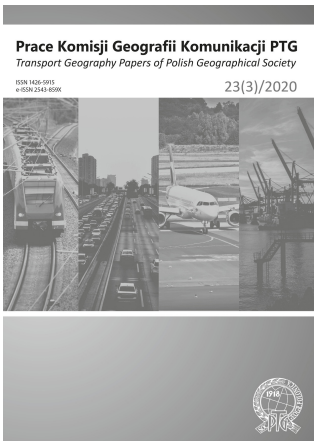

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THE IMPORTANCE OF INTERMODAL TRANSPORT IN POLAND IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Znaczenie transportu intermodalnego w Polsce w kontekście zrównoważonego rozwoju

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Abstract: Sustainable development is becoming a paradigm of civilisation changes of the contemporary world. Transport must be sustainable in the light of the challenges ahead. One of the most forward-looking types of transport, in terms of economy and ecology, namely intermodal transport, i.e., transport which uses more than one mode of transportation, has been recently gaining in importance. The purpose of this article is to present the role and importance of intermodal transport in Poland in the context of sustainable development. The first part of the study concentrates on the analysis of the issue of intermodal transport development, taking into account the assumptions of the policy of sustainable development. The further part of the study presents the essence of intermodal transport and its development potential in Poland, identifying the basic advantages and barriers in this area. The author has indicated the conditions that have shaped intermodal transport market and defined areas where changes and innovations need to be put in place to enable sustainable development of the intermodal market in the country. Intermodal transport is still struggling with many barriers, but the increasingly better infrastructure and policies of the European Union, which creates sustainable transport, have a positive impact on the growth of transport cohabitation. Based on the results of the conducted research, it can be concluded that there are both favourable external conditions and prospects for the intermodal transport development in Poland.

Keywords: transport, intermodal transport, sustainable development, sustainable transport

1. Introduction

The directions of the development of the world economy have fundamentally influenced changes in transport, which has become an indispensable element of modern social and economic processes. Transport constitutes the foundation of the national economy, and mobility is extremely important not only for the domestic market, but also for the quality of citizens' lives (Kościelniak, 2014; Rodrigue et al., 2017). Adverse effects of transport are felt by both environment and society. They are primarily associated with the consequences of road accidents and collisions, congestion, using fossil fuels (mainly crude oil), air, water and soil pollution, emission of traffic noise and limiting the land area (Motowidlak, 2017).

A deteriorating condition of the natural environment is one of the most important problems of 21st century societies. Transport enables economic growth and job creation, and its development must be sustainable in the light of future challenges. Therefore, a need for environmental protection that affects the preference for environmentally friendly transport branches and technologies is an important premise for the development of transport (Rosa, 2013). However, for sustainable development to be effective, close international cooperation is required (Korulczyk, 2014). Implementation of the assumptions of economics and the policy of sustainable development in terms of transport can be considered as an important course of action, conducive to achieving a balance between further economic and social development of the globalizing economy and the preservation of environmental values and resources (Motowidlak, 2017). One of the most forward-looking types of transport, in terms of economics and ecology, is intermodal transport. Ecology is the essential element in favour of intermodal solutions.

Intermodal transport is a category that has been given much attention in recent years, which results from globalisation, a growing importance of ecological aspects, high external costs of transport with a large share of road transport, a growing transport role of general cargo with a high degree of processing and a decreasing number of bulk transport (Agamez-Arias, Moyano-Fuentes, 2017; Przybylska, 2019). Globalisation of world production and emerging of new markets require efficient transport systems, including intermodal ones, that can move relatively large load streams (Rydzkowski, 2015; Whitty, 2018). Particular attention is paid to the possibilities associated with the development of railway as a branch with the best applicable parameters in intermodal transport. Due to its pro-ecological nature and support for the comodality of transport systems, this form of transport is strongly promoted in the European Union (Liberadzki, Mindur, 2006; Grzelakowski, 2012; Kostrzewski, 2013). In Poland, there are good prospects and conditions for the development of intermodal transport in relation to international and domestic transport. The location of our country at the intersection of important trans-European transport corridors East-West and North-South is an important asset, which means that we have a chance to become a significant intermodal hub of Central Europe (Wronka, 2017).

The purpose of this article is to present the role and importance of intermodal transport in Poland in the context of sustainable development. The first part of the study is devoted to an analysis of the issues of intermodal transport development in view of the implementation of the assumptions of a sustainable development policy. The further part of the study presents the essence of intermodal transport and its development potential in the country, identifying basic advantages and barriers in this area. The current conditions affecting the intermodal transport market have been indicated, and the areas in which it is necessary to implement changes and innovations enabling sustainable development of the presented type of transport in Poland have been defined. The study has primarily applied a research method of a critical comparative-descriptive analysis of the subject literature and the method of *desk research*. The conducted study was based on analysing the existing sources which are of a secondary nature – CSO data, available reports of the Office of Rail Transport as well as materials developed and published by other researchers. The issues discussed in the paper are quite broad and difficult to explore in depth, so only its selected aspects are illustrated, which is a certain indication for further considerations and research.

