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PROSPECTS FOR RESTORING THE TRANSPORT AND LOGISTICS INFRASTRUCTURE OF AIRPORT COMPLEXES IN UKRAINE AND ENSURING THE EFFICIENCY OF ITS OPERATION

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Summary

Introduction. *The full-scale russian military aggression had an extremely negative impact on the state of air transport and the transport and logistics infrastructure of airports in Ukraine, which makes the issue of restoring the operation of airport complexes and ensuring their efficiency in the post-war period relevant.* ***Purpose.*** *The purpose of the article is to identify possible prospects and reserves for the restoration of air transportation and the development of an organizational mechanism for ensuring the effective functioning of the transport and logistics infrastructure of airport complexes in Ukraine in the post-war period, using the example of the Kyiv International Airport. Methods. The following set of scientific methods was used in the study: analysis of scientific and technical literature, SWOT-analysis, structural analysis, systemic and synergetic approaches.* ***Results.*** *The article examines the nature and process of organizing the activities of the airport complex, the current state of the transport and logistics infrastructure of airports in Ukraine. On the example of the Kyiv International Airport, promising directions for ensuring the effective operation of the airport complex are determined, taking into account the peculiarities of the interaction of transport modes at airports as points for providing transport services on cargo flows processing. Schemes of interaction of transport modes during multimodal transportation of goods through the airport have been developed. Based on the results of technical and economic calculations, the expediency of increasing the throughput capacity of the cargo terminal of the Kyiv International Airport was substantiated. The application of SWOT-analysis made it possible to determine the factors of the internal and external environment and to develop priority directions for the restoration of the transport and logistics infrastructure of airport complexes during the war period to ensure their effective functioning after the war. Scientific novelty. Prospective directions for ensuring the*

effective operation of the airport complex have been determined, taking into account the peculiarities of the interaction of transport modes at airports, schemes for interaction of transport modes during multimodal transportation of goods through the airport have been developed. ***Conclusions.*** *Practical significance. On the basis of technical and economic calculations, it is proposed to increase the throughput capacity of the cargo terminal of the Kyiv International Airport and priority directions for the restoration of the transport and logistics infrastructure of airport complexes are determined.*

Key words: *airport complex, transport and logistics infrastructure, cargo air transportation, transport, airline, interaction of modes of transport, efficiency.*

ПЕРСПЕКТИВИ ВІДНОВЛЕННЯ ТРАНСПОРТНО-ЛОГІСТИЧНОЇ ІНФРАСТРУКТУРИ АЕРОПОРТОВИХ КОМПЛЕКСІВ УКРАЇНИ ТА ЗАБЕЗПЕЧЕННЯ ЕФЕКТИВНОСТІ ЇЇ ФУНКЦІОНУВАННЯ

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Анотація

Вступ. *Широкомасштабна російська воєнна агресія вкрай негативно позначилась на стані авіаційних перевезень і транспортно-логістичної інфраструктури аеропортів в Україні, що актуалізує питання відновлення роботи аеропортових комплексів і забезпечення їхньої ефективності в післявоєнний період.* ***Мета.*** *Метою статті є виявлення можливих перспектив і резервів відновлення авіаперевезень та розроблення організаційного механізму забезпечення ефективного функціонування транспортно-логістичної інфраструктури аеропортових комплексів України в післявоєнний період на прикладі міжнародного аеропорту «Київ». Методи. У дослідженні використовувався такий комплекс наукових методів: аналіз науково-технічної літератури, SWOT-аналіз, структурний аналіз, системний і синергетичний підходи.* ***Результати.*** *У статті досліджено сутність і процес організації діяльності аеропортового комплексу, сучасний стан транспортно-логістичної інфраструктури аеропортів України. На прикладі Міжнародного аеропорту «Київ» визначено перспективні напрями забезпечення ефективної діяльності аеропортового комплексу з огляду на особливості взаємодії видів транспорту в аеропортах як пунктах з надання транспортних послуг з обробки вантажопотоків. Розроблено схеми взаємодії видів транспорту в мультимодальних перевезеннях вантажів через аеропорт. На основі результатів проведених техніко-економічних розрахунків обґрунтовано доцільність збільшення*

