THE SIGNIFICANCE OF AIRPORT CERTIFICATION IN THE RECOVERY PROCESS SECURITY OF CIVIL AVIATION OF UKRAINE

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Abstract. The main goal of this study is the need to solve the problems of safe and effective development of airport infrastructure, since the implementation of effective international and European standards, transformation and modernization of airport infrastructure is one of the directions of Ukraine's work in the process of implementing international and European standards, as well as in the development of the UN Sustainable Development Goals. The authors used the method of analysis of the global reporting format to find out the requirements of the acts of international and European civil aviation organizations in the conditions of restoring the safety of civil aviation of Ukraine, compliance with standards and recommended practices regarding the certification of airport activities. Paths are defined recovery infrastructure of Ukrainian airports after the cessation of Russian military aggression, which caused horrible destruction, in particular, in the airport industry, the requirements for accreditation of airports, existing facilities on the territory of the airport were analyzed. The scientific novelty of the research lies in the fact that the authors carried out a thorough analysis of the requirements of international and European civil aviation organizations for airport activity, directions for certification of airports after the end of the war, which would contribute to the economic development of the state. The experience of Ukraine's cooperation with international and European civil aviation organizations in the field of airport certification should contribute to the restoration of state's capabilities for the safety of civil aviation flights.

Keywords: airport, certification, civil aviation safety, ICAO standards and recommendations, ACI, EASA, recovery civil aviation.

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1. Introduction

Ukraine's airspace and all airports in the country were closed to civilian aircraft on the night of February 24, 2022, the day of Russia's large-scale invasion of Ukraine. In order for Ukraine's airports to resume air traffic after the victory, they must have appropriate permits to start work. And even in the most difficult conditions, during martial law, the civil aviation authorities of Ukraine continue to work and fulfill their duties.

The operation of civil aviation airports must comply with the maximum safety of air transport. Compliance with international requirements and the system of reliability certification depends on the technical equipment of airports, in particular, the management and organization of activities related to the operation of airports. As a result of certification, the airport receives a document confirming compliance with certification requirements, that is, a set of technical and organizational requirements, the fulfillment of which is a necessary condition for ensuring flight safety.

The general requirements for ensuring international air transport and the rules on the determination at the discretion of member states of airports serving international flights are contained in Chapter XV of the Convention on International Civil Aviation of 1944 (International Civil Aviation Organization [ICAO], 1944). The provisions of Article 69 provide for the possibility of the ISAO Council providing assistance to contracting states for the development of airport infrastructure. In the event that the ICAO Council recognizes that the airports or other air navigation facilities of a Contracting State do not sufficiently meet the requirements for the safe, regular, efficient and economical operation of international air services, both existing and planned, the Council shall consult with this and other interested States in order to provide recommendations for correction this situation.

Chapter VI of the Convention on International Civil Aviation formulates requirements for international standards and recommended practice (International Civil Aviation Organization, 1944), which are specified in 19 Annexes to the Convention. In particular, Annex 14 "Airports" formulates standards and recommendations regarding the technical and physical characteristics of airports, their component units and the necessary aeronautical equipment (International Civil Aviation Organization, 1951).

Annex 14 clarifies that the certification of aerodromes by States in accordance with ICAO standards is of key importance to ensure the safe development of international air transport, as well as to ensure that States are able to access the sustainable development benefits associated with participation in the global flight network. ICAO standards and recommended practices take into account the needs of member states and non-governmental organizations. Application of the best technological achievements, compliance with ICAO standards and recommended practices are the main factors that the management of each airport strives to take into account in its activities.

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In the Annex 14 contains provisions on planning, design, operation, technical and physical characteristics of airports, objects in airports (width, surface slope, distance between objects), airspace of airports; set requirements for airport and air navigation equipment, visual air navigation aids (pointers, signaling devices, markings, lights, signs, markers), maintenance of airports, airfield operational services, equipment and installations; operation and equipment of the emergency and rescue and firefighting services, as well as the collection and provision of necessary information, in particular information about various areas of the airport, the strength of hard surfaces, the condition of the runway surface, the condition of the emergency and rescue and firefighting services of the airport (International Civil Aviation Organization, 1951).

