

The Central Polish Airport in the Rail Transport System

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Summary

The implementation of a multi-faceted undertaking related to the preparation, construction and commissioning of the Central Polish Airport (CPK) requires efficient transport. The selected location – 30 km from Warsaw, near Grodzisk Mazowiecki, where there already is a large concentration of transport routes and high speed railway lines are planned for construction – will facilitate the completion of this project. The article presents the transport environment of the CPK, the significant conditions and the capabilities in terms of transporting passengers to and from the airport by rail, including the division into metropolitan area and regional traffic and considering long-distance traffic, as well. One of the key requirements for the success of the project will be integrating the airport with the regional, national and international railway networks.

Keywords: railway transport, airport, transport system, integration

1. Introduction

One of the key problems related to the provision of logistic services for airports is the need to ensure the efficient transport of passengers, the persons seeing them off or picking them up, and the members of personnel. Airports are places of high concentration of transport roads used to provide services for them. Proper planning of these roads is a prerequisite for an efficient transport system that makes it possible to conveniently travel to and from the airport and is resilient to rush hour traffic and not prone to traffic disruptions. Railways play a particularly important role in providing services for airports [2, 16]. Today, most airports use rail transport, from light rail to high speed trains. The selected mode of transport depends on local conditions, the size of the airport and the technical capacities.

The project of constructing the Central Polish Airport (Centralny Port Komunikacyjny, CPK) between Warsaw and Łódź is not only a major investment undertaking. It is a systemic undertaking in which the investment issues are only one of the elements of success. Project risks are evenly spread across seven areas:

- social and political risks,
- legal and regulatory risks,
- organizational risks,
- market-related risks,
- costs and financing risks,
- risks related to interactions with the natural environment,
- technical and technological risks [3].

Ensuring efficient transport is a serious challenge and, from the very beginning, should be taken into account when making the assumptions necessary to carry out the project. The location [13], which is approx. 30 km west of the center of Warsaw (in the municipality of Baranów), is in line with the global trend of moving airports outside of urban areas [2, 16]. However, the condition for the entire undertaking to be a success will be to ensure efficient and reliable transport, both public and in the form of individual trips to the airport and back. Adopting a suitable transport model for the airport is one of the key elements of guaranteeing that the project will be a success. The estimated number of passengers that will use the Central Polish Airport is between 40 and 50 million per year [13]. The scale of the project and the expected impact of the airport require convenient access for travelers using various modes of transport, both public and private.

2. The Central Polish Airport and the development of the railway network in Poland

2.1. Location of the new airport

Locating the new airport close to Grodzisk Mazowiecki would correspond with the location proposed in 2010 by the Centre for High Speed Railways,

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next to a branch of the planned Warszawa – Łódź – Poznań / Wrocław high speed railway line, which would be a part of the south section (Warszawa – Katowice / Kraków) of the Central Railway Line. In the studies, it has been assumed that both lines from Warsaw to the Grodzisk Mazowiecki area would go along a new route, permitting speeds up to 350 km/h. Approx. 30 km from the Warsaw West station, they would split and the Central Railway Line would run in the corridor designed in the 1970s and then, from the Korytów station, it would use the section leading to Katowice and Kraków. In the future, the Central Railway Line could be extended towards Gdańsk and Bydgoszcz, in accordance with the old plans.

The location of the airport has been selected in cooperation with the Aviation Department of the Ministry of Infrastructure and social organizations that were involved in the then works on a concept of a new central airport for Poland. The location is very favourable from the point of view of providing transport services for the airport, since it is possible to use the existing, well-developed railway and road infrastructure and the existing documentation produced for high speed railway lines on the Warszawa – Łódź – Poznań / Wrocław route.

2.2. Trans-European Transport Networks (TEN-T)

The Polish railway system is a major element of the Trans-European Transport Network (TEN-T). TEN-T comprises the major railway lines of the European Union and is connected with the transport networks of other countries. TEN-T is regulated in Regulations (EU) 1315/2013 and 473/2014 and covers both existing and planned railways. The schedule of projects has the time horizons of 2030 (basic network) and 2050 (comprehensive network). According to Regulation 1316/2013 (currently under review), the projects are to be carried out using the Connecting Europe Facility (CEF) and other aid and loans.

TEN-T is divided into passenger and cargo networks. Both are important from the point of view of the CPK, since, according to the assumptions, the airport will handle not only passenger traffic, but cargo flights, as well. Regulation 1316/2013 specifies the main transport corridors in the European Union, two of which (out of a total of eight) run through Poland:

- the North Sea – Baltic Sea corridor,
- the Baltic Sea – Adriatic Sea corridor.

These corridors intersect in the Warszawa and Łódź Functional Area [4], which is the location of the CPK. Constructing the airport next to the Warszawa – Łódź – Poznań / Wrocław high speed railway line and the A2 motorway, which both belong to the North Sea – Baltic Sea corridor, will also make it a part of TEN-T through

the process of changing the location of the Warsaw airport, which is an element of TEN-T (Fig. 1).

