Electronic scientific and practical journal

INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

#16 (2022)
December '22

WWW.SMART-SCM.ORG
ISSN 2708-3195
DOI.ORG/10.46783/SMART-SCM/2022-16

ISSN 2708-3195
9 772708 319005

Electronic scientific and practical collection
INTELLECTUALIZATION OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Electronic scientific and practical publication in economic sciences

Electronic scientifically and practical journal "Intellectualization of logistics and Supply Chain Management" included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)

Field of science: Economic.
Specialties: 051 – Economics; 073 – Management

ISSN 2708-3195
DOI: https://doi.org/10.46783/smart-scm/2022-16

The electronic magazine is included in the international scientometric databases:
Index Copernicus, Google Scholar

Released 6 times a year

№ 16 (2022)
December 2022

Kyiv - 2022

Founder: Viold Limited Liability Company

The electronic scientific and practical journal is registered in international scientometric data bases, repositories and search engines. The main characteristic of the edition is the index of scientometric data bases, which reflects the importance and effectiveness of scientific publications using indicators such as quotation index, h-index and factor impact (the number of quotations within two years after publishing).

In 2020, the International Center for Periodicals (ISSN International Center, Paris) included the Electronic Scientific and Practical Edition "Intellectualization of logistics and Supply Chain Management" in the international register of periodicals and provided it with a numerical code of international identification: ISSN 2708-3195 (Online).

Recommended for dissemination on the Internet by the Academic Council of the Department of Logistics NAU (No. 7 of February 26, 2020). Released 6 times a year. Editions references are required. The view of the editorial board does not always coincide with that of the authors.

Electronic scientifically and practical journal "Intellectualization of logistics and Supply Chain Management" included in the list of scientific publications of Ukraine in the field of economic sciences (category "B"): *Order of the Ministry of Education and Culture of Ukraine dated October 10, 2022 No. 894 (Appendix 2)*

Field of science: Economic.

Specialties: 051 – Economics; 073 – Management

t.me/smart_scm
facebook.com/Smart.SCM.org
twitter.com/ScmSmart

DOI: https://doi.org/10.46783/smart-scm/2022-16
e-mail: support@smart-scm.org

тел.: (063) 593-30-41
https://smart-scm.org

Contents

UDC 005.935:658.7
DOI: https://doi.org/10.46783/smart-scm/2022-16-1
JEL Classification: L15, O11, Q13.
Received: 04 November 2022

Bugayko D.O. Doctor of Science (Economics), Professor (Associate), Corresponding Member of the Academy of Economic Sciences of Ukraine, Vice - Director of ES International Cooperation and Education Institute, Instructor of ICAO Institute, Professor of the Logistics Department National Aviation University (Ukraine)

ORCID – 0000-0002-3240-2501
Researcher ID – ABF-5564-2021
Scopus author id: – 57216582348

Shevchenko O.R. PhD in Economics, Director of ES International Cooperation and Education Institute, National Aviation University (Ukraine)

ORCID –
Researcher ID –
Scopus author id: –

Perederii N.M. PhD in Economics, Vice-Dean Faculty of Management, Transport and Logistics, Professor (Associate) of the Department of Air Transportation Management National Aviation University (Ukraine)

ORCID – 0000-0003-4173-9445
Researcher ID –
Scopus author id: –

Sokolova N.P. PhD at Technical Sciences, Professor (Associate) of the Automation and Energy Management Department National Aviation University (Ukraine)

ORCID – 0000-0001-5190-2934
Researcher ID –
Scopus author id: –

Podrieza M.S. Graduate student of the Department of Management of foreign economic activity of enterprises National aviation university (Ukraine)

ORCID –
Researcher ID –
Scopus author id: –

Bugayko D.D. Student of the Logistics Department National Aviation University (Ukraine)

ORCID –
Researcher ID –
Scopus author id: –

PROACTIVE RISK MANAGEMENT OF UKRAINIAN AVIATION TRANSPORT POST-WAR RECOVERY AND SUSTAINABLE DEVELOPMENT

Dmytro Bugayko, Olga Shevchenko, Nadiia Perederii, Natalia Sokolova, Mykhaylo Podrieza, Danylo Bugayko. "Risk management of Ukrainian aviation transport post-war recovery and sustainable development". *Global air transport is an open system that is influenced by a large number of factors, both related and unrelated. One of its most vulnerable components is the activity of airlines. This is especially felt during the period of hostilities. The Malaysian Airlines Boeing 777 crash as a result of being hit by a Russian missile and the 2014 Boeing 737 crash of Ukraine International Airlines in Iran as a result of being hit by Iranian anti-aircraft missiles in 2020 are examples of the vulnerability of civil aviation in the rapidly changing conditions of military operations and determine the need for anticipatory risk management of airlines. Unfortunately, the full-scale military aggression of the Russian Federation against Ukraine from the first minute dealt a devastating blow to the activity of air transport in general, and to the activity of Ukrainian airlines, in particular. In order to formulate strategic scenarios for the post-war recovery and sustainable development of air transport of Ukraine, the article proposes to use the Concept of National Integrated Risk Management of Air Transport of Ukraine.*

Keywords*:* aviation transport, risk management, post-war recovery, sustainable development of civil aviation.

