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INTERACTION OF AIRPORTS AND LANDSIDE AREAS DEVELOPMENT

Abstract

Contemporary airports are the centers of diffusion of global technological achievements and shaping socio-economic relations. As multifunctional transport hubs, they activate the socio-economic potential of space management structures. Increased flows of people, means of transport and investments located around them strengthen the competitiveness of urban areas and their regions. Airports generate jobs and the development of prestigious activities in their environment. Large-scale structures are created around modern airports – landside areas, and they are becoming carriers of targeted development of contemporary space development structures. There are various interactions between the development of airports and related, landside zones, strengthening the development and importance of both structures. The aim of the study is to present the conditions, scope and effects of mutual developmental links between airports and areas surrounding them, including the airport in Gdansk.

Keywords: airports, landside areas, development interactions

Introduction

The development of air transport and its branch infrastructure is conducive to the transformation of spatial development. Airports stimulate urbanization processes, including agglomeration processes, and the surrounding areas change public and economic usability. Along with the increase in aviation activity, infrastructural and suprastructural development of branches develop, and in the close neighborhood of airports unique functional structures emerge, triggering the development

potential of these areas. These are landside areas, multifunctional economic centers that are characterized by:
– original spatial order,
– diversified economic structure,
– attractive investment and transport availability,
– modern forms of management,
– unlimited media availability,
– orientation for permanent and unconventional development,
– increase in the quality of management,
– development of creative competences to:
  • achieving economies of scale and creating synergies,
  • business relations,
  • partnership cooperation,
  • managing the common good,
  • strategic shaping of a common space, taking into account expectations economic entities, settlement structures and their inhabitants,
– increase in the well-being of the inhabitants of these areas.

Airports and landside areas strengthen the market potential (competitive, marketing of cities and regions, stimulate their harmonious development and effective use of shared resources). Following the example of world-wide experience, around the airports in Poland, there are trends to create landside areas. The great example is among others the regional Gdansk Lech Walesa Airport.

1. Literature overview

Space management problems are a significant and current scientific and research issue of interdisciplinary, economic and political importance. They are an object of interest for urban planners, architects, geographers, engineers and transport economists, and the number of publications in this area is clearly increasing. Legislative and industry initiatives are also undertaken, taking into account territorial and planning conditions. The authors of these studies are representatives of science, urban and architectural studios, design offices. This issue is increasingly being taken up at scientific, departmental, industry conferences, seminars or as part of research projects and studies.

The precursor of research and publications on the interdependent development of air transport, cities and regions was the American sociologist W.F. Ogburn (1886–1959). Their results for the USA, where the processes of spatial changes were proceeding at a faster pace than in Europe, were presented as follows:
– in the times of un-mechanized (sled) transport in the USA, there were 210 regions serviced in the field of trade;
– in the period of railway and car transport domination in the years 1850–1950 there were only 60 regions, but their size increased about 3.5 times and the remaining 150 central centers lost their functions;
– the next stage of transformations in spatial development in the 1950s were

the so-called regions of the aircraft, and their central centers were the largest American cities, which previously reached the number of 500 thousand residents.

Although the research effects concerned the regions of the aircraft in the period preceding the existence of air transport, it was Ogburn originally pointed to its potential significance for the development of large cities and the most important coupling of these two elements of civilization (Ogburn, 1959). The problems of interdependence of the development of air transport and space development structures, including the impact of branch infrastructure on the development of metropolitan agglomerations and world cities, was described in more detail by J.H. Schulze (1959).

The issues of development of landside areas appeared in the English-language literature at the beginning of the 21st century. The concept of *Airport City and Aerotropolis* was not accidentally initiated in the USA, the country with the most developed market of air services in the world (Kasarda, Lindsay, 2011).

The overview of the world's literature shows that American publications dominated the knowledge market in this area, but studies of authors and practitioners representing countries in which the idea of *Airport Cities* development is at the center of justified interest due to the dynamic development of these structures around national airports become more and more often available (China, Korea, the United Kingdom, Germany, the Netherlands).

