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## FUNCTIONING OF SELECTED AIRPORTS IN POLAND

**Summary.** Nowadays, air transport is treated as a dynamically developing sector of the world economy. The technological solutions used in this kind of transport are highly advanced; thus, generate high costs, ranging from research through production to the implementation phase. Due to its technological advancement, air transport has several significant advantages over other kinds of transport. This paper presents the characteristics of selected airports in Poland together with statistical data characterising the functioning of the airports. In addition, the plans in recent years regarding the development of air transport infrastructure in Poland were summarised.

**Keywords:** transportation, air transport, civil engineering and transportation

### 1. INTRODUCTION

Air transport is the fastest and safest kind of transport for people and goods in the world. The importance of air transport on a global scale is constantly growing. The increase in the share of this kind of transport is majorly responsible for the development trends and intensification of international economic relations, as well as for the use of foreign investment capital and the generation of a high percentage in the tourism sector. A characteristic feature of air transport is the concentration of airports mainly around larger agglomerations with large

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population centres. The most famous and largest airports, in the case of Poland, are located near large metropolises such as Warsaw, Katowice and Poznań [3].

Air transport and its related market are presently treated as a dynamically developing branch of the world economy. The technological solutions used in this kind of transport are highly advanced; thus, generate high costs, ranging from research through production to the implementation phase. Due to its technological advancement, air transport has several significant advantages over other kinds of transport. Hence, many studies can be found on the subject in the scientific literature, both detailed and directly related to air transport, including the requirements related to this form of transport of people and goods, for example [2, 6-8, 12-14, 18, 20, 21], as well as concerning air transport as an element of the country's logistic system [1, 4, 9, 10, 15, 17]. Moreover, the outbreak of an epidemic related to the SARS-CoV-2 virus, which causes an infectious disease of the respiratory system – COVID-19, negatively impacted all sectors of the economy, including air transport, as reflected in numerous scientific works [16, 19].

This paper presents the characteristics of selected airports in Poland together with statistical data characterising the functioning of the airports. In addition, the plans in recent years regarding the development of air transport infrastructure in Poland were summarised.

## 2. CHARACTERISTICS OF SELECTED AIRPORTS IN POLAND

Discussing infrastructural issues in the air sector in Poland, one should start with the oldest airport in Poland, that is, the Fryderyk Chopin International Airport in Warsaw. The Frederic Chopin International Airport in Warsaw is the central and largest airport in Poland, located approximately 10 km southwest of the centre of the capital city. According to data [22], Fryderyk Chopin International Airport in Warsaw was put into use in April 1934. The first users of the airport were the LOT Polish Airlines and the first Polish Air Force Regiment. In the first year of its operation, the airport handled over ten thousand passengers. The significant development of passenger aviation in the second half of the 20<sup>th</sup> century contributed to the expansion of the airport to its present form. Currently, the manager of F. Chopin International Airport in Warsaw is the "Polish Airports" State Enterprise, and the estimated airport capacity is determined at the level of 20 million passengers per year.

The second loaded airport in Poland is the John Paul II International Airport Krakow-Balice. However, this facility is only the sixth largest airport in Poland in terms of usable space. According to [5], its area is over 310 ha. The John Paul II International Airport Krakow-Balice was put into operation in 1964. The current capacity of the airport is about 8 million passengers. In addition, another airport, the L. Wałęsa International Airport in Gdańsk, was opened in 1974, its capacity is slightly over 7 million passengers per year.

Another International Airport of key importance for Poland is the Katowice Pyrzowice International Airport, commissioned in 1966, located 45 km north of Katowice. In terms of area, it is one of the largest airports in Poland, with an area of 500 ha. Nonetheless, due to its infrastructure limitations, its capacity is only 4 million passengers per year, and according to statistical data from 2017, it has already used almost 100% of its capacity. According to [11], the airport's capacity is 32 landing or 15 take-off operations per hour. Moreover, 13 million people live within 100 km of the airport. According to statistical data, the number of passengers handled by the airport in 2017 was 3.877 million people.