ICAO develops standards and recommendations for the certification of airports, in particular, Document 9774 "Guide to certification of airfields" is important (International Civil Aviation Organization, 2021), which contains instructional and informational material. The purpose of the recommendations is to provide guidance to States developing national certification standards for land aerodromes. It is assumed that the creation of a national regulatory framework will ensure compliance of facilities, equipment and operational procedures at certified aerodromes with the Standards and Recommended Practices and any national standards and practices. In addition, this manual provides guidance on aerodrome certification procedures and subsequent compliance and enforcement by the aerodrome operator.

The safety of air traffic, in particular, depends on the certificates of aircraft and other aircraft, which the airport seeks to take into account. Only a comprehensive approach to the problem of improving security gives the desired results. Increasing the safety of air traffic is also achieved due to the use of new materials in the construction of aircraft objects. Before using a new or modified material, it undergoes detailed testing, after which it must be certified (Karpenko et al., 2023).

The implementation of aerodrome certification requirements into national legislation will ensure that aerodrome operators fulfill their responsibilities in accordance with the terms and conditions of the aerodrome certification document. Thus, the requirements and procedure for certification of civil airports are set out in the Rules for the Certification of Civil Airports of Ukraine (State Aviation Service of Ukraine, 2021). Airfield certification is a necessary condition for the start of airfield operation, and certification requirements are a set of technical and organizational requirements, the fulfillment of which by the airfield operator is a necessary condition for ensuring flight safety.

2. Research methodology

The methodological basis of the study consists of general and special means of scientific knowledge of the features of the modern practice of airport activity certification, which is of important practical importance for ICAO member states, including Ukraine. The substantiation of the priority directions of the airport certification research in the context of solvi. The study applied a global reporting format analysis method to investigate ICAO recommendations for airport health, runway conditions to minimize the risks, especially in adverse conditions, of the impact of aviation on the environment. Document analysis was used to collect data. Relevant information was obtained from trainings, webinars and documents on the ICAO website, which were constantly updated by international aviation organizations. This made it possible to reveal the current state of legal regulation of the implementation of the relevant regulatory framework, providing airports with the necessary powers to supervise the safety standards of ground operators working on the territory of the airport. The prognostic method made it possible to determine ways to improve air traffic in Ukraine and restore airport infrastructure. Research needs to be created of modern and universal airport certification system that can work seamlessly in different conditions and meet the changing landscape of aviation technology. Existing approaches, despite their value, often struggle to process real-time data and implement intelligent decision-making capabilities. To eliminate these shortcomings, a two-stage

approach to the certification of civil aviation airports is proposed, which allows to overcome the problems faced by traditional methods, there is an opportunity to improve the efficiency, adaptability and scalability of the airspace security system, all constituent elements of airports in dynamic environments.

Compliance with the requirements of standards and recommended practices regarding the certification of airport activities, clarification of the requirements of the acts of international and European civil aviation organizations in the conditions of restoring the safety of civil aviation of Ukraine requires attention, which determines the relevance of the chosen topic.

3. Research results

Airports Council International (ACI) was founded to share experience in solving problems related to the operation of airports, deals with issues of expanding cooperation of international civil airports of the planet; formation of a position on issues of interest to all participants and collective defense of interests; creation of a joint concept to ensure technical, ecological, economic safety of air transport, passengers, crew, cargo safety (Airports Council International [ACI], 2023a). Ukraine became a member in 2014. ACI provides accreditation programs for member airports worldwide, developed with the support of experts from international organizations, consultants and government agencies. Participating airports are accompanied during the accreditation process and supported to close potential gaps and achieve excellence in the most cost-effective and efficient way. ICAO's assistance in the area of aerodrome certification is aimed at building capacity and implementation of aerodrome certification worldwide, and primarily includes assisting States in transposing ICAO provisions into their national regulations, conducting gap analyzes and addressing operational issues identified in the certification process (Shilo, 2019).

The ACI accreditation process (ACI, 2023a) involves the airport conducting a self-assessment, providing a complete questionnaire and evidence initially for online validation. ACI conducts an online interview to discuss the information provided. As a result, accreditation is provided or individual recommendations are given, taking into account the characteristics of each airport. After the expiration date, airports can renew their accreditation by repeating the process.

Since July 2020, ACI has launched the "Airport Health Accreditation" program to assess the sanitary measures implemented at airports in accordance with international recommendations defined by a special working group of ICAO, EASA and ACI. The Health and Safety Accreditation Program focuses on emergency planning and management, auditing of sanitation measures implemented in all airport processes and areas. On August 12, 2020, Istanbul Airport received the first airport medical accreditation certificate for the implementation of strict health and safety

standards in the context of COVID-19 (Istanbul Airport, 2021).