In Poland publications of i.e. M. Stangel, E. Marciszewska, P. Wróbel, A. Ruciński, D. Rucińska employees of the University of Economics in Poznan, designs of architects, engineers and planners for Polish airports and *Airport Cities* around them are available. The subject area is gaining more and more research and commercial attractiveness, as evidenced by contributing scientific studies and reports and projects of effective development of landside areas.

2. Research methodology

The methodology of basic research on the impact of aviation infrastructure on space management structures including functional interactions is based on the techniques developed by the ACI (Airport Council International).

The presented study was prepared on the basis of long-term, focused studies and author's experiences. In primary research the method of direct interview, questionnaire and participant observation were used. Field studies, literary studies and the achievements of professional involvement in shaping the "Polish air reality" and the interdependence of airports with the market environment were used. A significant impact on the merits of the study were also numerous, official and behind-the-scenes discussions. Numerous views and findings in the thematic field were polarized in scientific bodies and representatives of economic practice. Detailed considerations regarding the Gdansk Lech Walesa Airport is an example of using the qualitative method of individual cases (case study) confirmed by participant observation and experience in the process of managing this enterprise.

3. The airport-a part of space management and its functions

The airport is a transport point (hub) with the city-forming and region-forming impact on the directions of spatial development and at the same time it fits into its structure. This influence is strictly territorial and procedural. It concerns the impact of airports on areas with a determined and diversified spatial scale. The basic function of an airport is a transport function, identified with the provision of air services to passengers, freight and mail (Rucińska, Ruciński, Tłoczyński, 2012).

A reflection of the city-forming function of an airport is the impact on the functioning and transformations of urbanized areas (cities, agglomerations, metropolitan settlement systems, etc.). These are areas with compact, intense buildings and population density as well as strong spatial cohesion thanks to efficient transport and communication connections. An important role in shaping the spatial connections of urban layouts lies in air transport.

The region-forming function of airports is expressed by the supralocal scope of airport connections with the open extra-urban area, diversified in terms of the structure of the settlement network, population density, development and hierarchical ordering of centers (Ruciński, 1971). The range of regional airports' markets is determined by the offer of services, network connections, transport accessibility, time of reaching the port or other competitive airports. An important role in the implementation of this function lies in the accessibility of the transport airport, which determines the attractiveness of the transport node, the immediate surroundings and the entire region. A strong growth impulse for regional spatial structures is the developed layout of transport infrastructure facilities in the region.

Spatial development structures and airports are characterized by development interactions resulting from the use of socio-production potential. Airports generate the development of the labor market, modern transport solutions, increased investment attractiveness, the increase of urban and regional assets due to increased business, tourist traffic, etc. Scientific research confirms the direct, indirect, induced and catalyzed effects of airport operations and neighboring spatial development systems, and mutual influence on strengthening development opportunities. The airport influences the lifestyle of the population through the interaction of settlement structures on the development of air transport. The attractiveness of cities in which airports are located contributes to the growth of air and tourist traffic as well as the improvement of the quality of their service. The authorities and entities operating on a local and regional scale, supporting the development of aviation infrastructure in these areas are interested in the development of airports.

4. Reorientation of the region-forming and forming-up functions of airports

In the region-forming and city-forming function of airports, evolutionary development and achieved effects are noticed. The strength and scale of their impact on the development of cities/regions increases in proportion to the degree of branch

development. Under the influence of the interaction, other spatial development structures become areas of development diffusion and poles of growth. The results of the research confirm the variable in time and space influence of airports on the development and functioning of the management structures and social behavior. The relationships described by Christaller were expressed by the influence of the newly emerging branches of transport on the increase in the size of settlement regions and the ranges of their central centers (Ruciński, 1968).

