

*Michał Kruszyński*¹, *Nataliya Struk*²

¹ International University of Logistics and Transport in Wrocław

² Ivan Franko National University of Lviv

Position and conditions of development of intermodal transport in Poland

Pozycja i uwarunkowania rozwoju transportu intermodalnego w Polsce

Abstract. The purpose of this paper is to present the development of intermodal freight transport in Poland for years 2010–2018. The study presents determinants and prospects of intermodal freight transport development in upcoming years. Intermodal transport in Poland is developing dynamically. It is determined by the geographical location of the country, the dense network of railway lines, the growing number of intermodal terminals and the increasing number of intermodal railway carriers. In the years 2010–2018, the volume of intermodal transport carried out using rail transport increased to 12.6 million t. Transport performance in the area of cargo transportation in 2018 reached the level of 6.2 billion tkm.

Key words: transport, combined transport, intermodal transport

Synopsis. Celem artykułu jest zaprezentowanie rozwoju intermodalnego transportu towarowego w Polsce w latach 2010–2018. Przedstawiono uwarunkowania i perspektywy rozwoju intermodalnego transportu towarowego w nadchodzących latach. Transport intermodalny w Polsce rozwija się dynamicznie. Rozwój ten jest wspomagany przez położenie geograficzne kraju, gęstą sieć linii kolejowych, rosnącą liczbę terminali intermodalnych i intermodalnych przewoźników kolejowych. W latach 2010–2018 wielkość transportu intermodalnego realizowanego za pomocą transportu kolejowego wzrosła do 12,6 mln t. Wydajność transportu w obszarze transportu ładunków w 2018 roku osiągnęła poziom 6,2 mld tkm.

Słowa kluczowe: transport, transport kombinowany, transport intermodalny

Introduction

Transport is considered a branch of the national economy that significantly determines economic and social progress [Klimek 2010]. In the national economy it plays the role of an instrument for the exchange of goods and services and is a factor, determining the choice of production location as well as the settlement in a given area. It generates an increase in gross domestic product (GDP) and development of the economy as a whole. It

also acts as an instrument securing the achievement of socially useful goals. This function refers to the prevention of communication exclusion, and also facilitates access to various spheres of life, e.g. health care, cultural institutions, educational institutions at all levels, as well as workplaces [Grzywacz et al. 1989]. Transport is an important pillar of modern society and economy, it forms the basis of the European integration process and is closely integrated with the creation of the internal market [Walasek 2018].

There are three terms in the transport area that need to be defined; we are talking about combined transport, intermodal transport and multimodal transport. Combined transport is a highly complex transport process in which loads are moved using means of transport representing different modes of transport. In the area of terminology accompanying combined transport, the concepts of multimodal transport and intermodal transport are very often used. These terms were defined and interpreted in 1998 on the basis of combined transport terminology [ECMT 1993] developed by the United Nations Economic Commission for Europe (UN/ECE), the European Conference of Ministers of Transport (ECMT) and Eurostat. Based on the cited document, it is assumed that multimodal transport is treated as the transport of goods for which at least two different modes of transport are used, and the goods may change the loading unit after changing the means of transport. In the case of multimodal transport, there are no restrictions specifying the share of road transport in relation to other modes. Intermodal transport differs from multimodal transport in that the load on the entire transport route stays in the same loading unit. In turn, combined transport is included in intermodal transport, in which a load unit (without reloading goods) is transported between terminals mostly by rail, inland waterway or sea, and its delivery to transshipment terminals is carried out, to a minimum extent, by road [Mindur 2014]. In the case of combined transport, one of the means of transport is passive and the other active.

Intermodal transport, which includes combined transport, is an alternative to road transport. Undoubtedly, it contributes to an increase in the share of transport in the greener modes of transport, which includes rail, sea and inland waterway transport. The implementation of cargo transportation using intermodal transport forces to take into account many organizational, as well as technical and technological aspects.

In the process of implementing intermodal transport technology, it is necessary to undertake infrastructural as well as legislative projects that will be aimed at applying preferences for this type of transport from the state. The development of intermodal transport will not be possible without changes at the microeconomic level. If business entities do not make a logistic revolution, the core of which will be the introduction of modern transport technologies and containerization of cargo, then the development of intermodal transport will not be possible.