2. The development of transport and the paradigm of sustainable development

A review of the literature enables defining different meanings and applications of the concept of sustainable development. A necessity to meet the needs of the present generation with equal attention to satisfy them by future generations is the starting point in debates on sustainable development. To achieve sustainable development, coherence of three key elements is necessary: economic growth, social inclusion and environmental protection. They are all interconnected and extremely important to achieve well-being of individuals and entire societies (Przekształcanie..., 2015). Therefore, stability of wealth in the intergenerational dimension is a feature of sustainable development (Kiełczewski, 2010). The paradigm of sustainable development is primarily

based on the policy of economic interventionism.

In recent years, there has been a growing interest all over the world in the phenomenon of sustainability and its implications for the processes of planning and functioning of the transport system (Litman, Burwell, 2006; Pawłowska, 2013). In practice, however, there are great difficulties in the development of transport in the convention of integrated order, i.e. in the context of broadly understood sustainable transport (Motowidlak, 2017).

The goal of sustainable development on transport service market is to provide society with a vision of long-term escalation. It is important to align the elements of the system shaping the community's prospects so that the development of one of them does not pose a threat to the others (Bujak-Szwaczka, Kolas, 2010). Therefore, sustainable transport development means that passenger and cargo transport are carried out in a way that simultaneously take into account environmental, social and economic criteria (tab. 1). It is affordable, supports the growing economy, offers a wide range of transport, reduces emissions and waste, minimises the use of non-renewable resources or land use, and reduces the noise level. It allows efficient functioning of individual sectors of economy, offering a possibility to choose the best means of transport, thanks to which it maintains the economy and supports regional development (Korulczyk, 2014).

Sustainable transport is an important element of the concept of sustainable development of the country. Furthermore, as emphasised in the strategy of its development until 2030, it is a tool that allows achieving both economic-social goals and those related to the use and preservation of the natural environment. The concept of sustainable development of transport (2019) is a planning concept that is a medium-term integrated action plan. It aims to achieve strategic goals that are embedded in the general strategy of sustainable development. The first dimension of these goals (economic) is expressed by a desire to improve the economic efficiency of passenger and cargo transport. In the social dimension, activities are subordinated to increase availability, quality and safety of transport. However, their third dimension, i.e. the environmental one, aims, among others, to reduce environmental pollution and emissions of greenhouse gases and to reduce energy consumption.

The idea of sustainable development and related issues of adjusting the strategy of transport development in the European Union have been emphasised for almost three decades in white books of transport. The evolution of the transport policy initiated in the 1990s has led to the formation of three clear paradigms, i.e. shifts, decoupling, and resource efficiency (Załoga, 2016). The first one is based on branch shifts in passenger and cargo transport (a need to reduce the role of road transport). In the second paradigm, a special role was assigned to two categories. One concerns economic growth, while the other comes down to a simultaneous reduction of transport needs. Balancing the development of transport resulting from the decoupling paradigm has led to

Tab. 1. Dimensions of sustainable development of transport.

Dimension	Specification
Economic	- intermodality - infrastructure (development / modernisation / investment / load capacity / quantity and quality of the transport network) - competitiveness - working conditions in the sector
Environmental	- environmental friendliness of transport (minimizing environmental impacts) - preventing and eliminating the effects of environmental transport hazards
Social	- integrity of the transport system - mobility - availability - flow - social cohesion - safety

Source: Work based on: T. Borys (2008).

reshaping the economy–society–environment relations. It resulted in adopting the third paradigm in 2011 (Motowidlak, 2017). Pursuant to *Biała Księga* [*White Paper*] (2011), the development of competitive transport was subordinated to the efficient use of resources. This document assumes that by 2030 30% of road cargo transport at distances over 300 km should be shifted to other modes of transport, e.g. rail or water transport, and by 2050 a level of over 50% should be achieved. However, to achieve this goal, relevant infrastructure must be developed and a dense rail network must be maintained in all EU member states. Moreover, a fully functional EU-wide multimodal TEN-T core network must be created by 2030, and high quality and high capacity of this network must be achieved by 2050, as well as appropriate information services must be created (Guszczak, 2014; Rabe, 2019).

3. Intermodal transport in the classification of transport systems – definition and basic features

Intermodal transport in the literature on the subject is defined in many different ways. In the common concept, it is the transport of cargo in the same load unit using different means of transport (Crainic, Kap, 2007; Wronka, 2008; Stokłosa, 2011; Bławat, Kalkowski, 2012; Fołtyński, Matusiewicz, 2015; Rydzkowski, 2015; Neider, 2019). It is also defined as a team of formally independent companies – "hubs" whose work is largely based on business and partnership relations between companies providing intermodal service (Antonowicz, 2015).

Development of cargo transport in load units as well as progressive integration in technical, organisational, documentary and legal aspects resulted in the development of transport systems – combined, intermodal and multimodal. In practice, these concepts are understood ambiguously. R. Tomanek (2004) emphasises that the only difference between them is that multimodal transport is widespread mainly in the United States, while intermodal and combined transport in Europe. Despite the fact that indeed these types of transport show similarities, they should be considered in a different way, which was clearly indicated, among others, in the document *Terminology on combined transport* (2001).