The proposed location of the new airport is also very favourable in the context of the international high speed railway network planned as part of TEN-T. This means that this network will be able to provide transport services for the future airport (Fig. 2).

2.3. Domestic railway network

The Polish settlement system is highly polycentric [12, 14]. The difference in terms of population between the capital and the other cities is much lower than in a number of other European countries. Five metropolitan areas (Kraków, Łódź, Wrocław, Poznań and the Tri-City) have approx. one million residents. Furthermore, the Upper Silesian conurbation has approx. 3.5 million residents. The metropolitan areas are the centers of the regions that have historically formed the structure of interregional links and the transport network. Polycentricity is a very valuable feature of a spatial structure, which positively affects the economic development of the country and contributes to smooth and even development [12, 14].

From the point of view of providing services for the new airport using long-distance railway transport, the quality of the railway links between the regions and Warsaw is important. Geographically, Warsaw is not located in the centre of Poland, but lies more than 100 km east of there. Furthermore, historically, the city's links with western regions used to be weak, which has resulted in the current inadequate availability of Warsaw when using transport from western Poland. Considering the needs in terms of long-distance railway transport, the existing railway network in Poland has relatively low technical parameters compared to the requirements that need to be met in order to ensure that railways are competitive. In recent years, significant funds have been allocated to improving the quality of the railway links between the regions and Warsaw. When all of these projects are finished, the railway lines from Warsaw will permit speeds up to 160 km/h. However, even after the National Railway Programme 2023 is completed, the average speed of the trains from Warsaw to other major cities will be approx. 100 km/h, with higher speeds only on some routes (Warszawa – Poznań, Warszawa – Kraków, Warszawa – Katowice). The travel times from Warsaw to the metropolitan areas that are most important from the point of view of the aviation market, i.e. those with more than 500,000 residents (Kraków, Katowice, Wrocław, Poznań and the Tri-City) will be in principle between 2 and 3.5 hours. The travel times from Warsaw to Lublin and Białystok will be between 1.5 and 2 hours; getting to Olsztyn and Rzeszów will take more time.

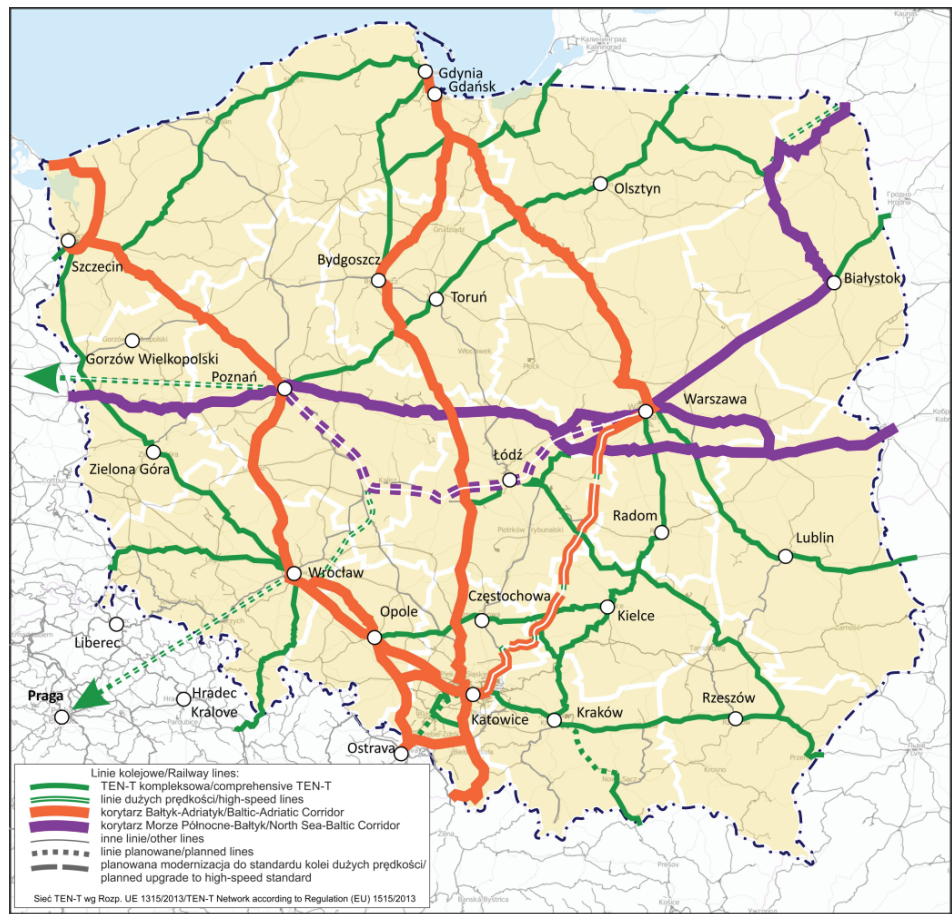


Fig. 1. TEN-T corridors and lines in Poland [11]

