

DETERMINANTS OF FREIGHT DEVELOPMENT IN THE CONTEXT OF INTERMODALITY PRIORITIES

Marzena KRAMARZ, Edyta PRZYBYLSKA

Silesian University of Technology, Gliwice, Poland, EU, mkramarz@polsl.pl, eprzybylska@polsl.pl

Abstract

Intermodality in freight transport is one of the key axes identified by the European Commissions. However, implementing the principles that intermodality requires is associated with a number of challenges and various barriers that effectively inhibit its development. The key priorities in the development of intermodality is to meet the needs of broadly understood clients while taking care of the aspects of sustainable development. Railway transport as a branch of transport that generates significantly lower external costs than road transport fits into these priorities. However, the pace and direction of development of railway transport as part of the intermodal transport chain depends on a number of factors. Among them are general factors - relating to the entire transport system and industry - that is, strictly connected with railway transport. Hence the purpose of the article is to identify and evaluate the factors determining the development of railway freight transport in the context of its participation in the intermodal chain. A preliminary group of factors has been distinguished on the basis of literature research. In the next stage, the identified factors were subjected to group expert assessment. These studies allowed the identification of key determinants included in the areas of: economic, political and legal, technological, social and environmental.

Keywords: Intermodal transport, intermodality priorities, development determinants, railway transport

1. INTRODUCTION

At the moment, the network-based approach in the management is one of the most developed paths of studies both basic and applied. The problem of organizations cooperation is very differentiated. This applies to economic, social and environmental aspects. However, gaining the competitive edge is the superior dimension of the cooperation. Intermodal transport comes under this heading the basic link of which should be the railway transport, generating the lowest external costs comparing to road transport predominating in Poland. Features such as: eco-friendliness, large capacity, safety, long range underline the necessity of railway transport development. Within the past years, the quantity data show the increase of intermodal transport utilization using the railway. However, its share in the total volume of freight is still too small in relation to the needs and the possessed potential. The railway transport in Poland has been facing a few problems for many years that weaken its position. The implemented and expected operations gradually contribute to the changes taking place in the railway. This is an important aspect of shaping the future intermodal freight transport. It of course depends on the railway transport conditions and the directions of its development as a partner of the intermodal chain. However, the level and direction of railway freight transport development depends not only on the transport sector itself but also on the external environment factors which are important stimulants or destimulants of such development. That is why, the purpose of this paper is to identify and evaluate factors determining the railway transport development in the context of its share in the intermodal transport chain. With this objective, there have been a few main study steps determined, such as: identification of potential railway transport development factors, design of a questionnaire evaluating the identified factors, performance of the factors evaluation, identification of key factors of the railway transport development as an element of the intermodal chain. In the remainder of the article, the mentioned steps will be briefly discussed together with their results.

2. RAILWAY TRANSPORT IN THE CONTEXT OF THE INTERMODAL NETWORK DEVELOPMENT

The network approach is based on the assumption that none of the contemporary organization is able to operate isolated from the surrounding entities [1], and the operations and competitive edge of individual entities are determined by the structure of relations with other organizations [2,3]. In other words, in this context, all contemporary organizations function within different types of - formalised and non-formalised - metaorganizations named the network [4]. Using the network paradigm in the context of logistics creates new opportunities for enhancing the logistic processes both inside and outside organizations, but first and foremost it discovers new opportunities for improving the management of chains and networks of supplies [5]. The logistic networks are special type of the supply network where the focus is oriented on cooperation of organizations creating the network in order to effectively and efficiently implement the material flows [6]. In this context of metaorganization, relationships are created both vertically - along the value added flow and horizontally. Relationships created between logistic service providers are especially important for the effectiveness and efficiency of the logistic network. Network configuration - including both the selection of service providers and relationships between them, affect the beneficiaries, both external and internal. When considering this aspect, the environmental impact, next to operational costs related to material flow, implementation of the cooperating organizations strategy (including the customer service strategy), is more and more analysed in the scientific studies by many different authors. It is affected by the way the freight transport is organized and the location and number of network nodal points, such as production and trade companies (and their own warehouses network) as well as distribution centres, logistic centres and reloading terminals. The external costs of the transport become however a key problem the logistic networks must face. The external effects of the transport include, among other things: polluted environment, accidents, congestion, noise, vibrations, land occupancy by transport infrastructure. The studies show that the predominating branch of the cargo sector, i.e. road transport, generates the greatest external costs of transport. As a consequence, at the level of both European documents (White Paper) as well as national and regional strategic documents, the necessity of transferring freight transport to other transport branches is underlined. Having the full awareness of the meaning of road transport in creating flexibility of the transport system, wherein the railway transport, inland waterway and maritime transport should dominate, the most important solution reducing the external effects of transport is the intermodal transport.