Дмитро Бугайко, Ольга Шевченко, Надія Передерій, Наталія Соколова, Михайло Подрєза, Данило Бугайко. «Ризик менеджмент повоєнного відновлення та сталого розвитку авіаційного транспорту України». *Світовий авіаційний транспорт є системою відкритого типу, на яку мають вплив велика кількість, як пов'язаних, так і не пов'язаних між собою чинників. Однією із найбільш вразливих його складових є діяльність авіакомпаній. Особливо це відчувається у період проведення воєнних дій. Катастрофа Боїнг 777 Малайзійських Авіаліній у наслідок влучення російської ракети та катастрофа у 2014 році Боїнг 737 Міжнародних авіаліній України в Ірані у наслідок влучення іранських протиповітряних ракет у 2020 році є прикладом вразливості цивільної авіації у швидкозмінних умовах воєнних дій та обумовлюють необхідність застосування випереджаючого ризик менеджменту авіакомпаній. На жаль повномасштабна воєнна агресія Російської Федерації проти України з першої хвилини нанесла руйнівний удар по діяльності авіаційного транспорту в цілому, та на діяльність авіакомпаній України, зокрема. У статті з метою формулювання стратегічних сценаріїв післявоєнного відновлення та сталого розвитку авіаційного транспорту України пропонується використання Концепції національного управління інтегрованими ризиками авіаційного транспорту України.*

Ключові слова: авіаційний транспорт, ризик менеджмент, повоєнно відновлення, сталий розвиток цивільної авіації.

Дмитрий Бугайко, Ольга Шевченко, Надежда Передерий, Наталья Соколова, Михаил Подреза, Даниил Бугайко. «Риск менеджмента послевоенного восстановления и устойчивого развития авиационного транспорта Украины». *Мировой авиационный транспорт является системой открытого типа, на которую оказывают влияние большое количество как связанных, так и не связанных между собой факторов. Одной из наиболее уязвимых его составляющих является деятельность авиакомпаний. Особенно это ощущается в период проведения военных действий. Катастрофа Боинг 777 Малайзийских Авиалиний в результате попадания российской ракеты и катастрофа в 2014 году Боинг 737 Международных авиалиний Украины в Иране в результате*

попадания иранских противовоздушных ракет в 2020 году является примером уязвимости гражданской авиации в необходимости изменяющихся условий военно-транспортных условий. К сожалению, полномасштабная военная агрессия Российской Федерации против Украины с первой минуты нанесла разрушительный удар по деятельности авиационного транспорта в целом, и на деятельность авиакомпаний Украины, в частности. В статье с целью формулирования стратегических сценариев послевоенного обновления и устойчивого развития авиационного транспорта Украины предлагается использование Концепции национального управления интегрированными рисками авиационного транспорта Украины.

Ключевые слова: авиационный транспорт, риск менеджмент, послевоенное восстановление, устойчивое развитие гражданской авиации.

Introduction. Global air transport is an open system that is influenced by a large number of factors, both related and unrelated. One of its most vulnerable components is the activity of airlines. Unfortunately, the full-scale military aggression of the Russian Federation against Ukraine from the first minute dealt a devastating blow to the activity of air transport in general, and to the activity of Ukrainian airlines, in particular. In order to formulate strategic scenarios for the post-war recovery and sustainable development of air transport of Ukraine, the article proposes to use the Concept of National Integrated Risk Management of Air Transport of Ukraine. The article is a logical continuation of a number of publications devoted to the development of air transport sustainable development of Ukrainian scientists Y. Kharazishvili [1 -4, 8], D. Bugayko [1 – 11], O.Shevchenko [11], A.Antonova [8], M. Hryhorak [3 – 4], Y. Ierkovska [6 – 7], O. Ovdiienko [4], V. Marchuk [4], V Lyashenko[5], V Sokolovskiy [5], V Baranov[5], M. Bahrii [7], Polish scientists (Z.Zamiar [3,8]), Azerbaijan Scientists F. Aliev [7], and scientists of other countries.

The purpose of the article is to provide structural analysis of risk management mesuares for Ukrainian aviation transport and to represent instutiom mesuares for post-war recovery and sustainable development of aviation industry.

Presentation of the main results.

Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of Ukrainian airlines

Table 1 offers strategic scenarios for the post-war recovery and sustainable development of Ukrainian airlines.

Threats to Ukrainian airlines:

– Delay in the evacuation of aviation equipment abroad. Planes of Ukrainian airlines partially remained at other blocked airports, which created a real threat to operations.

– Problems with the leasing fleet of aircraft. One of the indisputable immediately pre-war triggers was the refusal to further fulfill the leasing conditions of a number of leasing companies, which led to the return of a significant part of the aircraft equipment of the airlines "Ukraine International Airlines", "Sky Up", "Bees" in the last weeks before the start of hostilities. On the one hand, it protected them from possible destruction and damage. On the other hand, the operating fleet of Ukrainian airlines has been significantly reduced.

– Closure of Ukrainian airspace for civil aviation flights. Closing the airspace of Ukraine for civil aviation flights on the first day of the war is a necessary and effective measure to protect civil aviation in the conditions of military operations. At the same time, the operational activities of Ukrainian airlines are currently possible only from foreign bases under charter programs, which significantly narrows the potential market for air transportation and reduces possible financial income.

Therefore, the above-mentioned threats led to an increase in the *Vulnerability of Ukrainian airlines*, which is expressed in:

– Vulnerabilities of aviation equipment in the conditions of direct hostilities.

– Imperfections of the leasing conditions in terms of using the principle of force majeure in wartime.

– Impossibility of performing commercial air transport activities by airlines of Ukraine.

The combination of the mentioned threats and vulnerabilities leads to the following *Consequences for Ukrainian airlines*:

– Losses and damage to aviation equipment. Airline planes continue to be under attack from the air and the ground at other blocked airports and airports that are potential targets of enemy airstrikes.