Multimodal transport (which is the broadest concept) involves transport of goods using at least two branches of transport. Intermodal transport involves transport of goods in one and the same load unit or vehicle, using different branches of transport following one another, without reloading the goods themselves. On the other hand, combined transport is a type of intermodal transport, in which the main part of transport is made by rail or sea or inland waterway transport, while the short initial and/or final section is made by road (Bujak, 2007; Wronka, 2008; Zielaskiewicz, 2010; Mindur 2014; Salomon 2013). Intermodal transport is broken down into a number of different types (tab. 2).

Tab. 2. Classifications of intermodal transport.

Criterion of classification	Types of intermodal transport
Reach	domestic
	international
	continental
	intercontinental
Type of units used	container
	semi-trailers
	trucks
	swap bodies
	special containers
Operator character	direct, carried out by the carrier
	indirect, implemented by an ancillary carrier
The nature of the means of transport used	rail- road
	rail-road-sea
	rail-road-air
	rail-road-inland waterway
	road-sea
	road-air

Source: Work based on D. Bławat and K. Kalkowski (2012).

Intensification of transport carried out by means of intermodal transport is inseparably connected with the development of container transport. On a large, international scale, this process began already in the 1960s (although containers had been previously used, but only for local transport carried out in the United States). In Poland, intermodal transport began to be introduced only in the 1990s, which, according to K. Bartczak (2016), was mainly related to the gradual implementation of mechanisms of free market economy and the opening of our country to the West (previous contacts with it had been limited to the necessary minimum due to the fact that Poland was in the camp of communist countries).

4. Determinants and conditions of intermodal transport development in Poland

The dynamics of freight transport with all modes of transport (except pipeline transport and inland waterway transport) in Poland in the years 2010–2018 showed an upward trend (tab. 3). In 2018 in total, 2191.9 million tonnes of cargo, i.e. 19.2% more than in 2010 (1838.5 million tonnes) were transported with all types of transport. In the studied period, cargo transport by air increased the most – by over 50%. Currently, the market of freight transport in Poland is dominated by road transport, which accounts for over 85% of the total cargo mass transported and is gradually increasing. The growing importance of Polish road transport on the EU market is based on access to a large fleet of motor vehicles, the number of which is increasing proportionately to the GDP growth in Poland. Railways are second in terms of freight transport (11.3% in 2018), which is steadily increasing – by almost 15% over 8 years. The rail cargo market in Poland is liberalised and competitive. According to the strategy of sustainable development of transport until 2030 (2019), road freight transport is forecast to increase to a maximum of 1955 million tonnes in 2030, and rail transport to 280 million tonnes (Burnewicz, 2017).

In Poland, there are both favourable external conditions and prospects for the development of intermodal transport. Moreover, prognostic estimates for international transport indicate that there is a potential demand for services provided in the intermodal transport technology, which is often used in this type of transport (Mindur, Mindur, 2018). Numerous scientific studies and strategic works indicate factors that affect the development of intermodal transport. They are reflected both in its volume, the share of total transports carried out, and in the structure itself regarding the used combinations of transport branches and loading units (Mindur 2014; Agamez-Arias, Moyano-Fuentes, 2017; Erfurth, Bendul, 2017; Rodrigue et al., 2017; Przybylska, 2019). The growing demand for transport and logistics services is one of the most important determinants of the development of intermodal transport in Poland. Significant factors affecting its development may also include (Stokłosa, 2011; Szepietowska, Baran, 2012; Kozerska, 2014):

Tab. 3. Cargo transport by branch in 2010 and 2018 with a forecast until 2030.

Branches of transport	Cargo transport				Dynamics of transport growth in the years 2010–2018 [%]	Predicted transports in 2030 (million tonnes)
	2010		2018			
	in thousand tonnes	in %	in thousand tonnes	in %		
rail	216899	11.798	249260	11.372	14.9	254 / 280
road	1551841	84.408	1873022	85.452	20.7	1746 / 1955
pipeline	56208	3.057	55287	2.523	-1.6	60 / 64
inland waterway	5141	0.279	5107	0.233	-0.7	14 / 17
sea	8362	0.455	9149	0.417	9.4	95 / 116
air	41	0.003	63	0.003	53.6	0.2 / 0.3
Total	1838492	100.0	2191888	100.0	19.2	2168 / 2432

* minimum / maximum

Source: Own work based on: *Transport – wyniki działalności*, GUS, Warszawa 2010; *Przewozy ładunków i pasażerów w 2018 roku. Informacje sygnalne,* GUS, Warszawa 2018; J. Burnewicz, *Prognoza rozwoju transportu w Polsce do 2030 roku*, Warszawa 2017.

– the European Union's transport policy aimed at developing environmentally friendly modes of transport,
– favourable geographical location of Poland at the intersection of major European transport corridors (East-West: corridor I, II and III and North-South: corridor IV),
– an increase in international exchange, generating an increase in demand for international transport,
– increased demand for highly processed goods with high susceptibility to combined transport technologies,
– reserves for rail transport capacity – a prospect of railways taking some haulage from road transport,
– emergence of new operators on the market – companies, enterprises that have their own transportation and develop a network of their own intermodal terminals, which leads to an improvement in the quality of transport services.

These determinants have a significant impact on an increase in the volume of domestic and international transport as well as on transit traffic. It follows from the above that Poland has a good chance of developing intermodal transport.

