

VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

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THE RESEARCH OF THE INFLUENCE OF LOGISTICAL
FACTORS ON TRANSPORT FLOWS DISTRIBUTION

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VILNIUS GEDIMINO TECHNIKOS UNIVERSITETAS

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PASISKIRSTYMO TYRIMAS

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Introduction

Relevance of the dissertation is determined by the object of research – the influence of logistical factors on transport flows distribution. The growth of world economics, business globalization, progress in technology skills extends the distances between geographical points of raw materials resources, manufacturers and consumers. Due to the membership in the European Union (EU) Lithuania has got new opportunities for international trade growth, and all the Eastern Baltic countries have become the buffer region for the EU trading with the countries of the Eastern Europe and Asia. A proper transport policy and infrastructure development would increase significantly the GNP in warehousing, transport and distribution sectors. Forecasting of potential transport flows according to logistical requirements of freight suppliers is most important for transport network optimization.

Scientific problem. Contemporary transport engineering theory approaches the peculiarities of transport flows formation too narrowly, only as an analysis of internal factors determining freight flows. There is no analysis of external factors. Many researchers assume that transport flows are determined only by the existing transport network and its characteristics. Other researchers consider transport flows as a result of logistic elements only. The estimating of internal and external logistical factors provides a possibility to forecast the transport flows.

Aim of the research is to create a model of logistical factors influence on transport flows distribution. Seeking to meet this aim, the author of the dissertation has solved the following **tasks**:

1. To make an analysis of the theory provided by Lithuanian and foreign researchers concerning the common interaction of logistics and transport, as well as to point out the advantages and disadvantages in the approaches and hypotheses of many authors, and to propose own conclusions.
2. To create a model of logistical factors and their indicators, which determine transport flows distribution in the transport

network.

3. To make empirical research of indices of logistical factors in Lithuanian case.

Scientific novelty of the research

1. The analysis of the research level of the scientific problem shows a very narrow theoretical view of determining transport flows. Many authors analyze internal factors only and do not estimate logistical needs of consignors and consignees.

2. The created new models determine transport flows and freight flows in transport network by internal and external specific logistical factors as well.

3. The results of empirical research of external factors confirm the created new models and provide a new interpretation and theoretical view of regularities of freight flows formation. Direct influence on basic transportation process characteristics and control is exercised by clients of transport companies.

The basic attitudes for defending

1 The advantages and disadvantages of approaches of numerous researchers on logistic and transportation functions.

2 The models determining distribution of transport flows according to logistical factors.

3 The conclusions of empirical research of logistical factors' influence in Lithuanian case.

The significance of the research. Theories proposed by many authors on transport and logistic functioning and interaction are analyzed, and a new point of theoretical view is given. The created models would be fit for forecasting of transport flows and planning of investments in transport infrastructure. The models would help the government, transport and logistics companies to make strategic decisions for development projects. Results of empirical research, which prove theoretical models are important for transport and logistic service providers and their customers for better common understanding and common activities.

Methodology of the research is based on regression and correlative analysis, forecasting, as well as on market survey and

mathematical modeling.

Approbation of the work. Main theses of the dissertation were approbated in 3 scientific published works and 14 scientific conferences papers.

Dissertation's structure. The work consists of introduction, three chapters, conclusions and a list of literature (123 scientific works). The amount of the work is: 108 pages, 61 figures and 20 tables. The work includes 6 appendixes.

Chapter One. The analysis of logistics influence on transport flows theory of Lithuanian and foreign researchers

The analysis of scientific works shows a dual aspect towards the transport flows distribution. The first theory shows that transport flows are distributed by decision of transport and logistics service providers and their engineering results. According to this theory, such criteria as: route characteristics, transport modes, optimal warehouse positions, and shortest paths, are determined from the technological point of view (Ballou, Coyle, Bardi, Langley). In other case this theory does not integrate external influence.

The estimating of logistic factors influence on transport flows gives another approach to the scientific problem. Conception of transport as logistics element regards all transport flows as a subsystem of material supply system (Lambert, Stock, Kotler, Bowersox, Christopher, Gattorna). In conformity to this theory researches were performed solving the following tasks in logistics: 1) add of value; 2) minimization of logistic costs; 3) customer service. But technological approach of transport flows distribution is totally missing these tasks. The origin of different approaches is the dual interpretation of transport service: 1) as physical material supply and 2) as logistical element.

In Lithuania the scientific problem of the dissertation is analyzed very narrowly, however there could be found the same dual approach according to the research works of Lithuanian scientists Baublys and Palšaitis.

Baublys gives the theory of transport network structure and graphs. Attention there is focused on mathematical modeling concepts. Transport network is regarded as a set of links and nodes. For each link and node there are determined physical parameters and carrying capacity. Some tasks, such as the shortest path for transport flow, are comparatively easy to solve, but the author of the dissertation formulates the hypothesis that the determination of physical parameters and carrying capacity only is not enough for the determination of transport flows distribution.

The theory of value added is based on the axiom that “consumers buy not product but satisfaction”. The value of the product could be added by consumer characteristics and attainability (Dixton). In this case attainability is the primary implementation in competition. The attainability is increasing according to logistic solutions. If we see attainability as added value, it is certainly important to estimate added cost and price. The added cost must not exceed the competition level.