Intermodal transport falls within the area of unified transport technologies. The classification of unified technologies concerns the criterion of transshipment method, the criterion of an integrated loading unit, as well as the criterion for the location of the transshipment device. In the area of the first criterion, i.e. the method of transshipment, there are [Kwaśniowski et al. 2004]:

- horizontal transshipment (roll on – roll off);
- vertical transshipment (lo – lo);
- mixed transshipment (com – ro).

Considering the criterion of an integrated loading unit, unified technologies are divided into four groups: large containers (according to ISO, Eurocontainers), swap bodies, semi-trailers and self-propelled vehicles.

In the area of intermodal transport mainly containers are transported, but the transport of entire car sets including a tractor and a semi-trailer, which are transported using low-floor railway platforms – the RoLa system (Rollende Landstraße), is also gaining importance.

In addition, road-trailers moved with the use of pocket railway wagons (piggy-back system) and swap-bodies transported with the use of railway wagons – container platforms, are also subject to transport.

The main advantages of intermodal transport include [Brill and Łukasik 2014, Mindur 2014]:

- reducing the external costs of transport that are negative for the environment;
- improving the condition of the environment;
- providing transport services in the door to door relationship;
- greater access to transport services;
- participation in the process of reducing the global cost of the transport process;
- high level of transport and load safety;
- improving the quality of transport services;
- increasing road safety;
- reducing the rate of road pavement wear;
- the possibility of providing transport services in the just in time system;
- relieving border crossings by transferring customs clearance from the border to terminals (start and end);
- standardization of transport technology as well as transport equipment;
- possibility of carrying out transport in the countries, where the law restricts freight transport using road transport.

Discussing intermodal transport, it should be emphasized that it is particularly friendly to the natural environment, which manifests itself in energy saving, limited emissions, as well as reduced consumption of road infrastructure and not causing congestion [Engelhardt 2013]. However, we should not forget that intermodal transport involves an additional number of terminal operations, which generates additional costs that are reflected in the final price of the transport service. Intermodal transport logistics is characterized by a higher degree of complexity than traditional rail transport [Barcik and Bylinko 2018].

Study goal and methods

The purpose of the study is to illustrate the development of intermodal transport in Poland over the period of 2010–2018. The article contains statistical data on intermodal transport, and also characterizes the infrastructure necessary for their implementation. An important part of the study is to diagnose factors determining the development of intermodal transport, as well as to specify the perspectives of its development in the coming years.

The study is based on the available literature on the subject, data of general statistics, as well as legislation in the field of intermodal transport of national and European origin.

Intermodal transport in Poland in the years 2010–2018

One of the determinants of the development of intermodal transport is the number of intermodal terminals, in which the transshipment of loading units from one means of transport to another takes place. In 2018, there were 35 intermodal terminals in Poland, 29 of which were road terminals designed to handle shipments transported by rail and road. Others are sea terminals, responsible for handling transport carried out using sea and rail transport, as well as sea and road transport. The largest number of terminals have been located in Łódzkie and Wielkopolskie Voivodeships (5), as well as Dolnośląskie, Śląskie and Pomorskie Voivodeships (4). There are no access to intermodal terminals in the Kujawsko-Pomorskie, Opolskie and Podkarpackie Voivodeships (Fig. 1).



Figure 1. Intermodal terminals in Poland in 2018

Rysunek 1. Terminale intermodalne w Polsce w 2018 roku

Source: <https://portaltsl.pl> [access: 16.10.2019].

Intermodal terminals are characterized by a certain infrastructure, which is created by, among others parking and maneuvering space, total and separate storage area for containerized units, as well as the length of the railway line or the capacity of storage yards expressed in TEU units. Table 1 presents data on the infrastructure of sea and road terminals.

Table 1. Infrastructure of intermodal terminals in Poland in 2018

Tabela 1. Infrastruktura terminali intermodalnych w Polsce w 2018 roku

Specification	Terminals	
	sea	land
Length of transshipment quays in terminals (km)	7.1	–
Parking and maneuvering area of terminals (ha)	7.1	22.4
Total storage area of terminals (ha)	162.0	124.0
including area for containerized units (ha)	134.0	78.0
Capacity of terminal storage yards (thous. TEU)	93.2	90.7
Length of the standard gauge railway line in terminals (km)	13.5	78.2
Average length of train (number of wagons) operated at the sea terminal (pcs.)	53	33

Source: own study based on data from the Statistics Poland (Główny Urząd Statystyczny).

The parking and maneuvering area of the terminals in 2018 amounted to a total of 29.5 ha, with 75.9% of this area at the disposal of land terminals. The total storage area of the terminals is 286 ha, of which 56.6% is the technical potential of the sea terminals.