пропускної спроможності вантажного терміналу міжнародного аеропорту «Київ». Застосування SWOT-аналізу дозволило визначити чинники внутрішнього та зовнішнього середовища та розробити пріоритетні напрями відновлення транспортно-логістичної інфраструктури аеропортових комплексів у воєнний період для забезпечення їхнього ефективного функціонування після війни. Наукова новизна. Визначено перспективні напрями забезпечення ефективної діяльності аеропортового комплексу з огляду на особливості взаємодії видів транспорту в аеропортах, розроблено схеми взаємодії видів транспорту під час мультимодальних перевезень вантажів через аеропорт. ***Висновки.*** *Практичне значення. На основі проведених техніко-економічних розрахунків запропоновано збільшення пропускної спроможності вантажного термінала міжнародного аеропорту «Київ» і визначено пріоритетні напрями відновлення транспортно-логістичної інфраструктури аеропортових комплексів.*

Ключові слова: *аеропортовий комплекс, транспортно-логістична інфраструктура, вантажні авіаційні перевезення, транспорт, авіакомпанія, взаємодія видів транспорту, ефективність.*

Introduction. The air cargo market is developing and growing all over the world. In this regard, in order to maintain a correspondingly high level of competitiveness, there is a need to significantly increase the capacity of airport complexes. The rational functioning of the transport hub, the role of which is played by the airport, makes it possible to ensure the effective interaction of all agents of delivery. However, sometimes the transport hub is the "bottleneck" of the entire logistics chain of cargo transportation.

Statement of the problem. Taking into account the catastrophic impact of the Russian-Ukrainian war on the state of air transportation, as well as, the transport and logistics infrastructure of airports in Ukraine, the issue of restoring the operation of airport complexes and ensuring their efficiency in the post-war period is acute.

Analysis of recent research and publications. The problems of researching the transport and logistics infrastructure of airport complexes, the development of modern airports, business models of airport development, the organization of airport operations, as well as, the management of the logistics infrastructure of airports are considered in the works of Ukrainian and foreign scientists, such as: N. Ashford, H. P.M. Stanton, K.A. Moore, M.Yu. Hryhorak, O.M. Gorbachova, V.V. Zaporozhets, O.M. Bilyakovich, K.V. Marintseva, etc.

The issues of airport complex throughput, the structure of airports as a complex production system, the effectiveness of managing the processes of reproduction and renewal of airport infrastructure according to the stages of the life cycle are investigated in the publication [1]. In particular, the author notes that it is expedient to apply new approaches in the field of economic management of airport complexes, primarily management tools for the stages of the airport's life cycle, in order to enter the stage of "renewal" and achieve a higher level of their economic development.

The paper [2] examines the specifics of the airport complex, analyzes the interrelationship between the efficiency of airport complexes and the process of managing the loyalty of service consumers.

The work [3] considers the use of a logistics approach in airport management, the role of air transport in transport and logistics systems, innovative business models

for the development of international airports, as well as the development of airports as multimodal multifunctional enterprises.

The study of the importance of the airport complexes development in the context of ensuring the stable and reliable functioning of the market of transport services, namely air transportation, covers a wide range of relevant scientific aspects [4–6]. At the same time, despite deep and thorough research, the issue of restoring the transport and logistics infrastructure of airport complexes of Ukraine and developing an organizational mechanism to ensure the efficiency of its operation is currently being brought up to date.

Formulation of the purpose of the article. The purpose of the article is to identify possible prospects and reserves for the restoration of air transportation and the development of an organizational mechanism for ensuring the effective functioning of the transport and logistics infrastructure of airport complexes in Ukraine in the post-war period, using the example of the Kyiv International Airport.

Research methodology. The following set of scientific methods have been used: analysis of scientific and technical literature – to study the organization of airport complexes' operation; SWOT analysis – to reveal a complex of internal and external factors that affect the functioning of airports, like their strengths, weaknesses, opportunities, and threats; method of technical and economic calculations – to determine the duration and costs of cargo transportation in the interaction of air and road modes of transport on the base of airport complexes; systemic and synergetic approaches – to develop some priority directions for the renewal of airport complexes' transport and logistics infrastructure, as well as, ensuring its efficiency in post-war period.

