



Jan Raczyński, Marek Graff

Development of airports connections by high speed and conventional railways in Poland

Platform on station Cracow Balice Airport. Foto M.Wojtaszek

One of the key problems in the logistics service of airports is to ensure effective passenger transport. The airports are places where a large concentration of transport routes is used to provide the access to them. The airport's design is a prerequisite for the creation of an efficient transport system enabling convenient commuting without peak loads and movement disturbances. In the recent years, the railway plays an important role in transportations to the airport.

Today, most airports are served by rail transport of various types, ranging from urban railways to high-speed railways. The choice of the mean of transport depends on local conditions, size of the airport and technical possibilities. In the most developed systems, the market share of railways reaches up to 30%, and the exceptional cases are the services of Gardemoen airports in Oslo and Cracow Balice where more than 30% of their passengers use the rail [1, 7].

Ways of connecting the airports to railway

The choice of the type of transport to the airport is determined by many conditions. The most important of them are:

- ◆ airport size determined in travelers' flows;
- ◆ transport environment,
- ◆ technical requirements for connections,
- ◆ the location of the airport in relation to the major cities.

The local and international airports, are usually build or adapted on the basis of local lines of connection by fast urban, agglomeration or regional railways. In some cases, there are also metro or tram connections. The function of these connec-

tions is to bring passengers to the city center or important transport hubs, including the central one for the agglomeration or region of the railway station. These lines are a standard element of local transport systems but some of them have been specially built to provide railways to airports. In this way, airports in such large agglomerations as Munich, Berlin or Vienna are served. In recent years, airports have been built at an increasing distance from the agglomeration centers due to the inconvenience of the urban environment and the lack of availability of free areas. In order to support these airports, railway lines with high maximum speeds are built to achieve the shortest possible journey time. The distance of large airports from the city center is often several dozen kilometers. This is a case of Arlanda Stockholm,



Platform on station Warszawa Chopin Airport. Foto M.Graff

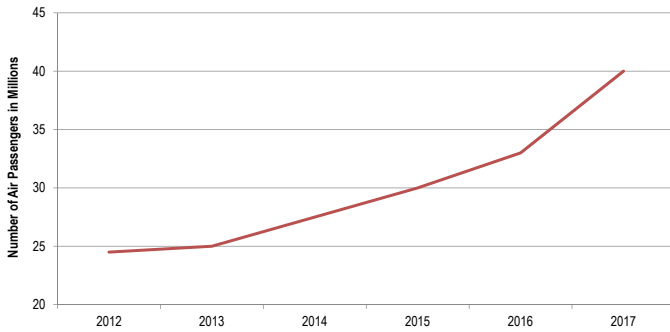


Fig. 1. Growth of number of air passengers in Poland

Gardemoen Oslo, Sheremetyevo Moscow, Heathrow London or Narita Tokyo. For the service of airports of national and international importance, the optimal solution seems to be their direct incorporation into the network of domestic long-distance trains. In such a case, the airport should be located directly in the proximity of at least one of the main national lines and the railway station. A model example is the Zurich airport.

In today's airport projects of international significance, the most effective solutions in the form of incorporating them into high-speed rail systems, which are currently more and more international in Europe, are increasingly being used. Examples of such solutions are Charles de Gaulle airport in Paris, Frankfurt am Main, Schiphol in Amsterdam and new airport projects in Prague (in the future high-speed line Vienna-Brno-Prague-Dresden) [5] and the airports of the Baltic countries to be connected by the high-speed Rail Baltica line and ultimately to the Helsinki transcontinental airport [6]. Airport services are also carried out in several parallel ways, e.g. by city rail and long-distance rail.

Railway connections to airports in Poland

In the recent years, the growth rate of air transport in Poland is high and reaches the value of over a dozen per year. Statistically, one inhabitant takes 1.07 flights per year. This rate is still lower than in Western Europe. In 2017, Polish airports served 40.1 million passengers.

Currently, there are 15 airports in Poland where of 7 are directly reachable by train. In addition, there are existing plans of construction of railway connection to the following airports: Katowice Pyrzowice, Rzeszow Jasionka i Lodz Lublinek.