Alternatively, one of the most modern airports in Poland is the Warsaw-Modlin airport located in Nowy Dwór Mazowiecki, which was put into service in 2012. The estimated capacity of the airport is 3.5 million passengers per year. The area of the airport is approximately 290 ha, and further expansion is planned. In 2017, 17,279 flights were made there, with 2.9 million passengers handled.

The M. Kopernik International Airport in Wrocław is located 10 km west of the city centre in the Strachowice district, with an area of 472 ha and was commissioned in 1945. According to [25], the M. Kopernik International Airport in Wrocław is capable of servicing approximately 3.2 million passengers annually in domestic and international traffic. The airport is equipped with a second-class ILS system. This is a radio navigation system designed to assist aircraft in landing in poor visibility. This airport ranks fourth in Poland in terms of the number of passengers served annually. Travellers consider the M. Kopernik International Airport in Wrocław as the most passenger-friendly airport in Poland. In 2017, 22,899 passenger flights were performed at the airport, with 2.8 million passengers. Also in 1945, the H. Wieniawski International Airport in Poznań (Ławica) was put into use. Its area is approximately 310 ha, and its capacity is 3 million passengers per year. With a slightly lower airport capacity than the H. Wieniawski International Airport in Poznań, the W. Reymonta International Airport in Łódź (Lublinek) can handle about 2 million passengers per year. Due to the small number of air connections, this airport usually does not use its full potential.

In turn, the airport in Jasionka near Rzeszów has an area of 459 ha, was put into service in 1941, and can handle 1.8 million passengers per year. Compared to the airport in Łódź, its capacity is slightly lower.

The football world championships organised in Poland and Ukraine in 2012 contributed to the development of the transport infrastructure, including the aviation infrastructure. In addition to the expansion and modernisation of several airports, new airports were also created, for example, the Lublin airport, located in Świdnik, put into service in 2012, with an area of 300 ha, and an airport capacity of 1 million passengers per year. In 2017, this airport handled over 429,000 passengers who used 3,249 domestic and international connections. A slightly newer airport is the Olsztyn Mazury Airport, which was put into use in 2016 with an area of 462 ha. Its capacity is slightly greater than that of the Lublin airport and amounts to 1.2 million passengers. In 2017, this airport handled over 101,000 passengers, these were usually international flights, as the airlines serving routes in the country gave up landing there. The last important airport from the viewpoint of analysis of the aviation infrastructure in Poland is the Szczecin-Goleniów Airport, opened in 1967, with an area of 300 ha and a capacity of just over 1 million passengers per year. Located in the Goleniów commune, in 2017, this airport served over 578,000 passengers.

The growing importance of air transport is conducive to the expansion of individual airports, as some of them achieve increasingly higher capacity values that are similar to their annual capacity, thus, necessitating the construction of new airports. Thus, to ensure an adequate supply of air services, as well as to obtain the largest possible number of permanent domestic and international connections offered by financially and organisationally stable carriers, airports should be adapted to the ever-increasing requirements of the customers. Investments carried out at many airports in Poland contribute to the comfort of travellers and facilitate the work of complex organisational structures of the airport, which require extraordinary precision during the working day. The development of aviation infrastructure translates into an increase in the number of air connections. In addition, a significant reduction in air transport costs favours the popularisation of travelling by this means of transport, which with the high accident rates typical of other forms of transport, makes this form of transport even more attractive.

## 2.1. Fryderyk Chopin International Airport in Warsaw

The Fryderyk Chopin International Airport in Warsaw is the fastest growing airport in Europe and ranks third in terms of the increase in the number of passengers served. It is also a central transfer point in Central and Eastern Europe. The dynamics of the airport's operation increases every year. The only limitation in its development is the dense buildings adjacent to it, which limits the further expansion of the airport area, therefore, requiring the expansion of the airport in Radom. Figure 1 shows the number of passengers handled in domestic, international and charter traffic in 2016-2019 via the Fryderyk Chopin International Airport in Warsaw.

