	Al^{j1}	ΣAl^{ij1}	…	Al^{i14}	…	Al^{j14}	ΣAl^{ij14}
	P_n	P_n^{i1}	…	P_n^{j1}	ΣP_n^{ij1}	…	P_n^{i14}	…	P_n^{j14}	ΣP_n^{ij14}
F3	L_E	L_E^{i1}	…	L_E^{j1}	ΣL_E^{ij1}	…	L_E^{i14}	…	L_E^{j14}	ΣL_E^{ij14}
	d_s	d_s^{i1}	…	d_s^{j1}	Σd_s^{ij1}	…	d_s^{i14}	…	d_s^{j14}	Σd_s^{ij14}
	W	W^{i1}	…	W^{j1}	ΣW^{ij1}	…	W^{i14}	…	W^{j14}	ΣW^{ij14}
F4	C_v	C_v^{i1}	…	C_v^{j1}	ΣC_v^{ij1}	…	C_v^{i14}	…	C_v^{j14}	ΣC_v^{ij14}
	C_p	C_p^{i1}	…	C_p^{j1}	ΣC_p^{ij1}	…	C_p^{i14}	…	C_p^{j14}	ΣC_p^{ij14}
	P_p	P_p^{i1}	…	P_p^{j1}	ΣP_p^{ij1}	…	P_p^{i14}	…	P_p^{j14}	ΣP_p^{ij14}
	D	D^{i1}	…	D^{j1}	ΣD^{ij1}	…	D^{i14}	…	D^{j14}	ΣD^{ij14}
	E	E^{i1}	…	E^{j1}	ΣE^{ij1}	…	E^{i14}	…	E^{j14}	ΣE^{ij14}
	Y	Y^{i1}	…	Y^{j1}	ΣY^{ij1}	…	Y^{i14}	…	Y^{j14}	ΣY^{ij14}
	N	N^{i1}	…	N^{j1}	ΣN^{ij1}	…	N^{i14}	…	N^{j14}	ΣN^{ij14}

3. Estimation of the reliability of a choice of an optimum route

To make a decision about the optimality of the route according to contradictory criteria (1), their reduction to an integrated assessment according to a nonlinear scheme of compromises following the convolution of Professor A.M. Voronin [4, 16], (3) using the technology of nested convolutions. The convolution uses a nonlinear scheme of trade-offs, which allows to obtaining a Pareto-optimal solution at low computational costs. The optimization problem is solved in the presence of constraints, which ensures the unimodality of the function of the generalized criterion and in any case guarantees a single solution. Convolution allows to using the minimax approach, ie to concentrate on extremization of the dominant partial criterion of optimality.

The rationing of partial optimality criteria is carried out by expression, rationing of weights coefficients according to equations):

$$Y(y_0) = \sum_{l=1}^{b} \gamma_{0l} \left(1 - y_{0l}\right)^{-1} \to \min \qquad (4)$$

where $l = 1..b$ – the number of included in the convolution of partial optimality criteria;

γ_{0l} – normalized weighting coefficient;

y_{0l} – normative partial criterion.

The requirement to use the convolution (4) is the normalization of the parameters that are part of them. Rationing provides a reduction to a single dimensionless scale of estimates of partial criteria of optimality with different physical essence and different absolute values. This allows you to equally influence the result of solving the optimization problem of each of the partial criteria.

Weights are normalized by the equation:

$$\gamma_{0l} = \frac{\gamma_l}{\sum\limits_{l=1}^{b} \gamma_l}, \qquad (5)$$

where γ_l – the current (unregulated) value of the weighting coefficient.

Since the convolution (1.4) is minimized, ie will include criteria requiring their minimization, then the partial discrete optimality criteria are normalized relative to the sum of current values separately for those that are minimized:

$$\varphi_{0l}^{\min} = \frac{\varphi_l^{\min}}{\sum\limits_{i=1}^{N} \varphi_{li}^{\min}}, \qquad (6)$$

and for those who maximize:

$$\varphi_{0l}^{\max} = \left(\varphi_l^{\max} \cdot \sum_{i=1}^{N} \frac{1}{\varphi_{li}^{\max}} \right)^{-1}. \qquad (7)$$

