

The Effects of Logistical Centers Realization on Society and Economy

Anna Dolinayova, Juraj Camaj, Martin Loch

Abstract—Presently, it is necessary to ensure the sustainable development of passenger and freight transport. Increasing performance of road freight has had a negative impact to environment and society. It is therefore necessary to increase the competitiveness of intermodal transport, which is more environmentally friendly. The study describes the effectiveness of logistical centers realization for companies and society and research how the partial internalization of external costs reflected in the efficient use of these centers and increase the competitiveness of intermodal transport to road freight. In our research, we use the method of comparative analysis and market research to describe the advantages of logistic centers for their users as well as for society as a whole. Method normal costing is used for calculation infrastructure and total costs, method of conversion costing for determine the external costs. We modelled total society costs for road freight transport and inter modal transport chain (we assumed that most of the traffic is carried by rail) with different loading schemes for condition in the Slovak Republic. Our research has shown that higher utilization of inter modal transport chain do good not only for society, but for companies providing freight services too. Increase in use of inter modal transport chain can bring many benefits to society that do not bring direct immediate financial return. They often bring the multiplier effects, such as greater use of environmentally friendly transport mode and reduce the total society costs.

Keywords—Delivery time, economy effectiveness, logistical centers, ecological efficiency, optimization, society.

I. INTRODUCTION

THE logistical centers are inseparable part of forward market economy. Logistical centers not only serve commodity with clients but sustain of useful reserves of products and accelerate international market. The term “logistic center” has been used to describe centers performing a broad spectrum of logistical functions and business processes. The term combines logistics, which refers to all operations required to deliver products or services excluding producing the goods or performing the services, which stands for a place where a particular activity is concentrated. [1]

The foremost tasks of logistical centers can be summarized as follows:

- integration of different kinds of transport to traffic chains;

Anna Dolinayova is with the University of Zilina, Faculty of Operation and Economics of Transport and Communications, Zilina, CO 01026 Slovakia (corresponding author to provide phone: 421-41-5133424; e-mail: anna.dolinayova@fpedas.uniza.sk)

Juraj Camaj and Martin Loch are with the University of Zilina, Faculty of Operation and Economics of Transport and Communications, Zilina, CO 01026 Slovakia (e-mail: juraj.camaj@fpedas.uniza.sk, martin.loch@fpedas.uniza.sk).

- projection and realization complex logistical chains between suppliers and subscribers;
- practice different logistical tasks for clients;
- preparing, realization and repairs of needed infrastructure for partners;
- preparing, realization and repairs of needed informative, managing and communication system.

II. THE EFFECT OF LOGISTIC CENTERS REALIZATION

Effectiveness in the logistics can be defined such as assignment of demanded level of logistical services in the course of acceptable total costs. There is needed to make differences between social and ecological, partnership and internal effectiveness.

A. Social and Ecological Effectiveness

Social effectiveness is related to all aspects which are invoked from logistics. Point is that like this social and ecological effectiveness which is not burdened organizations which are involved to logistical network. The social and ecological effectiveness can be following:

- stimulation of general economic development in region;
- optimization of modal split;
- stimulation to progress of combined transport;
- optimize material distribution by assigning material packages to vehicle and choosing the best route;
- more effectively exploitation of actual transport infrastructure;
- decreasing of frequency of commodity in the towns;
- reduction of burden of environment by road transport etc.