The impact of air transport in the years 1945–1970 was limited to strengthening the specialized function of cities as central centers, mainly in areas with the most intense use of them. It resulted from relatively small, mainly passenger air transport in the world and their upward trend. In 1945, 9 million people used branch services, in 1955 – 68 million, 1960 – 106 million, 1965 – 177 million and 1970 – 386 million PAX (ICAO Digest of Statistics, 2017). Since then, there has been a huge, quantitative and qualitative development of branches, measured by the number of transported passengers and cargo, new connections, services and airports. In 2014, global passenger air transport amounted to 32 billion, 2015 – about 3.5 billion, and in 2016 in 2016, the number of passengers increased to 3.6 billion, and revenues from aviation operations on a global scale amounted to approximately 142,5 billion USD (http://www.icao.int/sustainability, 2017).

In the 70s and 80s of the 20th century, interdependencies grew, but the small size of aviation activity caused interactions visible only on the examples of the largest, global agglomerations. The Japanese geographer S. Kiuchi described the world city as "... an economic, cultural and political center, whose activity is not limited to only one country, but is of an international nature" (Ruciński, 1971). From this definition follows the idea of globalization, which soon became a leitmotiv of scientific discourses and political doctrines, and in the 21st century a carrier of the integration processes of countries, societies, economies and cultures. Air transport became an unquestionable carrier of globalization, the branch that allows you to reach every part of the world within 24 hours.

Metropolitan agglomerations are centers of concentration of demand for air services. The increase in their population, well-being and the impact of specialized functions (political, administrative, industrial, transport, commercial, cultural, etc.) generate a quantitative and qualitative increase in demand and supply in line with the so-called transport postulates, relating to speed, capacity and transport capacity, range and appropriate conditions of transport, including safety. Air transport meets these demands to the highest degree, especially since the early 1960s of the 20th century, i.e. from the introduction to the mass operation of turbojet-powered airplanes – faster and cheaper to operate from means of transport of other branches. Breaking the rule: faster, but more expensive than slower but cheaper, contributed to, among others, the liquidation of world regular passenger shipping. The reorientation of the non-economic functions of airports is confirmed by:

– region-forming force of branches (from the 1960s),
– impact of the airport on the development of metropolitan agglomerations,
– the urban role of the airport [Ruciński, numerous publications from 1971–2010].

While the region-generating influence of branch on the development of space was noticed in the 1960s with relatively small air traffic of 100–200 million passengers

a year, the emergence of further development impulses required air traffic at a much higher level. It was also considered that large cities are bound by labor-intensive and capital-intensive industries requiring a highly qualified workforce and a significant share of know-how. The final products of these activities are usually characterized by high value in relation to their weight, which is a confirmation of their high paying ability, predestined for air transport. For this reason, they became the basic elements of demand for air cargo, construction of specialized rolling stock, terminals and logistics at airports. They initiated the development of a completely new, logistic function of airports. On the principle of feedback development interactions, production complexes oriented towards service and export of final products by air are created around the largest airports in the world. Also at a relatively small, regional Lech Walesa Airport in Gdansk (around 4.6 million passengers served in 2017) several companies, including IT industry, electronic, production of car parts and subassemblies, logistics and forwarding companies providing services for their service were created among others.

The development of the city-forming function of airports in the 21st century stimulates the growth of the number of employees at airports, their production environment, distance from the agglomeration centers (usually 15–45 km) and increasingly good communication conditions. The largest airports in the world and their surroundings there are tens of thousands of people employed, who often because of the need to travel long distances, cannot travel to / from work every day. Thus, they settle around ports creating dozens of thousands of settlements – cities, urban districts, housing estates that need to be equipped with efficient transport, communication, commercial, administrative, educational, cultural, medical, etc. to ensure the desired standard of living. On the principle of a multiplier effect there is an increase in the number of inhabitants of these clusters, which is a common phenomenon for large, but also smaller airports, including Poland.