The formation of generalized optimality criteria (1) for each route is carried out by equations:

$$F_{1_i} = \left(1 - q_{g_i 0}\right)^{-1} + \left(1 - q_{p_i 0}\right)^{-1} + \left(1 - l_{c_i 0}\right)^{-1} + \left(1 - l_{cp_i 0}\right)^{-1} + \left(1 - v_{d_i 0}\right)^{-1} \to \min; \qquad (8)$$

$$F_{2_i} = \left(1 - Pl_{i0}\right)^{-1} + \left(1 - Al_{i0}\right)^{-1} + \left(1 - P_{n_i 0}\right)^{-1} \to \min; \qquad (9)$$

$$F_{3_i} = \left(1 - L_{E_i 0}\right)^{-1} + \left(1 - d_{s_i 0}\right)^{-1} + \left(1 - W_{i0}\right)^{-1} \to \min; \qquad (10)$$

$$F_{4_i} = \left(1 - C_{v_i 0}\right)^{-1} + \left(1 - C_{p_i 0}\right)^{-1} + \left(1 - P_{p_i 0}\right)^{-1} + \left(1 - D_{i0}\right)^{-1} + \left(1 - E_{i0}\right)^{-1} + \left(1 - Y_{i0}\right)^{-1} + \left(1 - N_{i0}\right)^{-1} \to \min; \qquad (11)$$

In equations (8) – (11) the index $i = 1...N$ characterizes the corresponding partial and generalized criteria for different variants of construction of a route, the index normalized criteria are marked by an index zero.

The maximum and minimum values of the minimizing and maximizing criteria are grouped in the form of an abstract (worst) M_A route. The rationing of partial criteria is carried out relative to the maximum (minimum) values by equations, which makes it possible to obtain generalized criteria for the optimality of routes M1 – M14.

$$\varphi_{0l}^{\min} = \frac{\varphi_l^{\min}}{\max \varphi_l^{\min} + \Delta}; \qquad (12)$$

$$\varphi_{0l}^{\max} = \frac{\min \varphi_l^{\max} - \Delta}{\varphi_l^{\max}}, \qquad (13)$$

where $\max \varphi_l^{\min}$, $\min \varphi_l^{\max}$ – maximum and minimum values of minimizing and maximizing criteria in the interval of their consideration;

Δ – stock ratio, $\Delta = 0{,}03$;

$i = 1...N$ – the number of discrete values describing the change of partial optimality criteria.

The rationing of the generalized criteria is carried out under the conditions of their minimization according to the equation (14):

$$F_{0i} = F_i / F_{\max}, \qquad (14)$$

where $F_{\max}$ – the worst assessment of a particular option for building a system.

The parameter $F_{\max}$ is determined separately for each generalized criterion (8) – (11) and is formed from the worst (for normalized - maximum) values that describe the change of partial criteria when considering all the formed options for its construction.

The integrated optimality criterion is determined by normalized generalized criteria, which is a multicriteria optimization model:

$$F_{Mi} = (1 - F_{10})^{-1} + (1 - F_{20})^{-1} + (1 - F_{30})^{-1} + (1 - F_{40})^{-1} \to \min . \qquad (15)$$

The choice of the optimal route is to analyze the values that describe the change of the integrated criterion of optimality. In this case, the optimal route will be assumed ($i = 1...N$), for which the requirement of minimization of criterion (15) will be fulfilled.

$$N_{opt} = i, \ \text{якщо} \ F_{M\,i} \to \min . \qquad (16)$$

The minimization requirement is met to the integrated route criterion M14: $F_{M14} \to \min$, therefor $N_{opt} = M14$. The optimal delivery route is shown in Figure 5.

To assess the reliability of the choice of the optimal route of transportation in a multimodal transport network and make a final decision on the integrated assessment (15) it should be normalized according to the equation:

$$F_{M0} = 1 - \frac{F_{Mi}}{\max F_M} ; \qquad (17)$$

$$\max F_M = (1-[\max \mathrm{F}_{10} - \Delta])^{-1} + (1-[\max \mathrm{F}_{20} - \Delta])^{-1} + (1-[\max \mathrm{F}_{30} - \Delta])^{-1} + (1-[\max \mathrm{F}_{40} - \Delta])^{-1} . \ (18)$$