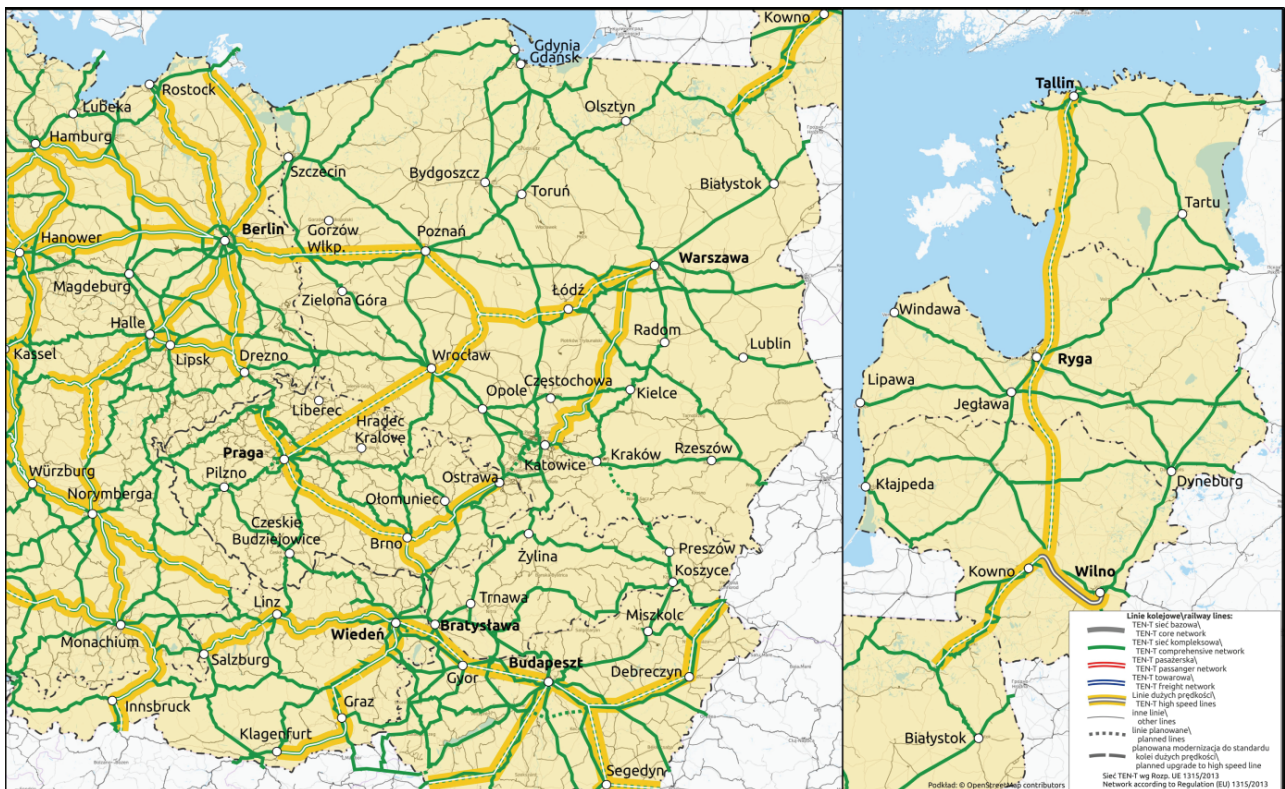


Fig. 2. The TEN-T comprehensive network in Central Europe, including high speed railways [By Tomasz Bużalek]

These long travel times will significantly limit not only the competitiveness of railways, but also the ability to have more trains running. In spite of this theoretically favourable railway situation in terms of domestic travel to Warsaw, there is still a high probability that western Poland will continue to use airports in western Europe, which will limit the impact of the new airport. A rapid improvement of the railway links in Poland can only take place after the high speed railway lines planned as part of TEN-T are constructed.

Studies on high speed railways in Poland were completed in 2015 [7]. The planned domestic network of high speed railways would include the route from Warsaw to Poznań and Wrocław via Łódź and the route from Warsaw to Katowice and Kraków, both to be connected to the modernized Łódź – Opatów route. According to the recommendations from the

European Commission, feasibility studies have been prepared for trans-border sections (Wrocław – Prague and Poznań – Berlin). The study for the new Katowice – Ostrava line had already been prepared in 2010.

In 2016, the new railway station in Łódź was also completed, which has been designed as capable of handling high speed trains. Contrary to popular opinion, the high speed railway programme in Poland has not been discontinued, but only delayed. The planned network is in line with the Concept for Spatial Development of Poland prepared in 2011 and meets the requirements in terms of ensuring domestic cohesion laid down in the latest strategic document, the Responsible Development Strategy [12]. The key element of the new high speed railway network based on new and modernized railway lines was to guarantee short travel times (3–3.5 hours) between the major centres of western and eastern Poland (Table 1, Fig. 3).