It is also worth pointing out the market interaction of the city-forming and region-forming function of airports, taken into account in the development strategies and promotion policy of cities and regions, often implemented jointly by airlines, municipal and regional authorities. In the context of processes of internationalization of economies, life of societies and ever better accessibility of air services, catchment areas become important business, tourist, etc. destinations. Airports are interested in developing and servicing business needs, and tourist destinations located near them improve availability of destinations chosen by partners, generating benefits for all participants.

5. Contemporary landside areas

The development of landside areas (the so-called airport towns), the most developed in the USA, is the rule in the vicinity of large airports, but also smaller are more and more often aspiring to the targeted development of the immediate neighborhood.

The landside area is characterized by commercial buildings integrated with airports with determined economic activity, including:

– main – air (technical related to the operation or use of transport – air traffic service),
– focused on extended, economic cooperation with the airport (Güller, 2003; Stangel, 2014).

There are four groups of business entities that have strong tendencies to locate their activity in the vicinity of the airport:
– those providing air services,
– those often using air services,
– those satisfying the additional needs of passengers and employees of the two group of entities mentioned above,
– those interested in the use of infrastructure-invested areas, not necessarily interestedin using air services (Kasarda, 2010).

In the 21st century, a new business model for the development of landside areas appeared as integrated commercial units bringing additional economic benefits. The basic models for the management of the landside areas are:
– commercial development areas in the vicinity of airports,
– *Airport City*, a multi-functional commercial development complex in the immediate vicinity of the airport terminal,
– *Aerotropolis*, a functionally developed space around a radius of several dozen kilometers from the port, typical of metropolitan areas,
– *Airport Corridor*, buildings concentrated along communication routes (transport corridors) integrating the airport with the city or agglomeration thanks high transport availability and a developed public transport network,
– *Airport Region*, areas with diversified functional and development potential as part of the region-forming function of the airport,
– *Airea*, insular zones or economic facilities in the city, agglomeration, metropolis or airport region (Schlack, 2010, Schaafsma et al., 2012, from: Stangel, 2014).

In the further neighborhood, mainly in the vicinity of communication lines, companies are created, e.g. related to the Transport-Spedition-Logistics, Informatics Technology, aerospace, precision, tourism, development, banking, insurance, etc. industries. They take areas around airports, achieving economic benefits from a convenient location. Figure 1 presents a simplified scheme for the development of the landside area, referring to the concept of J. Kasarda (founder of the Aerotropolis concept) and G. Lindsay.

The area of commercial development is made up of economic objects, conducting coordinated or uncoordinated activities with aviation activities (e.g. business, logistics, industrial parks), sometimes also generating additional profits for airports from their non-aviation activities. Their locations are accidental, though sometimes they can constitute obstacles to the rational development of landside areas.

Airport City is an economically active urban space, where multifunctional commercial facilities are located, constituting a continuation of the development of non-aviation functions of the air terminal. They are generally available shopping and service complexes, business parks, conference, exhibition, fairs parks, hotels, recreational and entertainment facilities associated with the airport, integrated with a common management system.

Figure 1. Spatial and functional structure of the landside area
Source: (own study based on: https://www.internationalairportreview.com/news/22393/aerotropolis-deeper-understanding/, Accessed 14 March 2017).

Aerotropolis is a vast, urban structure, a continuation of the development of the landside area. The center of *Aerotropolis* is the *Airport City* connected by communication routes with satellite areas with industrial and business functions, handling airport needs, research and development, housing (Stangel, 2014). Thanks to the functional connections with *Airport City* and *Arrotropolis*, airports can generate additional revenues from non-aviation activities. Practice shows that they can be higher than those achieved by aviation activities. It is estimated that 1,000 passengers served at airports has an average of 0.7 m^2 of retail space, generating 3–4 times more revenue per 1 m^2 compared to local shopping centers, and related to property management – about 40% airport revenues on a global basis. In Europe this share is 30% and shows a growing tendency. In this respect, investments improving the accessibility of airports (new road, rail and unconventional connections) are important, thanks to which the locations at airports increase commercial attractiveness (DTZ, www.dtz.com).