Intermodal terminals have a transshipment capacity of 9.1 million TEU. The transshipment capacity of sea terminals is 6.3 million TEU and is much higher than that of land terminals (2.8 million TEU). In 2018, 67.3 million t of cargo (7,301,094 TEU) were transshipped at Polish intermodal terminals, of which 27.6 million t were delivered by sea, 22.4 million t were transported by road and 17.3 million t by rail [GUS 2019a, b]. Compared to the volume of transshipped goods in 2017, this means an increase by 6.5 million t.

Particularly noteworthy is the increase in the volume of intermodal transport carried out using rail transport; over the past 10 years (2010–2018) there was an increase in the volume of transported loads by 12.6 million t – Figure 2.

The highest growth of transport dynamics expressed in millions of tonnes was recorded in 2016 in which there was an increase by 23% compared to the previous year (2015).

Transport performance in the area of cargo transportation in 2018 reached the level of 6.2 billion tkm and compared to 2010 increased by 4.3 billion tkm (Fig. 3).

The highest growth dynamics in the area of transport performance, expressed in billions of tonne-kilometers was recorded in 2017, in which there was an increase by 22.7% compared to the previous year (2016).

The group of railway carriers providing intermodal transport is dominated by PKP CARGO, which has the largest market share due to the criterion of transport performance (52.3%) and the weight of cargo (46.5%). Captrain Polska is right behind it (Table 2).

There are also other carriers on the intermodal transport market, including CTL Logistics Sp. z o.o., ECCO Rail Sp. z o.o., Eurotrans Sp. z o.o., Inter Cargo Sp. z o.o., Karpień Sp. z o.o., Lotos Kolej Sp. z o.o., LTE Polska Sp. z o.o., Metrains Polonia Sp. z o.o., Olavion Sp. z o.o., PKP LHS PKP Linia Hutnicza Szerokotorowa Sp. z o.o., STK SA Transchem Sp. z o.o. and Zakład Inżynierii Kolejowej Sp. z o.o. It seems important to note, that the position and significance of entities characterized by a smaller market share (e.g. Metrains Polonia Sp. z o.o.), which combined the carrier's functions with the function of a logistics operator, keeps growing. A favourable phenomenon in the area of intermodal transport is

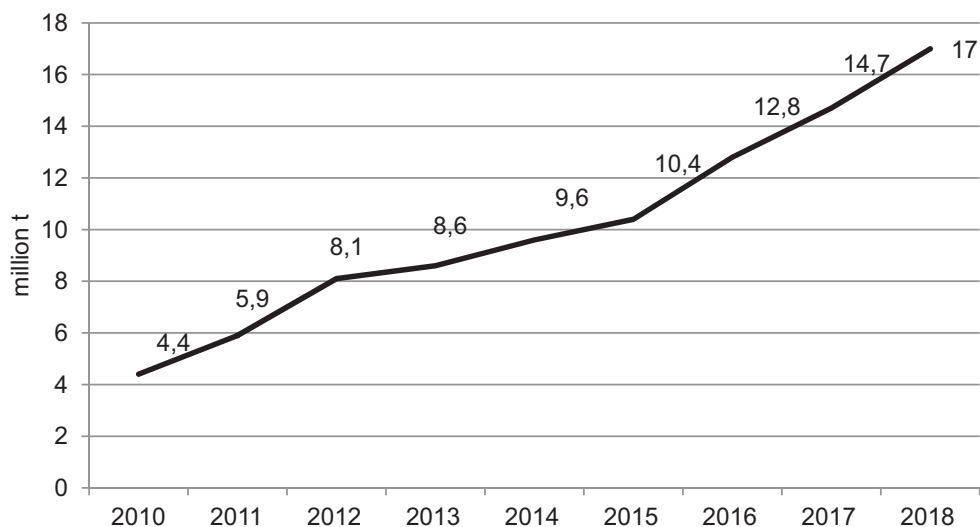


Figure 2. Intermodal rail transport in 2010–2018

Rysunek 2. Transport kolejowy intermodalny w latach 2010–2018

Source: own study based on data from the Office of Rail Transport (Urząd Transportu Kolejowego).

