

**AIRPORTS AND THEIR INFRASTRUCTURE**

UDC 528.9: 711.77

DOI: 10.18372/2306-1472.77.13496

**Olena Boyko<sup>1</sup>,  
Dmytro Prusov<sup>2</sup>****PREREQUISITES FOR THE INTEGRATED GEOINFORMATION SYSTEMS  
IMPLEMENTATION FOR SPATIAL PLANNING OF AIRPORT COMPLEXES**<sup>1</sup>National Aviation University, 1, Kosmonavta Komarova ave., 03058, Kyiv, Ukraine<sup>2</sup>Institute of Innovative Education of

Kiev National University of Construction and Architecture, 4, Osvity str., 03037, Kyiv, Ukraine

E-mails: <sup>1</sup>boyko\_lena@ukr.net; <sup>2</sup>d.e.prusov@gmail.com**Abstract**

*In the article the implementation possibilities of complex geographic information systems have been analyzed for spatial planning of airport complexes on the basis of research on the activity of Ukrainian airports, their passenger traffic over the last decade. Passenger traffic is one of the important factors and a prerequisite for the introduction at the airports of Ukraine of geoinformation systems that are used to monitor the state of objects, buildings, territory, management decisions, planning and reconstruction, etc.*

**Keywords:** airport; passenger traffic; geoinformation system (GIS); spatial planning**1. Introduction**

For the successful management of airport complexes, the design and construction of new terminals, buildings and runways, spatial planning, geographic information systems and technologies have been widely used in developed countries for more than 20 years. Their use makes it possible to make managerial decisions, attract investments, monitor the state of the territory, land plots, buildings and structures, communications, provide services to passengers, provide security for passengers, etc. Air transport in the countries of North America, the USA, Asia, Europe is popular among the population at the expense of affordable prices, good service, flight safety, speed.

In recent years, Ukraine has been implementing reforms in many sectors, including transport and infrastructure, and regulatory acts have been adopted at the state level for the development of air transport and airports. The Ukrainian passenger airline market for the second consecutive year demonstrates high growth rates, while Ukrainian airports continue to increase passenger traffic. The growth of airport activity and its integration into European and World

space is an important prerequisite for the implementation of integrated Geographic Information Systems (GIS).

The work on researching the passenger traffic of airports in Ukraine is relevant, as these data will be taken into account in the development and implementation of integrated geographic information systems.

**2. Statement of the problem**

The purpose of this study is to analyze the preconditions for the introduction of integrated geographic information systems at airports and the trend of increasing air travel.

The objective of the study is to analyze the activity and passenger traffic of Boryspil International Airport and other Ukrainian airports in order to identify the preconditions and further developing approaches to the spatial planning of airport complexes.

To study the state of airports and passenger traffic for 2009-2017, statistical data of the State Aviation Service of Ukraine were used, which is an open source and presented on the site <https://avia.gov.ua> [1].

### 3. Analysis of the latest research

Ukraine has almost no scientific research related to the development and implementation of integrated geographic information systems at airports.

In other areas of research of airport complexes using GIS technologies, there are issues of negative environmental impact in the field of civil aviation, the efficient operation of air transport systems, and many others. In Ukraine, research and development in the field of geoinformation technology and geospatial data and geoinformation systems is involved in many organizations, including the Research Institute of Geodesy and Cartography, Softpro, Ecomm co, and others.

### 4. The integrated geoinformation systems implementation for spatial planning of airport complexes

The most important stage in the development of territories is spatial or territorial planning. Today it can not do without the use of geoinformation systems and technologies that provide the opportunity to collect, store, analyze various geospatial data, update the necessary documentation, scientifically substantiate the proposals, simulate different scenarios, develop territorial development projects taking into account many factors, simulate the territory, take managerial decision, etc. Today, the issue of managing geospatial information at the national, regional and global levels is becoming increasingly important: efficient use of geospatial

data will meet the needs of society in current and official information, effectively take managerial decisions, avoid duplication of work, and increase investment attractiveness.

Ukraine, slowly, but confidently, is moving towards the introduction of geoinformation technologies at our airports, despite the financial problems and understanding of the management's pertinence of the use of integrated GIS. One of the prerequisites for the introduction of geographic information systems is the availability of a sufficient number of consumers of aviation services, ie passengers.

