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## ŁÓDŹ IN THE REGIONAL AND NATIONAL TRANSPORTATION SYSTEM

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**ABSTRACT:** This article presents the location of Łódź in the transport network of Poland and the Łódź region. It focuses on the centre's location in reference to the main elements of road, rail and air networks on a national and regional scale. Due to physical and geographical location of Łódź, the three branches of transport exhaust the city's transport possibilities. Besides that, transport relations of Łódź are characterized as far as the functioning public transport is concerned, considering all the aforementioned modes of transport. The study also includes information on the significance of Łódź as a transport node for cargo transport. All these analyses precede reflections on the location of Łódź against the background of trans-European transport corridors as well as an overview of historical conditioning of transport connections of the area of today's Łódź.

**KEYWORDS:** road infrastructure, rail infrastructure, air transport, passenger transport, cargo transport, Łódź.

### ŁÓDŹ W KRAJOWYM I REGIONALNYM SYSTEMIE TRANSPORTOWYM

**ZARYS TREŚCI:** W niniejszym artykule przedstawiono położenie Łodzi w sieci transportowej Polski oraz regionu łódzkiego. Skupiono się na lokalizacji ośrodka względem głównych elementów sieci drogowej, kolejowej i lotniczej we wskazanej skali krajowej i regionalnej. Ze względu na fizycznogeograficzne położenie Łodzi, te trzy gałęzie transportu wyczerpują możliwości transportowych powiązań miasta. Ponadto poddano charakterystyce relacje transportowe Łodzi w zakresie funkcjonującego transportu zbiorowego z uwzględnieniem wymienionych wcześniej form przewozu. Opracowanie zawiera

również informacje na temat znaczenia Łodzi jako węzła transportowego przy przepływach ładunków. Wszystkie powyższe analizy poprzedzają rozważania nad lokalizacją Łodzi na tle transeuropejskich korytarzy transportowych oraz przegląd historycznych uwarunkowań powiązań transportowych obszaru dzisiejszej Łodzi.

SŁOWA KLUCZOWE: infrastruktura drogowa, infrastruktura kolejowa, transport lotniczy, transport pasażerski, transport towarowy, Łódź.

## 4.1. Introduction

From the perspective of the impact on the city's economic growth, the centre's functioning in the transport system should be assessed in terms of its accessibility and the technical state of infrastructure. The centre's accessibility levels are conditioned by, for instance, the network density, its structure and layout, which can be described by means of different geographical, demographic or economic factors. The city's high accessibility level may directly translate itself into its investment attractiveness.

Considering the location of Łódź in reference to the Western border of Poland, Warsaw and international airports and seaports, it is worth stressing the city's high attractiveness for development of industry resulting from its outstanding transport accessibility. The high level of transport accessibility is also a strength of Łódź as a service development area. It is of particular importance here to see the role of the transport node of supraregional rank with access to an international airport as well as with beneficial location in relation to Warsaw. The same elements should be considered an advantage of Łódź as a high-tech development centre. Łódź is situated in the heart of Poland (the geographical centre of Poland lies 23 km in the direction of northern east of the city), which is very advantageous for its accessibility. The majority of the most important urban centres in Poland, including 9 provincial cities, is located in the equidistant of 200 km (physical distance) from the capital of the Łódź region. From the designated ten trans-European corridors (on the Second Pan-European Transport Conference on Crete in March 1994, and supplemented on the Third Pan-European Transport Conference in Helsinki three years later), four of them go through the territory of Poland, two of which through the region of the Łódź province. The first one is the corridor no. II with an East–West orientation connecting Berlin, Warsaw, Minsk and Moscow. This corridor comprises the A2 motorway and E20 railway main line. The latter one is the corridor no. VI from North to South, starting from Gdańsk, later going through Łódź/Warsaw to Žylyna (in its Western version through Ostrava to Brno). Within the boundaries of the Łódź province the corridor consists of the A1 motorway together with the S8 expressway and as for rail infrastructure – the Polish Coal-Trunk Line – Ports and the Central Railway Main Line. Priority investments in infrastructure included in the aforementioned corridors are targeted mainly at railway lines in the area of the Łódź province (Wiśniewski 2015a). For Łódź the

accomplishment of the investment in the two core network corridors is of key importance: the Baltic–Adriatic Transport Corridor – modernization of the railway line from Gdynia to Katowice, running the western part of the Łódź province – bringing it to the speed of 160 km/h for passenger trains (ultimately 250 km/h) and 120 km/h for goods trains) and the Warsaw–Berlin–Amsterdam/Rotterdam–Felixstowe–Midlands Corridor – modernization of the existing railway line from the Polish-Belarussian border through Warsaw and Poznań to the border with Germany – bringing it to the speed of 160 km/h for passenger trains (ultimately 250 km/h) and 120 km/h for goods trains as well as conducting conceptual works concerning high-speed rail.