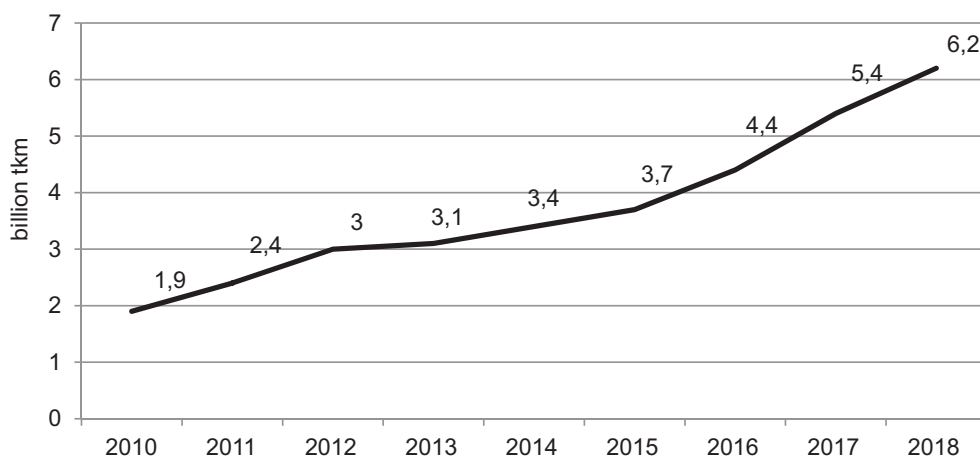


Figure 3. Transport performance in intermodal rail transport in the years 2010–2018

Rysunek 3. Wykonanie przewozów w intermodalnym transporcie kolejowym w latach 2010–2018

Source: own study based on data from the Office of Rail Transport (Urząd Transportu Kolejowego).

Table 2. Market share of rail carriers providing intermodal transport

Tabela 2. Udział w rynku przewoźników kolejowych zapewniających transport intermodalny

Carrier	Market share due to the criterion (%)	
	transport performance	the weight of transported cargo
PKP CARGO	52.3	46.5
Captrain Polska	12.5	13.7
PCC Intermodal	8.0	10.0
DB Cargo Polska	10.2	7.5

Source: own study based on data from the Office of Rail Transport (Urząd Transportu Kolejowego).

the increasing number of intermodal rail carriers; in 2016 there were 13, a year later 18, and in 2018 there were 20 railway companies providing this type of services.

Mainly containers are transported by means of intermodal transport, whose share in the total number of transported units in 2018 amounted to as much as 96.3%. Twenty-foot (47.8%) and forty-foot (43.8%) containers dominated here. The cited year 2018 was a record year in terms of transported load units: 1,894 thousand TEU.

Determinants of the development of intermodal transport in Poland

There are many different factors that influence the development of intermodal transport. Undoubtedly, the size of the country in which it is implemented is an important element determining the development of intermodal transport. Short connection relations translate into low efficiency of intermodal transport. The small area of the country eliminates intermodal domestic transport. The development of intermodal transport is also affected by the existing traffic restrictions. They may result from the terrain; in mountainous areas, cargo transport is transferred from road to rail. In the group of factors responsible for the development of intermodal transport, legal regulations which may stimulate the development of this type of transport through appropriate solutions, play an important role. In this area, the state of transport infrastructure as well as the number of transshipment terminals and their equipment also should be mentioned.

In the literature on the subject, the factors determining the development of intermodal transport include [Przybylska and Kruczek 2017]:

- situation on global financial markets;
- the possibility of obtaining financing sources;
- presence of well-qualified staff on the market;
- increase in the volume of bulk transport;
- international trade;
- development of international transport corridors;
- increased competition;
- development of road infrastructure;
- containerization development;
- the possibility of introducing innovations in intermodal transport;
- number and infrastructure capabilities of intermodal terminals;
- development of infrastructure of other transport branches;
- growing public environmental awareness;
- congestion and accident rate;
- promotion of intermodal transport;
- state policy in the area of intermodal transport support;
- concession for intermodal transport;
- road toll system.

Prospects for the development of intermodal transport in Poland are largely determined by the state of infrastructure, including rail infrastructure, which determines the competitiveness of this type of transport. It is also important to extend the existing terminals and construction of new reloading terminals, equipped with appropriate reloading devices.

