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LOGISTIC OPERATOR - FUNDAMENTAL FACTOR IN RATIONAL PRODUCTION OF SERVICES IN MULTIMODAL TRANSPORT

ABSTRACT

From its theoretical and practical point of view, traffic is one of the fundamental factors of the economy in a state. In the developed European countries, a rational production of transport services is presented by multimodal transport and the correct selection of a logistic operator. The aim of multimodal transport is to link together different forms of traffic in the most effective way, as well as all operations considering transport. The logistic operator is the only professional to perform complete services in multimodal transport, therefore it was necesarry to enable its further development and, in accordance with that, to suggest suitable solutions. An increase of the existing and the creation of new traffic currents can only be achieved with the development of multimodal transport, the correct selection of logistic operator and better organisation of the traffic system. In the future, the Republic of Slovenia should continue developing multimodal transport in order to decrease the differences in forms of transport in the developed European countries in the shortest time possible. The main task of the Republic of Slovenia is to integrate into the European flows as soon as possible, engage in a reciprocal cooperation by liberalization of flows of commodities and services, and create conditions for the inflow of foreign capital where all advantages of multimodal transport come into consideration. The result of the research is a model of multimodal transport logistic operator connecting the basic elements of that transport.

KEY WORDS

logistic operator, racionalization, multimodal transport, traffic system.

1. INTRODUCTION

International multimodal transport presents the transportation of commodities from the city in a state where the multimodal transport operator took over the merchandise to the place of delivery in another state with the use of at least two different means of transport, based on one multimodal transport contract and one document. One of the key elements for a rational functioning of a multimodal transport is the selection of a multimodal transport operator. Multimodal transport operator can be everyone that fulfils the terms of multimodal transport, but because of technical and technological qualification, the know--how in organizational law and experience, only the world's leading shipping companies, shipping agents, road traffic operators and renowned names of forwarding trade engage in multimodal transport (Schenker, MSAS Global Logistics, Panalpina, GeoLogistics, Ermefer, Intereuropa). A multimodal transport operator has to undertake constant adaptation to changing requirements of logistic demand. The tasks are more and more complex and require more knowledge, expertise, creativity and quality information. Along with the transformation of classic forwarding trade there is a necessity for a logistic operator.

The fact is that nowadays the relevant factors that have influence on the development of traffic, especially the development of multimodal transport are not being sufficiently researched and used. Because of the before mentioned problems a *problem of scientific research* is being defined: If we take into account that in highly developed states multimodal transport and logistic activities connected with transport are developing intensively, and mega and niche logistic operators are being affirmed, we can conclude that there is not enough attention being paid to the research of phenomena of multimodal transport, logistics and logistic operators in Slovenia.

According to the problem of research there is the *subject of scientific research: to research, to analyze, to confirm the actual theoretical and practical problems of mega and niche logistic operators in Slovenia and European Union, to formulate results of the research and submit a new model of logistic operator as a creator of rational production of services in multimodal transport in Slovenia.* The problem of scientific research and the subject of scientific research both apply to two real *objects of research:* logistic operator and multimodal transport in Slovenia. In accordance with the problem, the subject and the object of research, a *scientific hypothesis* is being set: *With scientific cognitions of logistics, multimodal transport and mega and niche logistic operators it is possible to form a new model of logistic operator as a creator of rational production of services in multimodal transport in Slovenia.*

2. DETERMINATION OF THE MEGA MODEL PARADIGM AND THE NICHE LOGISTIC OPERATOR

2.1. Terms: logistics as science, logistics as activity and logistic operator

By confirming all the relevant characteristics and factors of logistic multimodal transport and cognitions of logistic operator as the fundamental factor in the development of multimodal transport, the hypothesis is being confirmed: with cognitions about mega and niche logistic operators it is possible to transform forwarding agents and transporters into logistic operators that can have a positive effect on rationalization of multimodal and distribution chains and sustainable development of international multimodal transport. By setting the model of logistic operator, the fundamental scientific hypothesis has been proven and the basis for the development of a logistic operator in a modern multimodal transport system that will connect national traffic currents with the European traffic system is given.

For the practical realization of the logistic operator model it is necessary in an organization of a multimodal transport system to include all elements for rational functioning, together with a reciprocal coordination and integration of the entire multimodal transport system. The elements of a logistic operator model are elements that have influence on the realization of the multimodal transport system, such as: *multimodal infrastructure, multimodal suprastructure, multimodal technologies, multimodal commodity currents, multimodal law, multimodal logistic operator, multimodal sustainable development, intellectual logistic capital, global logistic chains, logistic distribution* *chains, logistic information systems and other multimodal factors.*

In the early stages of development of logistics as an activity (and as science), the know-how and experience were predominating (empirical knowledge), but later on this was replaced by science, scientific cognitions, scientific facts, law, regulations and theories. Despite the numerous definitions of the word logistics we cannot find a theory that would explain logistics as science and activity, therefore the definitions of these terms are defined in the following paragraphs.