During the last ten years the time of supply of goods in many cases is more important than the price, and the time terms of supply make the basic condition for purchasing (Christopher). It means that transport flows determine purchasing decisions.

The structure of logistic channels depends on the type of goods (Bowersox, Closs) as well. In case of wholesale, for terminals it is important to be not so far from intersection of basic transport corridors, railway and ferry approach, in case of retail the proximity of consumers market is important. Formation of transport flows in many cases does not depend from purposeful decisions, but is determined in long-term period by requirements of manufacturers, wholesalers, retailers and consumers (Lambert, Stock).

Chapter Two. The modeling of logistical factors determining transport flows

The model determining freight flows distribution. Since the flow of goods is limited, an issue of competitiveness among

logistical channels has arisen. In Fig 1 a fragment of the transport network is depicted, where Z_i – is a geopolitical region. In terms of application it could be a separate state, a union of states, an economic community or any other territorial unit. α stands for a consignor, whereas β symbolizes a consignee. Terminals or the nodes of the transport network are marked as k_i . The links connecting the nodes are transport roads.

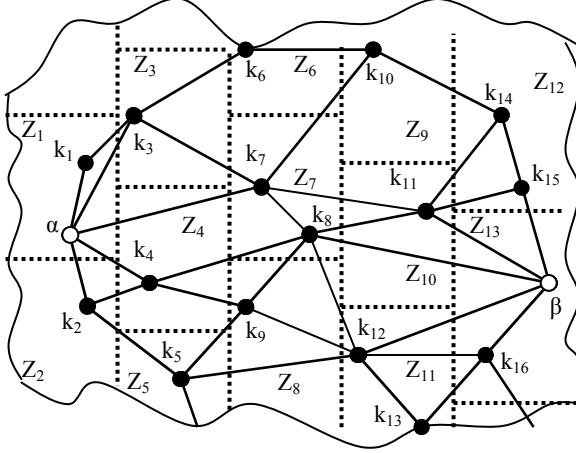


Fig 1. A fragment of the transport network

We are going to model the shipping of a particular goods set Ω during period T from consignor α located in geopolitical region Z_l to consignee β established in geopolitical region Z_{l3} . Goods traffic will take place through the intermediate nodes and links located in Z_i . As the purpose of this modeling is to define the factors which determine the formation of the goods flow along the subsystems of the entire logistical system from the geopolitical point of view, we have confined ourselves to the modeling of the case between one consignor and one consignee. Therefore, having modeled a single case between one consignor and one consignee, it is possible to use this model as a general case after the theory of entropies maximizing probabilities has been applied to it.

Let us mark the given fragment of the network as G , which is

composed of links N and M nodes.

$$G = [M; N]. \quad (1)$$

For each link of the network fragment $(k_i, k_{i+x}) \in N$, where x is a free operator of the node number, we ascribe a certain positive number $\lambda(k_i, k_{i+x})$, which is the competitiveness indicator of that link. This indicator of competitiveness can be expressed by means of a function:

$$\lambda(k_i, k_{i+x}) = f(c(k_i, k_{i+x}), d(k_i, k_{i+x}), e(k_i, k_{i+x})), \quad (2)$$

$c(k_i, k_{i+x})$ – physical capacity indicator showing the maximum amount of goods that can be carried between nodes k_i and k_{i+x} during a given time period;

$d(k_i, k_{i+x})$ – the indicator of price desirability showing the level of price competitiveness of goods carriage along link (k_i, k_{i+x}) ;

$e(k_i, k_{i+x})$ – the indicator of legal restrictions demonstrating the rate of restrictions imposed on the transportation within link (k_i, k_{i+x}) . The larger the amount of restrictive measures, $e(k_i, k_{i+x}) \rightarrow 0$.

For each network node $(k_i) \in M$ a certain positive amount $\delta(k_i)$ standing for the competitiveness level of the node has been ascribed. This competitiveness indicator can be expressed by a function:

$$\delta(k_i) = f(c(k_i), d(k_i), e(k_i)), \quad (3)$$

$c(k_i)$ – the physical capacity indicator showing the maximum goods amount which can be physically managed at node k_i during a given time period;

$d(k_i)$ – the price desirability indicator showing the level of price competitiveness of goods handling at node k_i ;

$e(k_i)$ – the legal restriction indicator demonstrating the rate of restriction imposed on goods handling at node k_i . The bigger the amount of restrictions, $e(k_i) \rightarrow 0$.

All possible sequences of nodes and links from α to β can be signified as logistical channels. Goods flows moving along these logistical channels can be stationary and dynamic. Here we are going to consider the case of stationary goods flow $v(\alpha, \beta)$ having size Ω along logistical channels. The amount of channels is

determined not only by the number of nodes and links existing in the transit region, but also by their configuration.

While modeling the alternatives of the traffic of the same goods flow along different logistical channels, the objective concerning the competitiveness of the logistical channel is solved.