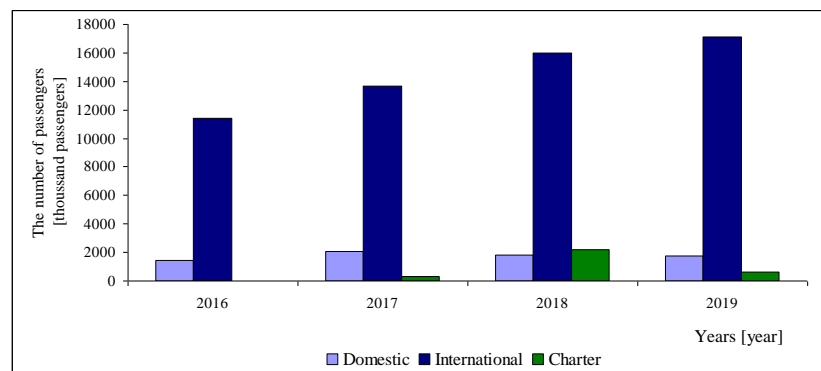


Fig. 1. The number of passengers handled in domestic, international and charter traffic by the Fryderyk Chopin International Airport in Warsaw in 2016-2019

Source: author's research based on data presented in [22]

In Figure 1, large discrepancies can be seen between the number of registered passengers on international and charter flights. The largest number of passengers travelled in 2019, this number exceeded 17 million passengers, which is slightly more than 1 million passengers more than in 2018. In the following years, the number of travellers systematically dropped. Due to the increased frequency of flights by LOT Polish Airlines on the routes Warsaw-Kraków, Warsaw-Gdańsk, Warsaw-Wrocław, Warsaw-Rzeszów and the launch of new destinations such as Zielona Góra and Lublin, travellers increasingly used domestic flights. In the case of passengers travelling on charter flights, the largest increase in the number of passengers took place in 2018, amounting to 2.2 million.

Situated at the F. Chopin International Airport in Warsaw, is the largest cargo terminal in Poland, operating cargo and courier services. The main carriers involved in cargo transport include LOT Polish Airlines, UPS Airlines, European Air Transport, Emirates, TNT Airways [23]. This airport currently handles over seventy percent of cargo traffic in Poland. In Figure 2, data on the volume of cargo and courier items for 2016-2019 are presented.

In Figure 3, scheduled carriers operating at the F. Chopin International Airport in Warsaw in 2018 are presented. LOT Polish Airlines performs the most flights on domestic and international routes. This is followed by WizzAir, which belongs to the group of "low-cost" carriers. This carrier is very popular in Poland. The F. Chopin International Airport in Warsaw is the largest transfer airport in Poland. Statistical data on the functioning of the F. Chopin International Airport in Warsaw allows one to state that the number of passengers using the airport is constantly growing.

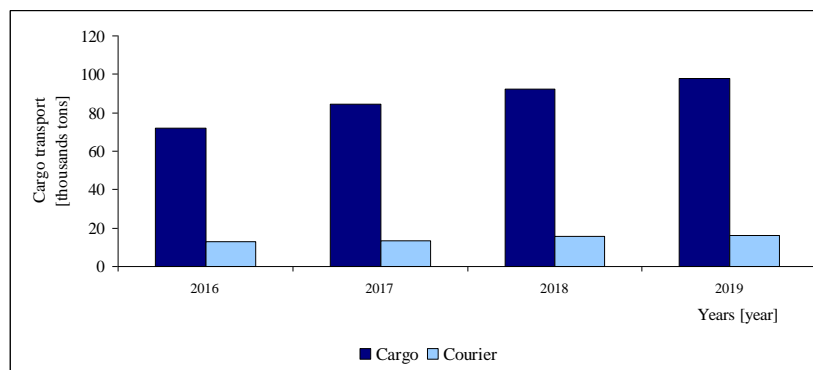


Fig. 2. Cargo transport in F. Chopin International Airport in Warsaw in 2016-2019  
Source: author's research based on data presented in [22]