The logistical center optimizes modal split by there is decreased exploitation of road transport. It has a lot of positive impacts of environment mainly climate change, air pollution and accident, but also congestion and noise. These are the costs that transport users impose on society and which are financed by the society as a whole. [4]

Realization of logistical center in region has a positive influence on economic development because there is possible to await inflow of investment for building new productive and service equipment, decreasing of unemployment, increasing of attraction of region. Manager of logistics centers should work closely with owners, builders, designers and contractors to supply material and equipment on time. [9]

B. Partnership Effectiveness

Partnership effectiveness appertains to relations between suppliers, consumers, mediators and clients which are participated in concrete logistical network. The principle of partnership in logistical network is attainment of benefit and

coordination of interconnected process, allocation of economic advantages but also is concerned on disadvantages. There is searched solutions whit the basest total costs although the costs some partners will be able to increase. It is necessary to provide so that partners, which will be higher costs, feel the results of total benefit. This principle can be denominate principle "win-win". [5]

The partnership effectiveness can be summarized as follow:

- favorable conditions for mutual cooperation carriers; they can make use of infrastructure, informational and communications system of logistical center,
- favorable conditions for economic profitable cooperation between carriers and clients which order the traffic services,
- all of manipulation services is possible to automate,
- there is possible to economize of using of transport capacity,
- small and middle enterprise can involve themselves to integrated transport chains,
- industrial enterprises can make use of reliable, flexible and budget-priced transport,
- increasing logistical output of enterprises by make use of quality logistical services,
- material stored at logistics center can be applied just in time,
- possibility of decreasing of reserves the more there are created conditions for effectively exploitation financial sources in production etc.

As companies in the construction industry look for way to reduce lead time, delivery uncertainty and logistical costs, the need for logistics centers is expected to increase.

C. Internal Effectiveness

Internal effectiveness allows for advantages and disadvantages in the inside logistical center. There is concerned mainly optimization of costs. With regard to a lot of activities which are accomplished in logistical center is suitable to use method Activity Based Costing. This method refers costs to separate processes in agreement with cost drivers. The method makes it possible to trace up relevant cost which are allied to concrete processes and concrete customer or partner.

Proceeding of method Activity Based Costing:

- limitation of activities and their total costs;
- definition of directive factors in favor every activities;
- calculation of cost rates of activities;
- consolidation of activities to compact processes;
- calculation cost of processes, products, chains;
- analysis of bigness and structure of costs of processes; products, chains and identification of potentials for improvement.

The method is not only instrument for measurement costs but for analysis their causes and looking for space for improvement.

In the logistical center can be defined following separate cost activities:

- administration and engineering of customer order;

- warehouse merchandise;
- manipulation by separate handling device;
- reloading;
- transport infrastructure etc.

The effectiveness in the logistical center can be influenced by non-performance delivery time. Breach of the term is considered to disagreement with requirements. [7] When it is not honored delivery dates there is happened to problems of other processes in clients that are losses internal and external. If the logistical center want to improve delivery time it have to know what values are reaching and what the price is to reach this values.

For evaluation it is possible use indicators of delivery time which should reflect:

- frequency and part of delivery truck which were not realized at the time;
- quantity of divergences from off agreed on delivery time;
- difference between delivery time estimated by clients and real negotiate delivery time. [6]

The costs is possible optimized by using E-commerce services which adds value by replacing physical paper-handling practice such as ordering with electronic ones, thus reducing cost and time. When equipped with the necessary information systems, a logistics center can apply e-commerce service such as vender managed inventory to reduce lead time and costs while increasing supply chain reliability.

III. MODELLING OF INTERNAL COSTS – COMPARATIVE BETWEEN INTERMODAL AND ROAD TRANSPORT

We realized modelling of unit internal costs (costs per one TEU) in the conditions of Slovak republic.

A. Transport Infrastructure Costs in the Slovak Republic

Road infrastructure uses a fee system of electronic toll for vehicles over 3.5 tons from 1.1.2010. The model of payment for infrastructure use changed from periodical fixed fee to fee according to actual mileage distance.

The toll rates were based on the Decree of the Government of Slovak Republic No. 350/2007 Code of Law as amended, setting the toll rates for the use of specified road sections. The charges are rated at distance travelled in kilometers. [10] Table I shows the toll rates for each category of vehicles according to emission class.