Let us say that a number of logistical channels connecting consignor α and consignee β in the transport network fragment G is H . In other words the flow $v(\alpha, \beta)$ in the fragment G of the transport network has H alternative logistical channels. It can be put down as:

$$H = f(M, N, \theta), \quad (4)$$

θ – the coefficient defining the configuration of the fragment G of the transport network.

A separate channel will be marked as h_j . Each h_j is composed of a certain set R_j of nodes k_i and a certain set Q_j of links (k_i, k_{i+x}) which are arranged in sequence s_j . Links $(k_i, k_{i+x}) \in h_j$ and nodes $k_i \in h_j$ can be called the elements of the logistical channel h_j . Each element k_i and (k_i, k_{i+x}) of a logistical channel can belong to set D_i of the logistical channels passing through that element. If $h_j \in D_i$, then h_j characteristics will depend on $k_i \in h_j$ and $(k_i, k_{i+x}) \in h_j$ characteristics. The characteristics of logistical channel h_j can be expressed employing the coefficient of logistical advantage φ_{h_j} . The advantage coefficient φ_{h_j} of the entire channel h_j is dependent on the characteristics of the links $(k_i, k_{i+x}) \in h_j$ and the nodes $k_i \in h_j$ located in the given channel. Correspondingly it depends on $\lambda(k_i, k_{i+x})$ and $\delta(k_i)$. It can be expressed as follows:

$$\varphi_{h_j} = (R_j + Q_j) \sqrt{\prod_{\substack{k_i \in h_j \\ (k_i, k_{i+x}) \in h_j}}^{R_j} \delta_{k_i} \lambda_{(k_i, k_{i+x})}}. \quad (5)$$

If any:

$$\delta_{k_i} \in R_j \rightarrow 0, \quad (6)$$

or

$$\lambda_{(k_i, k_{i+x})} \in Q_j \rightarrow 0, \quad (7)$$

then

$$\varphi_{h_j} \rightarrow 0 . \quad (8)$$

Here we deal with the critical competitiveness condition of a logistical channel. It is crucial to remember to evaluate another channel h_j characteristic, i. e. its length L_{h_j} applied for a certain goods flow $v(\alpha, \beta)$:

$$L_{h_j} = \sum_{(k_i, k_{i+x}) \in h_j}^{Q_j} L_{(k_i, k_{i+x})} , \quad (9)$$

Here $L_{(k_i, k_{i+x})}$ – the length of the link.

Scientists, however, analyzing the advantage of logistical channels often solve the multicriteria task of finding the shortest way, which can be generally described as follows:

$$MINSUM \sum_{(k_i, k_{i+x}) \in h_j}^{Q_j} L_{(k_i, k_{i+x})} \rightarrow \min . \quad (10)$$

The length L_{h_j} of channel h_j is undoubtedly, one of the most important factors determining the flow $v(\alpha, \beta)$ through fragment G of the transport network. However, besides evaluating L_{h_j} it is crucial to evaluate φ_{h_j} . Here the competitiveness indicator μ_j of logistical channel h_j will be introduced:

$$\mu_j = \varphi_{h_j} \cdot \frac{1}{L_{h_j}} = \frac{\varphi_{h_j}}{L_{h_j}} . \quad (11)$$

Each logistical channel h_j has its fixed distance $L_{h_j} = const$, thus the prerequisite for increasing the competitiveness of a particular logistical channel is:

$$\varphi_{h_j} \rightarrow \max . \quad (12)$$

If conditions (6) and (7) are satisfied, then it can be expressed as follows:

$$\mu_{h_j} \rightarrow 0 . \quad (13)$$

It can be assumed, then, that owing to the economic reasons each geopolitical region seeks to attract the transit goods flow $v(\alpha, \beta)$ and that the goods flow $v(\alpha, \beta)$ can develop only within the regions Z_i located along fragment G of the transport network. So now let us solve the issue concerning the factors determining the formation of the goods flow $v(\alpha, \beta)$ across the region Z_i . The flow of goods will form in those Z_i regions through which the logistical channel h_j , having the highest coefficient of competitiveness μ_j stretches. As it has been proved in formulas (5), (6), (7) and (13) the competitiveness of a logistical channel is dependent upon the characteristics of its constituent elements and the minimization of nay of them can cause μ_j minimization.

Practical example of the model. For example we have a task the purpose of which is to find the competitive logistic channel from Lipetsk (Russia) to Detroit (USA). The condition is as follows: the transportation price and time as well as other terms from Eastern Baltic ports of St. Petersburg, Tallinn, Riga, Ventspils, Liepaja, Klaipėda, Kaliningrad, and Gdansk to Detroit are equal. So we must find a competitive channel from Lipetsk to selected port cities.