By the end of 2023, 19 airports received ACI Airport Health Accreditation (Groupe ADP, 2023). To combat the pandemic, airports began to use a special system for disinfection with ultraviolet radiation, capable of destroying up to 99.9% of microorganisms (including SARS CoV-2) present on luggage trays at security checkpoints. Accreditation rules take into account cleaning and disinfection, physical distancing, staff protection, distance between passengers and passenger comfort, resulting in confidence and trust. Obtaining an airport health accreditation certificate means that all activities meet international standards. The specially designed housing of the UV lights poses no risk to staff or passengers and can be quickly and easily installed. Health safety is important as airports seek to restore the trust of travelers and staff through safety measures in the event of infectious diseases. On September 27, 2023, the Airports Council International (ACI World) published its quarterly assessment, which analyzes the impact of the COVID-19 pandemic on airports and the path to the recovery of air traffic (ACI, 2023b).

Analysis of ASI statistical data shows that the forecast of global passenger traffic in 2023 was approximately 8.6 billion passengers – 94.2% of the 2019 level. 2024 is expected to be a milestone year for the recovery of global passenger traffic as it reaches 9.4 billion passengers, surpassing 2019's 9.2 billion passengers (102.5% of 2019 levels). Compared to the pre-COVID-19 forecast of 10.9 billion passengers in 2024, the impact of the pandemic represents a potential loss of 13.9%. The analysis was based on ACI World statistics. The results of the analysis are presented in Figures 1–3.

The largest passenger traffic is predicted for the Latin America-Caribbean, Europe, North America destinations. Passenger traffic on other routes is also growing.

The main problem of the decrease in passenger traffic was related to the spread of the Covid-19 pandemic. ICAO experts provide a medium-term forecast of global passenger traffic, taking into account the implementation of standards and recommended practices.
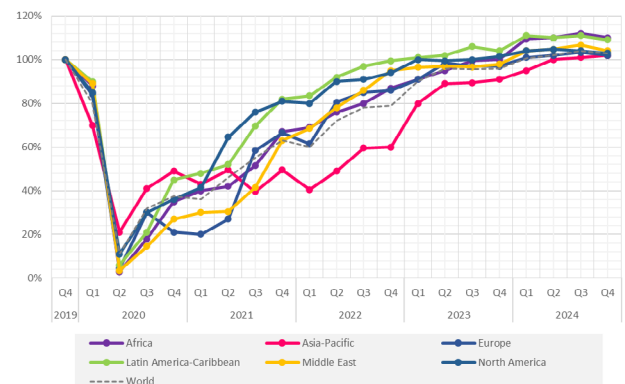

Figure 1. Projected global quarterly passenger traffic compared to the 2019 level (2020–2024, quarterly indexed, 2019 level = 100% (ACI, 2023a)
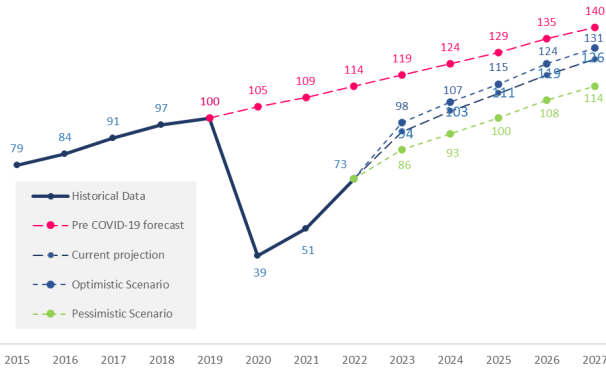
Figure 2. Medium-term global passenger traffic projection (indexed, 2019 = 100)

Figure 3. Global passenger traffic – estimated losses and recovery (in billion passengers)

The largest loss of passenger traffic occurred in 2020. With the development of recommendations by experts of international and European organizations of civil aviation, the passenger flow began to recover. As of April 2024, only 13% is missing from recovery.

Safety and security of airport operations is achieved through the implementation of new technologies and processes to improve safety standards and operational procedures. Effective airport security measures depend on the availability and analysis of information from airports around the world. The information helps identify priority areas, identify gaps and vulnerabilities, and promote airport security. The ACI World Security Data Collection Program requires airport members to provide security information through a centralized, confidential database to help develop security measures at airports around the world.