According to the State Aviation Service data, in August 2018 there are 20 airports, 11 civil aviation airfields, 2 helicopters and 42 landing sites. The largest airports in Ukraine are the "Boryspil" International Airport (Kyiv), "Kyiv" (Zhulyany), "Odesa", "Lviv", "Kharkiv", "Dnipro", and "Zaporizhia" [1]. It should be noted that 98% of the total passenger traffic and freight traffic are concentrated at these 7 major airports, while the share of Boryspil's main airport in the total passenger traffic dropped from 67% in 2016 to 64% in 2017 and at the same time slightly increased shares of airports "Kyiv (Zhulyany)", "Lviv" and "Kharkiv" airports.

The share of leading airports in the total passenger traffic by the State Aviation Service of Ukraine is shown in Fig. 1.

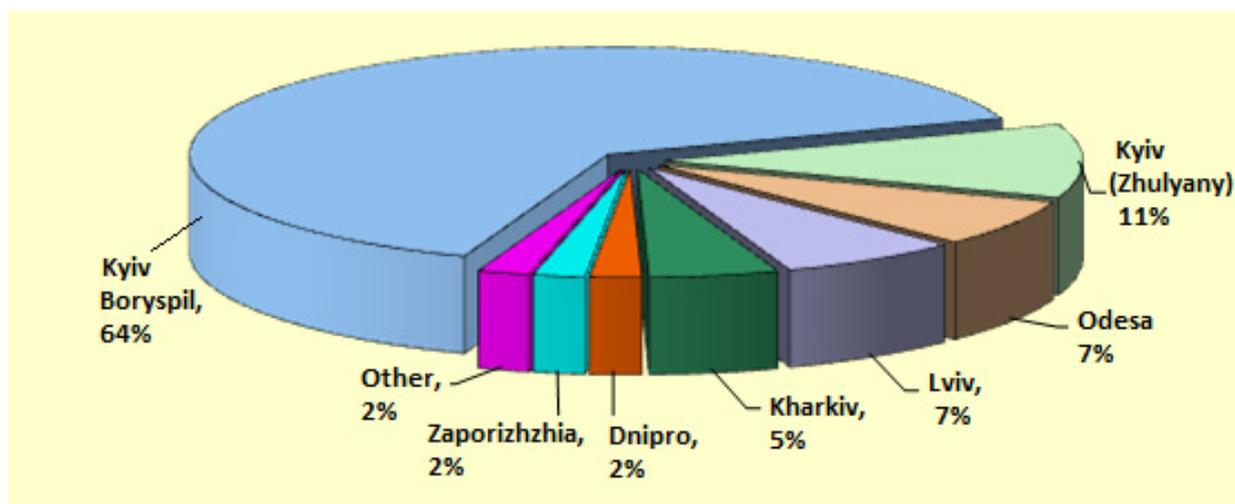


Fig. 1. Share of leading airports in total passenger traffic in 2017

In recent years, there has been a tendency to increase passenger traffic at airports in Ukraine, and airport complexes are becoming large financial regulators and infrastructure elements of territorial development, especially when implementing the law "On decentralization", when the funds earned in the region have the opportunity to spend on its development and territorial planning.

Every year, the number of people who use aviation increases. The analysis of the total passenger traffic of airports in Ukraine for the period of 2005-2017 indicates a steady tendency to increase passenger and cargo transportation, with the exception of the crisis in 2009 and 2014-2015, when the occupation of Ukraine and the air traffic dropped sharply (Fig. 2).