Tab 1. The coding of nodes

Node	City	Node	City	Node	City	Node	City
k_1	St. Petersburg	k_8	Briansk	k_{15}	Vitebsk	k_{22}	Kaunas
k_2	Novgorod	k_9	Smolensk	k_{16}	Gomel	k_{23}	Klaipeda
k_3	Tver	k_{10}	Velkyje Luki	k_{17}	Gardin	k_{24}	Panevezys
k_4	Moskow	k_{11}	Pskov	k_{18}	Brest	k_{25}	Riga
k_5	Tula	k_{12}	Mogiliovs	k_{19}	Gdansk	k_{26}	Liepoja
k_6	Lipetsk	k_{13}	Minsk	k_{20}	Kaliningrad	k_{27}	Daugavpils
k_7	Kursk	k_{14}	Pinsk	k_{21}	Vilnius	k_{28}	Tallinn

Table 1 provides the coding of nodes. Later we update transport network on the map (Fig. 2) and find the distances of the links. Having the distances we could have the shortest path (Formula 10) from k_6 to k_{19} , k_{20} , k_{23} , k_{26} , k_{25} , k_{28} , k_1 . The advantage characteristics of the channels estimated by transport experts are calculated by the Formulas (2), (3), (5). The integrated

competitiveness indicators are calculated by the Formula (11).

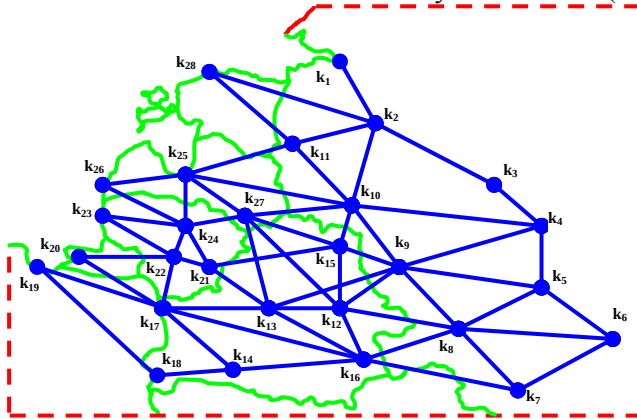


Fig 2. The transport network of East Europe

According to this calculation the primary channel is $(k_6, k_5, k_4, k_3, k_2, k_1)$ Lipetsk – Tula – Moscow – Novgorod – St. Petersburg.

The model of shipment grouping. In the last years the size of consignments is falling gradually. When attempting to maintain a high coefficient of loading of transport means, greater attention should be paid to grouped goods. Transport companies tend to have loyal clients and a flow of goods more stable because as the volume of goods fluctuates a lot, it becomes more difficult to organize the carriage and forecast the need for the transport means, their characteristics. As the size of consignments is diminishing, there appears a possibility of minimizing of volume fluctuations, i.e. grouping goods in accordance with the direction of the destination point.

The formulation of the condition for the carriage of on-line grouped goods. Let us now analyze the possibility of goods grouping given in Fig 3 fragment of the transport network. For example, a transport company carrying goods from k_1 to k_6 knows about the need to transport goods from k_2 to k_5 and from k_4 to k_6 . Let us mark single carriages of the goods $\Omega_j(k_1, k_6)$, $\Omega_j(k_2, k_5)$ and $\Omega_j(k_4, k_6)$, where Ω reflects the amount of the goods j - carriage.

On-line grouping of goods should meet four requirements:

a) Adequacy of route:

$$(k_2, k_5) \in (k_1, k_6); \quad (14)$$

$$(k_4, k_6) \in (k_1, k_6); \quad (15)$$

b) Adequacy of time $\Theta(\Omega_j)$ of j -carrying of goods:

$$\Theta(\Omega_j(k_1, k_6)) \cong \Theta(\Omega_j(k_2, k_5)) \cong \Theta(\Omega_j(k_4, k_6)). \quad (16)$$

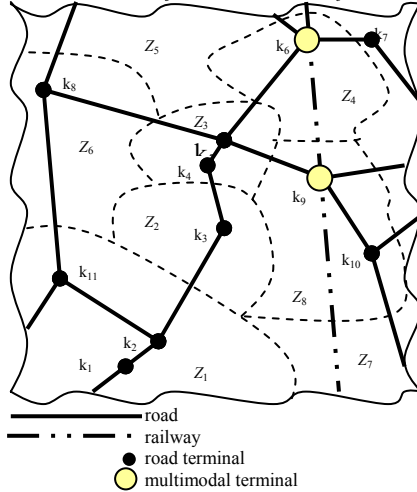


Fig 3. A fragment of the transport network

A possible time inadequacy error can be different in each separate case and it has to meet the needs of goods consignors and consignees.

c) Volume adequacy condition:

$$\Omega_j(k_1, k_6) + \Omega_j(k_2, k_5) + \Omega_j(k_4, k_6) \leq \Omega_{a/m} \quad (17)$$

$\Omega_{a/m}$ – the capacity of a transport means for carriage.

d) The condition ensuring the adequacy of legal means.