In the Łódź province the core TEN-T network comprises A1 and A2 motorways and the S8 expressway on the section from the province border to Rzgów, which together with the S14 expressway will make the ring road of Łódź. The core network also consists of cargo transport railway lines: line 1 (only on the Warsaw–Skierniewice–Koluszki section), line 4 (Warsaw–Mszczonów–Opoczno–Zawiercie), line 14 (only on the Koluszki–Łódź–Zduńska Wola Karsznice section) and line 131 (Tczew–Bydgoszcz–Inowrocław–Zduńska Wola Karsznice–Tarnowskie Góry). The core TEN-T network comprises the following railway lines providing passenger transport: the „Y” high-speed rail under design (Warsaw–Mszczonów–Łódź–Kalisz–Poznań, Wrocław), the aforementioned line 4 (Warsaw–Mszczonów–Opoczno–Zawiercie), line 14 (only on the Łódź–Koluszki section) and line 25 (only on the Łódź–Opoczno section). In the comprehensive TEN-T network, in the Łódź province additionally sections of motorways were taken into account: S8 from Piotrków Trybunalski in the direction of Warsaw, S12 (only on the section from Piotrków Trybunalski in the direction of Radom) and S74. The Railway no. 25 (Łódź–Opoczno–Skarżysko Kamienna–Tarnobrzeg–Mielec–Dębica) was qualified to the comprehensive TEN-T network of rail cargo transport. Łódź was designated as location of a road and rail terminal within the core TEN-T network, whereas Stryków – as location of the comprehensive network (COM/2011/650, TENtec Public Portal) (Napierała et al. 2013).

While analyzing relations between the settlement network of the Łódź province and its transport network, it is necessary to refer to Christaller’s Central Place Theory (1963). The author of this theory shows that from the transport principle perspective, such location of main centres is advantageous in which there is the biggest possible number of towns of greater importance lying on the transport line which connects the most important centres in the cheapest possible way. Under the transport principle, main centres are therefore located on transport trails being straight lines going radially from more importance centres, where theoretically the optimal number of such lines is six (Potrykowski, Taylor 1982). In the case of the Łódź province this type of layout is clearly marked for Łódź and the five national roads and one provincial road going radially from it.

The aim of this article is to present the current location of the city of Łódź in the transport network. The analysis is conducted on both the level of the Łódź region and the whole Poland. Individual parts of the work focus on the centre's location in reference to main elements of road, rail and air transport in the indicated national and regional scale. Besides the transport relations of Łódź are characterized, showing the functioning public transport, with special focus on the abovementioned forms of transport. The study also contains information on the importance of the city's impact as a transport node considering the movement of goods. All the above analyses are preceded by reflections on the location of Łódź against the background of trans-European transport corridors and an overview of historical conditioning of transport connections in the area of today's Łódź.

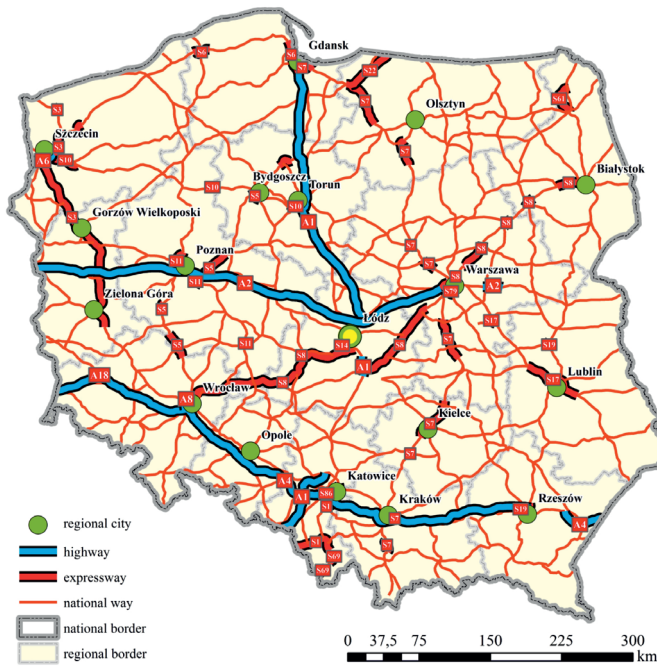
## **4.2. Location in the road network**

Polish transport policy is characterized by lack of internal cohesion due to historical factors and budget limitations (Komornicki 2005, 2007; Taylor 2006). Old industrial and political plans based on military needs (the Warsaw Pact) were not corrected in response to an increase in car ownership, domestic traffic and changes in transit directions after 1989. International transit routes remained a priority of transport policy. The scheme of building a network of motorways and expressways elaborated in late 1990s is being implemented despite numerous modifications. Changes introduced to the initial version of this scheme referred to such issues as: dates of completing individual sections or changes to the road class. In 2004 the Polish authorities adopted a very extended list of investments into the network of motorways and expressways connecting all the borders, all the province cities and most subregional centres. The investment process commenced in early 2000, initially as part of the pre-accession ISPA instrument. The development of infrastructure, however, had a limited scope and was rather random because of burdensome bureaucracy, lack of environmental decisions and problems with land purchase. Luckily, the following financial perspective (2007–2013) brought about bigger changes in the main investments concentrated in the Operational Programme Infrastructure and Environment (POIiŚ 2007). Besides that, Poland was preparing for the 2012 European Football Championships, which stipulated additional stimulus for investment. In 2011, however, some main roads were excluded from the list due to budget limitations.

As many as 9 national roads and 18 provincial roads, forming a radial concentric system mark the main features of the material base of the road transport in Łódź predominantly deciding about this centre's cohesion with the settlement network on the regional and national level (Bartosiewicz, Pielesiak 2012). The level of its transport accessibility is considerably increased by national roads of limited accessibility, i.e. A1 and A2 motorways and well as S8 expressway. Currently,

the motorway with an East–West orientation (A2) directly gives Łódź a quick and comfortable connection with Warsaw in the East and Poland’s Western border in the region of Ślubice or Frankfurt (Oder) through nodes located in the north of the city. In turn the A1 motorway (from Stryków) allows the inhabitants of Łódź to have a good connection with the Bay of Gdańsk. The S8 expressway with a diagonal orientation allows for a quick connection with Wrocław (Fig. 1).