Logistics as science is a combination of interdisciplinary and multidisciplinary knowledge, that study and use the regulations of many complex activities (functions, processes, measures, businesses, rules, operations, works...), and that functionally and actively connect all the partial processes of mastering spatial and timing transformations of material, goods, knowledge, people, information (...) into safe, fast and rational (optimal) unique logistic processes and currents of material (...), capital, knowledge, information (...) from the point of receipt to the point of delivery with the aim, by a minimal input of resources and potential (productive, human, financial...), of maximally meeting the demands of the market (buyers of goods, users of services, consumers). These activities offer the market more effective and optimal possibilities of solving its demands in the form of concrete and more suitable logistic services inside concrete and existing logistic systems.

It is necessary to distinguish the content and the notion of logistics as science and logistics as activity, for the logistics as science presents the most important basis for logistics as activity.

Logistics as activity denotes a combination of planned, coordinated, regulated and controlled non-material activities (functions, processes, measures, businesses, operations, works...), by which all partial processes of mastering spatial and timing transformations of material, goods, things, matter, semi-manufactures, repro-material, live animals, capital, knowledge, people and information (...) are functionally and actively connected into safe and rational (optimal) unique logistic processes and currents of material (...), capital, knowledge and information (...) from a sender (point of receipt of raw material base, semi-manufacturers, storehouses, terminals, sellers, exporters...) to a receiver (point of delivery (semi)manufacturers, storehouses, terminals, buyers, importers, users and consumers...) with the purpose of providing the market with optimal possibilities of solving its demands in the form of concrete and appropriate logistic activities of production, remaking, handling, completion, maintenance, packing, marking, arranging, sorting, weighing, measuring, embarking, disembarking, transhipping, storage, filling and emptying

containers and means of transport, transport, forwarding trade, agency, insurance, customs examination, deed of sale, distribution, marketing, management, calculations, financing, controlling (...), tracking of executions of certain activities, law-economic regulation of relations among many participants in logistic processes (...).

Logistic operator is a registered and authorized corporation or person that in its own name and for its own account performs or organizes numerous logistic activities in connection with manipulation, transport, transfer, distribution of raw material, semi-manufactures, repro-material, finished products, goods, things, matter and live animals (...) from the point of receipt, i. e. raw material base, (semi)manufacturers, storehouses, terminals, sellers, exporters, ... to the point of delivery, i. e. (semi)manufacturers, storehouses, terminals, buyers, importers, users, consumers..., which by minimal input of means and potentials (i. e. productive, financial, human...) maximally meets the demands of the market (i. e. buyers, users, consumers), such as their order givers or partners.

The fact is that logistic operators produce their specific logistic products (i. e. their own logistic services) with help of their interdisciplinary and multidisciplinary knowledge, relations of intellectual capital, especially human capital, where other elements of production of logistic services have a secondary notion (what is meant is the logistic infrastructure, logistic suprastructure, modern transport technologies, objects of transport, costs, speed and quality of distribution of logistic...).

2.2. Formation of a universal mega model and logistic operator niche

Rational realization of multimodal transport is conditional on compatible traffic system and logistic operators, where they play the most important role. To achieve the best possible compatibility and increase the efficiency of the multimodal transport system, a model of multimodal transport logistic operator in Slovenia is suggested in this section.

Based on cognitions on classic forwarding trade and logistic forwarding trade as science and as activity, and on cognitions on classic and logistic forwarding agents and forwarding and logistic operators, it is possible to define an international forwarding agent as a mega-logistic operator. Based on today's level of development of production capabilities, production and social relations, forwarding, traffic and logistic sciences and activities we can define that an international forwarding agent as a mega-logistic operator is a big logistic operator, often a corporation, that in its name and for its account or by other logistic legal subjects, performs and organizes numerous logistic activities in connection with manipulation, transport (as a rule multimodal transport), transfer, distribution of raw material, semi-manufactures, repro-material, finished products, goods, things, matter, live animals (...) from the point of delivery, i. e. raw material base, (semi)manufacturers, storehouses, terminals, sellers, exporters, ..., to the point of receipt, point of (semi)manufacturers, storehouses, terminals, buyers, importers, users, consumers, that by minimal input of means and engaged potentials (i. e. productive, informational, financial, human...) maximally meet the demands of their order givers and business partners (cf. scheme 1).

Scheme 1 : Mega logistic operator model

Mega-logistic operator is responsible for the selection and work of all participants engaged in execution of multimodal transport from the moment of receipt of consignment, to the moment when the same consignment is delivered in accordance with the terms of a concrete contract i. e. the document of multimodal transport. Mega multimodal transport operator (MMTO) can be a vessel-operating multimodal transport operator (VO-MTO). In that case, the mega multimodal transport operator can be a maritime operator as a vessel-operating mega multimodal transport operator (VO-MMTO). Mega multimodal transport operator (MMTO) can also be a non-maritime operator as a non-vessel operating multimodal transport operator-NVO-MTO). In the end, a mega multimodal transport operator (MMTO) can be a non-maritime operator as a non-vessel operating mega multimodal transport operator-NVO-MMTO) [4, 420].

By analogy with the term of international forwarding agents as mega-logistic operators it is possible to define the term of international forwarding agent as a niche logistic operator. In accordance with today's level of development of traffic, the forwarding and logistic sciences and activities, or sciences and activities that are studied and used in important logistic activities in management of commodity currents and informational currents from raw material base to consumers (...), it can be defined, that an international forwarding agent as a niche logistic operator is a small or middle logistic operator, a corporation or a person that as a rule in its name and for its account performs or organizes certain logistic activities (which are smaller and simpler in value, extent and importance) in certain logistic branches, in certain links in logistic chains or logistic distribution chains, in connection with manipulation, transport, transfer, distribution (...) of objects, separate logistic processes from the place of delivery (i. e. storehouse, terminal, ...) to the place of receipt (i. e. storehouse, terminal, ...), and which by a minimal input of means and engaged potentials (i. e. productive, informational, financial, human...) maximally meet the demands of their order givers and business partners (cf. scheme 2).

