

EFFECTIVENESS OF INTERMODAL TRANSPORT IN POLAND – RESULTS OF THE STUDY

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Abstract: Increasing demand for transport of goods exerts negative influence on the environment. Therefore most European countries divide realisation of transportation of commodities between various transport branches by using so-called intermodal transport. Therefore it seems reasonable to carry out an analysis with the predominant objective to try and present in realistic way the factors influencing the choice between a service realised only with the use of a road transport and intermodal transport. The author of the analysis put particular stress on the costs of the carriage service, time of its realisation and CO₂ emission. The analysis also aimed at showing which of the presented technologies of service providing is more friendly to natural environment. The results obtained from the comparison of intermodal and road transport for a given distance enable stating that effectiveness of railway-road transport is influenced by 22% lower internal costs than the ones of road transport and by lower emission of carbon dioxide.

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1. INTRODUCTION

No organisation of today operates in a vacuum. Dynamic changes taking place in the environment enhance various processes associated with functioning of enterprises (Gregor & Stawiszyński, 2002, p. 59). Fast economic changes conditioned by geopolitical situation and rapid technological progress have the greatest influence on the necessity to introduce changes in enterprises (Kotler, 1999, p. 18). Technological evolution is one of the values of post-modernism era, and it creates new challenges for logistic management, and in particular for TSL branch, fast developing on the international market.

In TSL transport is one of the most import and economical branches as well as the basic link in logistic chain. The European transport market intensely evolved towards liberalisation and effectiveness of access and towards uniforming economic, financial, technical and social relations, intercooperative growth and consistent rules of inner-branch and intra-branch competition. These activities aim predominantly towards increase of competitiveness inside a transport system and increase of transport effectiveness (Liberadzki & Mundur, 2008, p. 238).

Yet the increase of volume of transport services affects natural environment. Due to that reason, the eco-technological dimension, which involves the use of proper transport technologies, gains in meaning. Technological development causes a number of negative consequences, but it also creates new possibilities of reducing a harmful effect on the natural environment. The awareness of threats connected with transport leads to searching for new and pro-ecological system solutions, which at the same time serve for better use of resources. From this point of view a special attention should be attributed to intermodal transport, which within the framework of transporting of an integrated load unit connects together various branches of multi-branch transport, using their specific properties and advantages. The core of the process is an integration of inter-branch transport that enables increase of economic and ecological effectiveness as well as of safety of the realised transport.

The main objective of the study is to try and analyse the effectiveness of intermodal transport in relation to the transport realised only by means of road freight, taking into consideration the costs of service providing, its time-lines and accessibility as well as contamination of the natural environment with CO₂. The author of the study put special stress on the analysis of intermodal transport realised by means of railway and road.

2. INTERMODAL RAILWAY-ROAD TRANSPORT IN POLAND

The Its location in Central Europe makes Poland one of the most important transport trails in Europe. Transit routes from Western to Eastern Europe and to-

wards Eastern Asia as well as the trail from Northern Europe to the Mediterranean area have their crossroads in Poland. Therefore transport has such a great strategic meaning for the county, not only for its development but first of all for life of its citizens. And thus transport is the basic factor for spatial density, it activates the development of regions and communities. Currently transportation is dominated by its one branch only – the road transport. Its share in the transportation of commodities systematically and consequently increases, and it reaches today around 84% of all on-land transport counted in tones of carriage. According to a report of the Central Statistical Office of Poland, in 2013 1848.3 million tons of load were transported with the use of all means of transport, which was 3.3% more than a year before. Out of this number 1553.1 million tons were carried by car transport, and they were transported at the total distance of 347.9 billion kilometres, which was 6.8% more than a year before (GUS, 2014, p. 2).

Yet increasing demand for transport of goods exerts negative influence on the environment. Therefore most European countries divide realisation of transportation of commodities between various transport branches by using so-called intermodal transport. The development of intermodal transport, connecting together and integrating various branches of transport in order to use their best properties, is one of the ways to build the European sustainable transport system (Stokłosa, 2011, p. 5). Due to the above it is important to promote the transportation joining together various branches of transport that are more environmentally friendly, lead to realisation of the idea of sustainable European transport system and offer an alternative to the road transport.