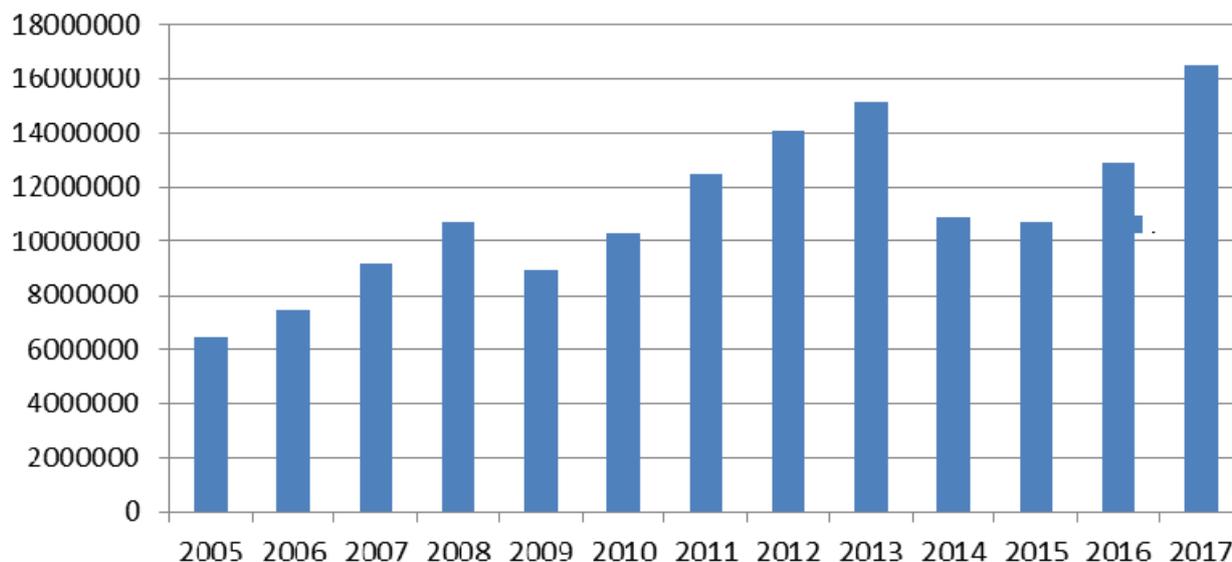


Fig. 2. Total number of passenger traffic by airports of Ukraine in 2005-2017

Considering airports as elements of territorial development and spatial planning, they are large enough for the area, with highly developed infrastructure, buildings and structures, communication lines, a large number of people and vehicles, etc. [2, 3].

According to the State Aviation Service of Ukraine in 2017, the passenger traffic at "Boryspil" Airport for the first time crossed the mark of 10 million and completed the year with an absolute record of Ukraine of 10.55 million passengers, 1/3 of which, traditionally, went for a shuttle by Ukraine. If we analyze the passenger traffic of the largest airports in Ukraine in recent years, it is clear that the international airport "Boryspil" is the most powerful air carrier, and the next years will not compete with it (Fig. 3).

The annual result of the main air gates of Ukraine is in the 50th place among European airports. The

"neighbors" of Boryspil are fluvial cities such as Stuttgart (Germany), Porto (Portugal), Venice (Italy) and Lyon (France). The European leader traditionally remains London "Heathrow", whose services were used by about 78 million people. And in general, the first step in the world has long been the Hartfield-Jackson airport in Atlanta (USA), last year it passed through 104 million passengers.

Analyzing other airports in Ukraine - Kyiv (Zhulyany), Odesa, Lviv, Kharkiv, Dnipro, Zaporizhia, Ivano-Frankivsk, Uzhhorod, Vinnitsa, Chernivtsi, Nikolaev, Kherson, Krivoy Rog, Rivne, it is evident that regional airports have the opportunity and desire to increase passenger transportation volumes, but without investment, without state support, without reconstruction, territorial development in general, it is practically impossible (Fig. 4).