The country's transport strategy pays a lot of attention to the importance of railways in transport. For long distance land transport, trains are faster, cheaper and more efficient. Polish rail transport has a dense network (6.8 km/100 km^2), which is largely electrified (58.8%). The argument for sustainable transport development is also natural. Carbon dioxide emissions in rail transport are much lower than in the case of equivalent road transport, which is proved by, among others, analysis of the Pro Kolej Foundation or Alianz pro Schiene[1].

Increasing the share of rail transport and modernizing the existing rolling stock open up opportunities to build intermodal terminals. Poland is the second largest rail carrier in the European Union in terms of both the weight of transported cargo and the performed transportation work.

In the opinion of the Office of Rail Transport, there are four factors strongly influencing the volume of rail freight in Poland:
1) economic situation (in particular related to foreign trade),
2) the degree of containerisation of cargo in international economic exchange (the structure of foreign trade is increasingly dominated by processed products, requiring more secure transport – in containers,
3) the state of linear and point logistics infrastructure needed from the perspective of multimodal transport of parcels or generating their streams, especially on the main transport routes,
4) rail network capacity and average commercial speed obtained by rail carriers on it (Antonowicz, 2018).

In the long-term prospect for the development of rail transport, several important issues are emphasised (*Przewozy intermodalne* ..., 2020):
– major restructuring challenges for rail transport – first of all, companies will have to adapt their offer to the changing demand – a growing demand in the intermodal transport segment and a decreasing demand for transport of coal;
– burdens resulting from rising energy prices, which will be a consequence of the restructuring of the energy industry related to the gradual departure from coal energy;
– infrastructural investments increasing the market potential and development of container terminals in Polish ports;
– good reputation of rail transport as the most ecological mode of transport, conducive to the development of the industry.

Among many factors that play a significant role in shaping intermodal transport, the importance of handling terminals, their condition and equipment as well as available intermodal loading units is strongly emphasised (ILU: containers, swap bodies, semi-trailers, road sets). When referring to the road-rail relationship, one can speak about handling in the horizontal, ro-ro, and the vertical, lo-lo, systems. In practice, vertical handling is definitely most often used (Przybylska, 2019). However, as emphasised by E. Truschkin and R. Elbert (2013), modern horizontal handling technologies can be seen as a powerful motor for moving loads from road to rail. This is related to the requirements posed to intermodal transport, which by definition favours sustainable development, reduction of energy consumption of the economy and external costs, such as congestion, accident rate and environmental pollution (Pisarek, 2018).

The intermodal transport system network is based on nodes being contact points of various branches of transport participating in transport-logistics connections and the line infrastructure – main railway lines and roads. The greater the number of nodes – intermodal terminals – the easier it is to access the rail network enabling a better use of rail transport possibilities (Barcik, Bylinko, 2018).

Transport infrastructure is one of the basic elements conditioning its efficient and effective development. Currently, there are 38 terminals in Poland that handle intermodal transport units – 6 sea and

[1] https://www.prokolej.org/pl (accessed on 18.05.2020); https://www.allianz-pro-schiene.de/(accessed 19.05.2020).

25 inland ones, combining road and rail transport, among which rail container terminals are of key importance (tab. 4, tab. 5). They are located in all major seaports (Świnoujście, Gdańsk, Gdynia and Szczecin) and close to the largest urban agglomerations (Poznań, Warsaw). In intermodal haulage, the location of terminals is one of the basic factors determining the efficient and effective movement of loads (Stokłosa et al., 2014). Considering the numerical development of container terminals in Poland in the years 1990–2019 (tab. 4), it should be stated that their number increased by 800% (from 4 in 1990 to 38 in 2019). Modern intermodal transport terminals are more than just handling points. Their development is conducive to the creation of cargo transportation centres with a broad spectrum of rendered services (forwarding agents, transport operators, warehouse companies). The construction of container terminals and an increase in container transport is one of the leading directions in the development of intermodal transport (Korulczyk, 2015).

After the crisis (in 2009), a steady increase in intermodal rail transport has been recorded since 2010 in terms of both weight, work performed and transported TEUs. In 2018, approximately 17 million tonnes of cargo were transported in intermodal transport, while in 2010 the figure was only 4.4 million tonnes. This means an increase of 12.6 million tonnes over eight years (tab. 6). Thus, the share of intermodal transportation in the market of rail transport measured by the weight of transported cargo reached 6.8%. Transport performance was at the level of 6.2 billion tkm. Comparing this with 2010 (1.4 billion tkm), an increase of 4.8 billion tkm (343%) was recorded. The share of intermodal traffic in the market of rail transport measured by transport performance reached over 10.3% in 2018, and it was the best result recorded in the history of intermodal rail transport in Poland (*Sprawozdanie*..., 2019). Rail carriers transported a record number of loading units – 1,259,000, of which nearly 1,212,000 were containers. Compared to 2010 (345,000 units), the number of transported units increased by 265%. Containers currently dominate intermodal transport in Poland. Their share in the total number of units at the end of 2018 was 96.3%. 20- and 40-foot containers are by far the most common among the transported units, representing respectively 47.8% and 43.8% of the total number of transported units in intermodal transport (*Sprawozdanie*..., 2019). Analysing intermodal rail transport in terms of the number of transported TEUs, in 2010–2018 a 232% increase was recorded (from 570,000 TEU up

Tab. 4. The number of container terminals in Poland in the years 1990–2019.