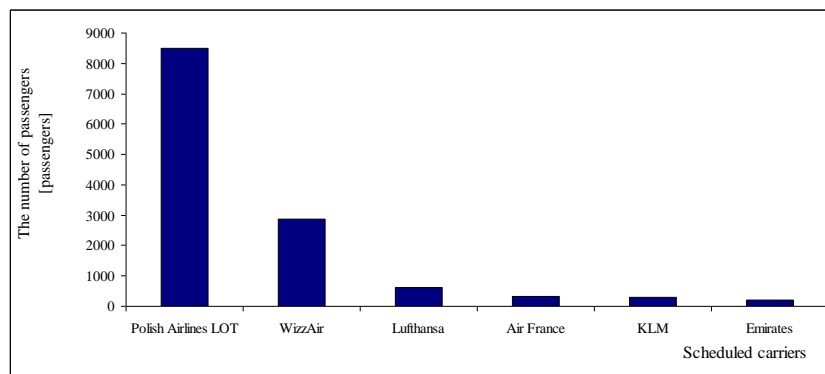


Fig. 3. Scheduled carriers operating at F. Chopin International Airport in Warsaw in 2018  
Source: author's research based on data presented in [22]

## 2.2. Katowice Pyrzowice International Airport

The Katowice Pyrzowice International Airport provides the largest number of charter connections compared to other airports in Poland. The airport serves passengers from neighbouring voivodeships with the Silesian voivodeship as well, for example, from the Opolskie, Małopolskie, Łódzkie voivodeships, and even the inhabitants of Ostrava (Czech Republic). The advantage of the airport is its location as it is the highest located airport in Poland, which often translates into very good conditions for landing and taking off, which is why this airport is often called an alternate airport, for example, for Krakow. The Katowice Pyrzowice International Airport performs flight operations almost 24 hours a day (unlike, among others, the Fryderyk Chopin International Airport in Warsaw, where there is a night break between 23:30 and 5:30). Figure 4 presents the number of passengers handled at the airport in regular and charter traffic in 2016-2019. Over the four years, the number of passengers gradually increased, which is undoubtedly influenced by the continuous modernisation of the airport and providing passengers with conditions enabling comfortable travel. In the analysed period, the number of passengers on charter flights grew and approached the number of passengers served on regular flights. In 2019, more than 2 million passengers on charter flights were handled at the airport, which is a much larger number compared to other airports in Poland. The most popular destinations for charter flights in the Katowice Pyrzowice International Airport in 2019 are Greece, Turkey, Bulgaria, Spain and Egypt.

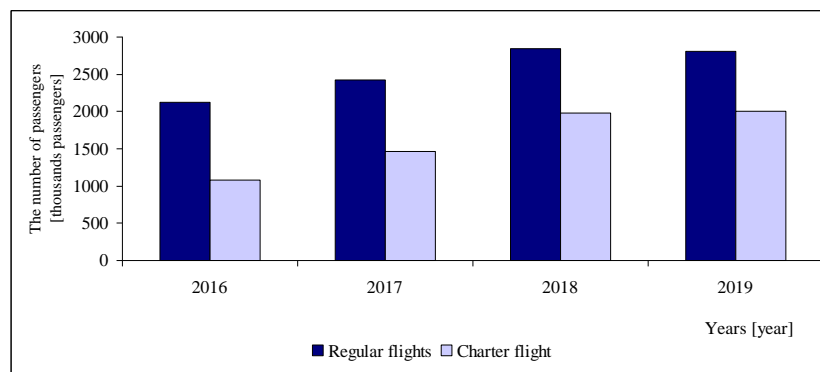


Fig. 4. The number of passengers served in regular and charter traffic at the Katowice Pyrzowice International Airport in 2016-2019

Source: author's research based on data presented in [11]

In Katowice Pyrzowice International Airport, cargo is also transported (Figure 5). The location of the cargo terminal with an area of 11,800 m<sup>2</sup> and a warehouse space of 9,800 m<sup>2</sup> in the Katowice Pyrzowice International Airport allows for its continuous modernisation and expansion. The most frequently handled shipping destinations are Leipzig / Halle by DHL, Cologne / Bonn by UPS, Paris by FedEx, as well as Timisoara and Warsaw by TNT.