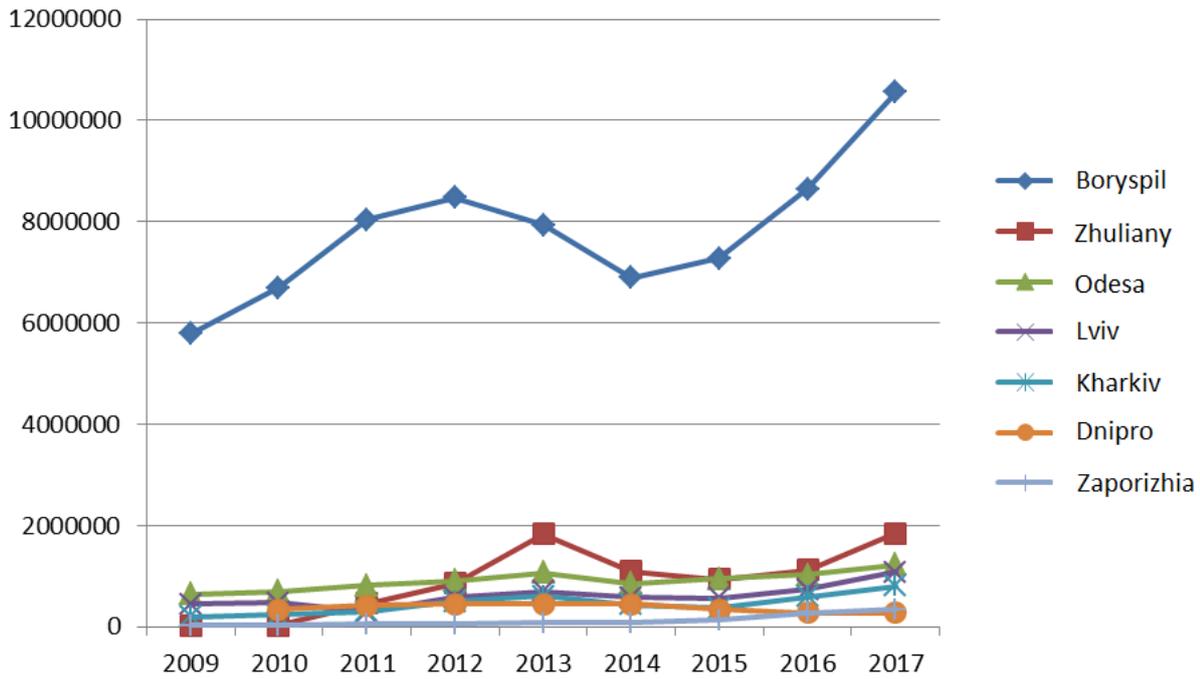


Fig. 3. Passenger traffic of Boryspil International Airport and other major airports of Ukraine for 2009-2017

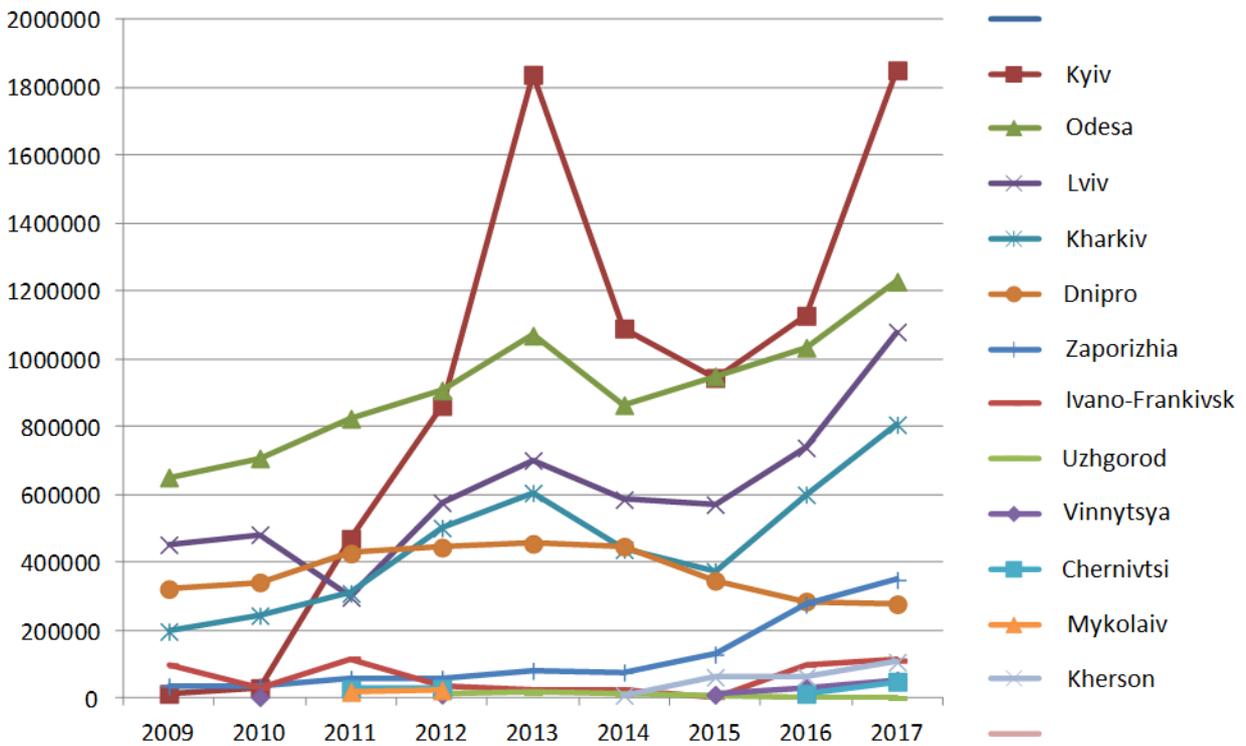


Fig. 4. Passenger traffic of airports of Ukraine for 2009-2017 years

The greatest indicators during the independence of Ukraine have made Odessa, Lviv and Kharkiv, and the first time since the collapse of the USSR, the Lviv airport returned to the cohort of "millionaires airports" - that is, those serving more than 1 million passengers a year. The development of an air harbor in Zaporizhia, which for the first time outstripped the airport of the neighboring and more populated Dnipro River, is notable.