– Some of the planes of the fleet of Ukrainian air carriers were recalled by lessors, which sharply reduced the operational capabilities of Ukrainian airlines.

– The suspension of commercial air transport activities in the airspace of Ukraine led to the suspension of the aviation activities of a number of Ukrainian airlines and to a sharp reduction in the operational activities of others.

The main negative results of the above were the decrease in the level of efficiency and safety of Ukrainian airlines, which consists of:

– Problems with maintaining the national agreed level of aviation security.

– Leads to possible bankruptcy of Ukrainian airlines.

– Leads to significant losses of the effective aircraft fleet of Ukrainian airlines

We offer to consider *optimistic*, *realistic and pessimistic strategic scenarios of post-war recovery and sustainable development of Ukrainian airlines*

The optimistic scenario includes:

– Updating the provisions of the Safery State Program (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) regarding the conditions of post-war reconstruction and sustainable development [12].

– Development of mechanisms for the support of domestic airlines in the post-war period by the state.

– Stopping the destruction of aviation equipment

– Optimization of the aircraft leasing fleet under conditions of dynamic recovery of the air transportation market.

– Gradual return to the level of profitability of Ukrainian airlines in the second year after the war.

A realistic scenario includes:

– Updating the provisions of the Safery State Program (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) regarding the conditions of post-war reconstruction and sustainable development [12].

– Development of mechanisms for partial support of domestic airlines in the post-war period by the state.

– Insignificant subsequent damage to aviation equipment as a result of hostilities

– Step-by-step optimization of the aircraft leasing fleet under conditions of gradual recovery of the air transport market.

– Gradual return to the level of profitability of Ukrainian airlines in the third year after the war.

The pessimistic scenario includes:

– Updating the provisions of the Safery State Program (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) regarding the conditions of post-war reconstruction and sustainable development [12].

– Impossibility of implementing support mechanisms for domestic airlines in the post-war period by the state due to a significant decrease in GDP.

– Considerable further destruction and damage to aviation equipment as a result of hostilities

Table 1 – Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of Ukrainian airlines

Classification of threats	Vulnerability of protection systems (GAP Analysis)	Consequences	Risks	Implementation of strategic scenarios
1. Threats to airlines:	***1. Vulnerability of airlines:***	***1. Consequences for airlines:***	***1. Reduction in the level of efficiency and safety of airline operations:***	***The optimistic scenario*** *1.1. Update of the provisions of the Safery State Program (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) regarding the conditions of post-war recovery and sustainable development* [12].
1.1 Delay in the evacuation of aircraft equipment abroad.	*1.1. Insecurity of aviation equipment in the conditions of direct hostilities.*	*1.1 Losses and damage to aviation equipment. Airline planes continue to be under attack from the air and the ground at blocked airports.*	*1.1 Problems with maintaining the national agreed level of aviation security.*	*1.2. The development of mechanisms for the support of domestic airlines in the post-war period by the state.* *1.3. Stopping the destruction of aviation equipment* *1.4. Optimization of the aircraft leasing fleet under conditions of dynamic recovery of the air transportation market.* *1.5. Gradual return to the level of profitability of Ukrainian airlines in the second year after the war*
1.2. Problems with the leasing fleet of aircraft.	*1.2. Imperfection of the leasing conditions in terms of the use of the principle of force majeure in wartime.*	*1.2 Some of the aircraft in the fleet of Ukrainian air carriers were recalled by the lessors*	*1.2 Bankruptcy of national airlines.*	***The realistic scenario*** *1.1 Update of the provisions of the Safery State Program (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) regarding the conditions of post-war reconstruction and sustainable development* [12]. *1.2. Development of mechanisms for partial support of domestic airlines in the post-war period by the state.* *1.3. Insignificant subsequent damage to aircraft as a result of hostilities* *1.4. Step-by-step optimization of the aircraft leasing fleet under conditions of gradual recovery of the air transport market.* *1.5. Gradual return to the level of profitability of Ukrainian airlines for the third year after the war*
1.3. Closure of Ukrainian airspace for civil aviation flights	*1.3. Impossibility of performing commercial air transport activities by airlines of Ukraine*	*1.3. Termination of commercial air transport activities in the airspace of Ukraine*	*1.3 Significant losses of the effective aircraft fleet of Ukrainian airlines*	***The pessimistic scenario*** *1.1 Update of the provisions of the Safery State Program (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) regarding the conditions of post-war reconstruction and sustainable development* [12]. *1.2. Impossibility of implementing support mechanisms for domestic airlines in the post-war period by the state due to a significant decrease in GDP.* *1.3. Significant further destruction and damage to aviation equipment as a result of hostilities* *1.4. Loss of the main part of the aircraft leasing fleet due to prolonged stagnation in the air transport market.* *1.5. Gradual return to the level of profitability of Ukrainian airlines for the fifth year after the war*

Source: developed by D. Bugayko

– Loss of the main part of the aircraft leasing fleet due to prolonged stagnation in the air transport market.

Gradual return to the level of profitability of Ukrainian airlines for the fifth year after the war.

Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the system of airports and airfields of Ukraine

The system of airports and airfields of Ukraine became one of the main goals of the aggressor from the first day of the war. In Table 2 strategic scenarios of post-war recovery and sustainable development of the system of airports and airfields of Ukraine are proposed.

Threats to the system of airports and airfields of Ukraine:

– Air and ground strikes on buildings, infrastructure and equipment of airports and airfields.