The main material of the article. An airport as a production system consists of airfield, aeronautical, apron and terminal complexes, as well as auxiliary units, ensuring their functioning [1]. Considering the concept of "airport complex", it should be noted that the following requirement is put forward for this transport and infrastructure object: the presence of at least one runway.

Interoperable elements of the airport complex are aimed at providing high-quality and timely aviation and non-aviation services. Every year, the British company Skytrax, which studies the quality of air services based on passenger reviews, publishes a rating of the best airports in the world. According to the rating in 2023, the Top 10 airports in the world included: Singapore Changi Airport (Singapore), Hamad International Airport (Doha, Qatar), Tokyo International Airport (Haneda) (Japan), Incheon International Airport (South Korea), Paris Airport named after Charles de Gaulle (France), Istanbul Airport (Turkey), Munich Airport (Germany), Zurich Airport (Switzerland), Narita International Airport (Japan), Madrid-Barajas Airport (Spain).

In the conditions of a globalized economy, airports are considered as multifunctional complexes. In particular, at the beginning of the 21st century, the American aviation expert John Kasarda proposed the concept of aerotropolises as subregions that would include not only airports, but also hotels, restaurants, business and logistics parks, entertainment centers, recreational areas, public spaces, residential districts with gradual transformation into separate cities. Currently, such an idea is being actively implemented in the Asia-Pacific region. Airports in Europe, North America, and Australia are gradually expanding in this direction [7].

As an operator of the transportation process, the airport provides a set of services for airlines in the reception, departure and technical support of air transport, as well

as passenger, baggage and cargo service. Among service consumers, according to the modern theory of segmentation, two segments can be distinguished: the B2B segment (air carriers, operators, cargo owners, cargo consignors, cargo receivers) and the B2C segment (air passengers, airport visitors; persons carrying out the shipment of cargo and luggage).

Both aviation and non-aviation activities create revenues of airport complexes. Tariffs and airport charges of airports in Ukraine are determined by government with a regulatory document for each individual airport. In accordance with the resolution of the Cabinet of Ministers of Ukraine dated December 25, 1996 "On establishing the powers of executive authorities and executive bodies of city councils regarding the regulation of prices (tariffs)" and the recommendations of the International Civil Aviation Organization (ICAO), the airport fees for servicing aircraft and passengers are determined in the airports of Ukraine (aircraft landing-takeoff, passenger service in the airport terminal, excess aircraft parking, aviation security) [8].

Airport fees from aviation activities do not recover all costs, so non-aviation activities become one of the sources of income. According to the Manual on Airport Economics of the International Civil Aviation Organization, the main elements of airport income are revenues from air transportation, ground handling, and from non-aviation (in ICAO terminology – "non-aeronautical") types of activities [2]. According to statistics, the share of airport revenues from non-aviation activities (medical services, fire services, ticket sales and reservations, duty-free shops, passenger luggage packing, parking lots, food outlets, etc.) is an average of 46%. Airports in European and Asian countries offer an average of 200–250 types of additional services to passengers, in Ukraine – 10–15 types of non-aviation services in the pre-war period.

Due to the military aggression of Russia against Ukraine, the introduction of martial law and the closure of the airspace of Ukraine, the operational activities and provision of services at the airports are suspended. The recovery rate of operational activities of airport complexes will depend on the prerequisites that affect the possibility of carrying out economic activities and form the demand for air transportation. However, in order to ensure a quick resumption of operation in the post-war period, it is necessary to develop a program of measures for the airport complexes' recovery. It should be noted that this issue was considered in June 2022 at the Assembly of the Airports Council International (ACI Europe), which took place in Rome at Fiumicino International Airport. During the meeting of the European Airport Community together with industry partners, the following issues were discussed: 1) providing a comprehensive recovery of aviation industry and infrastructure; 2) ensuring aviation security (organization of the work of the aviation security service, means of protecting objects and detecting dangerous objects, professional personnel); 3) developing strategic vision of the post-war development of the aviation industry in Ukraine [9].