Scheme 2: Niche logistic operator model

Niche multimodal transport operator combines the characteristics of a »niche« operator in a corresponding way. In this role there are maritime operators as vessel-operating multimodal transport operators (VO-MTO) and non-maritime operators as non-vessel operating multimodal transport operators (NVO-MTO).

3. QUANTIFICATION OF ELEMENTS IN THE NEW LOGISTIC OPERATOR MODEL AS A CREATOR OF RATIONAL PRODUCTION OF SERVICES IN MULTIMODAL TRANSPORT IN SLOVENIA

3.1. Definitions of the most important elements in the new logistic operator model in Slovenia

By making the logistic operator model as a creator of rational production of services in multimodal transport in the Republic of Slovenia, we have proven the fundamental scientific hypothesis and suggested the basis for the development of a modern multimodal transport system that will connect national traffic currents with the European traffic system. For the elements of a logistic operator model these are selected: *1) multimodal infrastructure, 2) multimodal suprastructure, 3) multimodal technologies, 4) multimodal commodity currents, 5) multimodal law, 6) multimodal logistic operator, 7) multimodal constant development, 8) intellectual logistic capital, 9) global logistic chains, 10) logistic distribution chains, 11) logistic information systems, 12) other multimodal factors.*

Based on the hypothetical values of coefficients of the elements in the model it is possible to determine the shares of multimodal elements in the realization of the logistic operator model. Values are placed in the model, by which in *the year 2003* the elements of a logistic operator model are valued, and also the supposed values for *the year 2007*, when the Republic of Slovenia will have been a member of the European Union for three years, and values for *the year 2012*.

3.1.1. Multimodal infrastructure

Compatibility of a modal infrastructure in the Republic of Slovenia can influence greatly the optimization of the traffic system and today, *the year 2003*, the Slovenian *input* in the realization of the logistic operator model *is 40*. Such a low input is a consequence of momentarily ineffective transport infrastructure, and the consequences of such infrastructure are bottle-

necks, pollution, social expenses and imbalance of forms of transport and public transport. The situation results in non-competitive terms of Slovene transport. The input of multimodal infrastructure can improve only by modernization of traffic currents and better connection of traffic routes, so that we can expect that *in the year 2007* the input in the realization of the logistic operator model will be *65*, and the realization of the logistic operator model for *the year 2012* is estimated to be *90*.

3.1.2. Multimodal suprastructure

Use of multimodal suprastructure together with infrastructure enables the production of multimodal transport services. To successfully incorporate the Slovenian traffic system into the European traffic system, the modernization of a multimodal suprastructure is necessary, such as means of transport, means of load in/out, that have *in the year 2003 input of 30* in the realization of the logistic operator model. In the realization of the logistic operator model for *the year 2007* the input could increase to *55* by purchasing special carriages that are used in land technologies. Railway traffic could become competitive and take over a larger share in transporting goods in comparison with the road traffic. By discharging the roadways, the value of the element of multimodal suprastructure in *the year 2012* would have an *input of 80* in the realization of the logistic operator model.

3.1.3. Multimodal technologies

Use of multimodal technologies in the Republic of Slovenia should be the framework for multimodal transport. Use of means for work with containers should be the base for multimodal transport. Multimodal technologies are not used enough, mostly because of technically inappropriate or non-existent infrastructure. This situation limits the competitiveness and the larger part of combined transport. Considering the fact that in the Republic of Slovenia work with containers is mostly used, the element of multimodal technology in the *year 2003* is estimated by *input of 40* in the realization of the logistic operator model. It is realistic to expect that in the *year 2007* the element of multimodal technology will increase to *input of 65* in the realization of the logistic model operator and in the *year 2012* to *input of 90* in the realization of the logistic operator model [1, 32]

3.1.4. Multimodal commodity currents

The existence of commodity currents is necessarily accompanied by a developed transport system. The condition of the traffic system in the Republic of Slovenia, as well as multimodal commodity currents in Slovenia is still not competitive with the European

market. Therefore, the element of multimodal commodity currents in the *year 2003* can be valued by *input of 30* in the realization of the logistic operator model. In the *year 2007*, three years after the incorporation of Slovenia into the European traffic currents, the input of multimodal currents will have increased to *55* in the realization of the logistic operator model. Together with the development of multimodal commodity currents and better organization of multimodal transport, the existing currents will increase and new currents will be created, which will definitely have an effect on the import-export balance. In modern economic and traffic conditions, such as flexibility, openness and competitive position, in the *year 2012* the input of the element of multimodal currents is estimated to *80* in the realization of the logistic operator model.