– Closure of airspace for civil aviation flights from airports and airfields. Closing the airspace of Ukraine for civil aviation flights on the first day of the war is a necessary and effective measure to protect civil aviation in the conditions of military operations. At the same time, the operational activity of the system of airports and airfields of Ukraine is currently impossible.

Therefore, the above-mentioned threats led to an increase in *the Vulnerability of the system of airports and airfields of Ukraine*, which is expressed in:

– Vulnerabilities of buildings, infrastructure and equipment of airports and airfields in the conditions of direct hostilities.

– Impossibility of performing commercial air transport activities in the system of airports and airfields of Ukraine.

The combination of the mentioned threats and vulnerabilities leads to the following *consequences for the system of airports and airfields of Ukraine*:

– Buildings, runways, taxiways, aprons and equipment of a number of airports and airfields were damaged to varying degrees, and they continue to be at risk of air and ground strikes.

– Termination of commercial air transport activities by the system of airports and airfields of Ukraine

The main negative results of the above were the decrease in the level of efficiency and safety of the system of airports and airfields of Ukraine, which consists of:

– Problems with maintaining the national agreed level of aviation security.

– Significant destruction of buildings, infrastructure and equipment of airports and airfields of Ukraine.

– Possibilities of bankruptcy of the national system of airports and airfields of Ukraine.

We offer to consider *optimistic*, *realistic and pessimistic strategic scenarios of post-war recovery and sustainable development of the system of airports and airfields of Ukraine*.

The optimistic scenario includes:

– Updating the provisions of the State target program for the development of airports for the period until 2023 (Resolution of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016) regarding the conditions of post-war recovery and sustainable development [13].

– Development of mechanisms for the support of the system of airports and airfields in the post-war period by the state.

– Stopping the destruction of buildings, infrastructure and equipment of airports and airfields

– Complex reconstruction of the system of airports and airfields of Ukraine

– Gradual exit to the level of profitability of the system of airports and airfields in the second year after the war.

Table 2 - Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the system of airports and airfields in Ukraine.

Classification of threats	Vulnerability of protection systems (GAP Analysis)	Consequences	Risks	Implementation of strategic scenarios
2. Threats to the system of airports and airfields:	**2. Vulnerability of the system of airports and airfields:**	**2. Consequences for the system of airports and airfields:**	**2. Reduction of the level of efficiency and safety of the system of airports and airfields:**	***The optimistic scenario*** *2.1. Update of the provisions of the State target program for the development of airports for the period until 2023 (Resolution of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016) regarding the conditions of post-war recovery and sustainable development* [13]. *2.2. Development of mechanisms for the support of the system of airports and airfields in the post-war period by the state.* *2.3. Stopping the destruction of buildings, infrastructure and equipment of airports and airfields* *2.4. Comprehensive reconstruction of the system of airports and airfields of Ukraine* *2.5. Gradual exit to the level of profitability of the system of airports and airfields in the second year after the war* ***The realistic scenario*** *2.1. Update of the provisions of the State target program for the development of airports for the period until 2023 (Resolution of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016) regarding the conditions of post-war recovery and sustainable development* [13]. *2.2. Development of mechanisms for partial support of domestic airlines in the post-war period by the state.* *2.3. Minor further damage to buildings, infrastructure and equipment of airports and airfields as a result of military operations* *2.4. Step-by-step reconstruction of the system of airports and airfields of Ukraine, primarily international hub airports and gradually regional airports/airfields.* *2.5. Gradual return to the level of profitability of the system of airports and airfields of Ukraine for the third year after the war* ***The pessimistic scenario*** *2.1. Update of the provisions of the State target program for the development of airports for the period until 2023 (Resolution of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016) regarding the conditions of post-war recovery and sustainable development* [13]. *2.2. Impossibility of implementation of support mechanisms for the system of airports and airfields in the post-war period by the state due to a significant decrease in GDP.* *2.3. Significant further destruction and damage to buildings, infrastructure and equipment of airports and airfields as a result of military operations.* *2.4. Partial reconstruction of the system of airports and airfields of Ukraine, primarily international hub airports, with a significant delay in regional airports/airfields.* *2.5. Gradual return to the level of profitability of the system of airports and airfields of Ukraine for the fifth year after the war*
2.1 Air and ground strikes on buildings, infrastructure and equipment of airports and airfields	*2.1. Vulnerability of buildings, infrastructure and equipment of airports and airfields in the conditions of direct hostilities.*	*2.1. Buildings, runways, taxiways, aprons and equipment of a number of airports and airfields were damaged to varying degrees, and as of May 2022, they continue to be at risk of air and ground strikes.*	*2.1 Problems with maintaining the national agreed level of aviation security.*	
2.2. Closure of airspace for civil aviation flights from airports and airfields	*2.2. Impossibility of carrying out commercial air transport activities by the system of airports and airfields of Ukraine*	*2.2. Suspension of commercial air transport activities by the system of airports and airfields of Ukraine*	*2.2 Significant destruction of buildings, infrastructure and equipment of airports and airfields of Ukraine* *2.3 Bankruptcy of the national system of airports and airfields of Ukraine.*	

Source: developed by D. Bugayko

Table 3 – Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the air traffic control system of Ukraine