The task of channel creating. We are going to evaluate a possibility of building a logistical chain (k_8, k_5, k_9, k_{10}) , for carrying on-line grouped goods. Let sign (k_i, k_{i+x}) as l_j . The territory under investigation is subdivided into trading regions. Z_j . A complete set of regions $P = \{Z_1, \dots, Z_{p.\max}\}$ is called a territory under development,

when the following requirement is met:

$$\forall 1 \leq i, j \leq p. \max_{i \neq j} Z_i \cap Z_j = \emptyset. \quad (18)$$

A complete set of trading regions $T = \{Z_1, \dots, Z_{t_{\max}}\}$ is called a territory under investigation, when the following requirement is met:

$$\forall 1 \leq i, j \leq t. \max_{i \neq j} Z_i \cap Z_j = \emptyset \quad (19)$$

The structure of a territory $S = (P, T, X, E, W)$ is composed of the following elements: the territory being planned P ; the territory under investigation T , where $P \subseteq T$; $X: T \rightarrow N$, i.e. a name granted to each trading region of the territory being researched; $E: P \rightarrow N$, the number of enterprises attributed to each trading region of the territory being planned; $W: P \rightarrow N$, the turnover of on enterprises dispatched and accepted goods of each trading region located in the territory is being planned. Here:

$$P = (Z_6, Z_3, Z_8), \quad (20)$$

$$T = P \cup (Z_1, Z_2, Z_4, Z_5, Z_7). \quad (21)$$

The task of carrying service supply. The network of channels can be described as follows: $G_R = (K, L, L_R, I, XY, Q, B)$. Here: K – a complete set of transport terminals belonging to the chains along which grouped goods flow. L – a complete set of links defined as $l \in L$, $l = (M, t, B)$ and consisting of the route of the logistical chain carrying grouped goods $M[k_1, \dots, k_n]$, where $\forall 1 \leq i \leq n \ k_i \in K$; the time period of carriage $t: \{1, \dots, n-1\} \rightarrow N$ between two terminals, the length of the links $B: \{1, \dots, n-1\} \rightarrow N$. A set of connections between non-oriented trading regions and transport terminals $L_R \subset T \times K$. Thus, each trading region is connected: $\forall Z \in K \exists k \in K (Z, k) \in L_R$. The numbers of terminals $I: K \rightarrow N$. The coordinates of terminals $XY: K \rightarrow N \times N$. The kind of transport and their combinations $Q: L \rightarrow \{\text{road}, \text{railway}\}$. The length of distances between terminals and links $B: L_R \rightarrow N, m$.

To prove the adequacy of theoretical assumption of models to practical factors the author has made empirical research, the results of which are presented in the next chapter.

Chapter Three. The empirical research of logistical factors influence on transport flows

Analysis shows, that the Baltic region has a positive geopolitical factor, which induces the transit of goods. East Baltic seaports are shipment consolidators and distributors for major West European seaports. There is a strong competition between the East Baltic logistic systems.

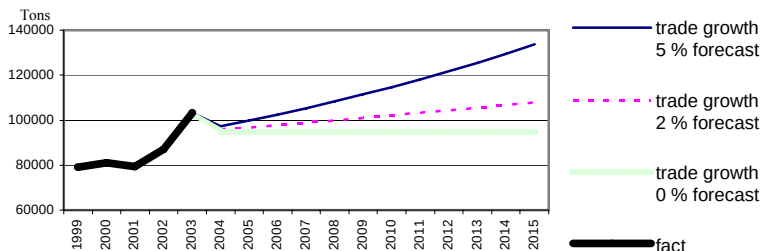


Fig 4. The forecast of freight flows

Analysis of secondary indicators shows that correlation of Lithuanian goods transportation and trade indicators in the period of 1999–2003 is positive 0.78. Regression and dispersion analysis provides the function $y = 0.9366x + 46119$, where y is freight volume in Tons and x is trade volume in LTL. Fig. 4 present forecasting by this function, with the condition of trade growth 0 %, 2 %, and 5 %.

Next follows the basic results of survey, which prove the characters of theoretical models. The survey was made in the period of December 2003 – January 2004 in 85 companies in Lithuania. All questions were divided according to six logical groups, the basic results of which are presented as follows:

1) *The basic factors determining warehouses' positions.* Fig 5 shows the hierarchy of parameters estimating the importance of warehouse position. Transport companies select more important technological parameters – positions: a, b, d, g. Trading companies

select supply management parameters – positions: c, e, f.

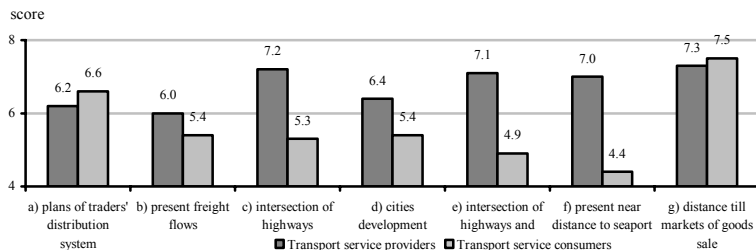


Fig 5. Hierarchy of parameters determining the warehouse position

Medium technological characteristics according to transport service providers is 7.3 and consumers – 4.7, in other case medium supply management characteristics according to transport service providers is 6.5 and consumers – 6.1. The survey shows the dual approach to transport flows distribution as well as theoretical analysis.

2) The basic factors determine selection of routes.

Fig. 6 shows the hierarchy of parameters estimating the importance of route selection. The survey shows also:

o 41.1 % transport service providers are under route selection influence of consumers.

o 75.0 % transport service consumers know exactly the transit routes of their goods, for 51.8 % route of their goods' transportation is important, 32.1 % make influence to route selection.