Last year, more than 800 regular flights and charter flights were made from the airport "Vinnytsa", 52,000 passengers were carried. Compared to the previous year, the number of passengers increased by two and a half times. And the number of flights from the Vinnytsa airport increased by more than 50%.

Summarizing the passenger traffic volumes by airports of Ukraine for 2017, the following groups can be distinguished: the number of passengers more than 1 million – Boryspil airport; from 5 to 10 million – there are no such airports in Ukraine; from 1 to 5 million - airports Zhulyany, Odessa, Lviv; from 500 thousand to 1 million – airports Zaporizhia, Dnipro; from 100 to 500 thousand – airports Ivano-Frankivsk, Kherson; from 50 to 100 thousand – airport Vinnitsa; from 10 to 50 thousand – airports Chernivtsi, Kryvyi Rih; from 1 to 10 thousand – the airport in Rivne. Airports in

Nikolaev, Uzhhorod, Zhytomyr, and Poltava have not been operating in recent years.

Looking at the results of the study of the state of passenger traffic and the state of Ukrainian airports themselves, it is not surprising that no Ukrainian airport was ranked among the 100 best airports in the world based on the British marketing company Skytrax, which was based on passenger feedback. The survey participants described in the questionnaires how satisfied they were with various services, in particular, data on registration for landing, arrival, security, shopping, and others were taken into account. The study was conducted from August 2017 to February 2018. In total, more than 13 million passengers were interviewed at more than 550 airports.

For the sixth consecutive year, the best airport is Singapore's Changi International Airport. The Top-5 also includes: South Korean Incheon, Tokyo Haneda, airports of Hong Kong and Doha, the capital of Qatar. From the European airports and the first ten were German Munich (on the sixth turn), British London Heathrow (8th), Swiss Zurich (9th) and German Frankfurt (10th).

The statistics of the transportation of the ten most loaded airports in the world in 2014 and 2017 indicate a steady increase in passenger traffic, and proportionally in different countries of the world, Fig.5.