Type of terminals	Years						
	1990	1995	2000	2005	2010	2015	2019
Sea	1	2	3	5	5	6	6
Land	3	7	9	16	25	32	32
Total	4	9	12	21	30	38	38

Source: Own work based on information published by individual operators; information obtained through the Real Estate Agency of PKP Cargo in Katowice; based on information published by UTK (Office of Rail Transport); https://www.utk.gov.pl (accessed on 10.03.2020).

Tab. 5. Container terminals in Poland in 2019.

Type	Number of terminals	container terminals,
Sea	6	DCT Gdańsk, GTK Gdańsk, BCT and GCT Gdynia, DB Port Szczecin, OT Port Świnoujście
Land	25	PKP Cargo Małaszewicze, Europort Małaszewicze Duże, Euroterminal Sławków, PCC Intermodal Gliwice, PCC Intermodal Kutno, Spedcont Łódź, Loconi Centrostal Lódź, Andrex Logistics Chryzanów, Metrans Dąbrowa Górnicza, PCC Intermodal Brzeg Dolny, Metrans HUB Poznań, Schavemaker Kąty Wrocławskie, PKP Cargo Poznań – Frankowo, Karpiel Brzesko, PKP Cargo Gliwice, Metrans Pruszków, Loconi Intermodal Radomsko, Ostsped Intermodal Szamotuły, PKP Cargo Warszawa, PKP Cargo Medyka, PKP Cargo Żurawica, Ostsped Logistics Kalisz, Nelport Ełk, PCC Intermodal Kolbuszowa, Loconi Intermodal Łódź, LTK Intermodal Nałęczów, Erontrans Radomsko, Rail Rzepin, Rail Polska Siechnice, Erontrans Stryków, CLIP Logistics Swarzędz, Rail Polska Włosienica

Source: Own work based on: List of terminals – https://www.utk.gov.pl (accessed on 10.03.2020); information published by individual terminal operators.

Tab. 6. Intermodal rail transport carried out in 2004–2018 in Poland.

Years	Intermodal transport (million tonnes)	Absolute increase in transport compared to the previous year	Growth dynamics 2004 = 100
2004	2272		100.0
2005	2183	-89	96.1
2006	3419	1236	150.5
2007	4084	665	179.7
2008	4772	688	210.0
2009	3315	-1457	145.9
2010	4402	1087	193.7
2011	5906	1504	259.9
2012	8056	2150	354.6
2013	8633	577	380.0
2014	9611	978	423.0
2015	10386	775	457.1
2016	12800	2414	563.4
2017	14700	1900	647.0
2018	17000	2300	748.2

Source: Own work based on: Analiza rynku kolejowych przewozów intermodalnych, Urząd Transportu Kolejowego, Warszawa 2012; Przewozy intermodalne w 2014, 2015, 2016, 2017 roku. Podsumowanie prezesa UTK (2015, 2016, 2017, 2018), Urząd Transportu Kolejowego, Warszawa; Sprawozdania z funkcjonowania rynku transportu kolejowego za lata 2016, 2017,2018, Urząd Transportu Kolejowego, Warszawa.

to 1,894,000 TEU). In 2018 PKP Cargo carried out intermodal transport on the largest scale in terms of both the transported weight and transport performance, just as in previous years. Due to the high costs of rail transport and the low commercial speed, competition of rail with road transport is hindered. Price is the main factor influencing the decision which mode of transporting goods to choose. Without a possibility to compete with price, one cannot talk about the efficient operation of this transport segment (Korulczyk, 2014). Reducing of transport costs and improving the quality of provided services generates a greater demand for services, and this may be crucial for the development of intermodal transport in Poland. It depends also from the direction in which activities for the development and improvement of the railway infrastructure will be implemented.

Intermodal terminals cover an area of nearly 500 ha. Their annual estimated capacity in 2018 was 8,547,720 TEU. Average distances for intermodal transport are around 350–370 km, and their profitability using rail increases with distance (*Sprawozdanie*..., 2019). The area of Poland allows crossing the distance threshold of profitability of intermodal transport (distances between the state's borders exceed 600 km). In addition, our territory is a bridge between Europe and Asia, where there are long distances (over 1000 km), favourable to rail and combined rail-road transport.

The geographical location of Poland between Scandinavia and Southern Europe is strategic from the point of view of transported goods. Seaports are the main generators of container transport, but EU–China rail connections are becoming increasingly important. Seaports should be seen as an element of the logistics chain whose potential significantly depends on the degree of development of the logistics infrastructure and its quality – both from the sea and the land. The efficiency of logistic operations in the port, including port and rail transhipment, is the key to efficient handling of shipped intermodal units. After a period of relative stabilisation in the volumes of intermodal units transhipped in Polish ports, the last few years have seen a high dynamics of their growth (Bocheński, 2016). Initially, intermodal rail transport in Poland focused on connections with