3.1.5. Multimodal law

Today, multimodal legal sources have very small significance with the realization of the multimodal transport in the Republic of Slovenia, for they are almost non-existent in the Slovenian legal regulations. Because of that, the multimodal law has in the *year 2003* a rather low input of *40* in the efficiency of the realization of the logistic operator model. One of the more important reasons for such a low input is that the Convention of the United Nations concerning international multimodal transport of commodities from the year 1980 is still not valid. If it was not so, many multimodal transport problems would be solved, where transport documents, operators or workers and use of multimodal transport or modern transport technologies in the states in transition and developing states were unified. By doing so, all the national regulations connected with multimodal transport should adjust to their Convention. When Slovenian legal sources are adjusted with the UN Convention, the importance of multimodal law will increase. It is only a matter of time when the UN Convention from 1980 is ratified. The value of multimodal law is therefore expected to grow and the input for the *year 2007* will be around *65* in the realization of the logistic operator model, and in the *year 2012 the input will be 90* in the realization of the logistic operator model.

3.1.6. Multimodal logistic operator

In today's form of multimodal transport in the Republic of Slovenia there are no real multimodal operators, but rather only operators of separate branches of transport services. The input value of the element of multimodal logistic operator in the *year 2003* is around *40* in the realization of the logistic operator model. It is expected that over time the niche operators of different branches of traffic will start uniting into mega multimodal transport operators, and so the value of

the element of multimodal logistic operator in the *year 2007* is expected to have an *input of 65* in the realization of the logistic operator model. The role of mega and niche operators in the realization of multimodal transport will surely increase and in the *year 2012* it is estimated to have an *input of 90* in the realization of the logistic operator model.

3.1.7. Multimodal constant development

As the element of multimodal logistic operator, multimodal constant development in the Republic of Slovenia had in the *year 2003* a low *input of 30* in the realization of the logistic operator model. It is expected that in the future this will increase and by the *year 2007* will have reached the *input of 55* in the realization of the logistic operator model. The declaration of the structure of costs in separate branches of traffic shows falling of prices in road traffic. The directing of cargo is still expected towards road traffic, but at a much lower rate than in the past. In the *year 2012* the multimodal constant development will have an *input of 80* in the realization of the logistic operator model.

3.1.8. Intellectual logistic capital

Intellectual capital as a »hidden value«, is the carrier of quality of multimodal service offer, therefore it requires special attention. Cadres, as the fundamental factors on which the »hidden value« of multimodal service is dependent on, have to be capable of successfully managing all logistic processes, coordinate them, and with individual efforts, communication and motivation, and bring into line individual needs and interests of an international multimodal transport. In the *year 2003* the element of the intellectual logistic capital in the realization of the logistic operator model has an *input of 30*, for it is not operated on sufficiently. For the state this means a loss of value and quality, and there is also not enough emphasis on multidisciplinary and interdisciplinary knowledge. In the future, educated experts with knowledge should create synergy effects in business and whole economy. So in the *year 2007* the growth of the input of this element is expected with the value of *55* in the realization of the logistic operator model, and in the *year 2012 the input should be 80* in the realization of the logistic operator model.

3.1.9. Global logistic chains

The existence of global logistic chains is a prerequisite for the functioning of multimodal transport. According to the level of development of multimodal transport in the Republic of Slovenia, the element of logistic operator model, connected with the global logistic chain is in the *year 2003* valued by the low *input*

of 30 in the realization of the logistic operator model. It is supposed that together with the development of multimodal transport in the Republic of Slovenia, the global logistic chains will also come into effect, so that in the *year 2007* the value of the *input will be 60* in the realization of the logistic operator model. In the *year 2012* the element of the logistic operator model connected with global logistic chain will reach the *input of 90* in the realization of the logistic operator model.

3.1.10. Logistic distribution chains

Distributional function can be found at the beginning and at the end of the supply chain. It is the closest to the consumer, it interprets the manners of consumption and preferences of consumers, which motivates activities and transactions in the supply chain. At the same time it leads the supply of products to buyers and concludes the line of demand-order-production-supply-consumer. The element of logistic distribution chain has in the *year 2003* a rather low *input of 30* in the efficiency of the realization of logistic operator model. Whether a logistic distribution chain will be selected depends on the transport route, appropriate packing, choice of the location of storehouses and their supply area, and transport insurance. According to the fact that the choice of all this is up to the multimodal logistic operator, whose input will increase, follows the growth of input of logistic distribution chains, that will reach in the *year 2007* the *input of 60* in the realization of the logistic operator model. In the *year 2012* the element of logistic distribution chain will have an *input of 90* in the realization of the logistic operator model.

3.1.11. Logistic information systems

The existence of logistic information system is necessary for optimal functioning of multimodal transport. According to the level of development of multimodal transport in the Republic of Slovenia, in the *year 2003* this element of multimodal logistic operator had an *input of 30* in the realization of the logistic operator model. The input is pretty low, because the functioning of the integral information system in transport activity is inadequate, and it does not enable optimal and competitive operation. To the candidate states the emphasis is given in the direction of linking the activities of the informational company and help with development of informational infrastructure. The possibility of access to the informational technology will become more important than physical nearness. Thus, it is expected that with further development the element of logistic information system will have in the *year 2007 the value of 60* in the realization of the logistic operator model. The development of informational technologies is in transport understood as

a contribution to the constant development, especially by reducing the unnecessary physical mobility. In connection with that, the growth of input of the logistic information system in the *year 2012* is estimated at *90* in the realization of the logistic operator model [2, 2].