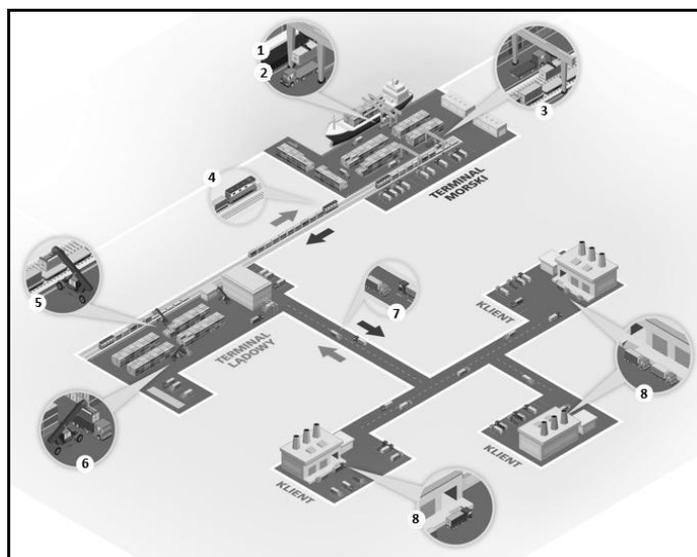


Fig. 1. Scheme of an intermodal transport process

Intermodal transport as such is a system that uses two or more branches of transport (compare Fig. 1) for carrying an intermodal transport unit or an engine vehicle within an integrated logistic chain in „door – to door” system. Although in economic practice the notion of intermodal transport is often used interchangeably with the notion of multimodal or combined transport, according to the assumptions and terminology developed by the United Nations Economic Commission for Europe, each of the notions is differentiated and defined in a different way. Intermodal transport is one of the most advanced forms of transportation, in which goods are transported from the point of shipment to the point of delivery with the use of a number of means. The most important advantage of intermodal transport is the use of integrated load units, thanks to which the freight is moved with the use of special transshipment – manipulation devices, without the need to violate the goods inside. In the whole process the main activities are associated with transporting the freight by different means of transport, operations of loading, transshipment, unloading and storage in terminals or sea harbours.

The choice of proper technology of a transport process depends to a large extent on aptness of a given freight to a specific transport, which results from its physical-chemical properties or the form it has been given. The type and the form of the load have a decisive influence on the choice of appropriate technical means. The carried load should reach the client in a given time and in untouched quality and quantity. Due to the above load unitization has the most profound significance in intermodal transport. The unitization in this case means setting of a specific amount of the load in one entity with the use of proper auxiliary means or transport devices and then carrying it in intermodal load units (UTI). The load units are dealt with by transport devices together with transport means. Road carriage of replaceable trailers is realised by car transport, whereas the railway transport is realised on wagons-platforms or container wagons. In practice containers are used most often for carriage of loads in intermodal transport. Swaps and semitrailers are less common. The main reasons for this situation in Poland are high costs of purchase of appropriate wagons, as well as the fact that only a few percent of the used semitrailers have a properly strengthened construction enabling vertical transshipment and an indentation needed for clamps. Lack of proper equipment of transshipment terminals for Modalohr system is an additional limitation (high financial expenditures on rebuilding of the existing terminals).

In Poland, like in the rest of Europe, intermodal transport is realised to a large extent with the use of railway-road transportation (compare Fig. 2). The core of railway-road transportation lies in the fact that the main section of car transport (by a truck, a tractor with semitrailer, a semitrailer or a swap) together with the load uses the transport service of railway (Nejder, 2008, p. 118). Joining together the road transport and railway transport in one transit process enables benefiting from advantages of both the branches, with a simultaneous elimination or reduction of their negative features.

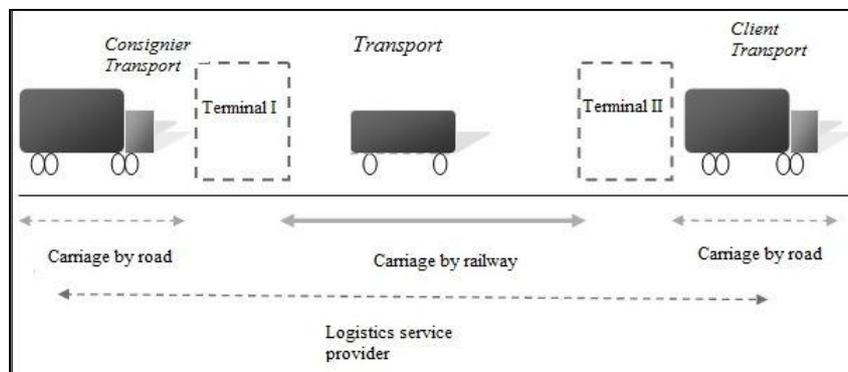


Fig. 2. Scheme of the railway – road transport

Intermodal road-railway transport in Poland (if chosen for realisation of a given transportation) is most often selected from the point of view of development of transport branches. Dropping-delivery transport realised with the use of road vehicles results from the fact that currently in Poland the network of roads is well developed and guarantees possibilities of fast and direct supply of goods to client. Whereas the profound part of the transportation is realised by railway, which with its average speed of approx. 26 km/h is still perceived as an ineffective and unattractive means of commodities transport. Still examples from other countries show that railway is able to offer high quality transport services. At present the railway transport of goods is under transformation and becomes more and more often appreciated and more and more often chosen by shippers and speditors. To a large extent the above is caused by economical as well as by environmental factors.