Accessibility to Łódź through the road network remains uneven, which results from unfinished investment process (without any motorways and expressways the system would be concentric). Partly, however, such a state of affairs should be accounted for assumptions of the network development formulated still in the 1970s. The chessboard model adopted back then may contribute to appearance of areas of lower accessibility (*Diagnosis of Polish Transport...* 2011).



**Figure 1.** Location of Łódź in the national transport network in 2015

Source: own work.

Łódź is well connected with the main economic and urban centres in the country through a network of national roads (including motorways and expressways).

The present system of road connections in Łódź makes the degree of road extension relatively high, especially in the direction of towns located in the North-Western Poland as well as to Kraków and Kielce. It is worth stressing that the network of national roads of the Łódź region includes all the province’s towns with the exception of such small centres (below 15 thousand inhabitants) as Szadek,

Żychlin, Koluszki, Zelów, Biała Rawska and Drzewica. In turn, centres being the main nodes, such as Łódź in particular, occupy the most advantageous position among the Łódź region towns in the national road network.

The Łódź province is relatively well equipped in public hard surface roads. The network of national roads belongs to one of the longest in the country. The region is also well equipped in the network of provincial and communal roads, yet their parameters are mostly not suited to the actual weights of vehicles and traffic volume. The technical condition of the functioning road system systematically improves, still many roads need repairing.

### **4.3. The rail and tram network**

The first railway line in the present boundaries of Poland was opened on 22 May 1842 and connected Wrocław and Oława. In the same year the line was extended to Brzeg. In 1843 the railway reached as far as to Opole. The second half of the 1940s brought development of rail in Lower Silesia. These lines were used mostly to transport of hard coal from Silesian mines to the centre of Germany. Some time later the rail began to develop in Pomerania and Greater Poland. In 1843 the line connecting Szczecin with the country's capital, Berlin, was opened to the public. Between 1846 and 1848 the railway line from Stargard to Poznań was built.

The shape of railway connections in Poland is to a large extent a reminder of the period of partitions even though liquidation of longer and longer sections of local lines is beginning to change this situation. In the Kingdom of Poland, which was dependent on Russia, construction of the first railway line was finished on 15 June 1845 with the commuter section of the future Warsaw–Vienna line. The line connected Warsaw with Grodzisk Mazowiecki. In 1845 the line was extended to Skierniewice and Łowicz. A year later the railway reached Częstochowa. Ultimately the Warsaw–Vienna line was finished in 1848.

Poland's railway network, after the period of maximum development between 1979 and 1985, gradually began to dwindle with simultaneous deterioration in quality standards. Some of these changes occurred in an uncontrolled or even chaotic way. The technical condition of the network underwent systematic deterioration and in a similar way the whole railway property experienced decapitalization and devastation. It should be remembered that the railway is an integrated system and this is its strength (Taylor 2007).

The first „Łódź” station was Rokiciny on the Warsaw–Vienna Railway inaugurated in 1846. It was the nearest railway station in the neighbourhood of Łódź. Transport to Rokiciny, which is 30 km away from Łódź, was provided by horse-drawn carts. On the area of the city trains appeared in 1866 on the so-called factory–Łódź line which was a branch of the Warsaw–Vienna Railway from the station in Koluszki. At present there are 18 railway stations and stops in Łódź.



The most popular ones are Łódź Fabryczna and Łódź Kaliska. The only terminus station in Łódź is Łódź Fabryczna, while the remaining ones are either pass-through-terminus or pass-through types. Łódź Fabryczna has been closed since 16 October 2011 as it is being rebuilt to be an underground station.

Considering railway connections, one should point to a considerable problem in handling long-distance trains in the Łódź province. Łódź constitutes a barrier for national connections, disrupting their smoothness, which results from using the same lines by commuter trains and long-distance ones. Łódź also divides the network of national connections into two parts handled by two stations: Fabryczna Station (under reconstruction) and Kaliska Station, which are not well communicated with one another. This contributes to problems with including the rail in the internal transport system of the province. A possible solution to these problems may be investments connected with the governmental programme of building and launching High-Speed Railway in Poland that was introduced in 2008. It is planned to build the Warszawa–Łódź–Wrocław/Poznań line. The programme envisages a subway through a tunnel under the centre of Łódź, with the underground Łódź Fabryczna station. Accomplishing this investment will make Łódź a vitally important railway junction (*Spatial Development Plan... 2010*) (Fig. 2).



**Figure 2.** Location of Łódź in the national rail network in 2015  
Source: own work.

The Łódź region has a specific situation in the system of national railway lines. Historical conditioning of railway line development resulted in a fact that the most important railway lines of national (and international) importance are located on the peripheries of the province, omitting the region's capital. This refers to the trans-European lines: E-20 Warsaw–Kutno–Poznań, the Central Railway Main Line, which transits through the province connecting Warsaw with Silesia and Zagłębie and Kraków (none of the province's towns is located on this route, with Opoczno being the closest to the line). A similar character has the coal main line Herby Nowe–Zduńska Wola (Karsznice)–Inowrocław–Gdynia with the cargo-junction station in Karsznice (Zduńska Wola). Consequently, the aforementioned lines are of no importance for the province's connections and for Łódź itself in interregional or international relations.