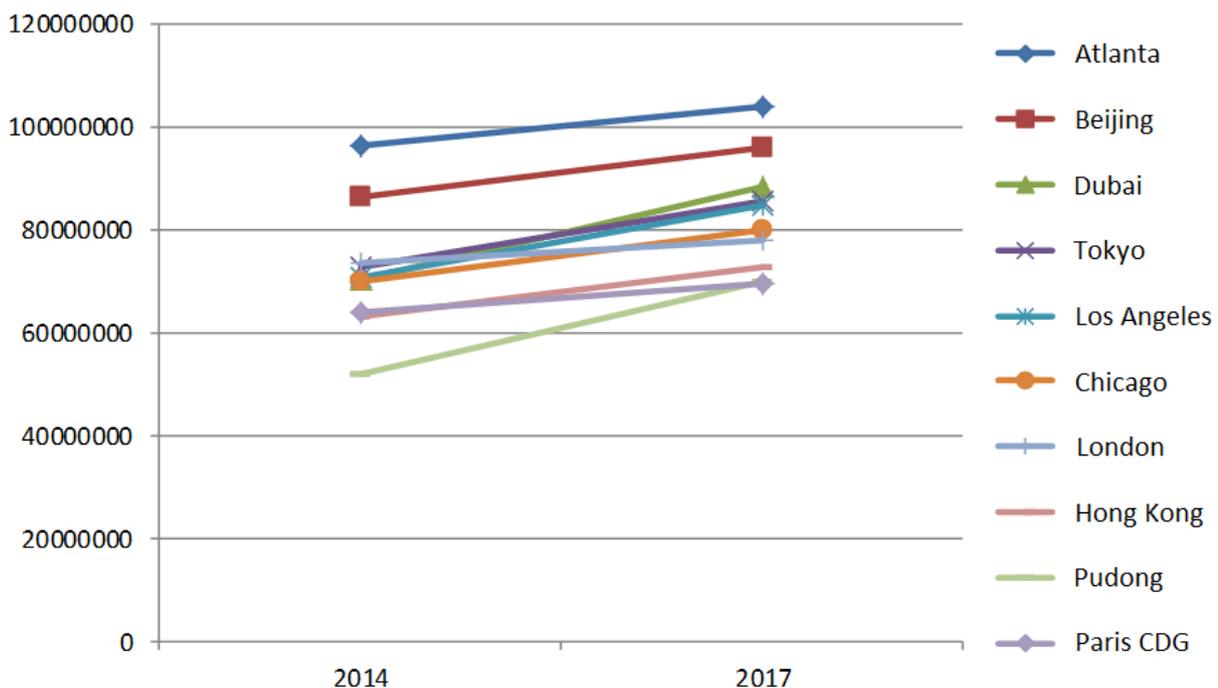


Fig. 5. The passenger traffic of the ten most loaded airports in the world in 2014 and 2017

According to statistics, in 2014, the list of 100 most loaded airports in the world began the airport Lisbon (Portugal), with a passenger traffic of 18,142,000 people, on the 10th rim was the airport of Hong Kong (China) 63122000 people, and the first place was occupied by the airport in the city of Atlanta (USA) with a passenger traffic of 96179000 people. In 2017, the 10th place was chartered by the airport Charles de Gaulle (France) with a passenger traffic of 69,471,000 and the first place remained at the airport of Atlanta (USA) with a record 103,902,992 passengers. Compared to the passenger traffic of the most loaded airport in Ukraine, Boryspil, the difference is tenfold.

It should be noted that all the world airports that were surveyed use geographic information systems to manage their territories. The integrated GIS of the world's foremost airport, Hartsfield-Jackson Airport (Atlanta, USA) is considered to be the best system for servicing various users of the system: operators, planners, mobile brigades on the airfield, engineers, contractors, inspectors, passengers, managers, etc.

## 5. Conclusions

The analysis of passenger traffic at Ukrainian airports in recent years shows that the number of people choosing aviation is increasing every year. This is supported by the policy of the state, which is aimed at transforming Ukrainian airports into modern hubs, attracting low-cost airlines and reconstructing airports and runways. An increase in passenger traffic is one of the important prerequisites for the introduction of modern technologies for management, monitoring and decision making, which are integrated geographic information systems.

Thus, the preconditions for the use of geographic information systems and technologies at world airports for spatial planning and management of the territory and the adoption of management decisions. Geospatial information of airport complexes is one of the important components in the overall system of spatial planning and regional development, which must be taken into account when developing concepts and plans for the development of territories, calculating economic and investment indicators.

The tasks of using geographic information systems and technologies are as follows:

- development and implementation of geoinformation technologies for management of territorial development and territorial planning;

- introduction of geoinformation technologies for management of territorial development in Ukraine;

- development of the structure of the airport complex as an important component of territorial development.

- definition of functions and capabilities of geographic information systems of airport complexes.

For the development of GIS airports in the world, the Esri software program, ArcGIS, has been the most proven. Also, Esri has developed a special software package, the GIS solution for airports - Esri Aeronautical Solution based on ArcGIS, which allows you to solve both aeronautical problems and economic.

Implementation of geoinformation systems of airport complexes allows the use of the following functions and capabilities: barrier analysis and simulation; aeronautical maps and charts; environmental safety of the airport and adjacent territories; assessment of the risks associated with the impact of nature; Emergency forecasting; managing the property of airports and controlling the lease of areas; servicing of goods and warehouses; runway service (RPS); GIS for operators and airport managers; organization of information services for passengers. The problem of the creation of complex GIS airports, the introduction of modern technologies for the formation of geospatial information on the territory of the airport and adjoining territories, the development of methodology and technology for data collection, the design and construction of new airports, terminals and runways has recently been very relevant and requires careful research.

To date, Ukraine devotes little attention to the development and implementation of geoinformation technologies in the system of spatial planning and management of the airport territory. Analyzing the functions and capabilities of modern geographic information systems, the experience of their practical use in the world for spatial planning of territories, the adoption of management decisions, monitoring of territories and enterprises, the organization of efficient operation of airport complexes, there is an urgent need to develop methodological foundations for the formation of geospatial information for GIS airports, the creation of geoinformation systems and geoinformation resources of the airport in the form of a set of information banks and geospatial databases data and

metadata, geospatial data services of the airport complex.