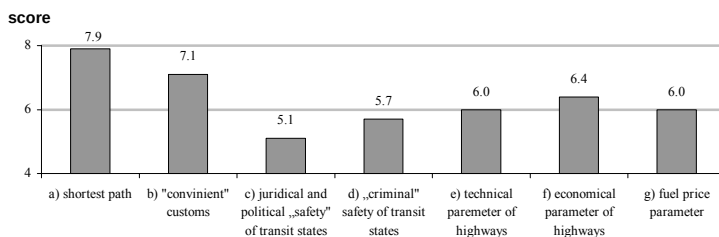


Fig 6. Hierarchy of parameters determining route selection

3) *The estimation parameters of delivery time.* Transportation distance determines the time of delivery. According to the survey, till 500 km average time of delivery by truck is 2 days, from 500 to 1500 km – 4.2 days, 1500 km and more – 8.0 days. The reason of this result is the grouping of goods. The grouping of goods provides a possibility to minimize cost per cargo unit, however for routing of the grouping of goods more time is necessary. 44.6 % goods by truck are carried as grouped goods. This shows necessity of creating the grouped goods channels.

4) *The estimation of delivery quality characters.* According to the survey, price (8.0) and time (7.7) are the basic factors determining selection of carrier. Safety (7.0) and reliability (7.1) are not so important for customers.

5) *The structure of logistical channel.* According to the survey 62.2 % of goods supply orders are direct from manufacturer and 37.8 % from distribution warehouse. This result shows a low level of distribution platform development in East Europe.

In large-size business import or export requires more goods direct from manufacturer. In small-size business more goods from distribution platform are required. So the type of logistical channel depends from business size and, of course, from supply order's size.

6) *The type of business contracts.* In regard of export and import, the contract customers of carriers are mostly the orders of Lithuanian companies. National factor is more important for selection of a transport company. According to the survey 72.9 % of contracts are long-term contracts and 27.1 % - casual.

Conclusions

The theoretical analysis of logistics influence on transport flows distribution concepts by many researchers, the mathematical modeling of transport flows determination factors and empirical research to give the following conclusions:

1. Many scientists explore logistics and transport by different concepts, however there are no special investigations of logistical

impact on transport flows distribution in their works. The analysis of scientific works shows a dual aspect of transport flows distribution. The first theory maintains that technological engineering solutions determine transport flows; the second theory considers that they are determined by logistical factors such as: 1) added value; 2) minimization of logistics costs; 3) customer service.

2. The supporters of technological approach focus the attention on mathematical modeling of freight flows in transport network, nodes and links, as well as logistical chains. According to this point of view, physical characteristics of links and nodes only give possibility to solve the task of freight flows distribution. The scientific problem is that physical characteristics do not suffice for the right solution of this task. It is important to find and estimate external logistical factors.

3. It is important to estimate that transport flows formation is determined in long-term period according to the requirements of manufacturers, wholesalers, retailers and consumers. The trade centralization is one of the basic elements in formation of logistical channels and distribution centers, and transport flows of course.

4. The mathematical model of transport flows distribution is created here. The model gives peculiarities of freight flows distribution according to estimation of economical, juridical and physical parameters of nodes and links. If a logistical subsystem of the given sub-region does not constitute the entire goods traffic channel from the consignor to the consignee, but it is a constituent part of the entire logistical channel from the consignor to the consignee, then the flow traffic goods through that sub-region will be dependent not only on the characteristics of the logistical channel existing in the sub-region's logistical system, but it will also depend on other regions, the logistical systems of which are involved in the common logistical channel. The minimization of the characteristics of any element may cause the minimization of the characteristics of the entire logistical channel as well as the loss of its competitive abilities.

5. The model of shipment grouping according to peculiarities of transport flows and logistic requirements is created. The model enables the estimating of characteristics of freight origins and destination points and forecasting of grouped shipment routes.

6. The survey shows dual approach to transport flows distribution as well as theoretical analysis. Transport flows are distributed according to logistic strategy of transport service consumers and technological solutions, and implementations of providers as well. The survey demonstrates that transport companies are not only 'sellers' or 'providers' of transport services. They are logistical partners of transport service consumers. The strategic partnership of trading and transport companies determines in many cases the formation of transport flows in Lithuania. According forecast of 5 % yearly trade growth, freight volume by road and rail in Lithuania will increase to 133.6 million tons in year 2015.

7. The basic logistical factors determining the distribution of transport flows in Lithuania according to the survey are these: geography of consumers markets, geography of basic transport nodes, structures of logistical channels, perspective of urban development, shortest paths, political and anti-criminal security of transit, grouping of goods, national factor.

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About the author

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SANTRAUKA

Temos aktualumas pagrįstas tyrimo objektu – logistikos veiksnių įtaka transporto srautų pasiskirstymui. Pasaulio ekonomikos augimas, spartėjantis globalizacijos procesas, technologijų pažanga didina atstumus tarp žaliavų gavimo, gamybos ir pagamintų prekių vartojimo taškų. Lietuva tapusi Europos Sąjungos nare, tampa Europos Sąjungos buferine zona prekybiniams mainams su Rytų Europos ir Azijos šalimis. Lietuvos transporto sistemą būtina pritaikyti esamiems ir potencialiems tarptautiniams krovinių srautams aptarnauti. Transporto srautų formavimosi išorinių veiksnių nustatymas ir įvertinimas Lietuvos transporto strategijoje gali suteikti šaliai didžiulį ekonominį potencialą.

