

## **AIRPORTS LOCATION PROBLEMS FOR WARSAW METROPOLIS**

### **Introduction**

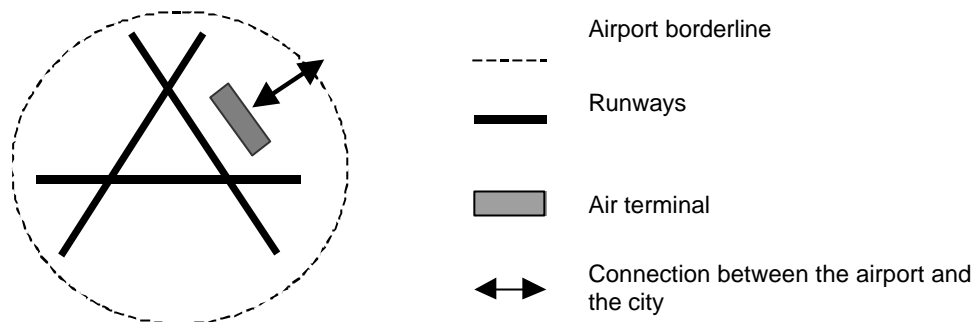
An airport is one of the main elements of the transportation infrastructure playing a vital role in managing a metropolitan area. In case of the metropolitan area of Warsaw, the history of airports development is quite rich. The most interesting are problems related to location of airports in this area. It refers not only to the airports that were constructed but also to those the construction of which was planned. These locations were analysed taking into account multiple variants.

The history of airport locations for civil purposes in the Warsaw metropolitan area can be divided into three main periods: before the Second World War, the 70's and the current period. The first airport location servicing Warsaw was the first airfield at Pola Mokotowskie. It commenced operating before the First World War. In the process of searching for a new airport location four airport sites were examined before the Second World War. In 1972 five airport locations were taken into account. At present, i.e. in 2004, seven airport sites are being analysed. Thus, in the period of almost a century, fifteen airport sites have been considered. Also the choice criteria for airport locations have been subject to changes. This presentation provides a description of these changes. For this purpose three airport locations conventionally defined as 1934, 1972, and 2004 will be presented. All analysed airport locations for these three periods, as well as the first location of the Warsaw airport, will be presented on the map of the metropolitan area.

### **1934 location**

Aviation activities commenced in Warsaw before the First World War were located in the area called Pola Mokotowskie, 3 km from the city centre. This site could not provide stable conditions for airport operations because the distance from municipal buildings was too small. Thus, as early as in the 30's the search for a new airport site was initiated. Four options were examined: Bemowo, Bielany, Goclaw, Okecie<sup>1</sup>. Out of these the Okecie option was chosen. In 1934 a modern transportation airport with three runways situated in a shape of a triangle was opened. The scheme of this airport is presented at Fig.1. The Okecie Airport is located 8 km from the city centre. It still fulfils its function of the main Warsaw airport. Its present capacity is estimated at the level of 10 million passengers per year. However, it services 5 million passengers annually. The other locations in question were used for military and sport aviation activities. At present these airports' sites are used for municipal development. The average distance from the Warsaw city centre for four analysed locations was 6 km. From the historical point of view, airport sites located close to city centers have always presented an attractive municipal development grounds for town planners. As a result of cities' territorial expansion airport sites are continuously absorbed for municipal development. This process can be observed in all major cities all over the world. Also in Polish major cities, grounds occupied by airports situated close to their centres have been absorbed by municipal developments.

**Fig.1. Scheme of the Warsaw airport –Okecie in 1934**  
Source: Own elaborated



### 1972 location

The search for a new Warsaw airport was carried out in two stages. The first stage focused on searching for grounds available for building an airport within 50 km from the city. Eleven such options were identified. In this process military airport grounds and areas were excluded. In this period, called “the Cold War”, in the area examined several military airports were located, limiting to a considerable extent the search options. The study was carried out for the eleven initially chosen locations and as a result three best airport locations were selected. The choice criteria were as follows: the distance of the airport from the city centre as well as the lack of considerable obstacles for the construction and operating of the airport. In the second stage, for the purpose of the analysis, two airport locations were included: the already existing Okecie airport and the already existing military airport in Modlin. Altogether during the second stage five location options were compared. The following airport sites were taken into account: Okecie – the existing airport, Modlin – the existing military airport, Mroków, Wrona and Zlotoklos.