The location of airports, usually away from city centers, makes it necessary to systematically improve their transport accessibility, and therefore to plan efficient connections, correlated with urban areas and ports' gravity markets, which corresponds to the concept of *AirPort Link* – railway connections of airports with city centers. The Institute of Railways research shows that good organization of railway connections to airports allows to reduce travel time to 50% and take over

approximately 40% of transportation traffic (Research by: The Institute of Railways, 2011/2196). According to the *International Air Rail Organization*, the concept of *AirPort Link* has been implemented in about 80 airports around the world, and it is planned for the next 230. Opportunities for development of solutions within *AirPort Link* are mainly seen in the dynamic development of air transport (increase in demand for passenger transport, number of airports, the development of the network of connections), the construction of integration nodes near railway stations, a high degree of reliability of rail transport.

Essential solutions for handling the needs of *Airport City* and *Aerotropolis* are the intermodal transport systems. Intra-industry integration in transport is essential for the effective use of existing infrastructure, reduction of congestion, external costs of transport, increased mobility of the society, formation of competitive conditions in transport and as a result improvement of environmental conditions (Laplace et al., 2004). The advantages of rail transport (mass, reliability, regularity, pro-ecological character) predestine the branch to serve the needs of airports and their economic environment. *Aerotropolis* development projects are also implemented in the PPP formula (Public-Private Partnership), which is taken into account, for example, in the project of construction of *Airport City* around the airport in Gdańsk (Ruciński, own research).

The Airport Corridor model requires concentration of the development of landside areas along communication routes between airports and city centers with a strong public transport function as well as developed commercial and residential development at bus stops or intermodal nodes. This trend of airports' impact on the development of areas directly refers to the historically established links of transport with other structures of space management.

The Airport Region model refers to functional development interactions resulting from the fact of an airport in the region. In the opinions of ARC (Airport Regions Conference) this is a political vision of thoughtful discounting of functional, infrastructural and organizational potential in the area around the airport.

The Airea model refers to a complicated situation, when in various parts of the metropolitan area, so-called "development islands", more or less related to the existence of an airport.

The presented models of areas and airports reflect the possible transformations of these areas and the interactions of the development of increasingly complex structures.

6. Landside areas in Poland – an example of the Gdansk Lech Walesa Airport

Regional Gdansk Lech Walesa Airport in its current location has been operating since 1974 and it is the only building of this branch in Poland built from scratch. During over forty years, he was subject to political, economic, proprietary and managerial changes. The airport in Gdansk is a spare airport for Warsaw and systematically increases the volume of production activity. It systematically

increases the volume of its production activity and capacity, which after putting the new Terminal 2 into use in 2018 is 5 million PAX. In total, the airport maintains more than 50 connections and many charter flights, and the most popular destinations are: London, Warsaw, Oslo, Stockholm and Munich. Table 1 presents data on air traffic at Gdansk Lech Walesa Airport in 2008–2017.

Table 1. Air traffic in Gdansk in 2008–2017 (in absolute numbers)

Specification	2008	2010	2012	2014	2016	2017
GDA-number of passengers served in regular traffic and charter	1,930,513	2,208,819	2,861,774	3,238,064	3,966,655	4,600,000 (a)
GDA-number of aviation operations	23,139	25,006	32,871	31,411	34,343	27,841 (x)
National – number of passengers	20,628 851	20,466,876	24,435,557	27,052,316	33,986,960	30,652,598 (x)
National –number of aviation operations	257,714	240,691	276,486	268,999	309,795	258,411 (x)

Explanations
(a) data obtained at the Gdansk Lech Walesa Airport, Gdansk,
(x) data concern serviced passengers and flight operations in three quarters of 2017
data does not include passengers in transit and General Aviation
Source: (own elaboration based on data from the Civil Aviation Office, www. ulc.gov.pl, Accessed 12 March 2017, and at the Gdansk Lech Walesa Airport)

Taking into account the contemporary determinants of the development of landside areas, it is necessary to point to the potential opportunities spread over their implementation in Polish airports. In most of the Polish transport airports operating in 2017, activities are undertaken or investments are discussed in this respect. The most advanced in this respect are the airports in Warsaw, Gdansk, Katowice, Rzeszow and Goleniow. The development around airports in Poznan, Bydgoszcz and Swidnik is gaining momentum, in each case taking into account local conditions.