As a result of shelling and hostilities in 2022, 11 airports in Ukraine were damaged or completely destroyed. So far, it has been possible to restore the damaged infrastructure of the Boryspil International Airport. The total cost was 1,8 million euros. In addition, the monthly costs for wages for airport employes and electricity bills amount to 3,2 million euros.

Lviv International Airport named after Danylo Halytskyi was checked by a group of experts from the US Transportation Security Administration (TSA). Experts examined

the existing state of the airport infrastructure, security during martial law, the personnel action plan in case of emergency situations, the state of cyber security, airport information systems, technical means of protection. Based on the results of the examination, TSA specialists determined that the airport infrastructure is in good condition, operational readiness is maintained, professional training of specialists is at a high level.

Therefore, the further international integration of the aviation services market and the restoration of the transport and logistics infrastructure of Ukraine requires the study of world experience in the organization and management of airport complexes, the development of projects for the industrial and technical development of airports, and the search for sources of financing.

An important aspect of the restoration of the transport and logistics infrastructure of the airport complexes in Ukraine is the development of an organizational mechanism to ensure the efficiency of its functioning in the post-war period. While the airport complexes are not working, it is advisable to radically update the airport's operation technology and business processes to ensure fast service at a low cost (simplified check-in, IT technologies, simplification of processes, short walking routes, increasing the efficiency of space use, etc.).

Using the example of the Kyiv International Airport, we will consider promising directions for ensuring the effective operation of airports in view of the peculiarities of the transport modes' interaction in airports as points for the provision of transport services on cargo flows processing.

Igor Sikorsky Kyiv International Airport, also known as Kyiv – Zhulyany Airport (IATA: IEV, ICAO: UKKK) is the second largest international airport of Ukraine and Kyiv. Kyiv International Airport is an important aviation transport hub in Ukraine. In terms of passenger traffic, Kyiv Airport provides 9% of air passenger transportation in Ukraine, and according to the results of 2021 served 1 418 153 passengers. Although the airport is mainly used for passenger transportation, it also provides cargo transportation services, in 2021 the volume of cargo and mail transportation was more than 1,1 thousand tons [10].

It is a multifunctional enterprise that provides services to aviation companies, passengers and cargo shippers in the aviation and non-aviation spheres of activity, ensures the regularity and safety of flights, and the main activities of the airport are:

– ensuring the operation and functioning of the airport's infrastructure facilities, means of mechanization and specialized transport;

– receiving and dispatching aircraft with the provision of air passenger and cargo transportation;

– providing aircraft take-off and landing services, their ground maintenance and servicing of aircraft, passengers, crews, baggage, cargo and mail;

– providing airlines and other enterprises with fuel, lubricants and other materials on a contractual basis;

– organizing measures to ensure aviation safety;

– organizing and implementing emergency rescue operations and firefighting measures during the flights and at the airport;

– guarding controlled, sterile and restricted access areas;

– ensuring the operational suitability of parking lots, aircraft taxiways and maneuvering areas;

– maintenance of aircraft and helicopters;
– preparing and management of aeronautical data and aeronautical information;
– providing air navigation services;
– auxiliary services for air and land transport, etc. [11].

The transport system, which ensures the delivery of goods and passengers to Kyiv Airport, is complex and includes various vehicles and infrastructure. Depending on the type of cargo, distance and delivery time, such components of transport systems as road, rail, sea and river modes of transport, as well as the corresponding transport infrastructure, can be used for the delivery of cargo to the airport, individually or in interaction with each other. The schemes of transport modes' interaction in multimodal cargo transportation through the Kyiv Airport can be as represented on Fig. 1.