A method which can be described by means of the following equation was applied for a comparative assessment of the five location options:

$$W_r = \frac{I + K}{P}$$

where:

$W_r$  - effectiveness rate of the location option, measured with the unit costs index,

$I$  - investment expenditures discounted for the year in which the investment was commenced,

$K$  - discounted operational costs,

$P$  - discounted airport traffic forecast for the same year.

In the analysis of these five location options, three airport traffic forecasts were additionally considered: min-, med-, max-, as well as four technical concepts of the airport: A, B, C, D and two variants of a discount rate: 6% and 8%. Moreover, for each option a transportation system between the airport and the city centre specific for a given airport site was taken into account.

Initial data for the above set of variables was prepared (altogether 6.9 thousand pieces of information). Both investment expenditures and operational costs increase in time, in the traffic forecast function. It was assumed that the analysis period covered 20 years. It was presumed that the increase of the airport capacity is controlled by the traffic forecast. Moreover, the operational costs were considered in two variants: including and excluding the value of the time needed to reach the airport.

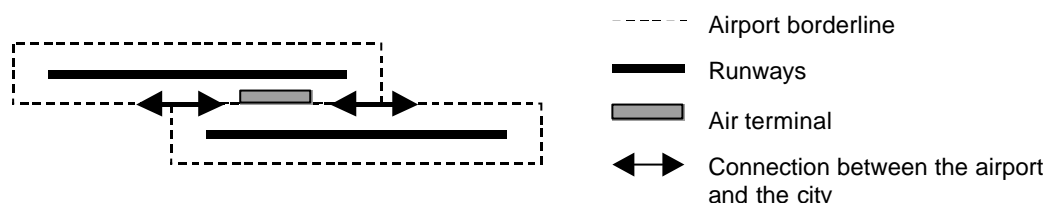
The analysis carried out showed that the lowest rates of unit costs occurred for:

- medium value of the airport traffic forecast,
- variant C of the airport technical concept,

- discount rate at 6 %,
- excluding the value of the time needed for reaching the airport.

It also indicates that the forecasted airport traffic variants, airport technical concept options, the value of the discount rate and the value of the time necessary for reaching the airport did not influence the choice of location. Out of four technical concepts the C variant was assessed as the best one. This variant had two parallel runways shifted along the axis in relation to each other. Airport buildings are located between the runways. The axes of the runways are situated in E – W direction. The scheme of the airport for the C variant is presented at Fig. 2.

**Fig. 2. Scheme of the Warsaw airport - 1972 location, option C of the technical concept**  
Source: Own elaborated

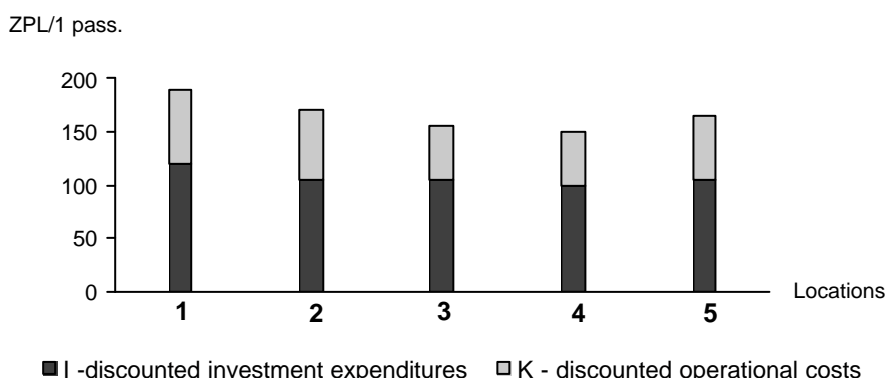


The results of the analysis indicated that the Okecie option was the best one out of 5 examined. The enlargement of the airport capacity up to the value arising out of the traffic forecast (1972) and amounting to 20 million passengers in 2000 was proposed for this option of the airport location, existing already since 1934. Simultaneously, with the view of building a new airport after the year 2000 another airport site was selected. It was Wrona location, the area of which was protected against intensive building development.