The following lines are vitally important for the city's national connections: the old railway line „Warsaw–Vienna” and „Kaliska” railway as well as the railway line from Łódź to Gdańsk and Gdynia. Over one third of the province's towns is situated away from railway lines. Łódź is particularly disadvantaged as far as the railway location is concerned, which results from its late economic development and short administrative practice. The coefficient of railway line extension in relation to rectilinear connections from Łódź to other provincial cities is on the whole 125. Łódź is an important rail junction for the direction Warsaw – Wrocław and Poznań–Lublin. The next railway junction is Koluszki, through which Łódź is connected with Warsaw, Lublin, Katowice and Kraków. Smaller junctions include: Skierniewice, Łowicz, Tomaszów Mazowiecki. The present railway line network caters solely for the region's basic needs. In turn the province, or Łódź and its agglomeration to be precise, lacks routes adjusted to high-speed trains.

The Łódź region is characterized by a relatively underdeveloped railway network: low railway network density and low technical parameters of most lines. The problem is that there are no main lines of international importance in the TEN-T network coming through Łódź and there are no good connections with the main cities in the country. The provincial railway network needs investments aimed at bringing back normal timetabled speeds as well as elimination of speed limits on the operating lines. Opportunities for elimination of problems with railway services for both Łódź and the whole region may be seen in the construction of High Speed Rail between Warsaw, Łódź, Wrocław and Poznań within the TEN-T project. The investment will be accompanied by construction of a tunnel subway under the centre of Łódź combined with the ongoing construction of the underground Łódź Fabryczna station. Plans also include modernization or construction of high-performance conventional lines (including the Łódź Fabryczna–Łódź Kaliska cross-town tunnel), at the same time taking into account incorporation of the Łódź Agglomeration Railway into the network of connections.



Within the railway infrastructure, beside modernization of main lines, it is also necessary to change the rolling stock. Special importance will be attached to the central multimodal node of Łódź Fabryczna bound by the aforementioned diametric tunnel for conventional rail. The Łódź Agglomeration Railway together with the Łódź Regional Tram as well as the „East–West” tram will ensure high effectiveness of the whole public transport system in the region. The decision on the construction and work timetable concerning the High Speed Rail construction will have been taken by 2020 (*ibid.*).

Łódź has 14 railway stations and stops, yet many of them remain unused or closed. The two most important stations are: the Łódź Fabryczna terminus station and the pass-through Łódź Kaliska station, the potential of which is not fully used either. It should be stressed that Łódź, like many industrial cities, has never in its history created a transport junction suitable for a city which, in fact, has metropolitan functions. The reason for such an illogical and unsuitable shape of railway in Łódź was the perception of the city as an overgrown factory settlement (Wesołowski 2005). On the construction of the first lines, nobody took into account transport needs of workers, and the focus was solely on cargo transport and priorities of the authorities in power back then. The past is of great importance nowadays when Łódź is no longer a textile centre. For the city to grow and change it is necessary to rebuild the railway junction so that it is perceived by investors as an advantage of this localization and in order to increase mobility of the inhabitants of the region. The effectiveness of the Łódź railway network may be boosted by the Łódź Agglomeration Railway.

The rail transport infrastructure connecting Łódź with some towns of the region is supplemented a tram network. It includes only five centres: Łódź, Pabianice, Zgierz, Ozorków and Konstantynów Łódzki.

#### 4.4. Air connections

Apart from road and rail connections Łódź also has access to air transport. Łódź-Lublinek Airport (code IATA: LCJ, code ICAO: EPLL) is located 6 km from the centre of Łódź in the south-western direction. The Łódź Kaliska railway station is about 6 km from the airport (all distances are given in real physical distances). The distance from it to the A1 and A2 motorway junctions (Stryków and Łódź Północ) is about 30 km (Fig. 3).

Since 2006 the official name of the airport is Łódź Władysław Reymont Airport. Łódź-Lublinek Airport was opened in 1925 and since 1927 it had regular connections with Warsaw and Poznań and in 1930s also with Lviv and Vilnius. During World War II it was used as a military airport by the Germans. The concrete 1,200-metre-long runway was built for purposes of military aircraft (Czecharowski 2003). After the war till late 1950s the airport in Łódź was an

important transport node in the domestic traffic. Till 1958 the airport in Łódź was the second biggest airport in Poland after Warsaw-Okęcie Airport, considering the volume of passenger traffic, and catered for over 40 thousand of passengers annually. Despite relatively big passenger traffic of Łódź-Lublinek Airport, in late 1950s a decision was taken on the central level that all the connections from this airport should be annulled (Czownicki 1990). There were even plans to close the airport down (Czecharowski 1999).



**Figure 3.** Location of Łódź in the national airport network in 2015

Source: own work.

It was only in early 1990s together with Polish political transformations that attempts were made to bring back passenger traffic to Łódź-Lublinek Airport. In 1996 the airport obtained the status of an international airport, following modernization and meeting security requirements. In late 1990s further modernization works were carried out. Changes in the airport infrastructure allowed to deal with medium-sized machines, such as ATR 42 and 72, Jak-40 or C-130 Hercules. In 1999 regular flights to Warsaw were launched although due to lack of navigation systems like ILS in the event of bad weather conditions flights were often annulled. In addition, low popularity of these flights caused that the PLL LOT board made a decision to suspend the connection between Warsaw and Łódź in the winter season of 1999/2000. In May 2002 installation of the ILS

system began. In 2005 the runway was extended to 2,100 metres, which enabled dealing with larger planes, such as Boeing 737 or Airbus A320. In 2005 the airport apron was extended and the second modular terminal was commissioned. Other investments followed in 2006 when the runway was extended to 2,500 metres, new runway lights were installed, a new watchtower for the airport fire brigade was built and the extension works on the second terminal were completed, making the departure and arrival lounges bigger.