Fig. 2. Localisation of airports in Poland

The first rail – airport connection in Poland was a line between Cracow Balice airport and Cracow centre. This connection was provided with the use of the former military siding leading to the fuel depot. The line launched in 2006 was initially operated with diesel motor units but the rapidly growing number of passengers contributed to an upgrade the line (construction of the second track and electrification, LK 118 – 10.8 km). The success of the line is caused by the popularity of Cracow among tourists. The number of passengers using the Balice airport is growing faster than expected.

Warsaw was the second city in Poland with a rail – airport link. For this purpose a short section of the 1853 m long line to the Chopin airport was built, the majority in the tunnel (1183 m) from the existing LK 8 Warsaw-Radom line (at the same time the section from the station was modernized) Warsaw West to Warsaw Służewiec station).

A direct impulse for the construction of the line was the EURO 2012 football championships organized in Poland and Ukraine. At the same time, the Modlin civil airport (in the same year) was commissioned, i.e. the rebuilt military airport serving as an additional airport for the Chopin airport. The problem remains unchanged, due to the lack of a direct railway line leading to it, the need to travel by bus from PKP Nowy Dwor Mazowiecki Modlin station on the main route Warsaw-Gdansk (LK 9) to the airport terminal (currently there

Tab. 1. Airport with railway connection in Poland

Airport	Passengers [mln]	Distance from city centre [km]	Date opening	Travel time [min]
Warsaw Chopin	15.8	12.5	2012	23
Warsaw Modlin	2.9	49.0	2012	55
Cracow Balice	5.8	10.8	2006	19
Gdansk Rębiechowo	4.6	16.1	2015	30
Lublin	0.4	13.3	2012	15
Szczecin Goleniów	0.6	42.0	2013	48
Olsztyn Szymany	0.1	54.8	2016	56

Source: own study.



Fig. 3. Railway service of Cracow Balice Airport. T. Bużalek

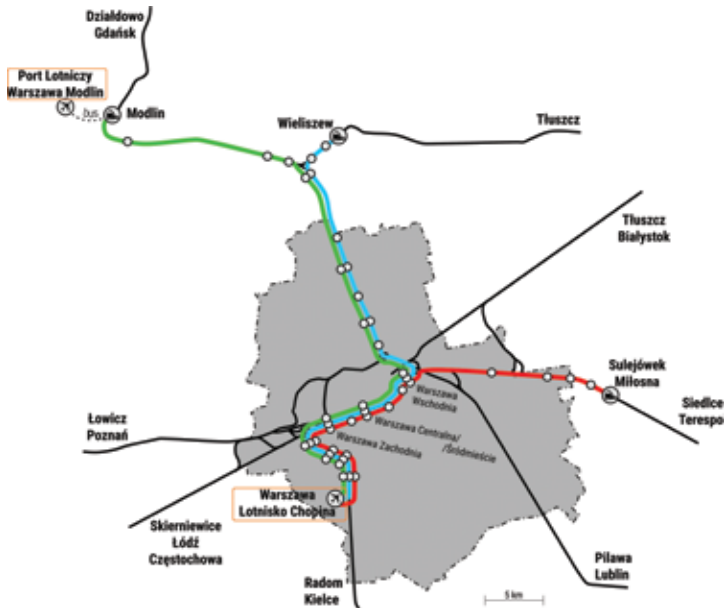


Fig. 4. Railway service of Warsaw Chopin Airport. T. Bużalek

is no decision to build a railway line to Modlin). Three city rail lines are used in communication from Warsaw Okęcie Airport: to Sulejówek, Wieliszew and Modlin.

Another city in Poland – Gdansk received a railway connection with the nearby civil airport in Rebiechowo as a part of the Pomeranian Metropolitan Railway, i.e. construction of a new line from the Gdansk–Wrzeszcz station towards the west and connections with the existing line (LK 201). The success of the line service is caused by relatively large (as per Polish conditions) number of passengers checked in Rebiechów, as well as the location of the Gdansk-city dormitory along the PKM line, which generates additional passenger flows. The airport is served by three train lines connecting not only with Gdansk and Gdynia but also with Kartuzy.