The charges for access to rail infrastructure are specified in the Decree No. 3/2010, issued by the Office of Rail Regulation (RRA). This regulation changed recently used maximum payment for access to rail infrastructure into the minimum access package and track access to service facilities with extra charges for extra services. [2]

The minimum access package includes:

- processing the applications for capacity;
- the right to use provided capacity;
- fee for using switches and junctions;
- train control including signaling, regulation, dispatching and communication and provision of information on train movements;
- other information required for the use of capacity.

TABLE I
ROAD TOLL FOR VEHICLES ON THE MOTORWAY AND THE 1ST CLASS ROAD

Category of vehicle	Emission category					
	EURO 0 – II		EURO III		EURO IV, V, EEV	
	motorway	1 st class road	motorway	1 st class road	motorway	1 st class road
3,5 tons – 12 tons	0,093 €	0,070 €	0,086 €	0,063 €	0,083 €	0,063 €
2 axle	0,193 €	0,146 €	0,183 €	0,136 €	0,179 €	0,136 €
12 tons or more	0,202 €	0,153 €	0,193 €	0,146 €	0,189 €	0,143 €
3 axle	0,209 €	0,156 €	0,199 €	0,149 €	0,196 €	0,146 €
4 axle	0,206 €	0,153 €	0,193 €	0,146 €	0,189 €	0,143 €
5 axle						

Track access to services facilities include:

- use of electrical supply equipment for traction current;
- refueling;
- passenger stations, their buildings and equipment;
- freight terminals;
- marshalling yards and train formation facilities;
- railway sidings;
- maintenance and other technical facilities.

Table II shows the charges for minimum access package and track access to service facilities for the first category lines and the access to freight terminals.

TABLE II
MAXIMUM PAYMENT FOR THE USE OF RAILWAY INFRASTRUCTURE FOR THE FIRST LINE CATEGORY

Payment for the minimum access package	
U ₁₁ per train km in € without VAT	0,0207
U ₂₁ per train km in € without VAT	0,958
U ₃₁ per thousand gross tonne-kilometers (grtkm) without VAT	1,311
The maximum payment for the use of electrical supply equipment for traction power	
U _E in € per thousand grtkm without VAT	0,260
Payment for access to freight terminals in ownership or management of the regulated entity	
U _{Nj} in € without VAT	56,537

There has been a fundamental change in rail infrastructure charging, which came into force by this Decree. The global price of rail transport path valid in this Decree enters into force, changed the price for the minimum access package and access to transport facilities. The fee for minimum access package must be paid by each railway operator. These fees are regulated by independent regulator - RAA. Infrastructure manager provides, in addition to the basic services, supplementary and ancillary services at unregulated prices for railway operators. Also the categorization of railway lines from three to six categories has changed and introduced special pricing for using marshalling yards and freight terminals and special pricing for using passenger stations, their buildings and facilities.

B. Comparison of the Transport Infrastructure Costs

The comparison between railway and road infrastructure costs was achieved for Sggmrss 90' wagons and truck. Costs were calculated for direct freight train.

Fig. 1 shows the comparison of unit transport infrastructure cost per three types of loading schemes and truck according to distance.

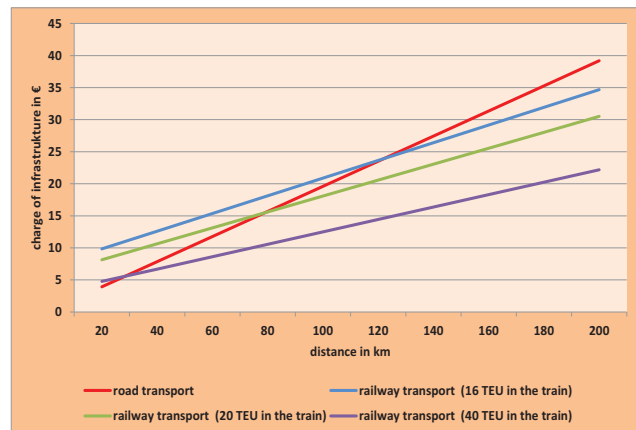


Fig. 1 Results of infrastructure cost – railway versus road

The costs of transport infrastructure are lower in railway than road transport at long and short distances too. Fig. 1 compares only infrastructure cost whereas in the railway transport was taken into account through train with 80 % load factor between two inter modal terminal.