Satisfaction of the needs of various clients with simultaneous care for sustainable development aspects are the key priorities of the intermodality development. Railway transport as a branch that generates lower external costs comparing to road transport matches the proclaimed priorities. At the same time, when analysing the structure of cargo flow in Poland, according to the transport branch criterion, one may notice that the railway transport comes second after the road transport. The predominating road transport represents ca. 85 % of all cargo flow, wherein the railway transport represents ca. 11 % and the remaining 4 % is spread among inland waterway and maritime transport, air transport and pipeline transport. Simultaneously, experts notice in this transport branch the greatest opportunity for taking over a part of the flow performed by road transport. When showing the determinants of the intermodal network development in Poland until 2030, the attention is paid to the railway freight transport development determinants.

3. FACTORS OF THE RAILWAY FREIGHT TRANSPORT DEVELOPMENT

As mentioned in the preceding item of the paper, the railway transport within the contemporary transport policy is the key element of the intermodal transport chain. However, its full utilization depends on the level of its development affected by a series of determinants. Part of them is of general nature related to the impact on the whole freight transport, regardless of the used transport branch. Other determinants are purely related to the factors affecting the railway transport without any impact (or only a negligible impact) on other freight transport branches. In general, the railway transport development determining factors can be grouped into four categories: political and legal, economic, social and environmental, technological.

As noticed by V. Reis, J.F. Meier, G. Pace and R. Palacin [7] building the railway infrastructure network and railway transport operations is frequently limited by political aspects. This results, among other things, from the fact that many railway companies were or still are the property of the state. Moreover, the railway sector is strongly supported by the state. The intermodal railway transport is, within major part, of international nature, hence it is affected by political situation of individual countries. Furthermore, this necessitates integration of various legal conditions present at individual stages of the transport process. Other issue that is politically conditioned is the EU transport policy that promotes sustainable development of the transport sector, therefore it shows the incentives for investments within the railway transport area. In this context, the attention is paid to stable, continuous and long-term strategy of the railway freight development supported by consecutive authorities. At the moment, the trend of transferring the global economic centre to the Far East and the South-Eastern Asia becomes even more noticeable, developing the Eurasian trade that strongly uses the maritime transport. Specific developmental operations within the railway transport may contribute to partial take over and support of the implemented transit [8]. The political and legal aspects are also noticed by M. Antonowicz [9], who relates them mostly to the principles of approving the railway forwarders for operations on the market or to observing the competitiveness rules. However, the principles of access and fees for the access to the railway transport infrastructure are identified as a superior example of the controlling factors.

A separate group includes technological factors, especially important on modern markets, which are strongly supported by dynamically developing technical and information solutions, related to innovativeness of companies and the whole country. I.S. Hegedüs and M. Stefan [10] especially underline the meaning of programs that will support implementation of new technologies in the railway transport. Moreover, a lot of attention is drawn in the literature to the nodal infrastructure. Due to the complexity of the intermodal transport that is based on various branches of transport, the importance of individual entities, services and infrastructure elements is emphasised. This means spatiotemporal coordination of the mentioned elements. Frequently, the reloading process between the railway and other branches is treated as a critical stage of operations that require significant engagement, close cooperation and high level of communication [11]. Separate discussion must be devoted to the planned infrastructural projects that should ensure improvement of technical and operational parameters designed for fast intermodal trains [12]. Within this aspect, a lot of attention is also paid to interoperability of the railway systems in order to level the technical nature barriers that limit the traffic between individual countries [13].

Among the economic factors, the most important are fees related to the infrastructure and the transport performed by the forwarders. These mostly include fees for the access to the linear infrastructure and the obtained so called intermodal relief. The internalization of the external costs is another problem, wherein according to the EU policy, each means of transport should completely cover negative effects of its operation. As mentioned by UTK [12], the road transport in Europe internalizes the costs only at the level of ca. 50 %, however the railway transport almost completely. The economic expression of the factors that determine the railway transport include also the forecasts concerning the level of freight transport in the world, their cargo structure or the scale of cross-border transport. All the more so since the practice shows changes in the transport structure, where the increase of general cargo at the expense of bulk one is noticeable. M. Kadłubek [14] attracts attention to the necessity of using the principles of state intervention in the intermodal transport development in order to create favourable technical, organizational and economic conditions to build sustainable transport system. Therefore, it is necessary to strive to create a solid plan for the development of intermodal transport based on railway transport.