3.1.12. Other multimodal factors

Forwarding agencies, insurance companies, distribution terminals and customs zones present secondary activities, without which a modern transport of goods cannot run smoothly. These activities are not sufficiently used at the moment, especially the distribution centres and the terminals that present a possibility for multimodal transport and manipulations. The element of other multimodal factors in the *year 2003* had the *input of 30* in the realization of the logistic operator model. In the future, the distribution centres and terminals will increase the competitiveness of multimodal transport and have a positive effect on the competitiveness of economy, as well as forwarding agencies and insurance companies. So, the input value of the element of other multimodal factors will in the *year 2007 be 55* in the realization of the logistic operator model, and in the *year 2012 the input will be 80* in the realization of the logistic operator model.

3.2. Evaluation of the elements of the new model of logistic operator in Slovenia from the year 2003 to the year 2012 according to the elements of such a model in the European Union (Table 1)

Based on the hypothetical values of coefficients of the elements of logistic operator model, it is possible to determine the share of the element of logistic operator model in the realization of the multimodal transport system. In the model there are values by which the elements of the logistic operator model are valued according to the same elements of the logistic operator in the European Union states, for the year 2003, year 2007, when Slovenia will have been a member of the EU for three years, and for the year 2012 (Table1).

4. CALCULATING DIRECT AND INDIRECT DEGREES OF GROWTH OF THE ELEMENTS OF THE NEW MODEL OF LOGISTIC OPERATOR IN SLOVENIA

Elements of the multimodal transport logistic operator model are elements that influence the realization of the multimodal transport system.

Table1 - Values of the elements of the logistic operator

Elements of the new logistic operator model	Input y_{it}			Increment
	2003	2007	2012	$\Delta y_{i,2012}$
1. multimodal infrastructure	40	65	90	50
2. multimodal suprastructure	30	55	80	50
3. multimodal technologies	40	65	90	50
4. multimodal commodity currents	30	55	80	50
5. multimodal law	30	55	80	50
6. multimodal logistic operator	40	65	90	50
7. multimodal constant development	30	55	80	50
8. intellectual logistic capital	30	55	80	50
9. global logistic chains	30	60	90	60
10. logistic distribution chains	30	60	90	60
11. logistic information systems	30	60	90	60
12. other multimodal factors	30	55	80	50

4.1. Implementation of the matrix of growth at forming the logistic operator model in Slovenia

Let us suppose that the multimodal transport system is composed of n interconnected elements. By y_{it} in $y_{i,t-1}$ the values of multimodal element are denoted (for instance such as input, parameter, etc.), of the i multimodal element (i = 1, ..., n) in the period t and $t-1$ [3, 352]

The input increment of the i element of multimodal transport is

$$\Delta y_{it} = y_{it} - y_{it-1} \qquad (1)$$

Indirect degree of growth of the i multimodal element according to j element is defined as the relation of increment of input of the i element of multimodal transport, Δy_{it} and the value of the input of j element of multimodal transport in the period t, or

$$r_{ijt} = \frac{\Delta y_{it}}{y_{it}} \qquad i,j = 1,...,n. \quad y_{i,t-1} \neq 0 \qquad (2)$$

Indirect degree of growth can be formed in the matrix of growth of elements of multimodal transport:

$$R_t = \begin{bmatrix} r_{11} & r_{12} & r_{1nt} \\ r_{21} & r_{22} & r_{2nt} \\ r_{n1t} & r_{n2t} & r_{nnt} \end{bmatrix} \qquad t = 1,...,T \qquad (3)$$

where elements on the main column denote direct (i = j) and the rest (i ≠ j) indirect degrees of growth. Elements in the i row denote the growth of input in the i element of the logistic operator model in the function of rational production of services in multimodal transport according to inputs in other elements. Elements in the i column denote growth in the value of inputs in all elements of the model according to the input of the i element in the t period.

In this way we can conclude that every element in the matrix of growth is presented by one row and one column, by elements that express indirect or relative relations of growth. In this way, for instance, in the first row the growth of input of the first element of multimodal model is presented according to other elements, and in the first column the growth of other elements according to the input of the first element is presented. Other rows and columns respond to other elements of the logistic operator model in the function of rational production of services in multimodal transport. Indirect degrees of growth can be defined also in accordance with inputs of the j element model in the t-1 period, i. e.:

$$r'_{ijt} = \frac{\Delta y_{it}}{y_{j,t-1}} \qquad i,j = 1,...,n \qquad (4)$$

The connection among indirect degrees of growth (2) and (4) can be established through the following relations:

$$r_{ijt} = \frac{r'_{ijt}}{1+r'_{j,jt}} \quad \text{in} \quad r'_{ijt} = \frac{r_{ijt}}{1-r'_{j,jt}} \quad i,j = 1,...,n \qquad (5)$$

The matrix of growth can also be determined by the external vectors of the elements of the model. This method of determination is useful for practical calculation of the matrix of growth. The vector of the growth of elements of the model

$$\Delta y_{ij} = (\Delta y_{ij},..., \Delta y_{m,t}) \qquad (6)$$

and vector of reciprocal values of elements of the logistic operator model in the function of the rational production of services in multimodal transport

$$\left(\frac{1}{y_t}\right) = \left(\frac{1}{y_{1t}}, \ldots, \frac{1}{y_{nt}}\right) \quad i,j = 1,\ldots,n. \quad y_{i,t-1} \neq 0 \quad (7)$$