Among the threats limiting the development of intermodal transport is the lack of sufficient cooperation between entities creating the intermodal transport market. This situation encourages actions aimed at taking over part of the domestic intermodal market by operators from European Union countries, who are stronger in terms of organization and capital [Mindur and Mindur 2018]. We should not forget about the insufficient number of specialized intermodal transport equipment, which is technically prepared for transporting trailers, swap chassis or trucks. Another problem is the lack of systems responsible for the overall monitoring of the passage of goods. Such systems should provide customers with information on the real time of transport as well as the status of shipments on the way. Finally, we should be aware of the limited price competitiveness of intermodal transport in relation to road transport. This situation is caused by the high level of rail freight, as well as the prices of reloading and handling operations in the area of road transport [Mindur 2010].

When considering the area of intermodal transport in Poland, it should be noted that it has many beneficial features that encourage the development of these transport technologies. This is the geographical location of a country whose territory is a bridge between Europe and Asia, since long distances are favourable for the development of intermodal transport. Successful forecasts in the area of the development of ports and their terminal infrastructure will increase transshipment capacity, and thus enable the development of intermodal transport. Improvement of the linear infrastructure and its satisfactory density as well as the level of electrification are also important in the area discussed. We should be aware that the volume of our foreign trade is conducive to the development of intermodal transport, and the area of the country's territory makes it possible to reach the distance threshold of profitability of intermodal transport [Antonowicz 2018].

Among the development opportunities in the area of intermodal transport, the following will be of significant importance [Engelhardt 2013]:

- An efficient network of night, fast container trains that will connect leading seaports with the largest and most important logistics centers in the country and abroad. This transport will be carried out by shuttle trains; their distinguishing feature will be the speed of implementation, reliability and comprehensiveness of provided services.
- An efficient network of night fast container trains that will connect logistics centers located in the immediate vicinity of major urban agglomerations.
- Reliable network of container trains in international relations (West–East, North–South).
- A reliable network of container trains serving large concerns operating on global markets.

Despite the existence of certain restrictions, it should be noted that intermodal transport in Poland has a very large potential, which results primarily from the density of railway lines, the degree of their electrification, as well as the intensive development of seaports in Gdańsk and Gdynia, which are infrastructurally prepared to provide highly complex transshipment services.

Intermodal transport is effective with at least a minimum degree of saturation with technical means in the form of transport equipment and the existence of a sufficient number of transshipment terminals, as well as relatively constant and balanced cargo flows, which are carried out by reliable organization of transportation [Brill and Łukasik 2014].

The ecological aspect of intermodal transport

The European Union's assumption in the area of transport is to balance existing transport modes, and also to raise the range of rail transport, so that in 2030 one can speak of a fully functioning intermodal transport network [GUS 2017]. The promotion of intermodal transport by the institutions of the European Union results from its pro-environmental nature. The use of various means of transport in this area means that the roads are less crowded, which in turn contributes to reducing congestion, but also slows down the wear rate of road infrastructure. Undoubtedly, combining and replacing with each other various means of transport, with particular preference of rail, brings tangible benefits to the environment. This is due to the fact that rail transport accounts for only 3% of external costs, while road transport accounts for over 50%. In addition, transport is responsible for 30% of total carbon dioxide emissions in the European Union, of which 80% produces road transport and only 1% rail transport. The small scale of territorial expansion of rail transport, as well as the fact that the amount of pollution emitted by diesel locomotives, when transporting 1 t of cargo is 10 times lower than in the case of road transport, argue for increasing the importance of rail transport, taking into account the popular concept of trucks on tracks.

Intermodal transport means less loads on the road, and this translates into the safety of all road users. Prioritizing rail transport eliminates emissions and reduces the noise level that accompanies road transport. Rail transport is responsible for 1.3% of all environmental pollution, with 98.7% of pollution generated by road transport. The use of intermodal transport technology contributes to a 17% reduction in fuel consumption and a 15% reduction in carbon dioxide emissions [Łukasik et al. 2017].

Conclusions

Intermodal transport in Poland is developing dynamically. It has increased almost four times within 10 years, from 2010 to 2018. The main routes on which intermodal transport is carried out, run from the East to the West, from the border with Belarus to the border with Germany, as well as in the South with the Czech Republic. The lines connecting ports located in Pomerania (Gdańsk and Gdynia) with terminals located in the interior of the country are also important. Intermodal transport mainly takes place using 20-foot (47.8%) and 40-foot (43.8%) containers. The geographical location of Poland is associated with the currently implemented concept of the New Silk Road, which predestines our country to be a European transit and distribution hub that will connect east and west, and the Baltic countries with the southern Europe. Intermodal transport in Poland is promising; this is determined by the density of railway lines and the increase in the number of intermodal operators.