The factors within the social and environmental area focus mostly around the ecological aspects, which are more and more important at the moment. Railway transport generates lower level of CO₂ emission, it is the most energy saving branch comparing to road, air or even water transport [10]. Other determinants within this group relate to environmental and geographical aspects concerning topography, climate or the consequences they generate. Other factors directly apply to the society and its behaviour in the market.

4. IDENTIFICATION OF KEY FACTORS FOR THE DEVELOPMENT OF THE RAILWAY FREIGHT TRANSPORT IN THE CONTEXT OF INTERMODALITY - STUDIES RESULTS

Based on the performed literature analyses, briefly mentioned in item 3 herein, a list of potential factors that may affect the future development of the railway freight transport in the context of its share in the intermodal transport has been developed. These factors are divided to four groups:

- political and legal factors - policy of the state within the scope of environment protection, transport policy of the state, international relationships of individual countries and linear infrastructure managers, level of intervention of the state in the railway market, uniformity of the law concerning the railway in individual countries, share of the state in the development of intermodal transport (public and private initiatives), policy promoting the railway and intermodal transport, principles of access to the linear railway infrastructure, level of political lobbying of railway associations, developed railway programmes and the degree of their implementation, restrictions and regulations concerning the traffic of road means of freight transport, level of political lobbying of non-railway associations, development of the New Silk Route, development of the TEN-T programme considering the railway transport;
- economical - level of state expenditures in the development of linear infrastructure, level of fees for the access to the linear infrastructure, level of the intermodal relief, procedures and their stability in assigning intermodal relief, level and fluctuations of the demand for railway transport, structure and arrangement of industry, level of demand for bulk and processed cargo, level of prices of the competitive branches of transport, level of the international trade exchange between Poland and other countries, development of trade between the Western Europe and the Eastern Europe and Asia - transit transport, level of energy costs, availability of investment financial support sources, level of customs fees, access and demand for raw materials, free flow of capital and workforce, currency exchange rate, tax rate, level of economic development of a state, level of percentage rates, inflation, internalization of external costs of transport, unevenness in financial support of individual branches of transport, costs of human resources, amount of budget for R&D;
- technological - level of cooperation within R&D, interoperability of the railway systems, development the ro-ro technology, development of intermodal loading units, development of the lo-lo technology, level of innovativeness of a state, development of the ro-la technology, network of intermodal reloading terminals (number and location), parameters of the reloading terminals, modern information solutions (e.g. tracking of containers route), access to new technologies - transfer of knowledge and technology, availability of qualified personnel, separation of the cargo linear infrastructure (separation of freight and passenger transport), adaptation of the infrastructure to handle trains of length up to 750 m, connecting the railway infrastructure with inland / sea ports;
- social and environmental - awareness and attitude towards ecological aspects, climate and topography, natural hazards (e.g. mining damage, landslides), density and structure of population, urbanization level, level of external costs of transport, level of population incomes, development of e-commerce, ecological movements.

The mentioned factors have been studied by experts representing both the science and economic domains related to functioning of the railway transport. A questionnaire evaluating the factors was developed for that purpose with the scale of grades from 0 to 3, where: 0 - no impact; 1 - minor impact; 2 - medium impact and 3 - deciding impact. The purpose of the studies was to identify key factors, i.e. the ones that determine the railway freight transport to the greatest extent.

Table 1 presents the results of the total score obtained by individual groups of determinants. Two groups of factors got the highest average score: technological (2.39) as well as political and legal (2.33). This shows great significance of these two groups of determinants for the development of the railway freight transport. First and foremost, the role played by well prepared and modern linear infrastructure and the applied reloading systems is underlined. One need to emphasise the meaning of the beneficiaries representing the state

authorities. They are mostly responsible for creating legal regulations, strategic programmes or taking decisions favouring the development of the railway and intermodal transport.

Table 1 Total score of the analysed factors group [own study]

No.	Economic factors	Technological factors	Political and legal factors	Social and environmental factors
Score	2.00	2.39	2.33	1.46

The performed expert's evaluation of all the previously mentioned factors allowed for selecting the ones which got the highest score. As the key factors, the ones with at least 75 % of the maximum grade, i.e. 2.25 points (per 3 maximum points) were identified. The identified key determinants satisfying the assumption are presented in **Figure 1**.