As the construction of railway connections to the airports in Warsaw, Gdansk or Cracow proved to be successful, those to Lublin, Olsztyn and Szczecin, which are also smaller urban centers, brought much lower effects. Their common point was the

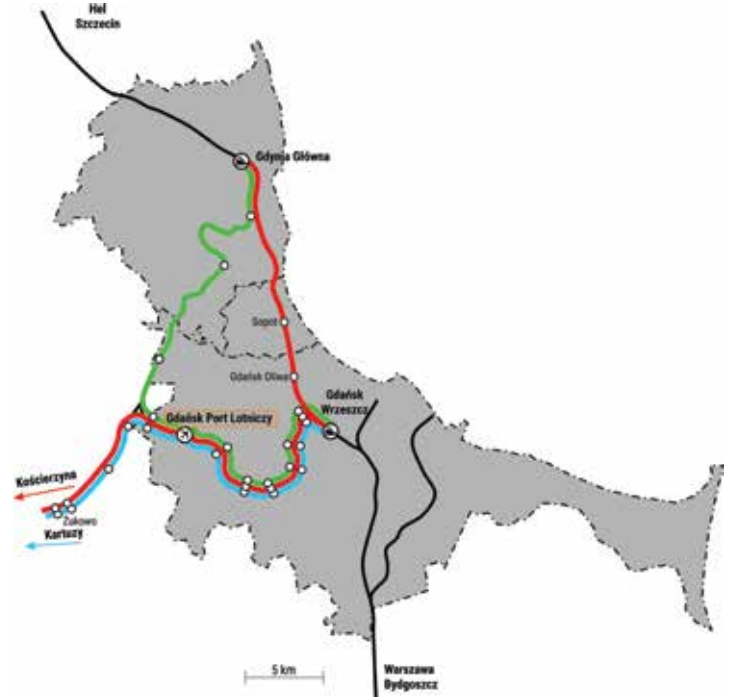


Fig. 5. Railway service of Gdansk Airport. T. Bużalek

construction of short sections (less than 3 km) from existing lines, often combined with their modernization and the construction of a new railway station at the airport from scratch. However, relatively small air traffic, as well as the proximity of Warsaw (for Lublin and Olsztyn) or Berlin (for Szczecin), where there are much larger airports (including a higher number of destinations), makes the success of airport lines in the agglomerations of Lublin, Olsztyn and Szczecin rather moderate. In the case of the airport in Olsztyn, the travel time by train to Warsaw is attractive (about 2.5 hours), which further reduces the attractiveness of the Szymany airport (a similar phenomenon is likely to occur for Lublin after finishing the modernization of LK 7 Warsaw–Lublin in 2021).



Station Gdansk Airport. Photo R. Stankiewicz





Station Lublin Airport. Photo M. Graff

Central Transport Hub and its operating condition by rail

The providing servicing of the planned new airport between Warsaw and Łódź is a major logistical challenge. According to the plans, it is going to serve up to 50 million passengers per a year (in the first stage). The use of rail transport is required for the efficient operation of such large airports. The analyze of share of particular means of transport in communizing to the large airports in Europe, suggests that railway transport would have a share in serving the new Polish port up to 30% of all passengers checked on it. In order to achieve this, it is required to adopt effective solutions in its transport service.



Fig. 6. Railway service of Lublin Airport. T. Bużalek

According to the preliminary forecast, 15 million travelers who will arrive by rail to the airport, about 10 million out of them will be travelers heading for the destinations inside of the province. Mazowieckie and Łódź, and about 5 million travelers from other regions of the country [7, 1]. The decision on the location of a new airport near Grodzisk Mazowiecki city is very advantageous from the point of view of its communication service. If possible, the existing well-developed railway and road infrastructure and documentation prepared for the planned high-speed lines Warsaw-Łódź-Poznan/Wrocław is going to be used. It will also be included in the main corridors of the TEN-T network. The new airport will be integrated with railway systems, both regional around Warsaw and Lodz and long-distance service.

The planned high speed lines give possibility to access to the new airport:

- ◆ in less than 1,5 hour from main Polish agglomeration,
- ◆ in less than 3 hours for the most of citizens across Poland.

The airport will be located in the area designated in the feasibility studies in 2009, branch of the Central Railway Line in the direction of Katowice and Cracow. In the future, the construction of the extension of the CMK line towards Gdansk and Bydgoszcz may also be implemented. Planned in the 1970s., the geometric parameters of these lines enable trains to operate at speeds up to 350 km/h and for CMK up to 300 km/h. North of the assumed location of CPK runs line 3 from Warsaw to Poznan and south line No. 1 to Katowice and Łódź. Both lines are already serviced by passenger, long-distance and local trains at speeds up to 160 km/h. Thanks to this configuration of the railway network in the vicinity of the port it will be possible to provide its universal service for several types of trains:

- 1) High speed trains in the direction of western and southern Poland - high line param-

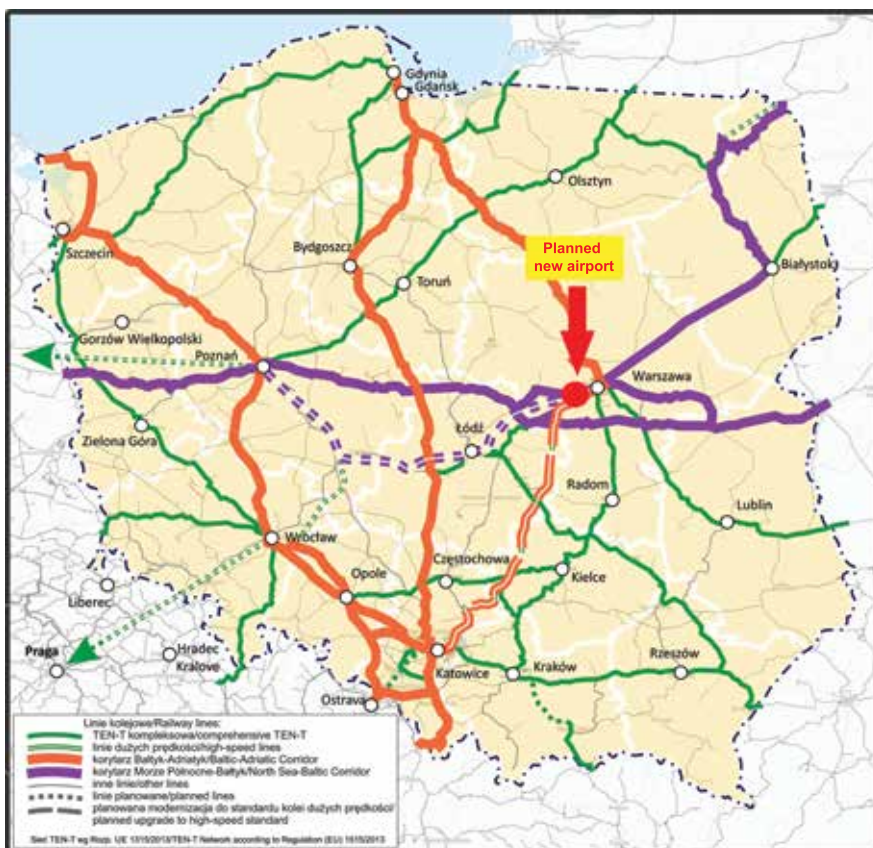


Fig. 7. Planned Central Airport in TEN-T. T. Bużalek

eters enable the use of typical rolling stock with maximum speeds of 300–350 km/h;

- 2) Inter-regional, conventional trains running on lines 1 and 3 with entry to the station servicing the airport; can be operated with standard conventional rolling stock of up to 160 km/h.
- 3) local trains serving the towns of the province mazowieckie and łódzkie – a typical rolling stock of regional or agglomeration construction can be used with the use of facilities for passengers with large luggage.

Due to the relatively large distance of the planned airport from the center of Warsaw, it will be advisable to launch a quick direct express connections using high-speed lines. Due to the large, projected in the feasibility studies, the load of this line with high-speed trains, and in order not to limit its capacity, express trains to the airport should have a high maximum speed similar to the other trains on this line, ie up to 250 km/h. Due to the fact that the high-speed line will be electrified by the voltage of 25 kV 50 Hz, the new rolling stock, in addition to the possibility of supplying 3 kV DC in the Warsaw node, should also be adapted to supply such a voltage. The construction and equipment of this rolling stock can be modeled on the foreign solutions already presented in the article.