Researchers around the world are constantly trying to improve air traffic safety. The problem is constantly relevant and multifaceted. The problem concerns the operation and certification of airports, as well as the identification of threats to the correct operation of aircraft. Karpenko M. provides an analysis of complex hydrodynamic processes responsible for the safety of aircraft systems. The correct identification of the weakest links of aircraft systems is useful for improving the reliability and safety of aircraft operation (Karpenko, 2022). The design and construction of airport complexes in Ukraine, the main types of work at the stage of construction, reconstruction, and repair of airport infrastructure facilities are analyzed in a monograph by Ukrainian scientists (Karpov, 2022). The main elements of the airfield are the runway, platform, terminal, maintenance hangar and taxiway. Among taxiway problems, the aeronautical ground lighting system is the most important because it indicates a safe path for the pilot and is related to the daily operational requirements of airports. Accurate and up-to-date runway condition reporting is critical to reducing the risk of a runway departure. This information allows flight crews to make informed decisions about take-off and landing conditions. A standardized approach to reporting ensures a common understanding of all stakeholders. Preparing all industry segments to implement such
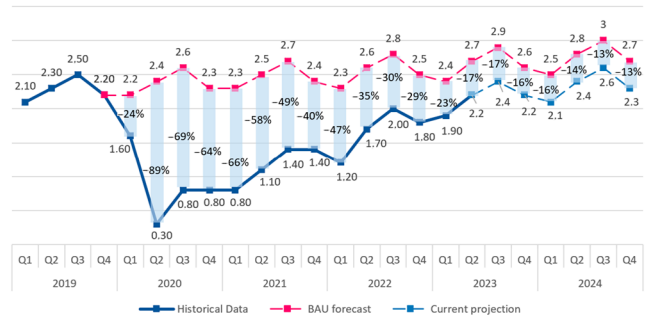
data is critical. The condition of runways and the accurate and timely reporting of their condition is one of the most important issues when it comes to aviation safety. Global Runway Reporter is a reporting application that complies with the updated legislation and allows runway inspectors to report on the condition of the runway (Global Runway Reporter, 2023).

Franklin John concludes that runway excursions are amongst the most serious risks in aviation. EASA's own Annual Safety Review placed runway excursions as one of the top two key-risk areas for large commercial aero plane operations – the top one being aircraft upset. In addition, an IATA study of incident and accident data during the development of the GAPPRE found that between 2005 and the first half of 2019, there were 283 accidents in IATA's global accident database that involved a runway excursion. This equated to 23% of all accidents (Franklin, 2021).

Among the negative factors, one can single out poor braking performance due to contaminated runways, combined with insufficient accuracy in assessing its surface condition and the timeliness of notifications about changes in conditions.

In the annual reports on airplane crashes, for example, analyze the accident the October 17, 2019, accident involving a Saab SA2000 airplane, operated by Peninsula Aviation Services Inc. d.b.a. (Huntlibrary, 2019). Pen Air flight 3296, which overran the end of runway 13 at Unalaska Airport, Unalaska, Alaska. The airplane was substantially damaged during the runway overrun; as a result, of the 3 crewmembers and 39 passengers aboard, 1 passenger sustained fatal injuries, and 1 passenger sustained serious injuries. Eight passengers sustained minor injuries, most of which occurred during the evacuation. Safety issues identified in this report include the potential for cross-wiring of airplane antiskid brake systems.

Truncal Arif determines that runway surface reporting based on aircraft performance allows operations to continue standard and determination of landing and take-off distances at the optimum level. Matching the standard reports obtained through observations with the performance data provided by aircraft manufacturers is a structural advantage of the GRF method (Tuncal et al., 2021).

Direct damage to the aviation industry from runway accidents in 2019 was estimated by the European Union Aviation Safety Agency at more than 4 billion US dollars (European Union Aviation Safety Agency [EASA], 2021). ICAO has developed a new methodology for runway surface condition assessment and reporting, known as the Global Reporting Format (GRF), which will apply from November 2021 (Civil Aviation Authority, 2021). Runways play a key role in aviation safety, providing vital visual guidance to pilots during the most critical phases of flight - takeoff and landing. Despite its apparent simplicity, runway marking is a complex and fine-tuned tool honed over many years of aviation experience. They reflect the industry's ongoing commitment to safety and efficiency, and their importance cannot be overstated.