## References

[1] State Aviation Service of Ukraine - Results of the aviation industry of Ukraine for 2017. Available at: <https://avia.gov.ua>.

[2] Prusov D.E. (2015) *The Methodology for the Forecasting Consequences of Engineering Preparation for Transformation the Urban Areas in*

*Dense Building and Complex Geology conditions* // Proceedings of the National Aviation University. – 2015. – Vol.63, No.2. – pp. 40–45.

[3] Prusov D.E. (2012) *Numerical Research of the Retaining Constructions During Reconstruction of the Transport Structures* // Transport (Lithuania), 2012.– Volume 27, Issue 4. – pp. 357–363.

**О.Л. Бойко<sup>1</sup>, Д.Е. Прусов<sup>2</sup>**

### **Передумови впровадження комплексних геоінформаційних систем для просторового планування аеропортових комплексів**

<sup>1</sup>Національний авіаційний університет, м. Київ, пр. Космонавта Комарова, 1, 03058, Україна

<sup>2</sup>Інститут інноваційної освіти Київського національного університету будівництва і архітектури, м. Київ, вул. Освіти, 4, 03037, Україна

E-mail: <sup>1</sup>boyko\_lena@ukr.net; <sup>2</sup>d.e.prusov@gmail.com

Проаналізовано можливості впровадження комплексних геоінформаційних систем для просторового планування аеропортових комплексів на основі дослідження активності аеропортів України, їх пасажиропотоку за останнє десятиріччя. Пасажиропотік є одним з вагомих факторів та передумовою впровадження в аеропортах України геоінформаційних систем, які використовуються для моніторингу стану об'єктів, будівель, території, прийнятті управлінських рішень, плануванні та реконструкції, тощо.

**Ключові слова:** аеропорт; пасажиропотік; геоінформаційна система (ГІС); просторове планування

**Е.Л. Бойко<sup>1</sup>, Д.Э. Прусов<sup>2</sup>**

### **Предпосылки внедрения комплексных геоинформационных систем для пространственного планирования аэропортовых комплексов**

<sup>1</sup>Национальный авиационный университет, г. Киев, пр. Космонавта Комарова, 1, 03058, Украина

<sup>2</sup>Институт инновационного образования Киевского национального университета строительства и архитектуры, г. Киев, ул. Освиты, 4, Киев, 03037, Украина

E-mail: <sup>1</sup>boyko\_lena@ukr.net; <sup>2</sup>d.e.prusov@gmail.com

Проанализированы возможности внедрения комплексных геоинформационных систем для пространственного планирования аэропортовых комплексов на основе исследования активности аэропортов Украины, их пассажиропотока за последнее десятилетие. Пассажиропоток является одним из весомых факторов и предпосылкой внедрения в аэропортах Украины геоинформационных систем, которые используются для мониторинга состояния объектов, зданий, территории, принятии управленческих решений, планировании и реконструкции, и тому подобное.

**Ключевые слова:** аеропорт; пасажиропотік; геоінформаційна система (ГІС); просторове планування

## **Olena Boyko**

Senior Lecturer at the Department of Land Planning and Cadastre of the Educational and Scientific Institute of Environmental Safety at the National Aviation University.

Education: Kyiv National University of Construction and Architecture, Civil Engineering Faculty, (1995).

Research area: Geoinformation modeling of topographic surfaces, objects and phenomena, representation of geospatial data in geoinformation systems of airport complexes, urban cadastre and regional development systems for spatial planning purposes.

Publications: over 50

E-mail: boyko\_lena@ukr.net

**Dmytro Prusov**

Doctor of Technical Sciences, Prof., Senior Researcher.

Head of the Department of Construction and Information Technologies of the Institute of Innovative Education of the Kiev National University of Construction and Architecture.

Education: Kyiv National University of Construction and Architecture, Civil Engineering Faculty, (1994).

Research area: New concepts in territorial planning for the urban territories engineering preparation, the creation of theoretical principles and new methodologies for objects research and processes mathematical modeling.

Publications: over 130

E-mail: [d.e.prusov@gmail.com](mailto:d.e.prusov@gmail.com)