Table 1

Basic assumptions for the travel times between the regions of Poland [11]

Routes	Travel times
From Warsaw to the largest cities of Poland within a 300 km radius (including Poznań, Wrocław, Katowice, Łódź, Lublin and Białystok)	Approx. 1.5 hours or less
From the cities of western Poland to the cities of eastern Poland (including from Poznań to Lublin / Białystok, from Wrocław to Lublin/Białystok, and from Poznań to Kraków)	Approx. 3–3.5 hours
From Warsaw to the cities located in border provinces (including Szczecin, Zielona Góra, Jelenia Góra, Zgorzelec, Zakopane, Rzeszów, Olsztyn and Gdańsk)	Approx. 3–4 hours or less

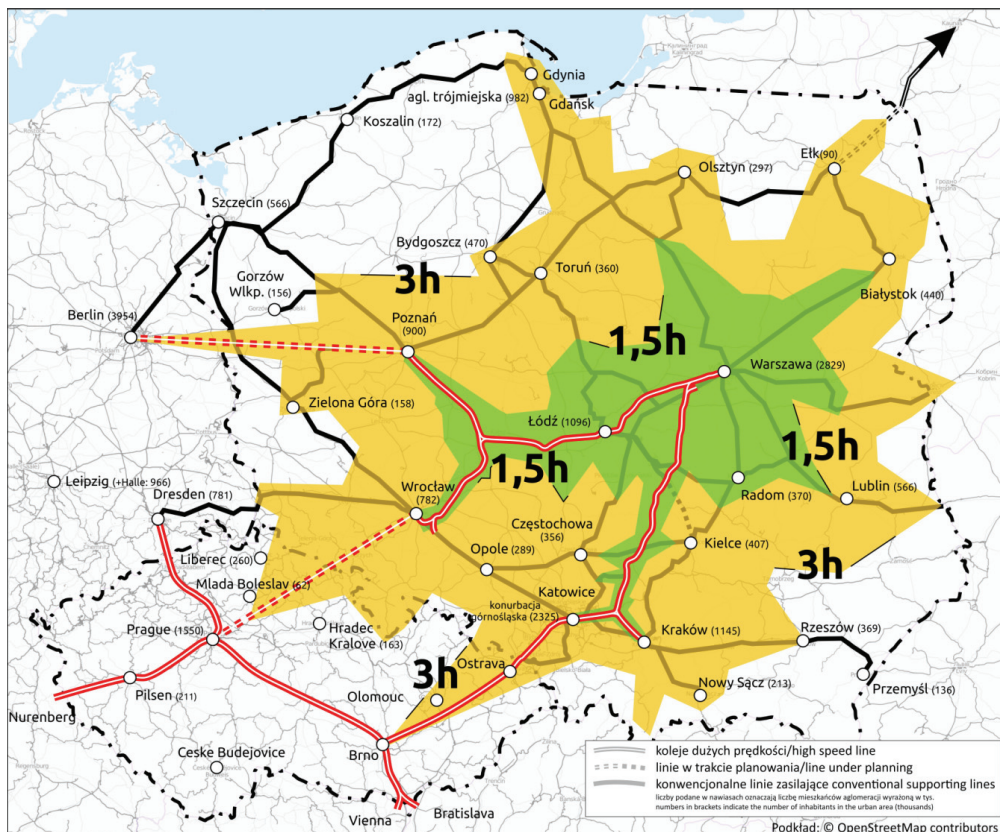


Fig. 3. Travel times to Warsaw after launching the high speed railway system in Poland [11]

These travel times make one-day trips possible, which is especially appreciated by those on business trips. With travel times of approx. 1.5 hours, the number of passengers is more or less identical throughout the day, which makes business trips possible at various times of the day. This also creates good conditions for people to live and work in different metropolitan areas, with the related services contributing to economic development. The market share of railways in this kind of transport can even exceed 80% [11]. The travel times to the future airport will be shorter by approx. 15 minutes for trains coming to Warsaw from the west and 15 minutes longer for trains coming to Warsaw from the east.

To achieve these travel times, it would be sufficient if the trains ran at speeds of 300–320 km/h, which is possible if generally available technologies are used. The Y line has been set up for speeds of up to 350 km/h and the geometric parameters of the Central Railway Line permit speeds of up to 300 km/h.

2.4. Location of the airport in the region

The Central Polish Airport will be located in the transport system between Warsaw and Łódź, which is particularly well-developed. The main domestic and international railways pass through it. To the north of the location of the airport, there is railway No. 3 from Warsaw to Poznań, while to the south, there is railway No. 1 from Katowice to Łódź. Both lines already handle passenger trains, both long-distance and local, at speeds of up to 160 km/h. These lines form the main transport corridors for both of the metropolitan areas they join and are already intensively used for metropolitan, regional and long-distance travel; during the rush hours, they come close to their capacities. Between these two lines, a Warszawa – Łódź high speed railway line is planned (Fig. 4). Ultimately, it should

take over the long-distance traffic from both the existing lines and increase their capacity, so that they can handle more metropolitan, urban and cargo traffic, in line with the assumptions presented in the 2011 White Paper concerning the Single European Transport Area [1].