External vector of growth of coefficients of elements in the model and vectors of reciprocal values define the matrix of growth of the logistic operator model in the function of rational production of services in multimodal transport.

$$R_{pt} = \Delta y_t' \left(\frac{1}{y_t}\right) = \begin{bmatrix} \Delta y_{1t} \\ \vdots \\ \Delta y_{mt} \end{bmatrix} \left(\frac{1}{y_t}, \ldots, \frac{1}{\Delta y_{nt}}\right) \quad (8)$$

$$iR_{pt} = \begin{bmatrix} \dfrac{\Delta y_{1t}}{y_{1t}} & \cdots & \dfrac{\Delta y_{1t}}{y_{nt}} \\ \vdots & \ddots & \vdots \\ \dfrac{\Delta y_{mt}}{y_{1t}} & \cdots & \dfrac{\Delta y_{mt}}{y_{nt}} \end{bmatrix} = \begin{bmatrix} r_{11t} & \cdots & r_{1nt} \\ \vdots & \ddots & \vdots \\ r_{m1t} & \cdots & r_{mnt} \end{bmatrix} \quad (9)$$

Observing the direct degree of growth, the growth of one element is expressed independently of the growth of other elements. Namely, when indirect degrees of growth are being defined, therefore the growth of the i element by comparison with j element (i, j=1, ...n), it is possible to determine the structure of the growth of elements and express all relations through the matrix of growth in a collective system. By expressing direct and indirect degrees, it is possible at the same time to observe the changes of intensity of growth of elements, as well as their structural relations.

4.2. Direct and indirect degrees of growth of elements in the new logistic operator model in Slovenia in the period from year 2003 to year 2012 by comparison with the elements of such a model in the European Union

Table 2 has been developed based on the previously described procedure of calculating the matrix.

The elements on the main diagonal denote the *direct degrees of growth* of elements in the logistic operator model. Statistical data show that multimodal infrastructure has increased by 55.6%, multimodal suprastructure by 62.5%, in the period from 2003 to 2012. The elements outside the main diagonal denote the *indirect degrees of growth* of the elements. In this way, the elements in the first row (without the first one) that belong to multimodal infrastructure denote the growth of multimodal infrastructure by comparison with all the other elements. Elements in the first column (without the first one) denote the growth of all the other elements by comparison with multimodal suprastructure. This is similar to rows and columns for all the other elements of the logistic operator model.

Direct degrees of growth of the logistic operator model in the year 2012 in % are shown in Graph 1
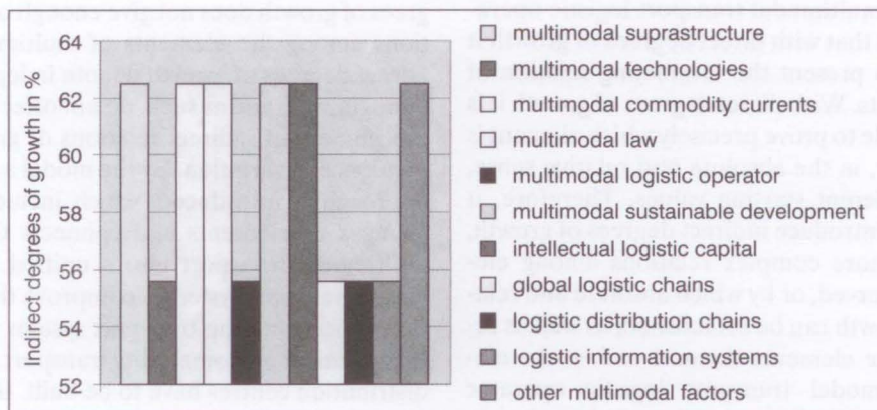
Graph 2 presents indirect degrees of growth of multimodal infrastructure by comparison with other elements of the logistic operator mode

Table 2 - Degrees of growth of the elements of logistic operator model from 2003 to 2012

