

MAJOR TRENDS IN AVIATION INDUSTRY DURING COVID-19

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The purpose of the research in this article is to identify the main trends in the development of aviation industry during COVID-19 pandemic. The authors identify the main problems facing aviation industry in the context of the developing world crisis and possible ways to solve them. As a working hypothesis, it is proposed to form the basic concepts necessary for preliminary preparation and implementation of operational measures to restore passenger and cargo aviation. Taking into account the main threats facing the aviation industry during COVID-19, the article proposes the organizational and economic mechanisms to restore the industry. Short-term, medium-term and long-term recovery scenarios are considered, taking into account the relevant factors that have a certain impact. The study is based on a comprehensive analysis of documentary data provided by government agencies in a number of European countries. Openly printed materials from the International Civil Aviation Organization (ICAO) are also used in the analytical report "Consequences of new coronavirus COVID-19 in civil aviation: analysis of economic impact". The research methods are working papers from the European and North Atlantic Offices of ICAO aimed at rebuilding the aviation industry after COVID-19 pandemic. An analysis of global and Russian passenger traffic for Q1-Q4 (quartile) of 2021 and a development forecast for Q1-Q2 of 2022 is provided. The scenario problems facing the aviation industry in the context of COVID-19 crisis are identified. There are key concepts necessary to start preparation and implementation of effective measures to restore the aviation industry.

Keywords: COVID-19 pandemic, aviation industry, aviation development trends, civil aviation, passenger traffic, economic development, innovation development, business transformation

1 INTRODUCTION

Aviation industry, in comparison with others, is experiencing the most severe consequences from the outbreak of the new coronavirus infection COVID-19, since its raison d'être is to transport people and deliver goods around the world for various purposes, such as business travel and travel, travel around the world, tourist cruises, interregional business and international trade [1]. The sharp decline in demand for air travel, compounded by various travel restrictions, has had very large negative results. The financial and economic indicators of virtually all parties involved have worsened significantly: aircraft manufacturing plants; large, medium and small aviation companies; international and regional airports, various navigation services. Since the end of 2019, when the first data on a new large-scale disease appeared, the entire aviation industry in the world has been in a "very deep depression." International experts, medical professionals, qualified forecasting specialists cannot yet, with a sufficient degree of probability, determine the nearest visibility of the horizon with a bright future. Unlike previous outbreaks of pandemics, such as those caused by the SARS or MERS viruses, which took about six months to recover, with an acute V-shaped scenario, the recovery period from COVID-19 will probably be much longer, which is in no small part due to the developing global economic recession.

Literally the entire world community, including representatives of business and economy, medicine, science and technology, has confirmed the particularly large-scale nature of the crisis of a new viral disease called COVID. The global pandemic has literally covered the entire aviation industry, both air carriers and manufacturers of modern aviation technology. A global agglomeration of all aggrieved participants is necessary for the constant exchange of information, experience and knowledge. Together, we need to find the best options for saving the global air transportation industry. Air transport, both passenger and freight, should work confidently despite various crisis phenomena [2].

Taking into account the main threats facing the global aviation, helping in the fight against the COVID-19 pandemic, the authors of the article recommend effective organizational and economic mechanisms for the recovery of the industry (short, medium and long-term recovery scenarios), taking into account the relevant influencing factors, and the perceived problems to be dealt with. In this respect, every state in the world should play a primary role in the restoration of its national air transport through the joint actions of all states of the world. At the same time, states need to provide comfortable compensation to all air carriers operating in the face of severe restrictive measures and a serious market decline.

The purpose of the research conducted by the authors is to identify the main trends in the development of the aviation industry during the COVID-19 pandemic, to identify the main problems facing the aviation industry in the context of the global crisis, as well as to form the basic concepts necessary for a real recovery of the global aviation industry.