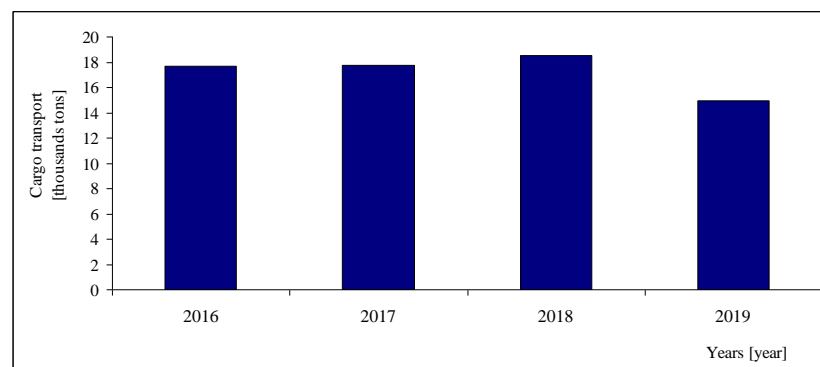


Fig. 5. The cargo transport at Katowice Pyrzowice International Airport in 2016-2019

Source: author's research based on data presented in [11]

### 2.3. Mikołaja Kopernika International Airport in Wrocław

The M. Kopernika International Airport in Wrocław handles regular and charter flights, the number of which is growing annually (Figure 6). Until 2015, this airport was the base for EuroLot. Furthermore, it has been the 47th base for Ryanair since 2012.

On the other hand, cargo transport in M. Kopernika International Airport in Wrocław is performed in the terminal, where there are, among others, domestic warehouse, customs warehouse, bonded warehouse, cold store, radioactive material storage room, and ramps. In addition, this terminal offers the possibility of high storage and is equipped with other specialised devices, including devices installed at the request of cooperating companies. In Figure 7, data on the volume of cargo transport at the M. Kopernika International Airport in Wrocław in 2016-2019 are presented. This airport is the loading and unloading base of the US AIR Force.

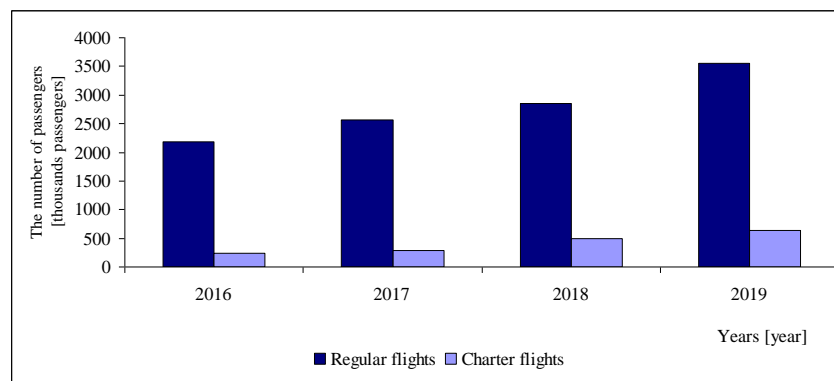


Fig. 6. The number of passengers served in regular and charter traffic in M. Kopernika International Airport in Wrocław in 2016-2019  
Source: author's research based on data presented in [24]

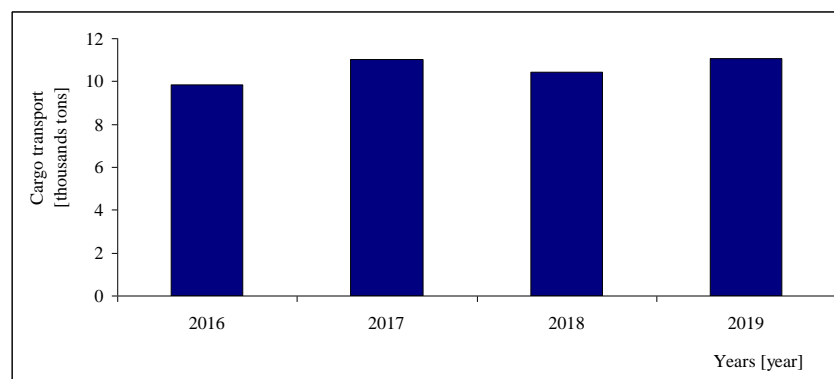


Fig. 7. Cargo transport at M. Kopernika International Airport in Wrocław in 2016-2019  
Source: author's research based on the data presented in [25]