the North Sea ports, then the ports of Gdańsk and Gdynia gained major importance. This was associated with the expansion of these ports, and in particular with the creation of the DCT deepwater terminal in Gdansk. Therefore, the main source of the volume of intermodal cargo arriving in our country are the Tri-City ports – Gdynia (GCT, BCT) and Gdańsk (DCT, GTK), and to a lesser extent the ports of Western Europe – among which Hamburg plays the dominant role. At the same time, it is the largest port from which cargo arriving in the Czech Republic and Slovakia comes in transit through Poland. In 2018, over 2.83 million TEUs were transhipped in Polish ports, of which 69% in Gdańsk, 28% in Gdynia, and only 3% in Szczecin. Nearly 100% of the goods handled in Polish ports go to recipients in the country. The main directions of intermodal relations generated from Gdynia and Gdańsk are transports to and from terminals located near Poznań, Kutno, Łódź, Radomsko and Warsaw (*Sprawozdanie*..., 2019). The share of goods for recipients from other countries, although slightly increasing, remains at a low level. Furthermore, DCT is a node terminal – some of the cargo goes to smaller ships that deliver it to other Baltic ports (so-called transhipment) (Bocheński, Palmowski, 2015).

The development of intermodal transport depends on the appropriate legal regulations supporting this technology, the appropriate number of highly efficient intermodal transport terminals equipped with a superstructure, i.e. manipulation devices and IT systems, adequate prices, both for access to terminals and line infrastructure (Bieniasz, 2014). Intermodal transport is the most dynamically developing segment of the transport business. Therefore, initiatives to develop terminals and transport infrastructure can count on support from EU funds. In recent years, thanks to significant promotion and support from the European Union aid funds[2], there has been a clear increase in the number of enterprises in Poland that operate on the market of intermodal transport. According to data from the Office of Rail Transport, at the end of 2019, 21 entities provided this type of services[3]. The growing number of intermodal carriers renders it necessary for all entities to prepare competitive offers that meet their clients' needs. International transportation dominates in intermodal transport served by Polish carriers. In 2018, domestic transport accounted for about 22.3% of intermodal transport, transit – 18.4%, import – 31.9%, and export 27.5%, as calculated by number of TEU.

The purpose of further development of intermodal transportation is to ensure appropriate conditions for implementation of services in this respect, including adequate capacity of the railway network and enabling fast connections. This requires preparing strategic plans for the coming years to stimulate further growth of this market segment. The intermodal transport market is open and creates great development opportunities. In recent years, the importance of entities with a smaller market share in this segment has increased, e.g. PCC Intermodal or Metrans, which combined the activities of a carrier and a logistics operator. However, it should be emphasised that the development of the domestic intermodal market is also influenced by global trends associated with container trading as well as the economic and geopolitical situation in individual regions of the world. Therefore, striving to develop intermodal transport is also important for economic and social reasons (Rosa, 2013). The literature on the subject emphasises the fact that the development of this type of transport in Poland requires an increased number of terminals equipped with horizontal and vertical transhipment equipment, new forms of intermodal system organisation and the creation of regional logistics centres in all large urban agglomerations. It is vital to ensure the neutrality of terminals and logistics centres and the possibility of their use by all market participants. According to N. Wagener (2014), intermodal transport requires a new approach and a redefinition of the applied solutions. The possibilities of its further

[2] Projects in the field of intermodal transport are financed under Measure 3.2. Development of maritime transport, inland waterways and multimodal connections, OPI & E 2014-2020. The maximum level of EU funding is 50% of eligible expenditure. According to the detailed description of the priority axes of the Operational Program Infrastructure and Environment 2014-2020, co-financing can be obtained for projects such as:
- construction or reconstruction of intermodal terminal infrastructure, including terminals located in logistic centres and seaports, including dedicated rail infrastructure (including sidings) / roads necessary for their inclusion in the railway network / road network together with the necessary terminal construction / remodelling of external devices;
- purchase or modernization of equipment necessary for the operation of intermodal terminals, in particular for lifting and other handling equipment, shunting locomotives;
- purchase or modernization of telematic and satellite systems (equipment and software) related to intermodal transport as well as expenditure on their implementation;
- purchase or modernization of rolling stock, including traction locomotives and specialized intermodal transport wagons (platforms).

[3] Carriers providing intermodal transport: PKP Cargo, PKP LHS, DB Cargo Polska, CTL Logistics, Captrain Polska, CD Cargo Poland, Ecco Rail, Eurotrans, Inter Cargo, Karpiel, Lotos Kolej, LTE Polska, Majkoltrans, Olavion, PCC Intermodal, Pol- Miedź Trans, Metrans (formerly Polzug), Rail Polska, STK, Transchem, ZIG Sandomierz.

development are based on several aspects, among which great importance is attached to technological innovations. Optimisation and sustainable development of intermodal transport on the Polish market concerns not only an improvement in Poland's infrastructure, but also an improvement in the quality of services offered by logistics operators and the condition of ecology (tab. 7).

Tab. 7. Potential effects of the development of infrastructure for intermodal transport.

Economic	Socio-environmental
• Increase in the competitiveness of the logistics system of the region as well as the country • Better service of load flows going through the region, and thus the functioning of the local economy • Reduction of external logistics costs incurred by the region • Increasing and stabilising cargo streams requiring transhipment handling	• Enhanced image of a town or region as being supportive of environmentally friendly modes of transport • Implementation of the European Union's policy on greenhouse gas emissions • Greater attractiveness of the region for companies looking for a place to operate

Source: own work based on (Antonowicz, Zielaskiewicz, 2018).