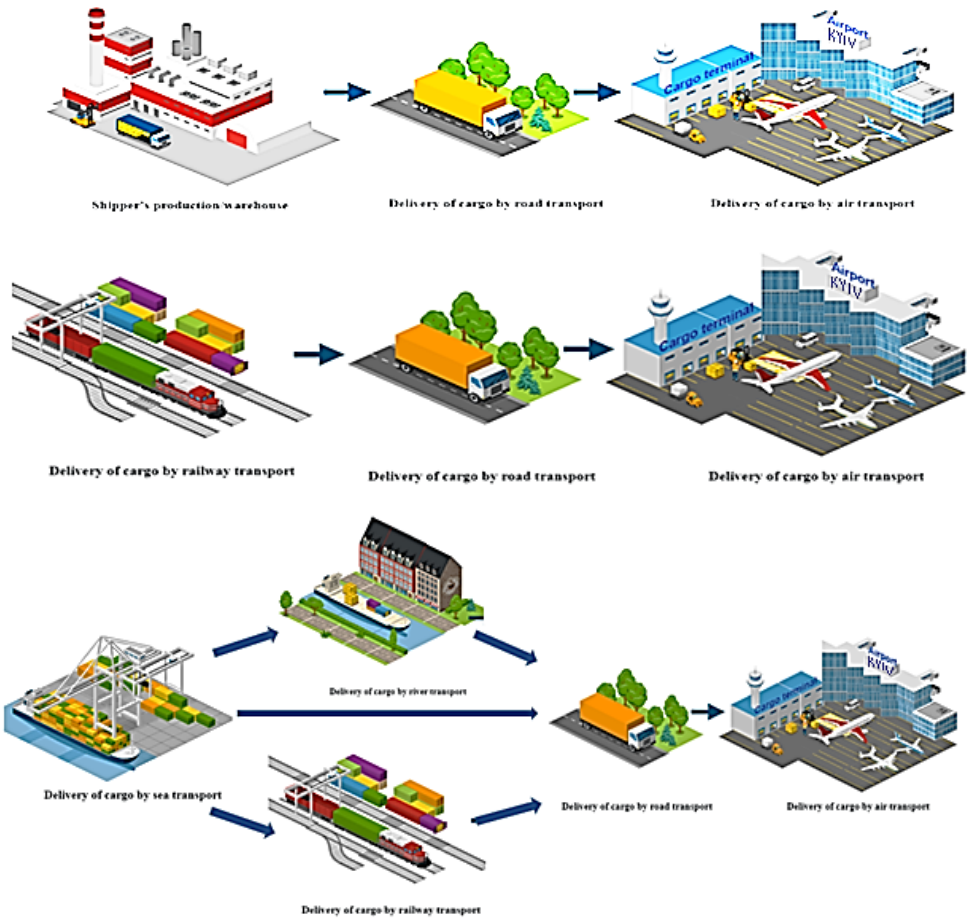

Fig. 1. Possible schemes of transport modes' interaction in multimodal cargo transportation through the Kyiv Airport

It should be mentioned that quite small consignments of cargo weighing from 500 to 4 500 kg are transported through the airport, since the throughput capacity of the airport cargo terminal is significantly limited, due to which for Kyiv International Airport, cargo

transportation has always been not the main, but an auxiliary activity. However, this direction is one of the priorities for the further development of the airport. This prospect is due to the increase in the growth and development of the cargo air transportation market all over the world, and also the need for a gradual but rapid recovery of airport activity in the post-war period.

Before starting the reconstruction of the international airport and the modernization of the cargo terminal, it is important to determine in advance:

– What are the possible threats for the company?

– What competitive advantages the company can potentially gain as a result of the implementation of the proposed actions?

– What can be the basis for successful modernization?

– What managerial, technological and technical aspects should be studied?

To solve this problem, we applied SWOT-analysis, which determined a complex of internal and external factors that affect the development of the company (table 1).