	Mult. infrast.	Mult. suprast.	Mult. tech.	Mult. commod. currents	Mult. law	Mult. log. op.	Mult. const. develop.	Intel. log. capital	Glob. log. chains	Log. distrib. chains	Log. inf. systems	Other mult. factors
Mult. infrast.	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Mult. suprast.	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Mult. tech.	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Mult. commod. currents	55,6%	62,5%	55,6%	62,5%	62,5	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Mult. Law	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	55,6%	55,6%	55,6%	55,6%	62,5%
Mult. log. op.	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Mult. constant develop.	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Intel. log. capital	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
Glob. log. chains	66,7%	75%	66,7%	75%	75%	66,7%	75%	75%	66,7%	66,7%	66,7%	75%
Log. distrib. chains	66,7%	75%	66,7%	75%	75%	66,7%	75%	75%	66,7%	66,7%	66,7%	75%
Log. inf. Systems	66,7%	75%	66,7%	75%	75%	66,7%	75%	75%	66,7%	66,7%	66,7%	75%
Other mult. factors	55,6%	62,5%	55,6%	62,5%	62,5%	55,6%	62,5%	62,5%	55,6%	55,6%	55,6%	62,5%
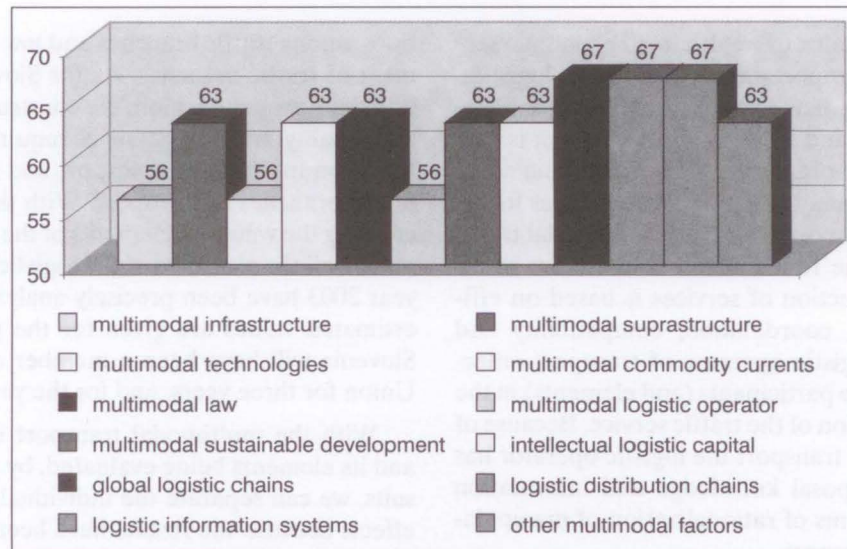
Graph 1

Graph 2

4.3. Synergy effects of the new logistic operator model in Slovenia

Requests for the research of multimodal transport with help of the matrix are relatively high. They come into consideration when, with direct degrees of growth, motions of sectors cannot be connected into a whole dynamic system. Many theoretical and practical models exist in dynamic analysis, in input-output analysis and in linear and non-linear dynamic programming. None of these models is based on indirect degrees of growth, although in this way, complex dynamic systems can be observed by different possibilities of programming. Effects of the multimodal transport model based on the matrix of growth have various purposes. The matrix of growth deals with structural relations of elements in a specific way; by help of the matrix of growth there is an opportunity for all relations inside the multimodal transport system to be taken into account simultaneously. Elements of the model inside the multimodal transport system are, as a rule, independent and their movement has to be observed over direct

and indirect degrees of growth. The specific characteristic of the matrix of growth is that this matrix denotes the relations of different elements in corresponding rows and columns, by which the synergy effects of the model are presented. Each row and each column of the matrix of growth denotes a relation of one element by comparison with other elements, including parameters (outputs) that denote direct degrees of growth or individual effects of the model. By introducing the indirect degrees of growth of multimodal transport system or the matrix of growth, one part of the research is complete in the theory of transport growth as well as economic growth. The main purpose is to make Slovenia competitive in the European traffic system and to join the European integrations. In this way, the fundamental scientific hypothesis is proven.

5. CONCLUSION

Multimodal transport is a prerequisite for efficient performance of all the traffic activities and an active representative of economic and traffic development,

and therefore a creator of wealth in all economic sectors. Exceptional importance also goes to logistics, which is a relatively new science discipline in the Republic of Slovenia and its theoretical research is currently very poor. Ignorance of logistic phenomena and regulations cause many negative consequences for all participants in transport, especially multimodal transport operators. The fundamental solution for rationalization of production of services is based on efficient cooperation, coordination, compatibility and complement of logistic operator of transport enterprise or other active participants (and elements) in the process of production of the traffic service. Because of that in multimodal transport the logistic operator has to have at his disposal knowledge and information about different forms of rationalization of manipulation and cargo transport.

There are many reasons for the need for the matrix of growth in the multimodal transport logistic operator model. One is that with direct degrees of growth it is not possible to present the interacting relation of growth of elements. With direct degrees of growth it is not always possible to prove precisely which element is developing faster, in the absolute and relative sense, according to different starting values. Therefore, it was necessary to introduce indirect degrees of growth, through which more complex relations among elements can be observed, or by which absolute and relative speeds of growth can be established, as well as relations among the elements themselves i. e. the elements of multimodal transport logistic operator model. With scientifically proven knowledge of making models and multimodal transport the logistic operator model is suggested with the purpose of more efficient integration of Slovenia into the European traffic system.

The elements of a logistic operator model are basically elements that influence the realization of the traffic system. These elements are multimodal infrastructure, multimodal suprastructure, multimodal technologies, multimodal commodity currents, multimodal law, multimodal logistic operator, multimodal constant development, intellectual logistic capital, global logistic chains, logistic distribution chains, logistic information systems and other multimodal factors. Based on hypothetical values of the coefficients of elements in the model it is possible to determine the share of multimodal elements in the realization of the logistic operator model. In the model there are values by which the elements of the logistic operator model are valued for the year 2003, also the values for the year 2007 are assumed, when Slovenia will have been a member of the European Union for three years, and values for the year 2012.

Low values of inputs of logistic operator elements in the year 2003 are the consequence of poor connections among traffic branches and low level of development of traffic branches. As for Slovenia's accession into the European Union, the construction of efficient and quality traffic system is required, that will be based on multimodal transport and will connect different branches of transport. With the purpose of increasing the values of elements of the logistic operator model, all the elements of the logistic operator for the year 2003 have been precisely analyzed, and also the estimated values are given for the year 2007, when Slovenia will have been a member of the European Union for three years, and for the year 2012.