The development of intermodal transport in Poland generates a number of benefits, the most important of which are:

– an opportunity to benefit from all the advantages of road or sea transport along with the neutralisation of a number of disadvantages of road transport, such as traffic disruptions and obstacles on the road,
– reduction of costs incurred in connection with the performance of transport services, which results from the fact that the average labour cost of transport by rail is lower than by road,
– shortening the time of delivery of goods, possible due to higher train speeds and bypassing road obstructions,
– reduction of drivers' working time, because the time in transport by rail is not included in it,
– limiting the negative impact on the natural environment, since rail transport does not cause as much emission of pollutants into the atmosphere as road transport (*Bariery Rozwoju* ..., 2013).

When writing about the conditions of the development of intermodal transport in Poland, one cannot forget about the potential threats to this development. A small number of intermodal terminals and logistics centres on the main lines and railway junctions is a significant problem (there were only 2 facilities in Poland that met the basic CL criteria). A serious threat to the development of intermodal transport in Poland may also lie in insufficient equipment and devices in already existing terminals – a lack of modern and efficient transhipment equipment or systems for monitoring the passage and safety of goods (Stokłosa, 2011; Kozerska, 2014). Important barriers preventing further development of intermodal transport mainly regard the state of infrastructure supporting the implementation of individual intermodal transport activities (outdated rolling stock, lack of modern railway lines, and insufficient density of container terminals and non-compliance of most of them with EU requirements). There are also organisational and legal barriers (lack of coherent state policy, an insufficient level of cooperation between transport and rail enterprises), as well as economic ones, related to the lack of financial resources needed to start activity in the field of intermodal transport (high costs of building and maintaining terminals) (Burchacz, Kurzewski, 2012; Beim et al. 2014; Bartczak, 2016). The chaotic development of container terminals is also a barrier – placing several facilities in one city/agglomeration belonging to different operators with a lack of this type of infrastructure in other regions of the country (Bocheński, 2018). The development of intermodal transport in Poland is also limited to some extent by a lack of cooperation between entities operating on this market and a lack of a uniform, comprehensive information system in land and land-sea chains of intermodal transport.

The existing deficiencies and barriers to the development of intermodal transport in Poland mean that this form of transport is less competitive than in other EU countries and brings smaller effects on the scale of national economy. In addition, it does not generate the expected microeconomic benefits for entities – transport and logistics operators that undertake and conduct this type of activity.

5. State policy on the development of intermodal transport

The development of intermodal transport is highlighted in both the national transport policy and the European Union policy (Engelhardt, 2013; Wojewódzka-Król, Rolbiecki, 2013). Forward-looking programs, updated and consistently implemented as the needs change, as well as technical and ecological progress are an important condition for the harmonious development of transport (Mindur, Mindur, 2018).

In the concepts of the Polish transport policy after the beginning of the transformation of the economic system, intermodal transport, as a particularly supported form of cargo transportation, appeared at the end of 1994 (document: *Polityka transportowa* [*Transport policy*] developed in the Ministry of Transport and Maritime Economy). This document was only departmental in nature and was never approved or adopted by the government, and most of the declared instruments were not implemented in practice. The provisions in the next document, *Narodowa Strategia Rozwoju Transportu na lata 2000–2006* [*The National Strategy of Transport Development for 2000–2006*] (from 2000), had a similar character; it also emphasised intermodal transport activities to a limited extent.

The first document that was officially approved by the government on transport policy, also specifying the principles of this policy in reference to intermodal transport, was *Polityka transportowa państwa na lata 2001–2015 dla zrównoważonego rozwoju kraju* [*The state transport policy for the years 2001–2015 for the sustainable development of the country*] (from 2001). Another document referring to intermodal transport – *Polityka Transportowa Państwa na lata 2006–2025* [*State Transport Policy for 2006–2025*] – was adopted by the Council of Ministers on June 29, 2005. Its authors envisaged a possibility of supporting intermodal transport not only in the scope of necessary investments, but also in the scope of operational activity of carriers or intermodal operators, suggesting opportunities for providing one-off subsidies for launching intermodal connections. It should be added that the years 2004–2006 resulted in the implementation of the first significant program of financial support for Polish transport from the European Union funds –the Sectoral Operational Programme Transport (SOPT).

In 2008, a supra-regional strategy was adopted by the government, *Master Plan dla transportu kolejowego w Polsce do 2030 roku* [*Master Plan for rail transport in Poland until 2030*], which defines the following main objectives:

- ensuring competitiveness of railways in relation to other modes of transport in the best-developing market segments,
- ensuring conditions for increasing the quality of service and customer satisfaction by rail carriers,
- sustainability of the branch structure of transport and limiting environmental damage that results from an increase in demand for this transport, including the very rapid development of road transport,
- operational and allocation efficiency of rail transport resources,
- ensuring stable and continuous financing of rail infrastructure,
- effective use of human resources and optimisation of employment.