3. Provision of transport services for the airport

3.1. Long-distance transport

In Poland, like in the rest of Europe, most long-distance passenger traffic takes place in transport corridors joining the major metropolitan areas. Currently, the major railway corridors in Poland are as follows:

- Szczecin – Poznań – Warsaw – Lublin,
- Wrocław – Łódź / Częstochowa – Warszawa – Białystok,
- Gdańsk – Warsaw – Katowice / Kraków,
- Gdańsk – Bydgoszcz – Łódź – Katowice,
- Przemyśl – Kraków – Wrocław – Poznań – Szczecin.

The Intercity offer of the Polish Railways, based on the rolling stock purchased between 2012–2015, covers additional corridors in which passenger numbers are steadily increasing:

- Poznań – Łódź – Kraków,
- Kraków – Kielce – Warszawa – Olsztyn,
- Bydgoszcz – Toruń – Warszawa.

Implementing the high speed train programme will strengthen long-distance transport by drastically reducing the travel times on the east – west axis. The construction of the new Warsaw – Łódź – Poznań / Wrocław high speed line will drastically reduce the travel times between the cities of western

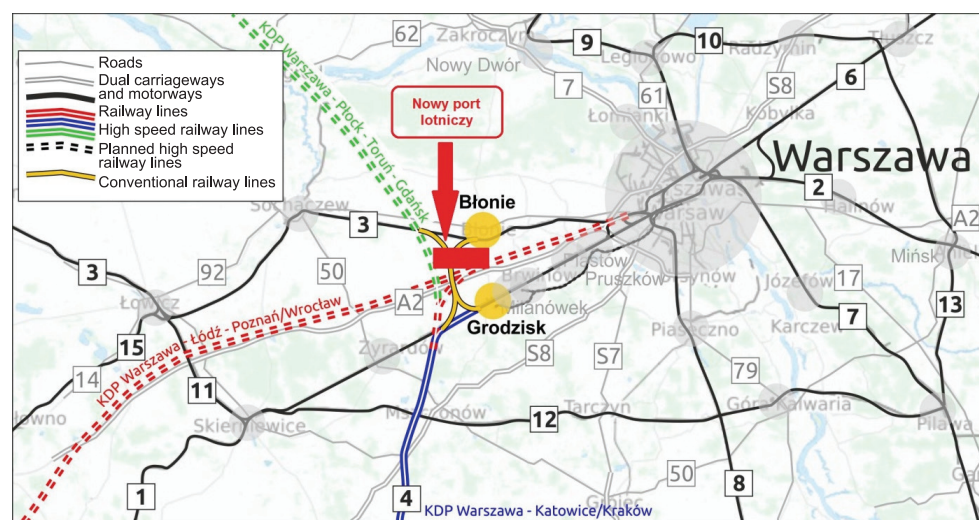


Fig. 4. Transport surroundings for the location of the Central Polish Airport, considering the planned high speed railway lines
[By Tomasz Bużalek]

Poland and Warsaw and the cities of eastern Poland, which will increase the demand for railway transport.

According to feasibility studies, the high speed train system in Poland is based on using high speed railway lines and conventional lines, which, once modernized, will form a cohesive system of long-distance transport for all of Poland.

This system will cover most of the big cities and regions in Poland that have a combined population of more than 15 million people [5]. The postulated return to the concept of constructing the northern branch of the Central Railway Line will make it possible to significantly improve the transport availability of Warsaw and the new airport for the Pomorze and Kujawy regions (Fig. 5). The main transport corridors that will be formed thanks to high speed railway lines will be focused both on connecting the regions with Warsaw and on creating direct links between the particular regions themselves, which will ensure balanced economic development across Poland.

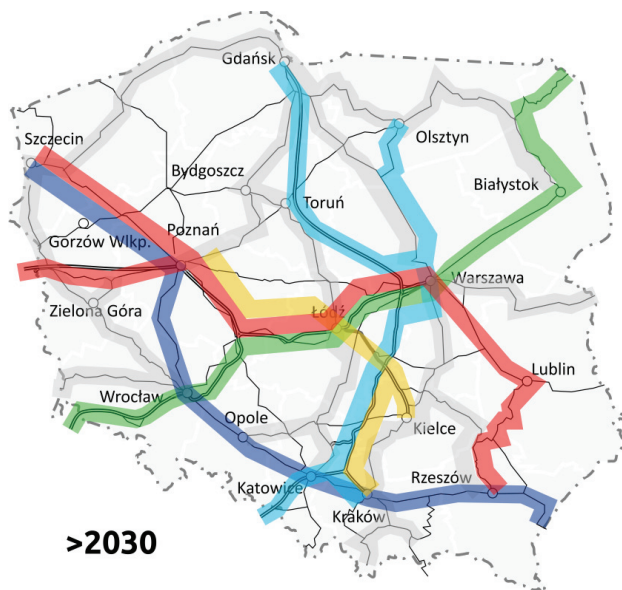


Fig. 5. The main high speed corridors based on high speed railways (including the northern branch of the Central Railway Line) [9]