The airport has a runway made of asphalt and concrete which is 2,500 metres long and 45 meters wide as well as a grass road which is 1,000 metres long and 300 metres wide. Terminal I is aimed at dealing with domestic flights and general aviation flights. Terminal II, commissioned in 2005, is an international terminal and deals with both passengers of low-cost airlines and charter flights. In 2009 the cargo terminal was commissioned and it was placed in the rebuilt hangar of Łódź aero club.

In 2010 the construction of a new passenger terminal no. III began and it was officially opened three years later on 1 June 2012. All air traffic was moved to it on 30 June 2012. On 13 September 2010 the construction of a new control tower officially started, while it was three years later that the first permission to land was issued (Pijet-Migoń 2012). Łódź airport can deal now with aircrafts like Boeing 737, 757, 767, Airbus A320, A330, MD80.

#### **4.5. Passenger transport**

The organization of public transport in Łódź is typical of the whole country. Passenger services are provided by the PKS companies, private carriers like minibuses, communal carrier companies (like Miejskie Przedsiębiorstwo Komunikacyjne in Łódź), Przewozy Regionalne or PKP InterCity. Connections provided by the PKS companies play by far the most important role in the structure of connections. These operators cater for the biggest number of connections, reaching the largest area of the region. The biggest number of connections is provided between Łódź and the region's biggest towns as well as along the most important transport routes (mainly national roads). On the territory of the Łódź province the PKS companies are located in thirteen towns and each of them offers transport to Łódź. These are companies which were founded from the state-owned companies operating in the early 1990s. The majority of them are private companies, mostly employee-owned ones, and some of them belong to the local authorities or to the state.

Most carriers provide local transport services, predominantly from Łódź to the neighbouring districts. Regional connections, although to a lesser extent, are also available (mainly to Łódź). Some companies from the car transport sector also offer domestic connections, mainly aimed at reaching bigger towns of the province or tourist destinations. The PKS companies from Łódź have the widest transport offer. The car transport company in Łódź offers connections mostly to the

region's capital along main exit roads in the direction of Głowno, Brzeziny, Ujazd, Tuszyn, Łask, Lutomiersk, Poddębice and Łęczyca. These are mostly connections on a regional scale. In every case on a typical weekday these are at least over ten connections daily. In contrast, the other aforementioned carriers play an important role in providing transport services of more significant transport trails, including above all connections between Łódź and the above-mentioned towns. For some part of directions long-distance connections are of considerable importance. These tend to be operated in an accelerated or fast mode, which brings about certain consequences as buses stop far less frequently only on certain stops. In this way they increase transport accessibility of usually larger centres of the province.

The offer presented by PKP carriers from the Łódź region is complemented by connections provided by companies located in towns of other provinces neighbouring with the Łódź province. There are many long-distance bus lines coming through Łódź and operated by the PKS companies from the whole country. Their role in public transport organization may be assessed twofold. It is considerable in the case of connections between towns as buses tend to stop only on their area. Long-distance connections are, nevertheless, rather insignificant on a local scale. International bus connections are operated by private carrier companies: Eurolines Polska, Zawadzkie, Orbis Transport, Delta Travel, Polski Bus, Eurobus, Polska Service, Polonia Transport, Ecolines, Comfort Lines (Paczkowski, Budler 2012). The other group of carriers are private companies offering minibus connections (in some cases connections are also operated by buses). These are companies which usually cover a few routes between Łódź and neighbouring communes, having at their disposal no more than several vehicles. Regular passenger transport services are in the case of these companies usually their core activity. Some of them extend their offer providing irregular transport services (e.g. tourist connections). They cover mostly these routes on which the demand for transport services is the greatest and their spatial range is definitely limited.

Transport services provided by private minibus carriers are the most common in the broadly understood Łódź agglomeration. Carriers offer their connections on the routes between Łódź and towns in the neighbouring districts, along the most important transport trails, such as Łódź–Pabianice, Łódź–Konstantynów Łódzki, Łódź–Aleksandrów Łódzki–Poddębice–Uniejów, Łódź–Zgierz–Ozorków, Łódź–Stryków–Głowno–Łowicz, Łódź–Andrespol–Rokiciny–Tomaszów Mazowiecki, Łódź–Rzgów–Tuszyn. In many cases these routes are operated by a few carriers and it is frequent that minibus transport services represent the dominant form of public transport. A much smaller role in organizing public transport is attached to urban (communal) transport companies which are usually responsible for only local connections (within the boundaries of the given commune unit). The MPK company in Łódź has by far the most extensive offer, providing both bus and tram connections (Kowalski, Wiśniewski 2013).

The Łódź tram network is one of the fourteen tram networks in Poland and their rails are 1,000 millimetres wide. It caters for the following administrative units: the city of Łódź, the town of Pabianice, the town of Konstaktyńów Łódzki, the town of Zgierz, the commune of Zgierz, the town of Ozorków, the commune of Lutomiersk and the commune of Ksawerów. Currently there are 17 tram lines operating within the boundaries of Łódź and 5 tram lines which connect Łódź with the neighbouring towns (communes) (the line no. 16 to Zgierz, the line no. 41 to Pabianice, the line no. 9 to Konstaktyńów, the line no. 43 to Lutomiersk, the line no. 46 to Zgierz and Ozorków).