The document that set the most important directions of middle-term development of transport in Poland was *Strategia Rozwoju Transportu do 2020 roku (z perspektywą do 2030 roku)* [*Strategy of Transport Development until 2020 (with prospects until 2030)*], adopted by resolution of the Council of Ministers on January 22, 2013. The strategy concerned all sectors of transport: road, rail, air, sea, inland waterway, urban and intermodal. The main goal of the national transport policy presented in the strategy was to increase the country's transport accessibility and to improve the safety of traffic participants and the efficiency of the transport sector by creating a coherent, sustainable, innovative and user-friendly transport system at national, European and global levels. This goal related both to the creation of an integrated transport system by investing in transport infrastructure and to the creation of favourable conditions for the efficient functioning of transport markets and the development of effective transport systems (Kostrzewski, 2013). The strategy shows that the main elements of intermodal transport determining its development are:

- a network of transhipment nodes (intermodal terminals, logistics centres);
- a network of high-gauge railways adapted to low-suspended trainsets;
- telematics and satellite systems, optimizing and controlling transport processes that contribute to shortening the delivery time and eliminate threats to the condition of transported loads;
- effective cooperation of rail carriers with combined transport operators, logistics centres, terminal owners, customs, veterinary and phytosanitary services.

Resolution of the Council of Ministers of September 24, 2019 adopted *Strategia Zrównoważonego Rozwoju Transportu do roku 2030* [*Strategy for Sustainable Development of Transport until 2030*]. The adoption of this document meant that the document was *Strategia Rozwoju Transportu do 2020 roku (z perspektywą do 2030 roku)* [*Strategy of Transport Development until*

2020 (with prospects until 2030)] and supra-regional strategy *Master Plan dla transportu kolejowego w Polsce do 2030 roku* [*Master Plan for rail transport in Poland until 2030*] ceased to be applicable.

The document points to innovative ("intelligent") solutions that facilitate the functioning of the entire transport sector, reducing its negative impact on the environment and climate, so that creating a sustainable transport system for the country would be possible by 2030.

One of the main barriers in the process of shaping the sustainable development of the transport system is the uneven distribution of transport tasks. Replacing some of the transport services performed by car transport with other modes of transport, friendlier to the environment and to human life and health, in order to reduce congestion, external costs and negative effects of transport, in accordance with the principles of sustainable movement and development, may be an opportunity to meet the ever-growing (simultaneously with economic development) transport needs (Pawłowska 2013).

The strategy presents the most important directions of actions necessary to be taken by 2030 which are aimed at, among others: construction of an integrated and interconnected transport network; improving the safety of traffic participants and of transported goods; reducing the negative impact of transport on the environment; improving the efficiency of using public funds for transport projects; improving the organisation and management of the transport system, also in the intermodal dimension. In order for the transport system to develop in accordance with the principles of sustainable development on the domestic and international market, readiness to cooperate with stakeholders and a rational policy of the state must be in place.

Conclusions

Intermodal transport has been intensively developing for over a dozen years in Poland, and this is favoured not only by the beneficial geographical location or global development trends in this field, but also by the inflow of EU funds allocated for the implementation of investments in transport infrastructure. However, the scope of investment support for intermodal transport in the years to come will primarily depend on the amount of funds that Poland will receive from the EU budget for 2021–2027 to finance transport and on the amount of national budget funds allocated for this purpose.

Intermodal transport has a small share in the total haulage in Poland, yet this indicator is increasing consistently and dynamically. The system of intermodal freight is forward-looking, considering the purpose and tasks of the transport policy. This is mainly due to its environmentally friendly nature, relieving road infrastructure and reducing external transport costs (e.g. congestion, accident rate, environmental pollution). It is assumed that container transport will be the dominant form of transport. However, for a further increase in the importance of intermodal transport in Poland, systematic improvement in the technical, legal, organisational, economic and financial conditions is necessary. The development of this type of transport requires an increase in the number of terminals in the country and the creation of regional logistics centres in large urban agglomerations. Existing terminals require modernisation and expansion. A key role in the context of the functioning and development of Polish intermodal transport is played by Polish seaports, which should be seen as specific generators of container traffic as well as multifunctional nodes and logistics centres.

Considering the current state of intermodal transport in Poland, it can be expected that preparation of appropriate infrastructure within modern transhipment systems will be necessary, and this will enable more effective development of intermodal transport and contribute to sustainable development, which is very important for the entire transport system. It creates prospects for railways as the main branch of land transport with higher ecological parameters. However, to take advantage of the emerging opportunity, the railways will be forced to take innovative actions related to the development of modern transhipment systems and means of transport, to improve the condition of the railway infrastructure and to balance the rates for access to this infrastructure. Therefore, appropriate and effective actions (legal, organisational, technical and technological) are necessary to increase the attractiveness of this branch of transport. That is why currently railway lines are being modernised, and many lines of regional significance are being reactivated in almost the entire country. It is likely that the development of intermodal transport will be more dynamic and it will grow systematically, which is particularly important because it creates an alternative to car transport, limiting the negative effects on the natural environment and human health and life; it enhances transport safety and, consequently, Poland's economic growth. Further development of intermodal transport also depends on correlating Poland's transport policy with the activities undertaken by entities operating on this market in terms of further enhancing the transport offer, improving the quality of offered commitments and extending the scope of services provided in intermodal transport chains. If the transport system in Poland is to devel-

op in accordance with the principles of sustainable development and sustainable transport, it is necessary that comprehensive measures to promote the development of intermodal transport in Poland be introduced.

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