Classification of threats	*Vulnerability of protection systems (GAP Analysis)*	*Consequences*	*Risks*	*Implementation of strategic scenarios*
3. Threats to the air traffic control system:	***3. Vulnerability of the air traffic control system:***	***3. Consequences for the air traffic control system:***	***3. Reduction of the level of efficiency and safety of the air traffic control system:***	***The optimistic scenario.*** *3.1. The development of mechanisms to support the system of commercial activity by the air traffic control system in the post-war period from the side of the state.* *3.2. Stopping the destruction of buildings, infrastructure and equipment of commercial activity by the air traffic control system.* *3.3. Comprehensive reconstruction of commercial activity by the air traffic control system of Ukraine* *3.4. Gradual exit to the level of profitability of commercial activity by the air traffic control system in the second year after the war*
3.1 Air and ground strikes on buildings, infrastructure and air traffic control system equipment	*3.1. Vulnerability of buildings, infrastructure and equipment of the air traffic control system in the conditions of direct hostilities.*	*3.1. Buildings, infrastructure and equipment of the air traffic control system, which, as of May 2022, continues to be vulnerable to air and ground strikes, sustained varying degrees of damage.*	*3.1 Problems with maintaining the national agreed level of aviation security.*	***The realistic scenario*** *3.1. Development of mechanisms for partial support of commercial activity by the air traffic control system in the post-war period by the state.* *3.2. Minor further damage to buildings, infrastructure and equipment of commercial activities by the air traffic control system as a result of hostilities* *3.3. Step-by-step reconstruction of the system of commercial activity by the air traffic control system of Ukraine, primarily to ensure air navigation support on the route, international hub airports and gradually regional airports/airfields.* *3.4. Gradual return to the level of profitability of the commercial activity of the air traffic control system of Ukraine in the third year after the war*
3.2. Closure of airspace for civil aviation flights	*3.2. Impossibility of performing commercial activities by the air traffic control system*	*3.2. Understanding of commercial activity by the air traffic control system*	*3.2. Significant destruction of buildings, infrastructure and equipment of the air traffic control system of Ukraine* *3.3 Bankruptcy of the national air traffic control system of Ukraine.*	***The pessimistic scenario*** *3.1. Impossibility of implementation of mechanisms to support the air traffic control system in the post-war period by the state due to a significant decrease in GNP.* *3.2. Significant further destruction and damage to buildings, infrastructure and air traffic control system equipment as a result of hostilities.* *3.3. Partial reconstruction of the air traffic control system of Ukraine, primarily to ensure air navigation support on the route, international nodal airports-hubs, with a significant delay of regional airports/airfields.* *3.4. Gradual return to the level of profitability of the system of airports and airfields of Ukraine for the fifth year after the war*

Source: developed by D. Bugayko

A realistic scenario includes:

– Updating the provisions of the State target program for the development of airports for the period until 2023 (Resolution of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016) regarding the conditions of post-war recovery and sustainable development [13].

– Development of mechanisms for partial support of domestic airlines in the post-war period by the state.

– Minor further damage to buildings, infrastructure and equipment of airports and airfields as a result of military operations

– Step-by-step reconstruction of the system of airports and airfields of Ukraine, first of all, international hub airports and gradually regional airports/airfields.

– Gradual return to the level of profitability of the system of airports and airfields of Ukraine in the third year after the war.

The pessimistic scenario includes:

– Updating the provisions of the State target program for the development of airports for the period until 2023 (Resolution of the Cabinet of Ministers of Ukraine No. 126 of February 24, 2016) regarding the conditions of post-war recovery and sustainable development [13].

– Impossibility of implementation of support mechanisms for the system of airports and airfields in the post-war period by the state due to a significant decrease in GDP.

– Significant further destruction and damage to buildings, infrastructure and equipment of airports and airfields as a result of military operations.

– Partial reconstruction of the system of airports and airfields of Ukraine, primarily international hub airports, with a significant delay in regional airports/airfields.

– Gradual return to the level of profitability of the system of airports and airfields of Ukraine for the fifth year after the war.

Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the air traffic control system of Ukraine

Together with the system of airports and airfields, the air traffic control system of Ukraine became one of the main goals of the aggressor from the first day of the war. Table 3 offers strategic scenarios for post-war recovery and sustainable development of the air traffic control system of Ukraine.

Threats to the air traffic control system of Ukraine:

– Air and ground strikes on buildings, infrastructure and equipment of the air traffic control system

– Closure of airspace for civil aviation flights

Therefore, the above-mentioned threats led to an increase in *the Vulnerability of the air traffic control system of Ukraine*, which is expressed in:

– Vulnerabilities of buildings, infrastructure and equipment of the air traffic control system in the conditions of direct hostilities

– Impossibility of performing commercial activities with the air traffic control system

– The combination of the mentioned threats and vulnerabilities leads to the following Consequences for the air traffic control system of Ukraine:

– Buildings, infrastructure, and equipment of the air traffic control system, which continues to be vulnerable to air and ground strikes have suffered varying degrees of damage.

– Suspension of commercial activity by the air traffic control system.

The main negative results of the above were the decrease in the level of efficiency and safety of the air traffic control system of Ukraine, which consists of:

– Problems with maintaining the national agreed level of aviation security

– Significant destruction of buildings, infrastructure and equipment of the air traffic control system of Ukraine

– Possibilities of bankruptcy of the air traffic control system of Ukraine.

We propose to consider *optimistic, realistic and pessimistic strategic scenarios of post-war recovery and sustainable development of the air traffic control system of Ukraine*.

The optimistic scenario includes:

– Development of mechanisms to support the system of commercial activity by the air traffic control system in the post-war period on the part of the state.

– Stopping the destruction of buildings, infrastructure and equipment of commercial activities by the air traffic control system.

– Comprehensive reconstruction of the commercial activity of the air traffic control system of Ukraine

– Gradual exit to the level of profitability of commercial activity of the air traffic control system in the second year after the war.

A realistic scenario includes:

– Development of mechanisms for partial support of commercial activity by the air traffic control system in the post-war period from the side of the state.