The development of this branch of transport in recent years has been closely connected with the implementation of the project of the Łódź Regional Tram (Feltynowski 2009). The aim of this project was to boost transport connections between the core of the Łódź Metropolitan Area and Pabianice and Zgierz on the aggregate section of 28 km. In the initial phase of the project there were plans to include a line to Ozorków to this system but the project in this shape was abandoned. This is why as part of implementation of the regional tram project only the technical condition of infrastructure on the area of was improved and more modern trams were purchased. Subsequent activities were supposed to focus on unification of transport fares as well as implementation of the urban electronic card together with information system for the passenger on the whole public transport system (Pielesiak 2012).

In 2012 unification of transport fares was implemented, due to which there was an unquestionable improvement in comfort of journeys between the core of the metropolitan area and its periphery. This solution still has not been implemented by a few communal carriers operating in the area of towns around Łódź and adjacent communes. For instance, urban public transport in Pabianice covers the following communes: Ksawerów, Dobroń, Rzgów and the rural commune of Pabianice. These carriers use their own fares which do not entitle to continue the journey with a valid MPK Łódź ticket.

Eighteen bus lines go outside the administrative borders of the city of and additionally reach Zgierz, Skotniki, Imielnik, Dobra, Stryków, Kalonka, Skoszewy, Natolin, Brzeziny, Andrespol, Stróża, Ludwików, Rzgów, Gadka Stara, Niesięcin and Aleksandrów Łódzki. Besides one line is managed by a carrier from Zgierz and has a terminus near the Łódź Kaliska Station. In the case of carriers from other towns of the province these are mostly single connections between the district town and the area of the commune from this district or alternatively between neighbouring district towns.

The public transport system in Łódź is complemented by rail transport. It should be borne in mind, however, that their role and spatial scope are clearly conditioned by railway line routes. Besides, passenger transport services are provided not on all the functioning railway lines. There are not many passenger trains on the following

routes: Kępno–Wieruszów–Wieluń–Herby Nowe, Tomaszów Mazowiecki–Drzewica–Przysucha–Radom and on the Polish Coal-Trunk Line. Passenger railway services which are important from the perspective of regional public transport are provided on the following routes: Łódź–Sieradz, Łódź–Kutno and Łódź–Koluszki (Piotrków Trybunalski–Radomsko)–Skierniewice. They are operated by the Przewozy Regionalne company (commissioned by the Marshall's Office in Łódź in the form of regional trains and InterRegio), which is responsible mostly for regional passenger connections on the aforementioned routes. Trains belonging to this carrier stop at all stations on the given route, which is of key importance for accessibility of Łódź on a local scale. Rail connections are also provided by the PKP IC company, which is responsible for fast supraregional connections.

The importance of rail transport in the case of Łódź is clearly smaller as compared to its role in other regions of Poland. Railway lines run through a small part of the province's communes and it does happen that the routes do not correspond to the contemporary character of the settlement network. In many cases stations and stops are located at a considerable distance from centres of towns, thus making it difficult to use the rail transport freely. Building a cross-city railway line is a solution which can foster effective operation of two stations which are equally important for dealing with railway traffic but which are not directly connected. Infrastructure investment combined with redesigning of the management system of regional connection system and preparing it for inclusion of high speed railway (Massel 2008) may result in creation of a rail node aimed at dealing with transit traffic (Pielesiak 2012).

The Łódź Agglomeration Railway in a way changes the disadvantageous situation for the better. Infrastructure modernization which accompanies it and an increase in the number of stops stands a chance of making it an important element of the region's transport system. It may also bring about transformations in the structure of connections on the area of broadly understood Łódź agglomeration. Connections are provided between the Łódź Kaliska Station and Pabianice, Łask, Zduńska Wola and Sieradz along the line no. 14. Along the line no. 15 the agglomeration railway connects Łódź Kaliska, Zgierz, Głowno and Łowicz. The third direction comprises Łódź Widzew, Zgierz and Kutno (line no. 16). The agglomeration railway will also join Łódź Fabryczna and Koluszki (line no. 17). The last connection will not go beyond the boundaries of Łódź as it will connect the Łódź Kaliska station with the stations in Chojny and Widzew (line no. 25/540). In the long run, railway is supposed to reach also towns outside the borders of the Łódź province. The organization of public transport, even though in different parts of the Łódź province it is characterized by different effectiveness, ensures Łódź certain, if minimal, cohesion with all the remaining 43 towns of the region.



Łódź is by far the most accessible city of the region as far as direct bus and van connections are concerned. In relation to railway connections timetable analysis points to Łódź as the place with the biggest number of changes. Out of all 276 combinations of connections on a regional scale as many 105 times Łódź appears as an interchange station (Wiśniewski 2015b).

In the case of tram connection only Łódź has direct connections with the remaining four towns with tram networks. The network layout implies a situation in which Ozorków and Zgierz have mutual direct connections whereas Pabianice and Konstantynów Łódzki have only direct connection with Łódź.

Considering frequency of connections, the strongest relation may be observed between Łódź and the remaining towns of the metropolitan area. Łódź is mutually linked with over 100 connections daily with Pabianice, Zgierz, Aleksandrów Łódzki, Ozorków, Konstantynów Łódzki, Tuszyn and Rzgów.

Among 24 towns of the Łódź province connected by a rail network in the topological sense Łódź is reached by over 300 connections daily (direct and with changing). Focusing on bilateral connections, the relation with the highest frequency of rail journeys is the connection between Łódź and Koluszki, which is provided by 35 pairs of trains on a daily basis.