Runway certification is carried out in order to increase airport safety and reduce the number of ground handling accidents. ACI World works closely with ICAO, EASA and IATA to ensure the implementation of the relevant regulatory framework and to provide airports with the necessary authority to oversee the safety standards of ground operators operating on airport premises. Member States receive best practices and recommended runway safety measures through various resources and training to help airports identify and reduce risks and hazards during take-off and landing. Workers ground handlers must implement safety management systems, and airports must grant operating licenses to qualified ground handlers who take into account safety standards.

It is worth paying attention to the ACI World APEX in Safety program, which helps airports in the certification process to optimize their security measures to promote compliance with ICAO standards. For this purpose, inspections adapted to the unique needs and operational realities of the host airports are carried out. Experts provide guidance and support throughout the inspection process, from assessing the airport's performance to implementing a specific action plan (ACI, 2021). The application of APEX in Safety helps airports to improve the level of safety and compliance with ICAO standards and recommended practices. The review is carried out on site by a team of experts who identify security gaps and contribute to the development of an action plan to eliminate problems in all areas related to aerodrome certification.

An important role is played by the European Union Aviation Safety Agency (EASA), which includes all EU member states, as it has the right to issue general standards that guarantee the highest level of safety, supervise their uniform application in Europe and promote these standards internationally levels. In accordance with its mandate, EASA develops standardized, comprehensive and mandatory rules relating to airport design, operations and equipment based on Annex 14 Aerodromes, Volume I Design and Operation of Aerodromes. This set of standards and recommendations represents international norms based on ICAO documents (EASA, 2023).

EASA contributes to the implementation of EU measures to limit the impact of aviation on the environment through the introduction of requirements in the field of gas emissions and noise, compliance with precise technical criteria for obtaining permits to perform flights. EASA's mandate stipulates that the resolution of safety issues must be free from any political influence. Therefore, the decision is made by a neutral and independent person supported by the Executive Director of EASA, which facilitates the practice of most states that have introduced aviation safety regulatory systems and SARPs recommendations.

To reduce aviation's environmental impact, Airports Council International and its member airports have committed globally to achieve net zero carbon emissions by 2050 with the support of governments. More than 130 ACI member airports have moved their target to 2030 or even earlier. Some plan to be net zero by 2040, while others will need additional support to develop and implement their decarbonization roadmaps. ACI works with governments to support all its members in achieving these ambitious but achievable goals (ACI, 2022a).

The program of voluntary accreditation of European airports regarding the implementation of limiting the impact of aviation on the environment began to operate in June 2009. This made it possible to manage carbon emissions according to a single standard. During the first year of the program, carbon emissions at airports were reduced by 56,633 tons (Carbon Brief, 2023). The following indicators are taken into account during the accreditation of airport activities: display (disclosure of carbon footprint measurement results); reduction (carbon management to reduce carbon emissions); optimization (involvement of third parties in reducing carbon emissions); neutrality (carbon neutrality for direct emissions by compensation) (Agieieva, 2019).

The share of 40 certified European airports in the total number of carbon-neutral airports is 82%, the share of 6 airports in the Asia-Pacific region is 12%. In the regions of Africa, North America, and Latin America, 1 airport is accredited by the level of neutrality, which is 2% of the total number of carbon-neutral airports. This is shown in Figure 4.

ACI's 2022 Annual Report highlights ACI's key achievements as it continued to advance airports' interests at important policy development stages and improve airport
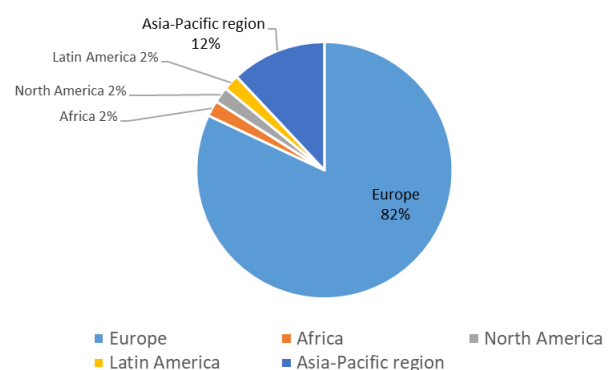

Figure 4. Distribution of the number of carbon-neutral airports by macro-regions of the world

operations. Analysis of the report shows that in 2022, more than 200 European airports participated in the fight against the climate as part of the carbon accreditation of airports (ACI, 2022b). Ukraine has undertaken international legal obligations regarding the implementation of sustainable low-carbon development in all sectors of the economy; creation of an effective legal mechanism that would reliably guarantee the priority of environmental safety; implementation of precautionary measures for environmental protection; safe implementation of the latest technologies, etc. (Verkhovna Rada of Ukraine, 2019).