– Minor further damage to buildings, infrastructure and equipment of commercial activities by the air traffic control system as a result of hostilities

– Step-by-step reconstruction of the commercial activity system of the air traffic control system of Ukraine, primarily to ensure air navigation support on the route, international hub airports and gradually regional airports/airfields.

– Gradual return to the level of profitability of the commercial activity of the air traffic control system of Ukraine in the third year after the war

The pessimistic scenario includes:

– Impossibility of implementation of support mechanisms for the air traffic control system in the post-war period by the state due to a significant decrease in GDP.

– Significant further destruction and damage to buildings, infrastructure and air traffic control system equipment as a result of hostilities.

– Partial reconstruction of the air traffic control system of Ukraine, primarily to ensure air navigation support on the route, international hub airports, with a significant delay in regional airports/airfields.

– Gradual return to the level of profitability of the system of airports and airfields of Ukraine for the fifth year after the war.

Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the aviation industry system of Ukraine

Table 4 offers strategic scenarios for post-war recovery and sustainable development of the aviation industry system of Ukraine.

Threats to the aviation industry system of Ukraine:

– Air and ground strikes on design bureaus, enterprises and infrastructure facilities of the aviation industry system

– Threats to serial production of aviation equipment during hostilities

Therefore, the above-mentioned threats led to an increase in *the Vulnerability of the aviation industry system of Ukraine*, which is expressed in:

– Vulnerabilities of buildings, infrastructure and equipment of design bureaus and enterprises of the aviation industry system in the conditions of direct hostilities.

– Impossibility of mass production of aircraft during hostilities.

Table 4 – Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the aviation industry system of Ukraine

Classification of threats	Vulnerability of protection systems (GAP Analysis)	Consequences	Risks	Implementation of strategic scenarios
4. Threats to the aviation industry system:	**4. Vulnerability of the aviation industry system:**	**4. Consequences for the aviation industry system:**	**4. Lowering the level of efficiency and safety of the aviation industry system**	**The optimistic scenario** *4.1. Update of the provisions of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020) regarding the conditions of post-war recovery and sustainable development* [14]. *4.2. The development of mechanisms for the support of the aviation industry system in the post-war period by the state.* *4.3. Stopping the destruction of buildings, infrastructure and equipment of the commercial activity of the aviation industry system* *4.4. Restoration of mass serial production of aviation equipment in the second year after the war* **The realistic scenario** *4.1. Update of the provisions of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020) regarding the conditions of post-war recovery and sustainable development* [14]. *4.2. Development of mechanisms for partial support of the aviation industry system in the post-war period by the state.* *4.3. Minor further damage to buildings, infrastructure and equipment of the aviation industry as a result of military operations* *4.4. Gradual restoration of mass serial production of aviation equipment in the third year after the war* **The pessimistic scenario** *4.1. Updating the provisions of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020) regarding the conditions of post-war recovery and sustainable development* [14]. *4.2. Impossibility of implementation of mechanisms to support the aviation industry system in the post-war period by the state due to a significant decrease in GDP.* *4.3. Significant subsequent destruction and damage to buildings, infrastructure, and equipment of the aviation industry as a result of hostilities.* *4.4. Gradual restoration of mass serial production of aviation equipment for the fifth year after the war.*
4.1 Air and ground strikes on the design bureau, enterprises and infrastructure facilities of the aviation industry system	*4.1. Vulnerability of buildings, infrastructure and equipment of design bureaus and enterprises of the aviation industry system in the conditions of direct hostilities.*	*4.1. Buildings, infrastructure and equipment of the air traffic control system, which continues to be vulnerable to air and ground strikes, sustained varying degrees of damage.*	*4.1. Significant destruction of buildings, infrastructure and equipment of design bureaus and enterprises of the aviation industry system of Ukraine*	
4.2. Threats to serial production of aircraft during hostilities	*4.2. Impossibility of serial production of aircraft during hostilities*	*4.2.Stopping serial production of aircraft during hostilities*	*4.2. Bankruptcy of the national system of the aviation industry of Ukraine.*	

Source: developed by D. Bugayko

The combination of the mentioned threats and vulnerabilities leads to the following *Consequences for the aviation industry system of Ukraine*:

– Buildings, infrastructure, and equipment of the air traffic control system, which, as of May 2022, continues to be vulnerable to air and ground strikes have suffered varying degrees of damage.

– Stopping serial production of aircraft during hostilities.

The main negative results of the above were the decrease in the level of efficiency and safety of the aviation industry of Ukraine, which consists of:

– Significant destruction of buildings, infrastructure and equipment of the aviation industry of Ukraine.

– Possibilities of bankruptcy of the aviation industry system of Ukraine.

We offer to consider *optimistic*, *realistic and pessimistic strategic scenarios of post-war recovery and sustainable development of the aviation industry of Ukraine.*

The optimistic scenario includes:

– Updating the provisions of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020) regarding the conditions of post-war recovery and sustainable development [14].

– Development of mechanisms for the support of the aviation industry system in the post-war period by the state.

– Stopping the destruction of buildings, infrastructure and equipment of the commercial activity of the aviation industry system.

– Restoration of mass serial production of aviation equipment in the second year after the war.

A realistic scenario includes:

– Updating the provisions of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020) regarding the conditions of post-war recovery and sustainable development [14].

– Development of mechanisms for partial support of the aviation industry system in the post-war period by the state.

– Minor further damage to buildings, infrastructure and equipment of the aviation industry system as a result of hostilities

– Gradual restoration of mass serial production of aviation equipment in the third year after the war.