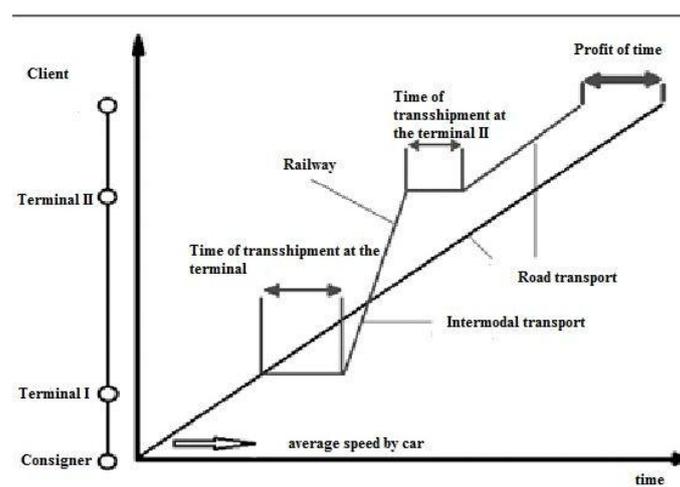


Fig. 3. Comparison of the time of road transport and railway-road transport

Yet the above clearly shows that in Poland intermodal transport is still considerably uneconomic compared to road transport. Therefore time has to be an important factor in its favour (compare Fig. 3). In case of railway – road transport proper organisation of transport for load units, distribution and number of terminals as well as the network of railway and road connections are crucial. These factors connected together will enable achieving time advantage over the road transport.

In the system of intermodal transport the task of road transport is limited to delivering the freight from the warehouse to the first terminal and receiving it from the second terminal and transporting directly to the final destination. Railway transport is the main and the longest part of transportation. According to the scheme during the intermodal transport the cargo is twice transhipped, which causes time losses. A compensation of the lost time should take place during the railway transportation when a train develops higher speed than a car and no stops are required, unlike in case of drivers in road transportation. By additionally improving the transhipment system in terminals, the transportation time can be additionally reduced. Thus intermodal railway-road transport has a chance to achieve time

advantage over the road transport when the following conditions are fulfilled (Krawczyk, 2011, p. 359):

- distance of the route covered by means of railway transport will be properly selected,
- train will reach high speed during transport,
- proper organisation in terminals will enable efficient transhipment,
- transhipment terminals function decently.

3. COMPARISON BETWEEN INTERMODAL AND ROAD TRANSPORT IN OVERLAND ROUTE BETWEEN ŚWIEBODZIN AND GDAŃSK THROUGH THE TERMINAL POZNAŃ FRANOWO

Numerous entities are engaged in realisation of intermodal transport chains. The entities include: shippers, carriers, infrastructure managers, terminal operators, intermodal transport operators, etc. Transport activities related to intermodal transport are comprehensive and each time are properly adjusted to the needs of the route and the cargo as well as the clients' requirements. The relation between the cost and price in the intermodal transport system is not transparent enough, additionally there occurs also diversity of prices (tariffs) between operators or transport corridors and market segments. The prices associated with intermodal services production are possible to estimate, yet this requires obtaining reliable information and data from the market. Still it has to be noticed that establishing of a realistic price for intermodal and road transport is possible only for selected

routes, and forecasting of this type of results should not influence the whole transport market, in the international as well as in the state or regional scale (Gońka & Wiśnicki, 2010, p. 1). Therefore it seems reasonable to carry out an analysis with the predominant objective to try and present in realistic way the factors influencing the choice between a service realised only with the use of a road transport and intermodal transport. The author of the analysis put particular stress on the costs of the carriage service, time of its realisation and CO₂ emission. The analysis also aimed at showing which of the presented technologies of service providing is more friendly to natural environment. The choice of sample for the analysis was purposeful. The analysis included the route of cargo from a warehouse located near Świebodzin to the final destination – land-sea terminal DCT Gdańsk. In the intermodal transport system the point joining together road-railway transport was located in the on-land terminal Poznań Franowo (code of the railway station: 028357). The railway tariff distance between DCT Gdańsk and Poznań Franowo is 309 km. The section of the route from the shipment location to the transshipment terminal