Figure 1 Evaluation of key factors [own study]

As shown in **Figure 1** the list of key factors includes 25 determinants. They represent three areas - political and legal, economic and technological. Within the social and environmental factors group, key factors affecting the railway transport development were not identified. From among all the selected factors, special meaning due to the highest and close to maximum score can be assigned to (score 2.9): expenditures on the linear infrastructure, network of intermodal reloading terminals, connection of railway routes with inland and sea ports. All key factors identified within the scope of the studies may be perceived as especially important and conditioning the future of the railway freight transport, being the part of the intermodal transport.

5. CONCLUSION

Studies performed by the authors represent a part of a wider analyses performed within the area of the intermodal transport development. This subject is strongly emphasised both in the European and Polish transport strategies. This is mainly the result of negative effects generated by continuously developing road transport, being the predominating branch in freight transport. However, the railway transport has many merits that correspond to the strategic goals given in the White Paper, adopted in the perspective to 2030 and 2050. One of the most important features of the railway is its eco-friendliness and from the wider standpoint significantly lower external costs of the implemented transport. Railway transport in Poland has undergone many changes within the past years. However, the level of its development is still too low in relation to the needs and capabilities. Thus, the paper tried to identify the key factors affecting the development of railway freight transport. Within the first stage of the studies, a set of 62 factors representing four areas was separated: political and legal, economic, technological, social and environmental. Within the next stage of the studies, 25 key determinants for the railway freight transport development were identified from among them, indicated by experts as the key element of the designed intermodal chains. These factors are especially important because they represent the grounds for further development of the railway transport. Their level and the changes within their surrounding will condition the pace and directions of the railway freight transport development in Poland.

REFERENCES

- [1] STAŃCZYK-HUGIET E., *Strategiczny kontekst sieci międzyorganizacyjnej* [w:] J. Niemczyk, E. Stańczyk-Hugiet, B. Jasiński (red.), *Sieci międzyorganizacyjne. Współczesne wyzwanie dla teorii i praktyki zarządzania*, C.H. Beck, Warszawa, 2012c, pp. 249-269.
- [2] CZAKON W., *Paradygmat sieciowy w naukach o zarządzaniu*, Przegląd Organizacji, nr 11/2011, pp. 3-6.
- [3] CZAKON W., *Sieci w zarządzaniu strategicznym*, Wolters Kluwer, Warszawa 2012, pp. 1-264.
- [4] KLIMAS P., *Podejście sieciowe w logistyce*, Studia Ekonomiczne, Uniwersytet Ekonomiczny w Katowicach, nr 249/2015, pp. 36-48.
- [5] BORGATTI S.P., LI X., *On social network analysis in a supply chain context*, Journal of Supply Chain Management, No. 45 (2)/2009, pp. 5-22.
- [6] KRAMARZ M., *Sieci logistyczne w naukach o zarządzaniu*, Studia Ekonomiczne, Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach, nr 251/2015, pp. 79-91.
- [7] REIS V., MEIER J.F., PACE G., PALACIN R., *Rail and multi-modal transport*, Research in Transportation Economics, 41, 2013, pp. 17-30.
- [8] BARTOSIK M., WIAK S., *Multi-annual program „By Railway to the 21st Century“ as key factor in the development of rail transport in Poland*, Transportation Research Procedia, 14, 2016, pp. 518-527.
- [9] ANTONOWICZ M., *Regulation and Logistics in rail freight transport*, The Archives of Transport, no 3, 2011, pp. 275-284.
- [10] HEGEDÜS I.S., STEFAN M., *External Factors of the rail freight transportation*, Bulletin of the Transilvania University of Brasov - Special Issue Series V: Economic Sciences, vol. 10 (59), no 2, 2017, pp. 25-35.
- [11] SCHÖNEMANN R., *Integrating railway services into the supply chain at the last mile of the transshipment interface seaport-rail*, Conference Paper: Transport XXI wieku, Poland, 2010, pp. 1-14.
- [12] *Zwiększenie roli kolei w równoważeniu transportu towarów w Polsce. Wyzwania, propozycje, dobre praktyki*. Wersja zaktualizowana, UTK, Warszawa, 2019, pp. 1-57.
- [13] WACŁAWIAK I., *Uwarunkowania rozwoju kolejowego transportu towarowego*, tts, 1-2, 2011, pp. 24-28.
KADŁUBEK M., *Railways in intermodal transport in Poland*, Research in Logistics & Production, vol. 1, no. 3, 2011, pp. 203-211.