References

1. Baca B., Bańczyk M., Drop W., Domagalski M., Gościński S., Konopiński M., Lis T., Opowicz M., Pomykała A., Raczyński J., Rekowski M., Szarata A., Wesołowski I., Wesołowski J., *Warunki realizacji przedsięwzięcia systemowego – Uruchomienie Centralnego Portu Komunikacyjnego wraz z towarzyszącą infrastrukturą biznesową*. Instytut Sobieskiego 2017.
2. Dyr T., Pomykała A., *Plan inwestycji strategicznych dla Europy*, „Technika Transportu Szybnego” 2015, nr 1–2.
3. Dyr T., *Strategia rozwoju transeuropejskiej sieci transportowej*, „Technika Transportu Szybnego” 2012, nr 1–2.
4. Graff M., Pomykała A., Raczyński J., *Tabor kolejowy dla obsługi portów lotniczych*, „Technika Transportu Szybnego” 2018, nr 1-2/.
5. Ilik J., Pomykała A., *Rapid Services – The Czech High-Speed Rail Project for Central Europe*. 13th International Conference Modern Electrified Transport, Warsaw, 5–7.10.2017.
6. Pomykała A., *Linia dużej prędkości Rail Baltica w aspekcie rozwoju połączeń kolejowych w Europie Centralnej*. „Technika Transportu Szybnego” 2017, nr 11.
7. Pomykała A., *Uwarunkowania obsługi Centralnego Portu Komunikacyjnego przez transport kolejowy*, „Technika Transportu Szybnego” 2017, nr 9.
8. Wesołowski J., *Integracja lotnisk z kolejami dużych prędkości*, „Technika Transportu Szybnego” 2017, nr 9.
9. Żurkowski A., *Duże prędkości – UIC, Polska*, „Technika Transportu Szybnego”, 2005, No. 5–6.

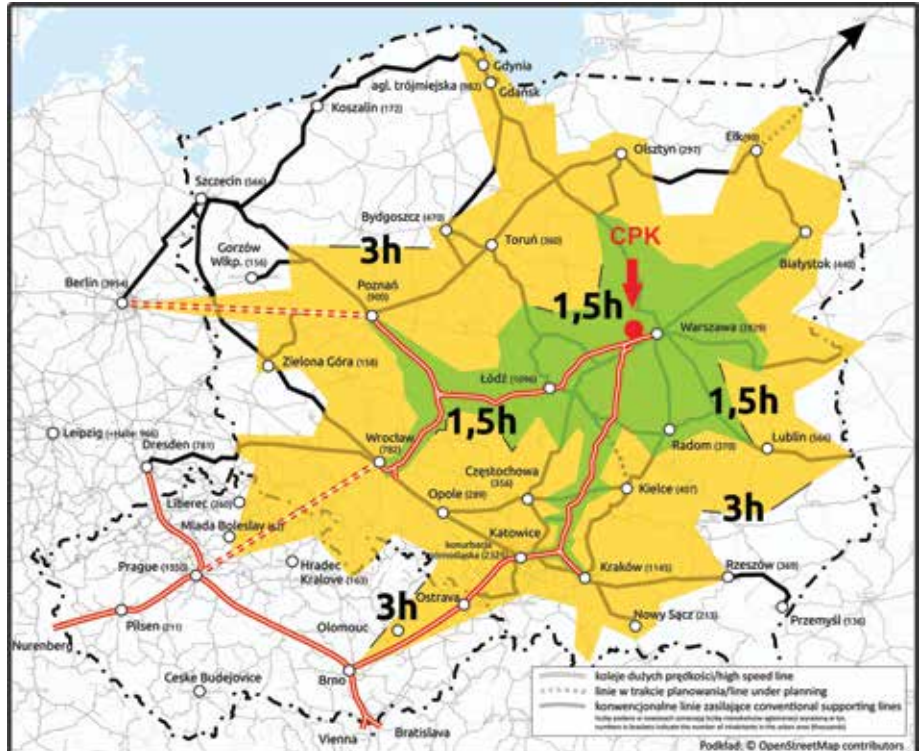


Fig. 8. Preliminary isochrone of travel time from Warsaw after construction of high speed lines



Fig. 9. Communication environment of the new airport near Warsaw and the potential for its service by rail. T. Tomasz Buzałek



Jan Raczyński

Jan Raczyński from 2014 Project Manager for Strategic and Research in Railway Institute in Warsaw.

From 2011 Member of Intercity & High Speed Committee in UIC From 2005 Speaker and deputy speaker in European Railway Agency designated by CER.

In 2001-2009 Project manager for development of rolling stock and interoperability in PKP CARGO. In 2009-2011 Director of High Speed Department in PKP PLK S.A.

In 2011-2014 Director responsible for strategy and development including rolling stock and interoperability in PKP Intercity.



Marek Graff

Marek Graff is co-worker of the newspapers „Transport, Technology, Systems” since 2007 and Swiat Kolei since 2004. He is author and co-author circa 150 articles about the high-speed railway, metro, trams and a conventional railway.