### 3. PLANS FOR THE DEVELOPMENT OF AIR TRANSPORT INFRASTRUCTURE IN POLAND

The National Strategy for Sustainable Transport Development in Poland until 2030 [6], presents the plans for the construction of the Central Communication Port (CCP), which is the most important infrastructure investment over the last century in Poland. The transfer airport is to be located between Warsaw and Łódź in the central point of Poland and will be designed to integrate air, rail and road kind of transport. Along with the investments in the construction of CCP, the development of road and rail infrastructure is planned, which will allow the largest Polish cities to be connected with the CCP up to a maximum of 2.5 hours of driving. The CCP is will be built on an area of 3,000 ha with a capacity of around 45 million passengers per year. The plans contained in the strategic documents assume the opening of the airport by the end of 2027. The transfer of the central airport from Warsaw to Radom (so far, it is considered to be the F. Chopin International Airport in Warsaw) seems to be a reasonable and natural action considering the existing restrictions related to the F. Chopin International Airport in Warsaw. Due to environmental requirements, as well as the proximity of the motorway, it is not possible to extend the F. Chopin International Airport in Warsaw for another runway and necessary

infrastructure elements to operate it. Hence, it is very difficult to further increase its capacity of 20 million passengers per year.

The central agglomeration in the capital city, the proximity of two airports and the construction of the CCP would contribute to the reorganisation of the air transport system in Poland and the pursuit of imposing a transfer policy with a stop in Poland on numerous airlines that are already operational in the Polish aviation sector. However, due to the very distant and relatively difficult to implement tasks in the field of infrastructural investments of this scale, focus on introducing ad hoc solutions would rather be suggested. When planning activities in the field of air transport in Poland, it should primarily be noted that the F. Chopin International Airport in Warsaw should play the role of a small hub, at least for the neighbouring countries of Poland and those travelling from the Far East. The nearby Warsaw-Modlin airport should be its indispensable supplement if it exceeds its real capacity.

#### 4. CONCLUSIONS

Upward trends in the air transport market in Poland suggests that investments in this kind of transport may bring real benefits in the form of the country's economic growth. Moreover, the development of infrastructure and investments in research and technological innovations in the air transport sector may bring about a further reduction of costs of air transfers, favouring the popularisation of this type of transport.

The low-cost airlines are a threat to the Polish air transport market, especially to LOT Polish Airlines, which, due to their accelerated development and faster modernisation of their air fleet, are competing with LOT Polish Airlines in terms of service standards for popular European routes. The existing share of LOT Polish Airlines in the broadly understood aviation market has not significantly decreased. However, it should be noted that the remaining part of the market is highly diversified; therefore, the supply of services with similar characteristics is increasing. Hence, LOT Polish Airlines must respond optimally to the threats and other elements, directly and indirectly, influencing the situation in the aviation sector.

Technological solutions implemented in aircraft with increasing efficiency are aimed at increasing the possibility of travelling on one fuel tank, mainly by limiting its use. Moreover, the aim is to introduce aircraft with higher transport capabilities, especially in the traffic of civil passenger flights, where solutions of the Airbus model aircraft are becoming the norm. Moreover, the efficiency of the operation of control towers, GPS systems and other auxiliary tools in passenger flights has to be further developed due to the increasing number of air traffic participants.

The statistical data cited in this paper indicates that the leading airport in Poland in terms of the number of passengers handled is the F. Chopin International Airport in Warsaw, which from year to year serves an increasing number of passengers. According to the data provided by the Civil Aviation Authority, the capacity of the F. Chopin International Airport in Warsaw is 20 million passengers per year, already in 2018, the number of passengers served by the airport amounted to 17.7 million.



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