The pessimistic scenario includes:

– Updating the provisions of the Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020) regarding the conditions of post-war recovery and sustainable development.

– Impossibility of implementation of mechanisms to support the aviation industry system in the post-war period by the state due to a significant decrease in GNP.

– Significant further destruction and damage to buildings, infrastructure and equipment of the aviation industry system as a result of hostilities.

– Gradual restoration of mass serial production of aviation equipment for the fifth year after the war.

Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of aviation education and science of Ukraine

Table 5 offers strategic scenarios for post-war recovery and sustainable development of aviation education and science in Ukraine.

Table 5. - Risk management and implementation of strategic scenarios of post-war recovery and sustainable development of the aviation education and science system of Ukraine

Classification of threats	Vulnerability of protection systems (GAP Analysis)	Consequences	Risks	Implementation of strategic scenarios
5. Threats to the system of aviation education and science:	**5. Vulnerability of the aviation education and science system:**	**5. Consequences for the system of aviation education and science:**	**5. Reduction of the level of efficiency and safety of the aviation education and science system:**	**The optimistic scenario** 5.1. Development and implementation of the national program of training of aviation personnel and scientific research in the field of aviation for the purpose of post-war recovery and sustainable development of aviation transport of Ukraine. 5.2. Stopping the destruction of buildings, infrastructure and equipment of the aviation education and science system. 5.3. Comprehensive reconstruction of the system of aviation education and science. 5.4. Restoration of a full-fledged off-line educational and scientific process. 5.5. Gradual exit to the level of funding of the aviation education and science system in the second year after the war **The realistic scenario** 5.1. The development and gradual implementation of the national program for the training of aviation personnel and scientific research in the field of aviation for the purpose of post-war recovery and sustainable development of aviation transport of Ukraine. 5.2. Minor further damage to buildings, infrastructure and equipment of the aviation education and science system as a result of military actions 5.3. Step-by-step reconstruction of the aviation education and science system. 5.4. Partial restoration of a full offline educational and scientific process. 5.5. Gradual exit to the level of funding of the aviation education and science system in the third year after the war. **The pessimistic scenario** 5.1. The development and delayed implementation of the national program for the training of aviation personnel and scientific research in the field of aviation for the purpose of post-war recovery and sustainable development of aviation transport of Ukraine. 5.2. Significant subsequent destruction and damage to buildings, infrastructure and equipment of the aviation education and science system as a result of military actions. 5.3. Partial reconstruction of the system of aviation education and science. 5.4. The impossibility of restoring a full-fledged offline educational and scientific process. 5.5. Gradual exit to the level of funding of the aviation education and science system for the fifth year after the war.
5.1 Air and ground strikes on buildings, infrastructure and equipment of the aviation education and science system.	5.1. Vulnerability of buildings, infrastructure and equipment of the aviation education and science system in the conditions of direct hostilities.	5.1. Buildings, infrastructure and equipment of the aviation education and science system, which continues to be under the threat of air and ground strikes, received damage of varying degrees of severity.	5.1. Significant destruction of buildings, infrastructure and equipment of the aviation education and science system of Ukraine	
5.2. Threats to the educational process and scientific activity of the aviation education and science system.	5.2. Forced evacuation of leading scientific and pedagogical personnel, doctoral students, graduate students, students from the combat zone.	5.2. Suspension or transfer to a remote form of the educational process and scientific activity of the aviation education and science system of Ukraine. 5.3. A significant decrease in the financing of aviation education and science in conditions of a significant decrease in GDP.	5.2. Reducing the effectiveness of the educational process and scientific research in the conditions of remote communication 5.3. Lowering the level of the educational and scientific process in the conditions of reduced financing of Ukraine.	

Source: developed by D. Bugayko

Threats to the system of aviation education and science of Ukraine:

– Air and ground strikes on buildings, infrastructure and equipment of the aviation education and science system

– Threats to the educational process and scientific activity of the aviation education and science system.

Therefore, the above-mentioned threats led to an increase in *the Vulnerability of aviation education and science of Ukraine*, which is expressed in:

– Vulnerabilities of buildings, infrastructure and equipment of the aviation education and science system in the conditions of direct hostilities.

– Forced evacuation of leading scientific and pedagogical personnel, doctoral students, graduate students, and students from the war zone.

The combination of the mentioned threats and vulnerabilities leads to the following *Consequences for the aviation education and science system of Ukraine*:

– Buildings, infrastructure and equipment of the aviation education and science system received damage of varying degrees of severity, which continues to be under the threat of air and ground strikes

– Termination or transfer to a remote form of the educational process and scientific activity of the system of aviation education and science of Ukraine

– A significant decrease in funding of aviation education and science in conditions of a significant decrease in GDP.

The main negative results of the above were the decrease in the level of efficiency and safety of the aviation education and science system of Ukraine, which consists of:

– Significant destruction of buildings, infrastructure and equipment of the aviation education and science system of Ukraine

– Reduction in the effectiveness of the educational process and scientific research in the conditions of remote communication

– Lowering the level of the educational and scientific process in the conditions of reduced financing of Ukraine.

We offer to consider optimistic, realistic and pessimistic strategic scenarios of post-war recovery and sustainable development of the aviation education and science system of Ukraine.

The optimistic scenario includes:

– Development and implementation of the national program for training aviation personnel and scientific research in the field of aviation for the purpose of post-war recovery and sustainable development of aviation transport of Ukraine.

– Stopping the destruction of buildings, infrastructure and equipment of the aviation education and science system.

– Comprehensive reconstruction of the system of aviation education and science.