4. Discussion and interpretation of the obtained results

The ICAO Council condemned the violation of the territorial integrity and airspace of Ukraine and called on the Russian Federation to stop its illegal activities to ensure the safety of flights and the safety of civil aviation in all countries (ICAO, 2023a). On February 26, 2022, the European Union Aviation Safety Agency EASA suspended the validity of all certificates if the holder is located or resides in Russia, which affected the rights of aviation companies under the aviation safety rules covered by EU Regulation 2018/1139. These are licenses of air carriers for products, spare parts, devices, licenses for technical aviation maintenance of airports, as well as licenses for training centers for organizations and training devices for simulating flights.

The EASA announcement of safe air routes is very authoritative for airlines, because there are only two organizations in the world that have global influence: the European EASA and the American FAA. Therefore, when EASA provides an opinion on the approval of routes that Ukraine can organize, it opens up opportunities for the development of civil aviation and the economy of Ukraine and shows that the European Union Aviation Safety Agency confirms the high level of safety guaranteed by Ukraine in the airspace.

In ICAO member states, certification of airfields is carried out according to established procedures. It is worth paying attention to the fact that the development of technologies affects the certification requirements for all airports in the world. The safety and security of airport operations depends on the implementation of new technologies and processes to improve safety standards and operational procedures. Changes in the field of flight safety make it necessary to revise the certification rules. The recommendations take into account accumulated experience, as well as comments and suggestions sent to the Secretary General of ICAO.

The agreement, which launched a new aerodrome certification implementation package (iPack) for airport regulators and operators, was signed in Montreal on 27 July 2023 by ICAO Secretary General Juan Carlos Salazar and ACI World Director General Luis Felipe de Oliveira (ICAO, 2023b).

The Aerodrome Certification Implementation Package (iPack) will assist participating airports, particularly in Ukraine, in the aerodrome certification process by providing access to training and technical assistance, as it contains documentation, tools and an online training course to facilitate each recipient in the aerodrome certification process. The specialist expert will also work with civil aviation authorities and airport operators to provide practical advice. In addition, airport operators receive an expert assessment of their facilities under the auspices of the ACI program. Based on ICAO standards, national regulations and ACI best practices, the new program combines regulatory compliance mandates with day-to-day operational needs to maximize operational efficiency and implement safety standards.

Among the priorities of the Aerodrome Certification Implementation Package are the physical environment of the aerodrome, visual aids and other infrastructure, its operational procedures and safety management system, relevant documentation, as well as the aerodrome's compliance with regulatory requirements for issuing a certificate (Maksym'yuk et al., 2022).

Legal regulation of airport activity is carried out by a number of acts that apply to all airports of EU member states. The main ones are carefully analyzed by O. Grigorov: Regulation No. 95/93 on uniform rules for the allocation of slots in EU airports; Directive No. 96/67/ EU on access to the ground handling market at EU airports; Directive No. 2009/12/ EU on airport charges; Regulation No. 598/2014 on the establishment of rules and procedures for the introduction of operational restrictions related to noise at EU airports, within the framework of a balanced approach; Regulation No. 139/2014 containing requirements and administrative procedures related to aerodromes (Grigorov, 2021).

The State Aviation Service of Ukraine provides information on commercial service entities and airport services that have a Certificate of Conformity or are in the process of certification (State Aviation Service of Ukraine, 2023a). In order for the airports of Ukraine to resume air traffic, they must have the appropriate permit documents for the start of work.

Airports of Ukraine must have appropriate certificates, documents on the possibility of launching regular flights to the territory of the EU; compliance with the requirements of the light signaling system, runways and others infrastructure elements that are not yet ready to receive regular flights. All Ukrainian airports are working on meeting certification requirements. The state bodies of Ukraine, the best specialists in the field of private passenger and cargo aviation for consulting and optimization of the airport, etc., are involved in the implementation of the complex of measures. Elements of the airport infrastructure operate according to the rules of martial law.