References

- Antonowicz M., 2018: Czynniki rozwoju przewozów intermodalnych w Polsce [Development factors for intermodal transport in Poland], *Studia i Prace. Kolegium Zarządzania i Finansów SGH* 170, 105–120.

- Barcik R., Bylinko L., 2018: Perspektywy transportu intermodalnego w Polsce [Prospects for intermodal transport in Poland], *Prace Naukowe Politechniki Warszawskiej, Transport* 120, 9–17.
- Brill J., Łukasik Z., 2014: Aspekty ekonomiczne, techniczne i strategiczne transportu intermodalnego [Economic, technical and strategic aspects of transport intermodal], *Technika Transportu Szybowego* 21 (3), 12–24.
- Engelhardt J., 2013: Polityka państwa w zakresie transportu intermodalnego w Polsce [State policy in the field of intermodal transport in Poland], *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Transportu i Logistyki* 22, 57–80.
- European Conference of Transport Ministers – ECMT, 1993: Terminology on combined transport, OECD Publishing, Paris.
- Główny Urząd Statystyczny – GUS, 2017: Transport – wyniki działalności w 2016 roku [Transport – activity results in 2016], Warszawa.
- Główny Urząd Statystyczny – GUS, 2019a: Transport intermodalny w Polsce w 2018 r. [Intermodal transport in Poland in 2018], Warszawa.
- Główny Urząd Statystyczny – GUS, 2019b: Transport – wyniki działalności w 2018 roku [Transport – activity results in 2018], Warszawa.
- Grzywacz W., Burnewicz J., 1989: *Ekonomika transportu* [Economics of transport], Wydawnictwa Komunikacji i Łączności, Warszawa.
- Klimek H., 2010: *Funkcjonowanie rynków usług portowych* [Operating of port services markets], Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk.
- Kwaśniewski S., Nowakowski P., Zajac P., 2004: Uwarunkowania funkcjonalne i techniczne rozwoju transportu intermodalnego [Functional and technical conditions of intermodal transport development], *Logistyka* 2, 18–20.
- Łukasik Z., Kuśmińska-Fijałkowska A., Kołodziejczyk P., 2017: Transport intermodalny alternatywnym rozwiązaniem dla zachowania równowagi ekologicznej [Intermodal transport as an alternative solution for maintaining ecological balance], *Autobusy: Technika, Eksploatacja, Systemy Transportowe* 18 (3), 45–50.
- Mindur L., 2010: Uwarunkowania dla rozwoju runku transport kombinowanego (intermodalnego) w Polsce w latach 1993–2009 [Conditions for the development of combined (intermodal) transport market in Poland in 1993–2009], multimedial presentation, Politechnika Łódzka, Łódź.
- Mindur L. (Ed.), 2014: *Technologie transportowe* [Transport technologies], Instytutu Technologii Eksploatacji, Radom.
- Mindur M., Mindur L., 2018: Transport intermodalny w Polsce w latach 2001–2017 oraz czynniki kształtujące jego rozwój w perspektywie [Intermodal transport in Poland in 2001–2017 and factors affecting its prospective development], *Prace Naukowe Politechniki Warszawskiej. Transport* 120, 297–308.
- Ministerstwo Infrastruktury, 2018: *Master Plan dla transportu kolejowego w Polsce do 2030 r.* [Master Plan for rail transport in Poland until 2030], Warszawa.
- Przybylska E., Zebrucki Z., Kruczek M., 2017: Identyfikacja czynników rozwoju transportu intermodalnego w Polsce [Identification of development factors for intermodal transport in Poland], *Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie* 103, 195–206.
- Walasek R., 2018: Interoperacyjność transport intermodalnego jako element jego konkurencyjności w Unii Europejskiej [Interoperability of Intermodal Transport as an Element of Competitiveness in the European Union], *Studia i Prace. Kolegium Zarządzania i Finansów SGH* 166, 153–164.

Position and conditions of development...

Correspondence address:

Michał Kruszyński, PhD, Eng
(<https://orcid.org/0000-0002-7905-1403>)
International University of Logistics and Transport in Wrocław
Department of Management
Soltysowicka St. 19b, 51-168 Wrocław, Poland
e-mail: mkruszynski@mail.mwsl.eu

Nataliya Struk, PhD habil.
(<https://orcid.org/0000-0002-1933-265X>)
Ivan Franko National University of Lviv
Faculty of Economics
Hetman Mazepy St. 10/13, 79068 Lviv, Ukraine
e-mail: natalistruk@hotmail.com