Therefore, on the basis of technical and economic calculations (table 2, table 3), as well as the SWOT analysis, for the Kyiv International Airport development regarding cargo transportation, the following priority directions can be determined:

– the reconstruction and modernization of the cargo terminal;

– the expansion of the existing routes' network due to restoring cargo transportation and increasing the share of transfer transportation;

– the implementation of measures to improve the level of cargo service, both in aviation and non-aviation activities;

– the development of the airport fueling complex which will allow to reduce the losses associated with the increase in the cost of fuel;

– the attraction of investors for the airport development;

Table 1

SWOT-analysis of the Kyiv International Airport

STRENGTHS (S)	WEAKNESSES (W)
– defined strategic direction of development; – available opportunities for infrastructure expansion; – high quality of aviation and non-aviation services provided; – modern terminal infrastructure; – using of modern systems and tools in the ground handling of aircraft, passengers and cargo; – convenient location within the city; – base airport for leading Ukrainian and foreign airlines; – high efficiency of transport service; – positive dynamics of demand for passenger and cargo transportation; – a large share of international air transport; – availability of transcontinental flights network; – the large territory and convenient location of the airport allow the expansion of non-aviation activities; – qualified staff.	– existing restrictions on aircraft types; – restrictions on the capacity of the runway, passenger and cargo terminals; – restrictions on noise characteristics, environmental restrictions; – further development of the infrastructure is restrained by the city limits.

Table 1 (continuance)

OPPORTUNITIES (O)	THREATS (T)
– geographical position, which contributes to the development of the routes' network; – increasing the volume of transportation and connecting flights; – increasing demand for air cargo transportation; – delayed demand for air transportation, which should be satisfied after the stabilization of the situation in the country.	– closure of the aviation space and suspension of the airport as a result of the Russian-Ukrainian war; – possible damage or destruction of the airport infrastructure; – complex socio-political situation in the country, decrease in the attractiveness of Ukraine for potential passengers due to hostilities; – economic crisis, unstable financial situation; – more successful and dynamic development of competitors' airports; – rising prices for fuel and lubricants and spare parts; – strengthening of environmental and noise restrictions on the functioning of the airport within the city.

Source: developed by authors based on [9].

Table 2

The duration of cargo transportation in the interaction of air and road transport modes[1]

№	The name of the moment of time of the cargo transportation process	The weight of the consignment, kg				
		500	1 500	2 500	3 500	4 500
1	Starting the entire freight transportation cycle	13:51	13:46	13:41	13:36	13:31
2	Departure of the road transport from the point of the logistics company UPS	14:16				
3	Arrival of the road transport at the Kyiv airport	14:20				
4	Arrival of the air transport at the Kyiv airport	16:15				
5	The moment of time of departure of air transport from Kyiv airport	16:34	17:12	17:50	18:28	19:06
6	The moment of time of arrival of the aircraft at the destination Warsaw airport	18:04	18:42	19:20	19:58	20:36
7	The moment of time of the end of the entire freight transportation cycle	19:13	21:49	23:25	01:01	02:37
	TOTAL TRANSPORTATION TIME, h-min	6–22	8–03	9–44	11–25	13–06

[1] *The calculations in carried out for multimodal transportation of cargo from the warehouse of the logistics company UPS through Kyiv International Airport, which acts as a transport hub, to Warsaw Chopin International Airport.*

Table 3

The cost of cargo transportation in the interaction of air and road transport modes

Cost of cargo transportation	The weight of the consignment, kg				
	500	1 500	2 500	3 500	4 500
Total delivery cost, USD	1 162	2 970,4	4 579,05	5 987,2	7 645,6
Unit cost of delivery, USD/kg	2,32	1,98	1,83	1,71	1,69

– the use of outsourcing to approach the level of successful foreign airports without increasing the debt burden.

Moreover, one of the important tasks in the coming years is the further modernization of the airfield infrastructure, special airfield equipment and the cargo handling equipment.

The existing runway does not allow serving long-haul wide-body airliners making long (6–12 hours) and ultra long (up to 17 hours) flights. The reconstruction of the runway with its extension by 460–500 m to 2 770 m, enabling the reception of heavier aircraft. The increase in bearing capacity of the runway surface, and increasing the radius of the geographical network, will make it possible to increase both cargo and passenger traffic through the airport, which will help develop and rise the competitiveness of Kyiv Airport in both promising directions.

Furthermore, in order to increase the volume of transit cargo transportation and improve the efficiency of the enterprise activity, the creation of a nodal terminal logistics complex-hub on the basis of the International Airport Kyiv is being considered. This logistics hub is a large-scale logistics center created to optimize the entire volume of cargo transportation. And all enterprises as well as modes of transport united by such a logistics center can receive correct and appropriate loading and the most rational routes.