A quarter of a century ago, when 70 000 passengers a year were served at the Gdansk airport, cultivated fields were spread around this airport. During its expansion and modernization, the number of passengers served was increasing, the surrounding areas of the former villages of Klukowo, Kokoszki, Matarnia, Firoga, Banino and Rebiechowo were expanding to several tens of thousands of new residents in 2018, and some of them were incorporated into the city. New production, commercial, transport and hotel facilities were created. The communication conditions of this area improved significantly. The economic effect of this process is over a hundred-fold increase in the value and prices of land surrounding the airport. In the 1990s, 1 m^2 of land was valued at 0.05–0.06 USD. In 2018 these prices are 80–115 USD per 1 m^2.

Explanation: red line – coverage zone – average time of car access to the passenger terminal – 7 minutes.

Figure 2. The zone of influence of the Gdansk Lech Walesa Airport
Source: (www.dtz.com, Accessed 15 March 2018).

Figure 3. Airport City around Gdansk Lech Walesa Airport – projection
Source: (trojmiasto.pl, Accessed 15 March 2017).

In 2013, the initial concept of building a multifunctional commercial complex of the *Airport City* type for Gdansk was presented. Details of the development of areas belonging to the airport and outside its area were shown. The project includes: 20,000 m^2 of office space, 110 m^2 of retail space in the form of modern facilities with a minimum lease area of 5,000 m^2, 90,000 m^2 of modern warehouses and so-called light production and employment of 7,000 employees [www.dtz.com]. In 2018, the effects of this undertaking are visible in the form of the location of several modern enterprises, office and hotel facilities, car parks, development of the communication system (modern artery of Slowackiego, Pomeranian Metropolitan Railway) in connection with the A-1 motorway. The plans also included the creation of an exhibition center, further development of the housing function and activity

of residents in the provision of services related to the needs of the airport and its new surroundings. The location conditions of the airport in Gdansk favor its development and strengthening the interdependence with the surrounding area.

Conclusions

Air transport has become the main branch in long-distance passenger transport and a basis of the phenomenon on a global scale – globalization. In the conditions of integration of economies and markets, only air transport meets the needs of a globalized economy and a global society.

Branch transport points – airports are the largest interchange hubs for passengers in the world, of which the largest serve 50–80 million travelers a year. Many airports develop logistical functions. Such a large scale of transport and economic activity could not have had an impact on the areas surrounding airports, cities, metropolitan agglomerations, world cities and their regions. There are numerous interactions in the development of these structures. There is also a full analogy to the previous impact of the previously established branches of transport, i.e. water, rail and road transport, although each of them, due to technological differences in various areas, has left its mark on urban civilization.

The primary source and factor of the issues presented in the study are demographic processes and an increase in the number and mobility of societies. Its dynamics from 2.5 billion in 1950 (9 million passengers served by air transport) to 7.43 billion in 2016 (3.7 billion used from air services) points to the identity seal and the unique impact of this branch on the structure space development. New spatial systems are created and developed, generated by infrastructural point elements of one only branch of transport – airports. The concepts and structures of commercial development areas in the vicinity of airports, *Airport City*, *Aeropolis*, *Aerotropolis*, *Airport Corridor*, *Airport Region* and *Airea* are also a direct consequence of the development of air transport. Landside areas, incubators of know-how, the latest techniques and technologies were created and developed, contributing to the increase of attractiveness, competitiveness of cities, regions and wealth of their inhabitants. The example of Gdansk presents the strength of processes and interaction of the development of modern airports and other elements of spatial development.

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