– Restoration of a full-fledged off-line educational and scientific process.

– Gradual rise to the level of funding of the aviation education and science system in the second year after the war

A realistic scenario includes:

– Development and gradual implementation of the national program for training aviation personnel and scientific research in the field of aviation for the purpose of post-war recovery and sustainable development of aviation transport of Ukraine.

– Minor further damage to buildings, infrastructure and equipment of the aviation education and science system as a result of military actions

– Step-by-step reconstruction of the system of aviation education and science.

– Partial restoration of a full offline educational and scientific process.

– Gradual rise to the level of funding of the aviation education and science system in the third year after the war.

The pessimistic scenario includes:

– Development and delayed implementation of the national program for training aviation personnel and scientific research in the field of aviation for the purpose of post-war recovery and sustainable development of aviation transport of Ukraine.

– Significant further destruction and damage to buildings, infrastructure and equipment of the aviation education and science system as a result of military operations.

– Partial reconstruction of the system of aviation education and science.

– The impossibility of restoring a full-fledged offline educational and scientific process.

– Gradual exit to the level of funding of the aviation education and science system for the fifth year after the war.

Conclusions. The above research allows us to come to the conclusion about the expediency of the proactive risk management toolkit for the recovery of air transport in Ukraine. Ukraine, which is among the ten countries with a full cycle of development, serial production, exploitation of aviation equipment, as well as a system of training and retraining of personnel for the industry and aviation science, should maintain and develop its position in the post-war period. This concern requires the development of a complex long-term program for the development of the industry, taking into account force majeure circumstances. Implementation of optimistic and realistic strategic scenarios of post-war recovery is the key to sustainable development of aviation transport of Ukraine:

.

References

1. D. Bugayko, Yu. Kharazishvili. Theoretical principles of strategic aviation safety management in the context of ensuring sustainable development of the national economy. Bulletin of Economic Science of Ukraine. 2020. № 1 (38). P. 166-175.

2. Kharazishvili Yu.M., Bugayko D.O., Lyashenko V.I. Sustainable development of aviation transport of Ukraine: strategic scenarios and institutional support: monograph / edited by Yu.M. Kharazishvili; NAS of Ukraine, Institute of Industrial Economics. Kyiv, 2022. 276 p.

3. D.Bugayko, Yu. Kharazishvili, M.Hryhorak, Z.Zamiar. Economic Risk Management of Civil Aviation in the Context of Ensuring Sustainable Development of the National Economy. Logistics and Transport– Wroclaw: International School of Logistics and Transport in Wroclaw. – 2020. - №1-2(45-46). – P.71– 82.

4. Ovdiienko O., Hryhorak M., Marchuk V., Bugayko D. An assessment of the aviation industry's impact on air pollution from its emissions: worldwide and the Ukraine. Environmental & Socio-economic Studies. [Katowice]. 2021. Vol. 9. № 2. P. 1-10.

5. Yu Kharazishvili, D Bugayko, V Lyashenko, V Sokolovskiy, V Baranov. Strategizing for sustainable development of transport systems in the safety dimension. IOP Conference Series: Earth and Environmental Science. IOP Publishing. P. 012025.

6. Dmytro Bugayko, Yuliya Ierkovska. Institutional Measures of Air Transport Safety Strategic Management at the Level of State Regulation. Intellectualization of Logistics and Supply Chain

Management. The electronic scientifically and practical journal v.9 (2021). P.6 – 19. ISSN 2708 - 3195. https://smart-scm.org.

7. Dmytro Bugayko, Yuliya Ierkovska, Fariz Aliev, Mariia Bahrii. The Concept of National Integrated Risk Management of Aviation Transport of Ukraine. Intellectualization of Logistics and Supply Chain Management. The electronic scientifically and practical journal v.10 (2021). P.6 – 18. ISSN 2708-3195 https://smart-scm.org.

8. Bugayko D., Kharazishvili Yu., Antonova A., Zamiar Z. Identification of Air Transport Ecological Component Level in The Context of Ensuring Sustainable Development of the National Economy. Intellectualization of Logistics and Supply Chain Management: the electronic scientifically and practical journal. 2020. № 3. October. P. 38-53. URL: https://smart-scm.org/wp-content/uploads/3_20_titul_j_full.pdf

9. Bugayko, D. (2012, September). Safety and Effectiveness of Civil Aviation in Conditions of Air Traffic Globalization. In Proceedings the fifth World Congress «Aviation in the XXI-st century»,«Safety in Aviation and Space Technologies (pp. 25-27).

10. D.O. Bugayko, OL Rybalko. Trends in the development of the air transport market of Ukraine. Economics, entrepreneurship and management–Journal of scientific works: Issue 9. P. 80-85.

11. D.O. Bugayko, O.R. Shevchenko, D.D. Bugayko. Proactive risk management of the post-war sustainable development of the airports and airfields system of Ukraine. Proceedings of World Congress AVIATION IN THE XXI-st CENTURY 2022 National Aviation University September 28, 2022 – September 30, 2022. ttps://conference.nau.edu.ua/index.php.

12. Safery State Program on (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021) (Decree of the Cabinet of Ministers of Ukraine No. 656 dated June 16, 2021).

13. On the approval of the State target program for the development of airports for the period until 2023: Resolution of the Cabinet of Ministers of Ukraine dated February 24, 2016 No. 126. Government courier. 2016. No. 41 (March 2).

14. Concept of the State targeted scientific and technical program for the development of the aviation industry for 2021-2030 (Decree of the Cabinet of Ministers of Ukraine No. 1412-r dated November 11, 2020).