Fig. 3 presents the diversified values of the economic effectiveness rates for the airport location options. The rates were calculated for: the medium value of the traffic forecast, variant C of the airport technical concept, and 6% discount rate. (the locations numbers stand for: 1 – Wrona, 2 – Modlin, 3 – Zlotoklos, 4 – Okecie, 5 – Mroków). The maximum airport's area was estimated to cover 2400 ha. According to this analysis the best location was Okecie. As a result, a decision to enlarge the Okecie Airport was made and the area of the site in Wrona was reserved with the view of building a new airport. The average distance from the city centre for the analysed locations (except for Okecie) was 33 km. The most distant location - Wrona - is situated 45 km from Warsaw.

**Fig.3. Value of the location options rates from 1972: air traffic forecast: med.-technical concepts- option C, discount rate – 6 %, including the value of the time used for reaching the airport**

Source: Own elaborated



## 2004 location

Changes that have occurred in Poland after 1989 influenced considerably the attitude towards the issue of airports locations. The military aviation operations were ceased at several airports situated around Warsaw. As a result the city's airspace became much wider. Moreover, the environmental requirements concerning aviation activities have become greater. Since the Polish economy has opened also a considerable growth in Warsaw airport traffic has to be taken into account. Thus, the need for finding a new location for another international airport for Warsaw has emerged. It has been decided that the area reserved in 1972 for the construction of the Wrona airport does not meet the current expectations.

The choice of the new airport location out of seven possible options has been carried out in two stages. In the first stage a preliminary choice has been made, limiting the number of options to two sites. In the second stage the final choice will be made. The following airport parameters were assumed: two 4 km parallel runways separated by 2 km stretch of land. The airport's target capacity is planned at the level of 500 000 operations annually. The area of the airfield is estimated to cover 1300 ha. Moreover, it is necessary to reserve an area of 6000 ha of a land used in a limited way. It has also been assumed that there exists a possibility of a railway and motorway connection between the airport and the city of Warsaw. The scheme of the airport is similar to the scheme presented at Fig.2.

It was agreed that self-government authorities could submit proposals for potential locations. Seven possible locations were proposed: Babsk, Modlin, Mszczonów, Nowe Miasto n/Pilica, Radom, Sochaczew and Wolomin. Four of them are located at the former military airports (Modlin, Miasto n/Pilica, Radom and Sochaczew).

The criteria used for the assessment of the potential location options are the following:

- a) possibility for the new airport to be connected with Warsaw by means of a railway and motorway,
- b) favourable environmental conditions at the airport's area,
- c) airport's meteorological conditions,
- d) air traffic control conditions,
- e) the airport investment financing aspects,
- f) national defence and safety requirements.

Multi-criteria analysis was applied in the process of the preliminary choice of the airport location. Diversified numerical values were ascribed to each of the above-mentioned criterion for each location option. Then the significance of each criterion in the location was determined – weights were ascribed to a particular criterion. The ranking of airport sites is the sum of the product of each locations points for each choice criterion, by weight (share in %) of a particular criterion. The scheme of the airport location choice is presented in Table 1.

**Table 1. Scheme of the airport location choice – 2004**  
Sources: Own elaborated

Choice criteria	Points for the airport location / in the order of appearance in the text/							Weights of criteria in %
A	1	2	3	4	5	6	7	
B								
C								
D								
E								
F								
Ranking of locations: sequence I, II, III	II	I	I	III	III	II	II	S 100%