An increase in the volume of transportation leads to the simultaneous increase in the volume of cargo handling, as well as the probability of cargo losses, which in turn have a negative impact on the profits and image of the company.

To solve and prevent these problems it's necessary to introduce the effective systems of operational management and automation of processes, like the use of automated cargo sorting and tracking systems, because in this case human involvement is minimized.

Currently, Kyiv International Airport uses the SITA BagManager system for baggage handling, which helps airlines, airports and ground freight forwarders coordinate and carry out constant baggage control [13]. The system also provides porters with real-time information about baggage, its status, and helps them resolve problems arising during unloading baggage to passengers.

At the cargo terminal of Kyiv airport, the use of RFID (Radio-frequency Identification) tags for cargo is proposed. RFID tags can be scanned and tracked using the existing SITA BagManager system. RFID technology allows automatic identification of cargo. To do this, special radio tags are attached to the cargo at the processing point of the cargo terminal, which will later be recognized by an RFID reader from a distance of 2–3 meters, and all information on the cargo is stored in the data accounting system and can be checked at any time [14].

Thus, the proposed measures will contribute to the expansion of the airport's activities in cargo transportation and the achievement of the maximum efficiency from the interaction of the transport modes on the basis of the airport complex as a transport hub.

Concerning the potential rise in the volume of cargo transportation, the implementation of the proposed measures requires further modernization and expansion of the available loading and unloading equipment.

To facilitate and speed up cargo operations, the purchase of CLT-8 Loader/ Transporter loading and unloading equipment may be offered [15]. CLT-8 is a self-propelled single-platform container loader that can lift, lower and transport LD-2/3 containers. The equipment is able to lift and carring cargo units up to 3 600 kg.

Conclusions. The airport as a complex production system with appropriate transport and logistics infrastructure aims to provide high-quality and timely aviation and non-aviation services. Modern airport complexes are characterized by multifunctionality and the strengthening of their role in ensuring the maintenance of cargo and passenger flows in the conditions of modern globalization processes.

Unfortunately, due to military aggression, the airports of Ukraine were forced to suspend their economic activities. Damage to the transport and logistics infrastructure requires appropriate restoration after the end of hostilities, as well as the implementation of an organizational mechanism for exiting the crisis of domestic airport complexes and ensuring the efficiency of their functioning in the post-war period.

Technical and economic calculations were carried out and the results were systematized regarding the time and costs of cargo delivery. According to obtained results, the time and the cost of transporting cargo in a multimodal transportation directly depend on the weight of the consignment of cargo being transported. In addition to the time and money spent on the necessary operations for maintenance and cargo handling, unproductive downtime occurs due to incomplete planning on the schedule of the vehicles' arrival at the transport hub, which also entails unnecessary costs.

Similarly, calculations show that quite small consignments (500–4 500 kg) are transported through the airport, since the throughput capacity of the airport cargo terminal is significantly limited, due to which, cargo transportations have always been not the main, but an auxiliary activity for Kyiv International Airport. Nevertheless, this direction is one of the priorities for the further development of the airport. This prospect is due to the increase in the growth and development of the cargo air transportation market all over the world, as well as the need for a gradual but rather rapid recovery of airport activity in the post-war period.

Therefore, on the basis of technical and economic calculations, as well as the SWOT-analysis, the following priority directions for the development of Kyiv International Airport regarding the cargo transportation have been determined: the reconstruction and modernization of the cargo terminal and runway; the expansion of the existing network of routes; improving the level of cargo service; modernization of the airfield infrastructure, special airfield equipment and cargo handling equipment; the development of the airport fueling complex; attracting investments for the development of the airport; the creation of a nodal terminal logistics complex-hub on the basis of the Kyiv International Airport to increase the volume of transit transportation and improve the efficiency; synchronization of the cargo flows and complex airport processes.

Prospects for further research are justifying strategic priorities for the expansion of airport complexes located within megacities; developing effective management of transport flows during multimodal transportation with the participation of air transport; using innovative technologies in the design of transport and logistics infrastructure at airport complexes.

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