3.2. Metropolitan area and regional transport

The Central Polish Airport will be located to the west of the Warsaw metropolitan area, near Gro-

dzisk Mazowiecki (the municipality of Baranów). Its purpose will be to handle both the Warsaw and Łódź metropolitan areas. On the basis of comparison with similar foreign airports, one could assume that the majority of the passengers using the airport will be the residents of these two metropolitan areas. For this reason, it is especially important to ensure a quick and reliable mode of transport to and from the direct surroundings of the airport. If good links are provided by the regional and metropolitan area railways, up to 30% of the airport users may choose this mode of transport. In the vicinity of the airport, four sub-systems may be differentiated, as presented in Table 2 together with the number of their residents. This division reflects the variety of the transport problems related to transporting passengers to the airport.

- **Provision of transport services for the Central Macroregion**

Both of the provinces comprising the macroregion are relatively large, but have extensive railway networks focused on their capitals. It is assumed that, in order to travel to the airport by public transport, the residents of these provinces will use the intermodal nodes located in the province capitals. In this respect, it should be assumed that a large number of residents living on the outskirts of the two provinces will use private cars, as this guarantees shorter travel times without the need to switch between modes of transport, or bus lines that will be designed specifically to handle traffic to and from the airport.

- **Provision of transport services for the Warszawa and Łódź Functional Area**

Between the Łódź and Warsaw metropolitan areas lies a settlement belt several dozen kilometers wide, with cities with a population of fewer than 100,000 residents, leaning mainly towards Warsaw. These cities are located either by railway No. 1 (Łódź – Koluszki – Warszawa) or by railway No. 3 (Poznań – Kutno – Warszawa). The optimum solution in terms of providing the residents of this region with access to the airport would be to use these two railway lines to ensure rail links with the airport (see Fig. 6).

Table 2

Transport sub-systems for the Central Macroregion [15]

Sub-system	Territorial reach	Number of residents
Central Macroregion	Mazowieckie and Łódzkie Provinces	7.8 million
Warsaw and Łódź Functional Area	Warsaw Metro Area, Łódź Metro Area, and nine other districts	4.7 million
Warsaw Metropolitan Area	The City of Warsaw and 49 neighboring municipalities	2.8 million
Łódź Metropolitan Area	The City of Łódź and 18 neighbouring municipalities	1.1 million

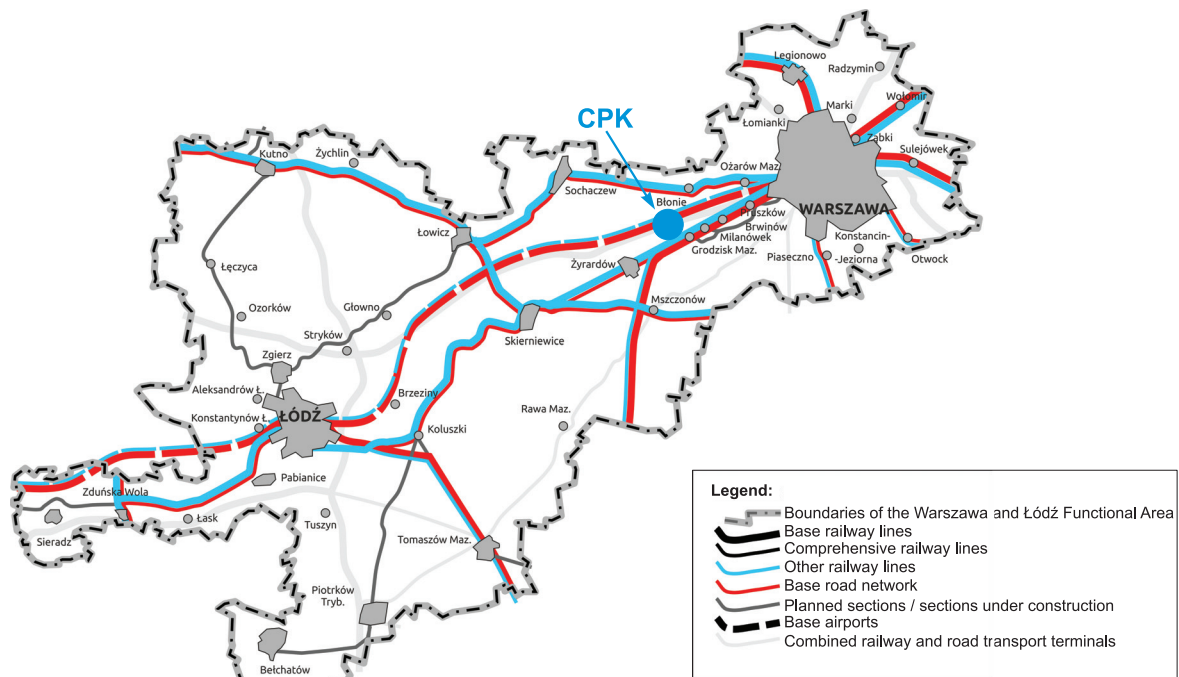


Fig. 6. The main transport routes in the Warsaw and Łódź Functional Area forming the matrix for the spatial structural of the area [8]