is 113 km long. PKP CARGO Connect was the operator of the intermodal transport. The freight, according to the harmonised commodity code system (NHM) was a neutral commodity, item NHM 73220000, dimensions 800x110x600 mm and weight 43 kg each. The load was carried in a standard sea container 20' with inner dimension of 5758 mm in length, 2352 mm in width, 2385 mm in height, as a consolidated load. During loading the load was properly secured inside a container by especially made wooden constructions and by additional dunnage airbags, assuring stabilisation and safety in transport. 441 items of the total mass of 18963 kg (approximately 19 tons) were carried in the container.

For the railway transport in the intermodal transport system realised by PKP CARGO Connect from the terminal Poznań Franowo to DCT Gdańsk a transit with the following lines was assigned: 823, 394, 353, 131, 726, 729, 730, 265, 9, 226. On the map the route is marked pink (compare Fig. 4). Poznań Franowo terminal connects together two important European corridors, East – West and North – South, significantly influencing the development and continuous increase of intermodal transport. So-called operator trains between Trójmiasto and the intermodal terminal Poznań Franowo go in a shuttle system five days a week, and can carry about 90 TUE.

In the road transport the distance between Świebodzin and DCT Gdańsk is 434 km. The route for articulated vehicle (tractor-trailer) to a large extent overlaps with Pan-European road corridors no. II and VI (compare Fig. 5). The route connects together the main via points: DK92 – E65/S3 – A2/E30 – E261/S5 – A1/E75 – E28/ S6 – E75/91. The whole route was determined to run along the main road trails so as to shorten the transport time to the minimum. The assumption of the shortest time did not cause the route to be the shortest possible.

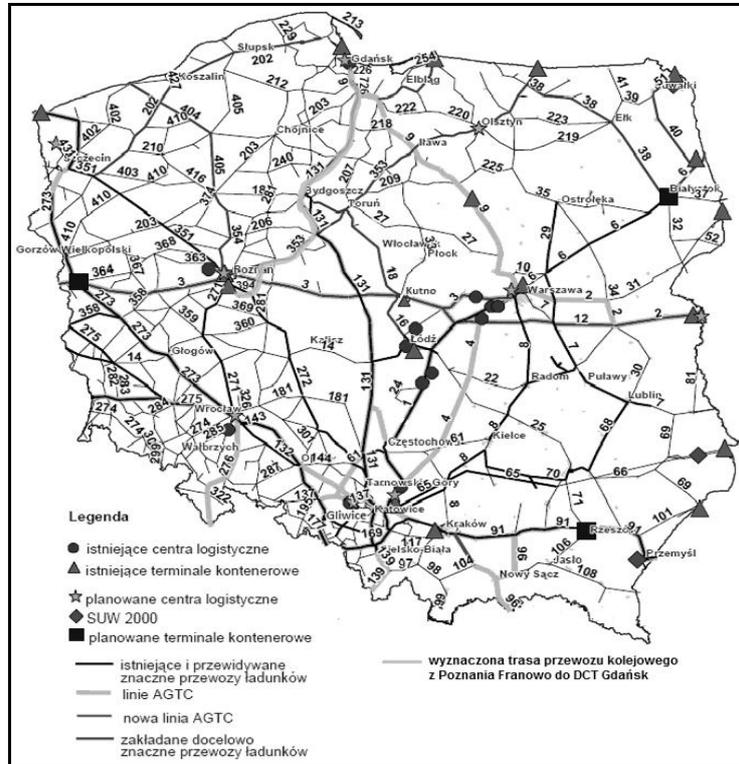


Fig. 4. The route of the railway connection between Poznań Franowo terminal and DCT Gdańsk

In order to perform comparative analysis of prices of intermodal and road transport on the route Świebodzin – DCT Gdańsk the following data was used: a tariff for intermodal transport (by railway) from/to terminal PKP Cargo Connect Poznań Franowo, a tariff for intermodal (truck) transport from/to terminal PKP Cargo Connect Poznań Franowo, payment for the service of containers in DCT Gdańsk, the fee for road transport of a 20' and 40' container on a given route.