With the multimodal transport model being set, and its elements being evaluated, by analyzing the results, we can separate the individual and the synergy effects because the results have been obtained by direct and indirect degrees of growth. Researching the growth of multimodal transport only with direct degrees of growth does not give enough basis for connections among the elements of multimodal transport. Direct degrees of growth denote independent parameters (inputs) and as such, do not offer a chance for establishment of indirect relations of growth and independence of variation. By the model a new theoretical approach is introduced, which includes the relative changes of elements and connects the elements of multimodal transport into a unified dynamic multimodal transport system. To improve the current situation concerning the transport system in the Republic of Slovenia, new commodity transport and commodity distribution centres have to be built, the current technology in multimodal transport has to be analyzed, the existing transport technologies have to be modernized and new technologies introduced, forwarding agents and other multimodal transport logistic operators included in an organization of traffic and economic system, and educated at different professional consultations and symposia, and also the systems and models need to be defined for the use of palettes and containers in all traffic branches.

Poor condition of the traffic system in the Republic of Slovenia is a consequence of inadequate theoretical studying of transport and later on insufficient use of knowledge that have an effect on the development of transport in general, mostly multimodal transport. Making models in multimodal transport is an efficient method for solving such problems, for the integration of the Republic of Slovenia into the European traffic currents is necessary. In the future, the connection of SŽ (Slovenian Railroads) with other multimodal transport operators in Slovenia, such as Luka Koper, Adria combi, and some important and big European or world organizers of multimodal transport chains will be of greatest significance. Business success will depend on timely decisions and their realizations and correct choice of the »global« partners.

The facts show, that in Slovenia and Europe it will be necessary to improve the quality of multimodal transport and lower the costs mainly on new market segments, i. e. on markets where multimodal transport has not been put into effect yet. It will also be necessary to modernize the offer of services in multimodal transport and adapt to the users' needs. The fact is that Slovenia is lagging behind in the technical, technological as well as organizational field in comparison with EU, despite the fact that the connection of this segment with the European system is fairly good. Regarding the course of the European corridors and the existing traffic infrastructure the geographical position of Slovenia is very favourable. The neighbouring states are investing greatly into their traffic infrastructure which will present a serious alternative for the traffic routes along the Pan-European corridors. The variants of the connection along corridor V that would bypass Slovenia also have to be taken into consideration. The modernization of European corridor IV, that passes through Germany, Austria and Hungary along corridor V is on the macro level very competitive for the development of the whole corridor V.

With the multimodal transport logistic operator model being set it is possible to completely rationalize the traffic system of the Republic of Slovenia. Almost through the whole research the role and importance of the multimodal transport logistic operator for economic and traffic development has been emphasized. The suggestions for the guidelines of the development of multimodal transport logistic operator model should be taken as a framework for planning of multimodal transport as a logistic system. This model should offer a framework for the transformation of the Slovenian forwarding agents and transporters into the logistic operators who would be competitive tomorrow in the multimodal network of the European Union. The strategic aim of the Republic of Slovenia is an active cooperation in the process of integration in the European Union. New organizing on the side of logistic operators is necessary in multimodal transport as the fundament of the economic system in the Republic of Slovenia. The market adaptation demands from the Slovenian forwarding agents and transporters a new quality and higher speed of their services. If the real needs of the Slovenian economy and the European transit are surveyed, it can be noticed that it is necessary to accede to a better organization of the existing transporters in all branches to meet the needs of the Slovenian and European economy in new working conditions and to transform the Slovenian forwarding agents into logistic operators, so that they could integrate into the European processes and thus become full members of the European traffic of the 21st century.

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POVZETEK

LOGISTIČNI OPERATOR - DEJAVNIK RACIONALIZACIJE PROIZVODNJE STORITEV V MULTIMODALNEM TRANSPORTU

Promet je iz svojega teoretičnega in praktičnega vidika eden od temeljnih dejavnikov gospodarstva določene države. V razvitih evropskih državah predstavlja racionalno proizvodnjo prevoznih storitev multimodalni transport ter pravilen izbor logističnega operatorja. Cilj multimodalnega transporta je čim bolj učinkovito povezati različne veje prometa, oziroma vse operacije, ki so povezane s transportom. Logistični operator je edini profesionalec za nudenje celovitih storitev v multimodalnem transportu, zato je bilo potrebno utrditi njegov nadaljni razvoj in skladno s tem predlagati ustrezne rešitve. Samo z razvojem multimodalnega transporta, pravilnim izborom logističnega operatorja ter z boljšo organizacijo prometnega sistema je možno povečati obstoječe in ustvariti nove prometne tokove. Republika Slovenija mora razvijati multimodalni transport, da bi v najkrajšem času zmanjšala razlike s takšnimi oblikami transporta v razvitih evropskih državah. Glavna naloga Republike Slovenije je čimprejšnja vključitev v evropske tokove, medsebojno sodelovanje z liberalizacijo tokov blaga in storitev ter ustvarjanje pogojev za dotok tujega kapitala, kjer prihajajo do izraza vse prednosti multimodalnega transporta. Torej rezultat raziskovanja je model logističnega operatorja

KLJUČNE BESEDE

logistični operator, racionalizacija, multimodalni transport, prometni sistem

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