Mokslinė problema. Dabartinis transporto inžinerijos mokslas transporto srautų formavimosi ypatumus nagrinėja per daug siaurai ir apsiriboja tik vidinių transporto sistemos charakteristikų modeliavimu, tačiau per mažai dėmesio skiria išoriniam poveikiui. Daugelis mokslininkų laikosi požiūrio, kad transporto infrastruktūros konfigūracija ir jos charakteristikos iš esmės lemia transporto srautus. Kiti mokslininkai propaguoja teoriją, kad transporto srautus lemia logistikos elementai. Tik nustačius išorinius logistikos veiksnius ir jų įtakos dėsningumus ir žinant žaliavų tiekimo, gamybos ir prekybos vystymosi kryptis, galima kryptingai planuoti transporto sistemos plėtrą.

Disertacinio darbo tikslas – ištirti ir sumodeliuoti logistikos veiksnių įtaką transporto srautų pasiskirstymui. Tikslui pasiekti darbe iškelti ir sprendžiami šie ***uždaviniai***:

1. Atlikti Lietuvos ir užsienio mokslininkų tyrimų ir pateiktų hipotezių apie logistikos įtaką transporto srautams analizę, išanalizuoti mokslininkų požiūrius, įvertinti jų privalumus ir trūkumus, pateikti savo pastabų ir papildymų.

2. Sumodeliuoti pagrindinius logistikos veiksnius ir juos apibūdinančius rodiklius, lemiančius transporto srautų pasiskirstymą transporto tinkle.

3. Remiantis sukurtuose modeliuose aprašytais parametrais atlikti pirminių ir antrinių logistikos veiksnių įtakos transporto srautų pasiskirstymui rodiklių tyrimą. Nustatyti įtakos dėsninumus Lietuvoje.

Darbo naujumas.

1. Išanalizuotas problemos ištirimo lygis ir nustatyta, kad kitų mokslininkų darbuose daugiausia dėmesio skiriama vidinių transporto sistemos veiksnių modeliavimui, neįvertinant labai svarbaus išorinio veiksnio – krovinių siuntėjų ir gavėjų logistikos poreikių charakteristikų.

2. Sukurti du nauji modeliai, kuriais matematiškai aprašomi ne tik vidiniai, bet išoriniai transporto srautų formavimosi veiksniai ir įvertinami jų parametrai.

3. Atliktas empirinis tyrimas, kurio rezultatai patvirtino teorines modeliavimo prielaidas ir leido įvertinti išorinių veiksnių charakteristikas Lietuvoje.

Ginamosios disertacijos nuostatos:

1. Disertacijai aktualių užsienio ir Lietuvos mokslininkų keliamų teorijų privalumai ir trūkumai.

2. Transporto srautų pasiskirstymą lemiančių veiksnių modeliai.

3. Lietuvos įmonių logistikos poreikių ir transporto srautų tyrimo rezultatai ir išvados.

Darbo reikšmė. Teoriniu požiūriu darbas reikšmingas, nes jame susisteminti požiūriai į logistiką ir transporto srautus, išnagrinėti mokslininkų požiūrių privalumai ir trūkumai. Darbe pateikti matematiniai modeliai leidžia toliau detalizuoti logistikos įtakos transporto srautų pasiskirstymui ypatumus. Praktiniu požiūriu darbas naudingas transporto politikos formuotojams. Šiame darbe pateikti modeliai ir atlikto tyrimo rezultatai gali būti pritaikyti tiek transporto paslaugas teikiančiose, tiek ir jas užsakančiose įmonėse bei pagerinti jų tarpusavio sąveiką.

Darbo metodika. Mokslinis darbas atliktas naudojantis sistetine analize, funkcinė analize, regresine ir koreliacine analize bei jomis paremtu prognozavimu, paklausos ir pasiūlos rinkos

tyrimu, matematiniu modeliavimu.

Darbo aprobacija. Darbo rezultatai aprobuoti 17 mokslinių publikacijų, iš jų 3 moksliniai straipsniai Lietuvos recenzuojamuose žurnaluose, 6 tarptautinių konferencijų ir 8 respublikinių konferencijų pranešimų rinkiniuose.

Disertaciją sudaro įvadas, trys skyriai, išvados, literatūros sąrašas (123 šaltiniai), pagrindinis tekstas išdėstytas 109 puslapiuose, yra 61 paveikslas, 20 lentelių. Disertacijoje pateikti 6 priedai.