Road transport is characterised by a reduced number of indirect operations, that is by a lower number of stages realised in a transport process. Intermodal transport is divided into five stages, while in the road transport there exist three stages, presented below:

- stage I – loading in the place of shipment (Świebodzin),
- stage II – road transport,
- stage III – transshipment to the storage yard in DCT Gdańsk.

The table below presents in detail a number of transport operations, which are performed in a predetermined order on a given route forming the whole transport process. Setting together of a road and intermodal transport takes into account the criterion of a distance, CO₂ emission and cost as well as time of carriage.

Table 1. Comparison between costs, time and CO₂ emission in intermodal and road transport: route Gdańsk – Świebodzin

TRANSPORT SYSTEM									
Intermodal transport					Road transport				
Section	Distance [km]	Time [h]	CO ₂ emission [kg]	Cost [PLN]	Section	Distance [km]	Time [h]	Emission CO ₂ [kg]	Cost [PLN]
Świebodzin – loading	-	3	-	-	Świebodzin - loading	-	3	-	-
Świebodzin - terminal Poznań	113	1:45	140	800	Świebodzin - Gdańsk	434	8:20	530	1840.6*
Terminal transshipment 2 movements	-	0:10	-	Included in the freight price	DCT – transshipment to the place	-	0:5	-	138.6**
Poznań - railway – DCT	309	12	130	600					
DCT – transshipment to the place	-	0:5	-	138.6					
Total	422	17	270	1538.6	Total	434	11:25	530	1979.2

* Euro exchange rate Table no 076/A/NBP/2016 of 2016-06-10, 1€ = 4.33 PLN (425€ = 1840.60 PLN)

** Euro exchange rate Table no 076/A/NBP/2016 of 2016-06-10, 1€ = 4.33 PLN (32 € = 138.6 PLN)

The above analysis proves that in spite of carrying of one 20 feet container the final price of intermodal transport (1538.60 PLN) is lower than the price of road transport (1979.20 PLN). In case of a comparable transport time the obtained results are not in favour of intermodal transport, because it is 5 hours 35 minutes longer than the road transport. The above is caused by poor condition of line infra-

structure of railway transport and low trade average speed, which in this case is 26 km/h. In spite of a larger number of performed transshipment tasks in intermodal system (3 loading processes), their total time is only 10 minutes longer than in car transport (2 loading processes). With a correct organisation of terminal activities, this difference has no major influence on the duration of the whole transport process. In the analysed example the dropping-delivery costs (800 PLN) in intermodal transport due to a long distance (113 km) constitute 51% of the total costs of the load carriage. The costs exceed the price of railway freight (600 PLN), in which two transshipment movements on Poznań Franowo terminal are included. Moreover it should be noticed that intermodal transport is definitely more environmentally friendly because carbon dioxide emission on the analysed route is lower by 49% compared to the road transport.

4. CONCLUSION

A growing number of containerized cargos transhipped by Polish sea harbours, continuous development of container terminals infrastructure and increasing importance of energetic efficiency of particular branches of transport (a system advantage of railway transport) opens new possibilities to the intermodal transport. At the same time the intermodal transport has become more effective and more strongly oriented towards the clients' needs thanks to opening of the market, growing competition, and thus to the emerging variety of offers.

Intermodal transport is the basis of alternative solution in case of limitation of road transport. Yet the realisation of intermodal transport system requires not only a good knowledge of advantages and disadvantages but first of all of a strong integration of a number of means of transport, offering higher quality of services and more economically effective solutions than the one the road transport offers. It is even more important because intermodal transport should play a significant role in trade services within the country, export and import, in particular in services for increasing quota of containerized cargos in on-land – sea terminals. Intensification of intermodal transport development can be reinforced by the transit location of Poland additionally supported by preferential rates for access to railway infrastructure. Transport development stimulates and is stimulated by the development of world economy and continuously growing international exchange of good. Yet further economical development requires continuous investments in development of transport infrastructure in Poland. Thanks to the European Union funding Poland has a chance to modernise and adjust its transport infrastructure to the EU standards in a considerably short time. Yet transport modernisation should be organised in a sustainable way without giving a privilege of one branch over the others, unlike in case of road transport. In order for the transport to be maximum effective

numerous of its branches have to be developed, and intermodal transport is one of the most prospective branches.

The results obtained from the comparison of intermodal and road transport for a given distance enable stating that effectiveness of railway-road transport is influenced by 22% lower internal costs than the ones of road transport and by lower emission of carbon dioxide. The companies taking into consideration external factors of transport will choose intermodal transport. Whereas the attractiveness of road transport still lies in its shorter time and the flexibility of provided service.

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BIOGRAPHICAL NOTES

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