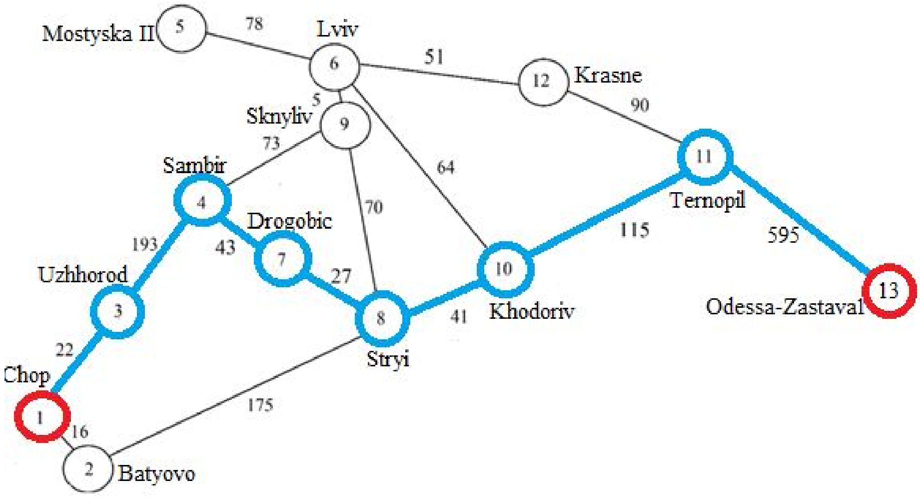

Figure 5. The optimal delivery route is M14

Integrated evaluation is normalized to the worst-case scenario of evaluating the effectiveness of the system as a whole. Such rationing allows to make the decision on the optimality of a route and to establish a comparative estimation of alternative routes. After normalization of the integrated estimate, we will have its change within in the range from zero to one with the highest score – close to one, and the lowest - close to zero. The integrated assessment of system efficiency takes into account its tasks, functions, and factors, as well as indicators of optimality criteria. It is according to the integrated assessment that the final decision on the optimality of the delivery route is made. The decision is made subjectively on the basis of an integrated assessment in the form of a linguistic category "good-bad". Therefore, it is natural to use a fundamental scale of assessment, which allows you to move from a numerical measure of efficiency to a linguistic category. This transition scale may have the form given in Table 3.

Table 3.

Fundamental rating scale

Integrated assessment of the effectiveness, F_{M0}	Linguistic category of efficiency
1,0 – 0,7	High
0,7 – 0,5	Good
0,5 – 0,4	Satisfactory
0,4 – 0,2	Low
0,2 and less	Unsatisfactory

As a result of calculations, the correspondence of alternative delivery routes to certain categories is determined, Table 4.

Table 4.

Distribution of routes by linguistic categories

Integrated assessment of the effectiveness, F_{M0}	Linguistic category of efficiency	Route
1,0 – 0,7	High	M14
0,7 – 0,5	Good	M13, M1, M10
0,5 – 0,4	Satisfactory	M3, M6, M8, M12
0,4 – 0,2	Low	M5, M7, M9, M11
0,2 and less	Unsatisfactory	M2, M4

Since the integrated assessment of the effectiveness of the route M14 belongs to the linguistic category "High", it is considered that the optimal route is established reliably.

Thus, the assessment of the reliability of the multicriteria choice of the optimal route for the carriage of goods in a multimodal transport network includes the following steps:

1. Construction of an infographic model of factors, indicators, and criteria for the optimal route of transportation, Figure 3, Table 1, equations (1) – (3);

1.1. Formation of a system of partial criteria for the optimality of the transportation route, equation (1).

2. Construction of the graph of the transport network, Figure 4;

2.1. Calculation of partial criteria for the optimality of alternative routes table 2;

3. Estimation of the reliability of a choice of an optimum route:

3.1. Development of a decision on the optimality of the route (1.5) – (14);

3.2. Formation of an integrated criterion of route optimality according to the mathematical model (11);

3.3. Selection of the optimal route from the set of alternatives under condition (16).

4. Formation of integrated assessment of route optimality in the form (17), (18) and determination of the linguistic category of efficiency on a fundamental scale, Table 3, 4.

Conclusions

To solve the problem of increasing the reliability of the choice of the optimal route of cargo delivery, a method of assessing the reliability of the multicriteria choice of the optimal route of cargo transportation in a multimodal transport network was proposed. The method is synthesized based on an infographic model of factors, indicators, and criteria for the optimal route of cargo transportation. The calculation of partial criteria for route optimality was performed on the graph of the transport network. The decision on the reliability of the optimal transportation route was made according to the integrated criterion in the form of the linguistic category "good-bad". The result is the confirmation of the reliability of the determined optimal route of cargo delivery and the distribution of alternative routes by linguistic categories.

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