The routes on which the public transport to Łódź is provided radiate in all directions. Łódź, as the region's central city, the biggest labour market, seat of administrative institutions and many service facilities of considerable regional range (education, health care, trade, culture and entertainment), requires an adequately developed public transport system which allows to reach it from the whole province area. The number of connections may be disparate in the same way as the importance of Łódź is diversified (for areas adjacent to Łódź it is considerably greater than for areas situated at a bigger distance). The frequency of connections ranges from a few a day, as in the case of Szadek, to over 200 for Ozorków. Irrespective of that, at least minimal availability of connections should be ensured for every inhabitant of the region. Journey time to the city also gradually decreases together with decreasing distance. Only in the case of the tram connection between Łódź and Ozorków as well as train stops before Koluszki, journey times are considerably longer.

The Łódź airport catered for the general passenger traffic on the level of 253,772 people in 2014. Its bigger part was by far represented by scheduled flights (214,233) complemented by charter connections (37,629 passengers) and diversions (1910). In the first four months of 2015 the total passenger traffic reached almost 70,000 passengers.

Regular connections currently link Łódź with Amsterdam, Dublin, East Midlands, London Stansted, Munich and Oslo Rygge. Charter flights operate in turn to Antalya, Burgas, Chania, Enfidha, Corfu, Kos, Rhodes and Zakynthos.

## 4.6. Cargo transport

Analyzing the functioning of Łódź in the regional and national transport network it is necessary to account for the cargo flow. In Poland there is a zone which meets requirements of an ideal location as far as expressway and motorway network is concerned (both existing ones and those in the planning phase), constituting the most attractive place for investors from the TSL industry (transport, shipping, logistics). It is located in the region of three centres: Łódź, Stryków and Piotrków Trybunalski and referred to as the so-called golden triangle of logistics (Skowron-Grabowska 2010).

As the most developed forms of logistic facilities logistics centres need transport infrastructure with certain specification. On the one hand, infrastructure must be characterized by high resistance to surface pressures (caused by movement of vehicles with large axle loads). On the other, however, it must have a good connection with expressways and motorways allowing lorries to reach the logistics centre. It is also necessary that the infrastructure is characterized by big capacity due to medium- and small-tonnage supply transport catering for senders and recipients concentrated around the logistics centre. Transport infrastructure is a prerequisite which conditions cargo transport processes by logistics operators (Wiśniewski 2015c).

Focusing on logistics centres enabling intermodal transport it should be stressed that there are premises in Poland for increased development of intermodal transport due to the location on the intersection of the main European transport corridors (with the particularly beneficial position of the Łódź region), development of the Polish economy and standard of living as well as European integration. These factors contribute to a surge in the domestic and international transport services as well as transit transport.

In Łódź alone there are a few distribution/logistics centres, like the intermodal Łódź Olechów container terminal, Aviva Business Centre Łódź, Diamond Business Park Łódź, Panattoni Park Business Centre Łódź, Panattoni Park Łódź East, Panattoni Park Łódź South, Segro Business Park Łódź (two facilities), Segro Business Park Łódź II (two facilities), or Goodman Łódź Logistics Centre.

The majority of nodal elements of the logistic chain are located in the aforementioned „golden triangle of logistics”. As many as 10 of them is situated within the boundaries of Łódź, out of which the bigger part is situated on the border of Widzew and Górna districts in the railway fork on the lines no. 14, 17, 458, 540 and 541. The car transport is based, in turn, on the provincial road no. 713 (from the north and north-east) and on the national road no. 1 (from the south and south-west). One of the centres within Łódź is situated in the southern part of the city near the border with the Rzgów commune and national road no. 1. Among all these centres only the Łódź Olechów Container Terminal is based on

intermodal transport while the rest are multi-branch companies using only car transport. From the perspective of physiognomy, all centres comprise of a single element.

Land cargo transport in Łódź is complemented by air cargo transport. Łódź Władysław Reymont Airport is an example of an airport in which cargo transport constitutes an increasing share of all performed operations. The path of its development and realities of functioning is an interesting illustration of a facility with a regional scope for which cargo flow increases in importance.

Air cargo transport is based on liaison of complicated means of transport, navigation systems and aircraft ground handling connected with dealing with the airplane itself but also manipulation of transported goods and it requires big capital expenditure and highly qualified staff. It is perceived to be one of the biggest sectors of the global economy and it belongs to the fastest growing transport branches in the world (Panasiuk, Pluciński 2008). Airplanes are more and more efficient and increasingly better suited to cargo transport and they make it possible for goods to be transported at speeds unattainable for other means of transport (Mikulski, Glass 1980). Air transport is also generally perceived as the most buoyant form of transport in recent years. Resource efficient air transport is currently profitable not only on the longest and medium-sized lines but also on individual shorter routes or even local ones. Regular cost-cutting also refers to airport tariffs.

However, despite these two factors the cost of cargo air transport is still rather high as compared with other means of transport. The factors which may overcome cost barriers include journey time reduction and safety. Recent years have brought a clear pickup in cargo air transport, which results in changes to the share of goods in the total cargo load. This is a consequence, for instance, of introduction of dedicated cargo airplanes (Neider 2008) which are characterized by a beneficial for cargo flows ratio of paid commercial cargo capacity to the aircraft's total takeoff weight. All this makes cargo transport equal passenger services if we consider the volume of air transport (Kochański 2013). In the scenario predicting a pessimistic economic growth, the number of passengers from the year 2008 will have at least tripled by 2035 (*Concept of Central Airport for Poland* 2010).