- **Provision of transport services for the Warsaw Metropolitan Area**

According to Resolution No. 173/2017 of the Council of Ministers of 7 November 2017, the new airport will be located approx. 30 km from the centre of Warsaw. In the opinion of the residents of Warsaw (as potential passengers), in comparison with the Chopin Airport, this location seems to be less convenient, as the access to the existing airport is relatively easy from various points in Warsaw. However, there are no significant technical problems that would make it impossible to ensure convenient railway transport from the centre of Warsaw to the CPK that would take 15–20 minutes. A system of links with the city's public transport and the relevant infrastructure at the intermodal nodes need to be provided, as this will condition the attractiveness of traveling to the new airport by train.

- **Provision of transport services for the Łódź Metropolitan Area**

The distance between the CPK and Łódź will be approx. 100 km. The existing railway link between Łódź and Warsaw (lines Nos. 1 and 17) will not guarantee a sufficiently short time of travel to the new airport. It is expected that the travel time when using these lines would be more than one hour. A solution would be to use the planned high speed railway lines, ensuring a travel time of approx. 20 minutes. Since the metropolitan area is relatively large (a radius of approx. 40 km), the Łódź Metropolitan Area Light Rail should play an important role, transporting passen-

gers to the intermodal nodes from which trains for the airport would leave.

Assuming that the CPK will handle 50 million passengers per year [13], the metropolitan area and regional railways should transport approx. 15 million airport users in a year. This is not a large number considering the total number of passengers transported in 2016 by the following railway companies: Koleje Mazowieckie, SKM Warszawa, Łódzka Kolej Aglomeracyjna and Przewozy Regionalne, which was approx. 95 million. Journeys to the airport would comprise approx. 15% of the total volume of transport in both provinces [6].

The organization of train traffic on the lines transporting passengers to and from airports is peculiar. First of all, a high frequency of journeys is necessary. Large airports usually have trains leaving every 10–15 minutes. The Chopin Airport uses four pairs of trains every hour: two via the Central Railway Station in Warsaw (long-distance trains) and two via the local Warsaw City Centre railway station. The frequency of trains from Warsaw to the future airport should not be lower than for the existing airport.

Depending on the final location of the new airport, journeys from the center of Warsaw may be based on the existing railway lines, No. 1 (in the direction of Koluszki and Katowice) and No. 3 (in the direction of Kutno and Poznań). This solution would make it possible to cover the towns between Warsaw and the new airport. Similarly, the Nos. 1 and 17 railway lines could be used in the case of Łódź (see Fig. 7).

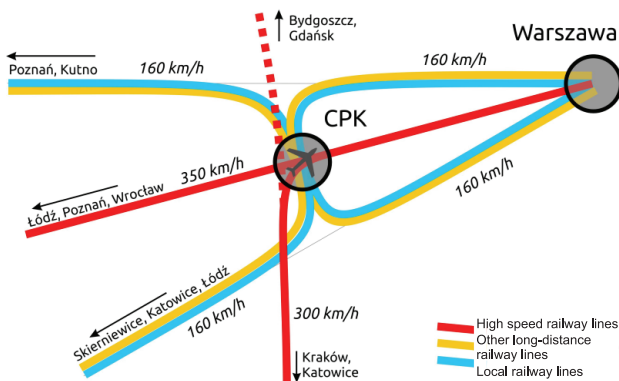


Fig. 7. The transport surroundings of the new airport west of Warsaw and the options in terms of railway transport
[By Tomasz Bużalek]

It would also be possible to use high speed railway lines to transport passengers to the airport from Warsaw. However, the trains used on these lines will run to Łódź, Wrocław, Poznań, Katowice, Kraków and Bydgoszcz, which, in the long run, will limit the usefulness of this solution due to high saturation. It should be assumed that some of the high speed trains will have to stop at the airport station, which, especially in the case of people traveling by a direct train from more remote areas of Poland, could be a major facilitation.

4. Conclusions

Integration of the new airport with the regional, national and international railway networks will be one of the key elements determining the success of the entire project. The existing railway network to the west of Warsaw is relatively well-developed, but will require improvement with high speed railway lines to Łódź and to western Poland. This is a condition for effectively including this part of Poland in the area of impact of the CPK.

1. The assumed number of passengers to go through the CPK requires that most of them are able to use public transport. Otherwise, the increased number of journeys to and from the airport by cars may contribute to excessive congestion on the roads around the airport.
2. The planned central location of the CPK will make it possible to use the railway network to efficiently transport passengers to and from the airport. However, due to its low technical parameters, the existing railway network needs to be supplemented with high speed railway lines, especially in the west and the south. This is also a condition for increasing the reach of the airport's impact and attracting the regions of Poland that today are more likely to use foreign airports located close to them.