C. Total Costs (Principle Calculation for One Train and One Truck)

Total costs for intermodal transport include costs for railway transport, cost for delivery transportation (vehicle, driver, power consumption, infrastructure costs, indirect costs) and costs in the intermodal terminal (fee for access to the terminal, costs for transshipments of containers).

Total costs to train are:

- costs for wagons:
 - capital costs;
 - maintenance costs;
 - insurance;
- costs for locomotive:
 - capital costs;
 - maintenance costs;
 - insurance;
- costs for driver:
 - direct total labor costs;
 - deductions for employee and employer;
 - statutory social costs;
 - indirect labor costs (staff training, uniform, travel costs ...);
- energy costs;

- railway infrastructure costs (presented in part *A* of this paper);
- indirect costs (share of overhead costs, share of general expense). [3]

Total costs to direct road transport are:

- costs for vehicles:
 - capital costs;
 - maintenance costs;
 - insurance;
 - the cost of vehicle downtime;
 - other charges;
- costs for diesel fuel;
- costs for driver:
 - direct total labor costs;
 - deductions for employee and employer;
 - statutory social costs;
 - indirect labor costs (staff training, travel costs ...);
- toll costs (presented in part *A* of this paper);
- indirect costs (share of overhead costs, share of general expense).

Direct cost was calculated by using normal costing system. The main principle of this method is to calculate single cost element by multiplication appropriate norm and cost rate. There is necessary to calculate with comparable unit of the cost.

D. Comparison of the Total Cost of Intermodal and Direct Road Transport

Comparison of the total costs is realized for intermodal transport (using direct train with different loading schemes, truck and reloading in the inter modal terminal) and direct road transport. Fig. 2 shows the comparison of total costs of intermodal and direct road transport.

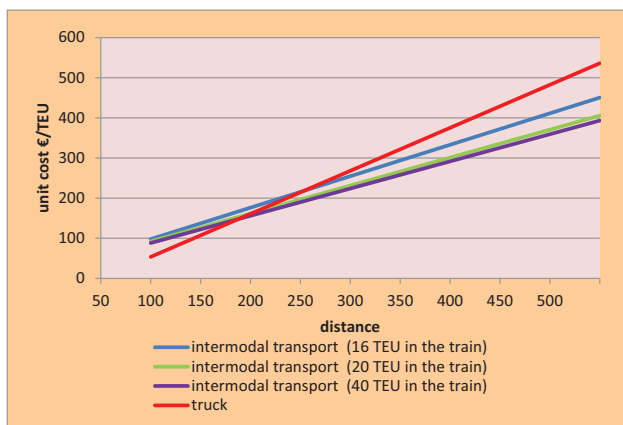


Fig. 2 Results of total internal cost – intermodal transport versus direct road transport

As can be seen in Fig. 2 costs of one TEU depends on the distance of delivery transportation and number of containers in the train.

IV. MODELLING OF TOTAL SOCIETY COSTS – COMPARATIVE BETWEEN INTERMODAL AND ROAD TRANSPORT

External costs refer to the difference between social costs and private costs. But in order to produce quantitative values, the definition has to be more precise. Based on the economic welfare theory, transport users should pay all marginal social costs which are occurring due to a transport activity. Considering the private marginal costs (such as wear and tear costs of the vehicle and personal costs for the driver), optimal infrastructure charges should reflect the marginal external costs of using an infrastructure. These costs include wear and tear costs for the use of infrastructure, congestion costs, accident costs and environmental costs. Only parts of these costs are monetary relevant. Some parts (such as time losses, health damages, etc.) are social welfare losses.