The State Aviation Service of Ukraine adopted for application the requirements for certification (State Aviation Service of Ukraine, 2023b), defined for subjects of civil aviation activity of Ukraine. Ukraine is interested in certification of its aviation equipment according to ICAO standards, it is one of the few countries in the world that has its own aircraft industry, manufactures aircraft and aircraft engines. In the field of air traffic safety organization,

Ukraine can be considered fully integrated into the EU technically, organizationally and legally since receiving the certification of the European Union Aviation Safety Agency (EASA) in 2019. Aviation rules of Ukraine "Civilian certification rules aerodromes of Ukraine" (2021) were adopted for the purpose of state supervision of compliance with the requirements established by law regarding civil aerodromes and implementation of airfield certification procedures (State Aviation Service of Ukraine, 2021). The rules take into account the requirements of Annex 14 regarding the provision of a specific plane of the runways, their dimensions and the limitation of obstacles, determine the requirements for the arrangement aerodromes, as well as airstrips of the state aviation of Ukraine in order to ensure the safety of aircraft flights.

Annexes to the Airport Certification Rules regulate the types of airport activities subject to certification: aviation fuel-supply of aviation transportation and works; provision of service for passengers, baggage, mail and cargo; ground administration at the airport; service on the apron and aircraft parking areas. Facilities, equipment and aviation ground equipment subject to mandatory certification include: airfield; lighting equipment of airfields; radio equipment; meteorological equipment installed at the airfield; aviation fuels and lubricants and special liquids. Operation of the airfield for the purpose of air transportation and/or aviation operations in the absence of a certificate or in case of termination or cancellation of the certificate obtained in accordance with the Aviation Rules is prohibited.

During the shelling, rocket-bomb strikes caused countless damage to Ukrainian airports, destroyed runways, airfields, airport terminals, and technical equipment. It will take a long time to restore such destruction, and new programs for the development of the airport industry must be adopted. The material and technical base of the airports was damaged. To date, more than half of all Ukrainian airports and airfields have been damaged by missile strikes. Some of the airfields were repeatedly shelled. Experts emphasize that detailed information on the state of damage for the repair of airfields at most airports can be established only after detailed technical surveys, which are possible only after the end of active hostilities in the area where the airports are located (Kyiv School of Economics KSE, 2023a).

According to preliminary estimates by experts, the restoration of Ukraine's aviation infrastructure and personnel will cost more than $10 billion (State Aviation Service of Ukraine, 2023c). The scale of all destruction is still impossible to assess due to constant shelling. In addition to infrastructural damage, for example, at the Kherson airport, there is another problem – the territory of the airport, which is more than 300 hectares, is completely mined. According to Kyiv School of Economics (KSE), one inspection of the airport costs approximately UAH 0.5 million (Kyiv School of Economics, 2023b).

In December 2020, Odessa International Airport received a certificate of construction readiness for a new runway. The airport's runway received its first aircraft in

July 2021. Due to a missile attack in April 2022, the runway of Odesa Airport was completely destroyed. Its further use is impossible.

In July 2022, Ukraine presented a plan for the post-war reconstruction of the state in the Swiss city of Lugano, the result of which was a joint declaration of 40 states on the support of Ukraine on the road to recovery after the military aggression of the Russian Federation. Ukraine recovery plan (State Aviation Service of Ukraine, 2022) is aimed at accelerating sustainable economic growth. The recovery plan and the road map of this recovery must be ready before the end of the war. Of course, the plan will undergo adjustments depending on different circumstances. The Cabinet of Ministers of Ukraine created the National Council for the Recovery of Ukraine from the Consequences of the War (Cabinet of Ministers of Ukraine, 2022). Recovery of any airport is a long and expensive process. It certainly depends on the scale of the destruction of the runway. Its recovery takes a long time. If the resort is in critical condition (up to the physical destruction of the runway), it can be years. It will also be necessary to provide control and management of the airspace, and for this, special radars are needed, because this is a very specialized technique.

In 1.5–2 years, you can build a normal functional terminal with all the necessary infrastructure from scratch. Infrastructure related to the runway is being built over the course of 2–5 years. If these processes take place in parallel, it is realistic to plan the construction of a regional airport in 2–3 years. Of course, if there are all the necessary funds, contractors and so on. The most expensive is the runway, it costs from $100 to $300 million depending on the length, thickness and width. First of all, after the opening of the airspace, airports in Boryspil, Lviv, Odesa will be restored. Recovery airports of Ukraine, taking into account the great destruction, in our opinion, depends on the possibilities of various sources of financing, for example, excise tax on aviation fuel, dividends of state, state guarantees funds under, infrastructure bonds, International organizations, funds of institutional investors and others, this is shown in Figure 5.