Functioning of the Łódź Airport requires special attention due to its location on the way of the trans-European Baltic–Adriatic Transport Corridor with North–South orientation. Special importance in this project is attached to nodal facilities which allow to deal with intermodal flows. With the present tendency concerning development of cargo flows and accomplishment of planned infrastructure investments concerning transport (S14 expressway), Łódź Władysław Reymont Airport stands a chance of performing a function of an intermodal node. Here the role of nodal infrastructure elements should be highlighted. They allow for efficient co-operation and transport work division into at least two transport

branches, making the whole connection network less strained due to division of transport load and more flexible to handle a big cargo wave.

In the case of the Łódź region it is possible to take into consideration only the combination of car, rail and air transport because of environmental conditioning while planning intermodal solutions. If Władysław Reymont Airport is included as a node handling cargo flows, then it is possible to use the region's multimodal potential to the full in particular due to the characteristics of cargo transport from the airport on the RFS principles.

The abovementioned factors naturally imply very big opportunities for dynamic growth of logistics on the basis of connections of the Łódź region nodes which are situated on the route of the transport corridor. This may ensure growth opportunities for the existing Łódź–Stryków–Piotrków Trybunalski golden triangle of logistics. Potentially, high levels of transport accessibility of the Łódź airport in the light of infrastructure facilities is ensured by the currently constructed S8 expressway, alternative to its route national roads no. 12 and 14, S14 expressway as a bypass road of Pabianice (ultimately planned as the western bypass road of Łódź). Because of the used Road Feeder Service formula, it is very important for the competitiveness of Łódź Airport to be able to reach A1 and A2 motorway nodes.

Under the decision of the President of the Civil Aviation Authority in 2011 Łódź Airport obtained the status of a registered cargo agent. It was not until in November and December 2014, however, that the tonnage of checked in cargo exceeded 100 tons. In 2012 it showed considerable fluctuations, reaching its maximum value at the end of the year. The year 2013 was characterized by a clear increase in the volume of checked in cargo. Only in January and August it fell below 200 tons. In turn September and December results exceeded 350 tons. In 2014 there was a clear and stable surge in the tonnage of checked in cargo. In the first six months the results oscillated in the region of 400 tons only to come close to 500 tons in the second half of the year. In February 2015 the checked in cargo exceeded 700 tons. At the moment Łódź Airport cooperates with such carriers as: DB Schenker, Expeditors, DHL, Panalpina, a.hartrodt and DSV while cargo transport is operated, for example, by: Lufthansa Cargo, cargolux, Air France Cargo, SAS Cargo, Swiss WorldCargo oraz SkyXS.

Due to the fact that in the last decades the demand for air transport has been growing and at the same time airport capacities have not caught up with this demand, many airlines switched to the RFS system (Road Feeder Service) in which cargo is transported through „hubs”. On the order of airlines goods are transported by lorries from the so-called „off-line-airports” to bigger transshipment airports, such as Frankfurt, Paris or London, and subsequently they are shipped with the use of air transport. This system also works in the reverse direction, i.e. cargo is delivered to a transshipment port with the use of air transport and

it is shipped by lorries to airports „off-line-airports” (<http://www.intralog.pl/rfs-road-feeder-service/> (access: 30.10.2014)). This model of operating cargo flows is of particular importance for Łódź Airport. Currently almost all cargos reaching Lublinek are transported on the RFS basis. In the case of Lublinek 99,9% of cargo in 2013 was operated on the RFS basis (<http://www.pasazer.com/> (access: 29.10.2014)).

## 4.7. Conclusions

Taking into account the information presented in this article, it is worth stressing the very high transport potential of Łódź both on the regional and national scale. Outstanding levels of transport accessibility are ensured by the city’s central location in relation to the area of the Łódź province and Poland combined with the functioning, accomplished and planned layout of the main elements of the road and rail transport network.

It should be stressed that a *sine qua non* condition of ensuring transport accessibility of the given city is organization of appropriate access to both infrastructure elements and transport services. These two elements are closely related as using transport services is impossible without adequately easy access to infrastructure. On the other hand, even easy and general access to it does not guarantee transport accessibility on the desired level. Maximum level of transport accessibility of diversified and useful places, goods, persons and services which are often located at a certain distance is conditioned not only by the access to transport itself but also other elements (e.g. financial means) contributing to accessing these places, persons or services. The functioning of public transport enabling to reach Łódź seems not to use fully the potential arising from infrastructure connections. At the same time the level of using these opportunities is systematically growing due to the implemented improvements both in the sphere of transport organization, its multimodality implementation of increasingly modern and effective suprastructure.

In the light of the conducted analysis it is possible to point to examples of undertakings which could contribute to an increase in the transport accessibility of Łódź. One possible solution is reviewing the course of planned railway infrastructure investments as the course of lines and location of stops, for instance, of the Łódź Agglomeration Railway, do not correspond to the most important functional areas for passenger transport in Łódź. Great attention should be paid to the provincial roads, especially their technical condition. Modernization of these infrastructure elements, neglected for the benefit of priority sections of expressways and motorways, may contribute to an increase in transport effectiveness on a regional scale, complementing the main East-West and North-South axes which go through the city. Admittedly, investments in provincial or

district roads do not result in fundamental changes to accessibility but they may contribute to eliminating the psychological barrier which accompanies journeys on lower category roads through higher safety and comfort as well as lower congestion. As far as public transport is concerned it is necessary to integrate individual systems, including in it different levels of local administration as well as carriers offering car, rail and tram services. Due to the vast scope of necessary modifications it seems justified to limit them to main connections in the first place enabling multi-branch transport to the region's centre which would include rail, local transport and car transport companies.

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