In the short run, these costs are linked to constant infrastructure capacity. Thus fixed infrastructure costs are not relevant for efficient pricing. In the long run however, the change of infrastructure capacity due to the construction of additional traffic infrastructure is relevant, too. From an economic viewpoint an infrastructure project is economically viable, if additional social benefits of a specific project exceed additional social costs.

Whereas the short run marginal costs are relevant for efficient pricing of existing infrastructure, the long run marginal costs have to consider as well the financing of infrastructure extension. The distinction between short and long run marginal costs requires a clear statement on how to treat existing fixed and variable infrastructure cost and related financing schemes such as transport related taxes and charges. Thus it is useful to separate infrastructure costs, taxes and charges from other external cost components.

Table III presents the comparison of external costs of road and rail freight transport in accordance with Handbook on estimation of external costs in the transport sector using load factor. [8]

TABLE III
COMPARISON OF EXTERNAL COSTS OF ROAD AND RAIL FREIGHT TRANSPORT IN €/TKM

Externality		HDV		Freight Train	
		Urban	Inter-urban	Urban	Inter-urban
Noise	Day	0.61	0.09	0.12	0.11
	Night	1.12	0.17	0.49	0.19
Accidents		0.92	0.23	0.02	0.02
Air pollution	Train Electric	0.93	0.73	0.00	0.00
	Train Diesel	0.93	0.73	1.05	0.88
Climate change	Train Electric	0.23	0.19	0.00	0.00
	Train Diesel	0.23	0.19	0.08	0.08
Up- and down-stream processes	Train Electric	0.27	0.23	0.13	0.13
	Train Diesel	0.27	0.23	0.10	0.10
Nature and landscape		0.00	0.10	0.00	0.02
Soil & water poll.		0.09	0.09	0.02	0.02
Day (Diesel/Electric)		3.04	1.66	0.29	0.31
Day (Diesel/Diesel)		3.04	1.66	1.40	1.24
Night (Diesel/Electric)		3.55	1.74	0.66	0.39
Night (Diesel/Diesel)		3.55	1.74	1.77	1.32

Fig. 3 represents the comparison of total costs (internal and external) of intermodal and direct road transport.

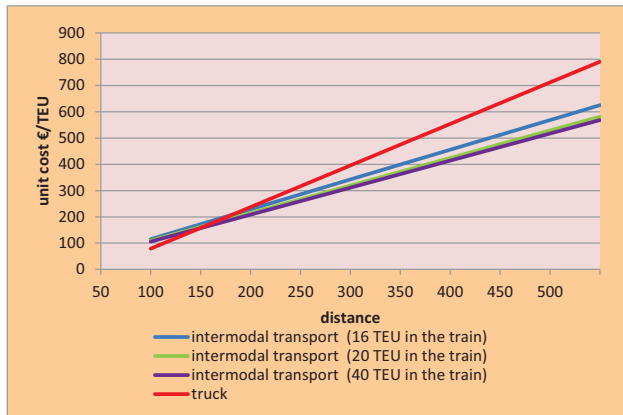


Fig. 3 Results of total cost – intermodal transport versus direct road transport

By using average external cost to calculation total cost we can see significantly reduce distance for use intermodal transport. We considered only 20% of average external costs.

V.CONCLUSION

In the actual global economy are formed very strict conditions for preciseness, reliability and flexibility of delivery. These conditions are been able to of assumption of improvement modern informational and communicate sources and that transport and handling technique and technologies. The all these can be achieve to realization quality logistical center.

The EU transport policy and many others documents which deal with the transport system indicates that it is necessary to ensure the sustainable development of rail freight. Increase in use of intermodal transport can bring many benefits society, which do not bring direct immediate financial return. They often bring the multiplier effects, such as greater use of rail in intermodal transport, less traffic congestion, reducing the need for new high-speed communications, while increasing traffic safety, reduce the environmental impact of traffic and improve the health status of the population and so on.

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