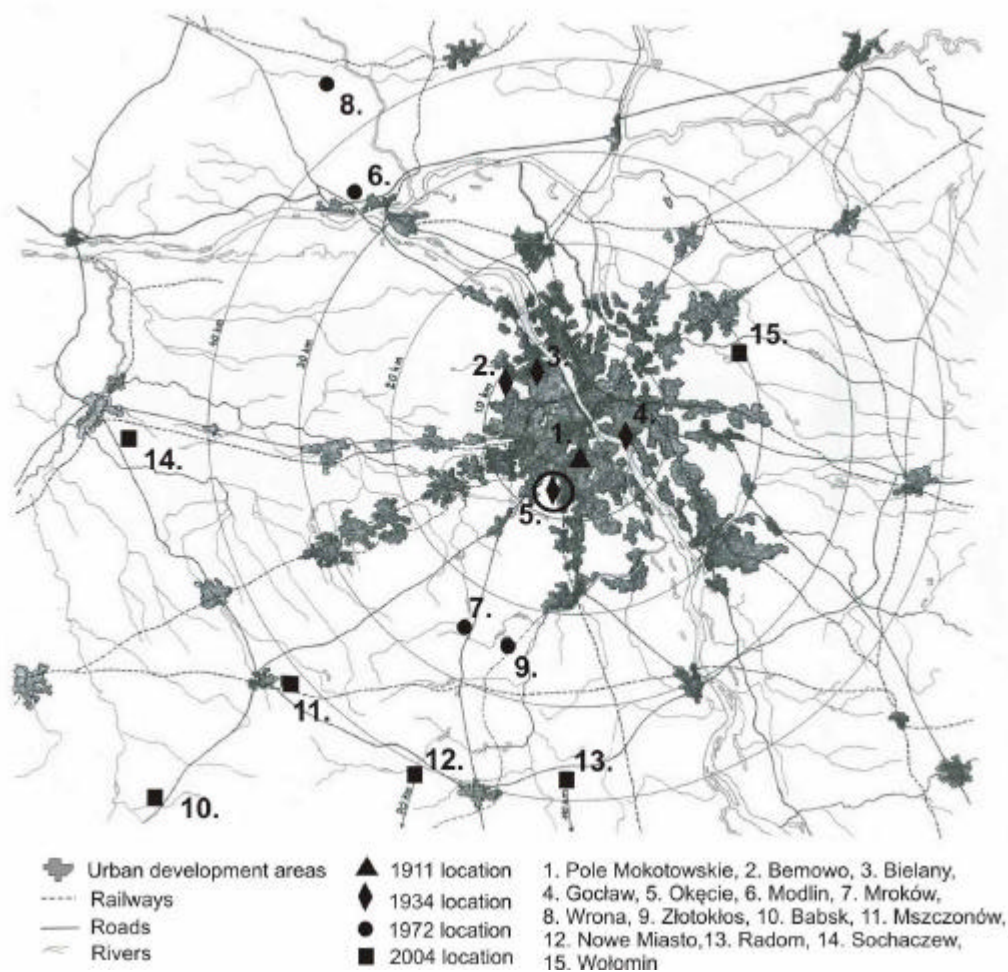
After summing up these weighted number values the particular locations were classified into the following groups;

- group I: Modlin and Mszczonów,
- group II: Babsk and Sochaczew,
- group III: Nowe Miasto at Pilica, Radom and Wolomin.

Thus, in the first stage, as the result of the preliminary choice, the number of the location options was reduced to two: Modlin and Mszczonów. In the second stage of the final choice, which is currently under way, one location out of these two will be chosen. In this choice methodological approach will be applied, similar to the approach used in the choice of airport location in 1972. The average distance of the analysed locations for Warsaw airports is 55 km. The distance of the airports chosen for the second stage of analysis is 34 km in case of Modlin and 42 km for Mszczonów.

All analysed airport locations in the Warsaw metropolitan area are presented on the enclosed map (Fig. 4) including the first location of the airport in 1911 – Pola Mokotowskie. It stopped operating in 1939. Next, four locations analysed in the 1934 period are presented, when Okęcie location was selected. Furthermore, five locations analysed in 1972 are shown (including four new ones). In addition the map shows seven locations (including six new ones) examined in 2004. Altogether fifteen various airport locations are presented on the map out of which nine were or have been used for aviation services.

Fig. 4. Location of airports in Warsaw metropolitan area  
Source: Own elaborated



## Summary

Five statements are contributed in this summary.

The first: with the time passing, the distance of the analysed airport locations from the city centre increases. In 1934 the average distance was 6 km, whereas in 1972 it was 32 km, and in 2004 – 55 km. Thus, the metropolitan area of the cities expands and the airports account for one of the main components of the urban area management.

The second: the area of the land functionally connected with the airport expands: beginning with 500 ha in 1934, to 2400 in 1974 and over 7000 ha at present.

The third: procedures of location choice are becoming more complicated and the complexity of methods used increases. The role of self- government authorities responsible for urban space planning is gaining greater importance within the framework of these procedures.

The forth: more former military airport sites are available for civil aviation services, which indicates that the significance of the airspace used for aviation operations is greater in favour of civil aviation.

The fifth: the significance of the air transport in servicing the transportation needs is growing and so is the importance of airports. Therefore, the aim is to reserve and protect against urban development metropolitan areas that are potentially suitable for aviation activities.

---

<sup>i</sup>1. Later these grounds were absorbed by Warsaw. At present these names relate to city districts.