3. Integrating the airport with the railway system is a condition for good and reliable transport services, which is confirmed by foreign experiences. In well-developed systems, railway transport may handle even up to 30% of the passengers traveling to and from the airport. The share of long-distance railways in providing transport services for the major airports in Europe is between 6% and 17%; these railways are based on high speed trains, with the airport being located in the direct proximity of a railway station capable of accommodating such trains (Frankfurt, Germany and CDG Paris, France).
4. The Central Polish Airport will function in the middle of the existing Polish railway network, most of which is part of the TEN-T. This will make it easier to ensure the high availability of transport, for both passengers and cargo.
5. The CPK and high speed train projects are mutually complementary and together will significantly improve the transport availability and cohesion of Poland.

Literature

1. WHITE PAPER. *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*. COM(2011) 144, Brussels, 28.3.2011
2. Graff M., Pomykała A., Raczyński J.: *Tabor Kolejowy dla obsługi portów lotniczych* [Rolling stock for providing services for airports]. Technika Transportu Szynowego, vol. 1-2/2018
3. Lis T., Drop W.: *Systemowe zarządzanie przedsięwzięciem wielkim na przykładzie CPK* [Systemic management of a large project on the example of the Central Polish Airport]. The "Intermodal transport – integration of global transport" academic and technological conference, Warsaw, 21 March 2018.
4. Markowski T.: *Zintegrowana Strategia Rozwoju Warszawsko-Łódzkiego Obszaru Funkcjonalnego do roku 2030. Projekt* [The Integrated Development Strategy for the Warsaw and Łódź Functional Area until 2030: a plan]. Łódź–Warsaw, September 2015
5. Massel A., Pomykała A., Raczyński J.: *Perspektywy rozwoju kolejowych przewozów pasażerskich międzynarodowych w Środkowo-wschodniej Europie w aspekcie budowy linii dużych prędkości* [Prospects for the development of international railway transport of passengers in Central and Eastern Europe in the context of the construction of high speed railway lines]. Technika Transportu Szynowego, vol. 6/2017.
6. Pomykała A.: *Uwarunkowania obsługi centralnego portu lotniczego dla Polski przez transport kolejowy*

- [Conditions determining the provision of services for the Central Polish Airport by means of railways]. *Technika Transportu Szynowego*, vol. 9/2017.
7. Pomykała A.: *Realizacja programu przygotowania i uruchomienia przewozów kolejami dużych prędkości* [Implementation of the programme intended to prepare and launch high speed railway transport]. *Technika Transportu Szynowego*, vol. 6/2017.
 8. Raczyński J., Bużałek T., Pomykała A.: *Rola kolei w rozwoju obszaru funkcjonalnego aglomeracji warszawskiej i łódzkiej (1). Diagnoza obecnego stanu* [The role of railways in the development of the functional area of the Warsaw and Łódź metropolitan areas (1): diagnosis of the current state of affairs]. *Technika Transportu Szynowego*, vol. 3/2016.
 9. Raczyński J.: *Koncepcje budowy linii dużej prędkości CMK Północ z Warszawy do Gdańska* [Concepts for the construction of the high speed North section of the Central Railway Line to Gdańsk]. *Technika Transportu Szynowego*, vol. 11/2017.
 10. *Studium wykonalności dla budowy linii kolejowej dużych prędkości „Warszawa – Łódź – Poznań / Wrocław”* [Feasibility study for the construction of the Warsaw – Łódź – Poznań / Wrocław high speed railway line]. IDOM, Warsaw 2013.
 11. Szarata A., Raczyński J.: *Analiza symulacyjna wielkości przewozów dla kolei dużych prędkości w Polsce* [Simulation analysis of the transport volumes for high speed railways in Poland]. *Technika Transportu Szynowego*, vol. 6/2017.
 12. Resolution No. 8 of the Council of Ministers of 14 February 2017 regarding the adoption of the Responsible Development Strategy 2020 (with a time horizon of 2030). Appendix.
 13. Resolution No. 173/2017 of the Council of Ministers of 7 November 2017 regarding the adoption of a Concept for preparing and implementing the Solidarity Airport – the Central Polish Airport investment project. Appendix.
 14. Resolution No. 239 of the Council of Ministers of 13 December 2011 regarding the adoption of a Concept for the Spatial Development of Poland 2030. Appendix.
 15. *Warunki realizacji przedsięwzięcia systemowego: Uruchomienie Centralnego Portu Komunikacyjnego wraz z towarzyszącą infrastrukturą biznesową. Raport* [Conditions determining the implementation of a systemic undertaking: launching the Central Polish Airport and the accompanying business infrastructure: a report]. Instytut Sobieskiego, Warsaw 2017.
 16. Wesołowski J.: *Integracja lotnisk z kolejami dużych prędkości* [Integrating airports and high speed railway lines]. *Technika Transportu Szynowego*, vol. 5/2017.