Išvados

Disertaciniame darbe atlikta mokslininkų pateikiamų logistikos veiksnių įtakos transporto srautų pasiskirstymui koncepcijų analizė, matematinis veiksnių, lemiančių transporto srautų pasiskirstymą, modeliavimas ir empirinis tyrimas leido suformuluoti šias išvadas:

1. Mokslininkai logistiką ir transportą nagrinėja atskirais aspektais ir aiškiai neapibrėžia konkrečių išorinių veiksnių įtakos transporto srautų pasiskirstymui ypatumų. Nustatyta, kad egzistuoja dvejopas požiūris į transporto srautų pasiskirstymą. Pirmoji teorija teigia, kad transporto srautus lemia transporto tinklo teorijos inžineriniai sprendimai, antroji – logistikos veiksniai vadovaujantis: 1) pridėtinės vertės kūrimo, 2) logistikos kaštų minimizavimo ir 3) klientų aptarnavimo teorijomis. Šie principiniai teorijų skirtumai atsiranda dėl logistikos ir transporto paslaugos skirtingo interpretavimo: 1) kaip fizinio prekių judėjimo transporto tinkle ir 2) kaip logistikos elemento.

2. Technologinio požiūrio į logistiką šalininkai krovinių srautus transporto tinkle modeliuoja remiantis globalaus logistikos tinklo teorija, pagal kurią logistikos sistema interpretuojama kaip tinklas turintis mazgus – viršūnes ir jungtis tarp mazgų – briaunas. Logistikos grandinės interpretuojamos kaip atskirų logistikos grandžių sekos, kurias savo ruožtu sudaro viršūnių ir briaunų sekos. Šiais modeliais krovinių srautų pasiskirstymo transporto

tinkle uždaviniai gali būti išspręsti naudojant transporto tinklą bei mazgų ir briaunų pralaidumą charakterizuojančius fizinius rodiklius. Tokie uždaviniai nesunkiai matematiškai išsprendžiami, tačiau vien fizinių rodiklių vertinimo, kaip pagrindinio krovinių srautų formavimosi veiksnio nepakanka.

3. Nustatyta, kad transporto srautai nėra kuriami dirbtinai. Jie ilgainiui susiformuoja patys pagal gamintojų, didmenininkų, mažmenininkų ir vartotojų poreikių komplekso ypatumus. Toks stichiškas transporto srautų formavimasis ne visuomet leidžia įvertinti alternatyvių srautų naudos potencialą, tačiau transporto subjektai – kompanijos, siekdamos išvengti permainų rizikos, stengiasi išvengti didelių pokyčių. Svarbu išskirti, kad centralizuoti prekių mainai yra vienas svarbiausių globalinių logistikos kanalų ir paskirstymo centrų formavimosi veiksmų, o kartu transporto srautus lemiančių veiksmų.

4. Sukurtas transporto srautus lemiančių veiksmų matematinis modelis. Įvertinus transporto tinklo briaunų ilgius, briaunų ir viršūnių ekonomines, teises ir praleidžiamumo charakteristikas, modelis leidžia nustatyti krovinių srautų formavimosi ypatumus. Pateiktas praktinio modelio taikymo pavyzdys. Galima teigti, kad jeigu subregiono logistikos posistemis nesudaro pilno krovinių judėjimo kanalo nuo siuntėjo iki gavėjo, o yra tik sudedamoji viso logistikos kanalo dalis nuo siuntėjo iki gavėjo, tuomet krovinių srautų judėjimas per subregioną vyks atsižvelgiant ne tik į subregione esančio logistikos kanalo charakteristikas, bet ir kitus regionus, per kuriuos formuojasi logistikos kanalas. Bet kurio logistikos kanalo elemento vienos iš charakteristikų minimizavimas lemia viso kanalo konkurencingumo praradimą.

5. Sukurtas krovinių grupavimo atsižvelgiant į transporto srautų ypatumus ir logistikos poreikius modelis. Jis unikalus tuo, kad leidžia įvertinti regione esančių krovinių šaltinių ir nuotėkių charakteristikas bei numatyti rinktinių krovinių maršrutus. Modelis pagrįstas netiesioginio prognozavimo metodu. Tai leidžia tiksliau numatyti krovinių srautus, nes vertinamos ne ankstesnės

tendencijos, o krovinių siuntėjų ir gavėjų poreikiai.

6. Atliktas empirinis tyrimas patvirtino dvejopą požiūrį į transporto srautų formavimąsi, kaip ir teorinė analizė. Transporto srautai pasiskirsto pagal transporto užsakovų logistikos strateginius sprendimus ir transporto paslaugų teikėjų technologines galimybes. Tyrimas parodė, kad transporto kompanijos nėra vien tik transporto paslaugų pardavėjai, o yra šių paslaugų vartotojų logistikos partneriai. Galima teigti kad šių paslaugų teikėjų ir vartotojų strateginė partnerystė lemia transporto srautų formavimosi ypatumus Lietuvoje. Pagal prekybos apimčių 5 % kasmetinio augimo prognozes, krovinių vežimo apimtys 2015 m. pasieks 133,6 mln. tonų.

7. Atliktas tyrimas įrodė, kad pagrindiniai logistikos veiksniai, nulemiantys transporto srautus Lietuvoje yra produkcijos realizavimo rinkų geografija, įvairių transporto rūšių magistralinių mazgų geografija, prekybininkų tiekimo kanalų struktūros, perspektyviniai miestų plėtros planai, trumpiausi keliai, krovinių tranzito saugumas politine ir kriminaline prasmėmis, galimybė grupuoti skirtingų siuntėjų krovinius, nacionalinis veiksnys.

Andrius Jaržemskis

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