In November 2022, member states of the European organization Eurocontrol, which is engaged in supporting European aviation and works in the field of air traffic management in the European region, approved the creation
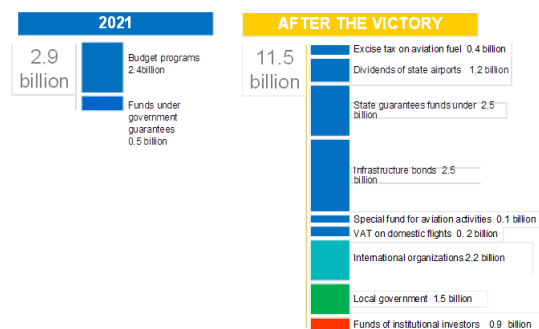

Figure 5. Financing recovery airport infrastructure of Ukraine

of voluntary solidarity funds to support member states affected by the war (Eurocontrol, 2022). Eurocontrol member states announced the creation of a voluntary Aeronautical Solidarity Fund to support Ukraine during the suspension of flights in Ukrainian airspace. In particular, this Fund will make it possible to finance measures to restore air navigation services and provide financial support to Ukraine for the period of martial law.

At the end of 2023, Boryspil International Airport, the largest airport in Ukraine, received a Primary Award certificate from the Chartered Institute of Procurement & Supply (CIPS), the largest professional procurement and supply management organization in the world, for its procurement system in compliance with CIPS global standards (Cabinet of Ministers of Ukraine, 2023). This certificate confirms the airport's transparent, efficient and ethical procurement system. This is an important step towards the future sustainable development of Boryspil International Airport in the context of recovery, the certificate confirms that the company's procurement system works at a high level of standards for all partners, state and international financial institutions, investors. The airport implemented a compliance system to meet international standards, developed new procurement strategies, and implemented anti-corruption measures.

Successful completion of the certification is a confirmation that procurement activities at Boryspil Airport are organized in accordance with the highest international standards for procurement and supply management. The certification program was developed by SIPS, as the largest professional organization in the world that sets benchmarks for the procurement function and the company's supply chain at all levels and cooperates with leading global organizations such as the European Central Bank, UBS, Bank of England, BAE Systems Air, American Express, Xerox Corporation. In extremely difficult circumstances, specialists focus their attention on improving all elements of the airport for the purpose of the safety of Ukrainian civil aviation.

5. Conclusions

At the current stage of the development of civil aviation, the main universal legal requirements for the operation of international airports are concentrated in the Chicago Convention of 1944, and the standards and recommended practice are set out in Annex 14 to the Convention, the Manual on the Certification of Airports, EU regulations and directives on airport operations. Taking into account this experience in Ukraine's cooperation with international and European civil aviation organizations in the field of airport certification will contribute to the implementation of plans to intensify cooperation between Ukraine and the EU in the aviation sector, as well as recovery capabilities of our state for the safety of civil aviation flights. The infrastructure of the airport needs constant attention, it is important to implement a set of measures to restore the operational

and technical suitability of the airport, terminals, energy systems and water supply, IT systems, elevators, parking lots, all special equipment and machinery.

The civil aviation authorities of Ukraine perform the necessary work to comply with the standards and recommended practices of Annex 14 and other relevant provisions of ISAO to ensure the safety, regularity and efficiency of the aerodrome operation after recovery. In modern realities, the restoration and development of the infrastructure of airports in Ukraine requires the allocation of funds from international funds and organizations. Airports must be ready to receive or send civil flights, that is, to obtain certification from the Airports Council International, the European Aviation Safety Association. Recovery destroyed airport infrastructure, obtaining the necessary certificates takes time. Understanding and applying the best advances in technology, adherence to ISAO standards and recommended practices are the main factors that airport management strives to take into account in its operations. After guaranteeing safety in the sky, access to the aviation industry of Ukraine will be given to international organizations that carry out control and supervision in the field of civil aviation.

Disclosure statement

The authors declare that there is no conflict of interest. In this study, there is no need for ethics committee approval because of using open-source databases.

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