2 LITERATURE REVIEW

The global transport and logistics system have turned out to be one of sensitive areas of the economy that is most affected by the worldwide COVID-19 pandemic [3, 4]. The negative consequences are based on various factors: closure of state borders between countries, imposition of restrictions on the movement of people and goods, rupture of supply chains and decrease in demand and purchasing power [5, 6]. The combination of these factors had a significant impact on all types of transport: from the use of personal and public transport in cities to the implementation of passenger and freight transport within countries and between them. The scale of the existing negative consequences depends, as a rule, on the type of transport and the state's integration into the world transport and logistics system [7, 8]. During the pandemic, 90% of flights were canceled in the countries of European Union (EU), there was a decrease in the volume of passenger traffic by cars by 60-90% and by public transport by 50%. Under the leadership of the United Nations, international organizations and international Unions and Air Carrier Associations, taking into account the emergency situation in the world, took a joint decision to develop effective recovery mechanisms and an anti-crisis action plan for emergency stabilization and accelerated recovery of the industry, after the emerging economic difficulties. It is expected that by the end of 2021, the global volume of freight traffic will decrease by 31%, and the losses of Russian transport companies will amount to \$ 3.95 billion.

Today, many European countries are in a transitional stage: in transport sector, there is an adaptation to the updated operating conditions and gradual recovery from the crisis. However, there are still a number of risks [9, 10]. The anticipation of a second wave of the pandemic, increase in the number of COVID-19 cases in some regions of the world, partial restoration of previously removed restrictions and other factors create further uncertainty regarding global transport and logistics systems. At the same time, the uncertainty concerns not only the timing of a return to pre-crisis indicators, but also the future image of the transport sector in the post-coronavirus world as a whole. The initial exposure to COVID-19 was limited to specific countries that had an outbreak in January-February 2020. Most countries in the world, starting in March 2020, have closed their borders and imposed tighter restrictions on the movement of people as the spread of the disease continued to grow, affecting most governments as one of the measures to contain the spread of the disease. This resulted in sharp cancellations of flights by airlines and a strong reduction in demand for air travel, creating tangible pressures on the revenue and cash flows of all stakeholders in the aviation sector [11]. The International Civil Aviation Organization monitors the economic impact of COVID-19 on civil aviation and adjusts its analytics as the situation evolves. New assessments of the situation, which experts made already in 2022, demonstrate the very significant devastating consequences of the COVID pandemic for the resumption of permanent air routes for passenger traffic in the near future [12]. Unfortunately, even the most pessimistic forecasts for the resumption of flights in 2020, which were made by analysts of aviation companies, did not come true:

- total reduction in seats offered by airlines: 39%;
- total reduction in passengers: 472 million;
- potential loss of airline gross operating income: approximately \$ 96 billion.

The most significant negative impacts on the aviation industry as a whole are forecasted in the European continent and in many countries of the Asia-Pacific region. Further, they are followed by countries located in the Middle East, as well as in North and South America. For example, most airlines will lose more than \$ 23 billion in financial profits from international passenger traffic to China in the same period. These estimates were based on the V-path recovery scenarios from the end of 2021, and the U-shaped recovery scenario, which foresees a steady decline until mid-2022. The difference in the development of the situation depends, first of all, on the availability of supply and demand:

- real periods of time for recovery, and the amount of material losses of aviation companies;
- value of passengers' confidence in air transportation, which is estimated by the value of the aircraft load factor.

We believe that one of the two forecasted scenarios for the development of the situation can be realized. Realistic pathways to recovery are highly dependent on a variety of factors that rapidly change over time, such as the duration and magnitude of outbreak response and containment, the availability of government assistance, consumer confidence, and economic conditions. The imbalance between supply and demand in transportation services due to the impact of COVID-19 pandemic naturally affected not only carriers, but also vehicle manufacturers. The situation on the aircraft market was not easy and before the start of the pandemic. Boeing (USA), one of the largest aircraft manufacturers in the world, was already in crisis due to two disasters of 737 MAX model.

As in many other industries, in the aircraft industry, COVID-19 pandemic catalyzed trends that emerged before the virus began to spread: airlines stop generating demand for Jumbo Jets, the largest of the wide-body airliners. Changes in the economy of flying have reduced the need for aircraft serving major hub airports, and manufacturers have phased out the Airbus A380 and Boeing 747 assembly lines. Meanwhile, British Airways announced the early termination of operation of the entire Boeing 747 fleet; many other airlines are making similar adjustments: for example, Delta (USA) and Lufthansa (Germany) have reduced their fleet by 100 aircraft each one. In the future, the aviation industry will get rid of a significant part of the wide-body passenger liners: many of them will be converted to carry cargo. Boeing Corporation predicts that of the 32 700 new aircraft it plans to build over the next 20 years, the vast majority will be single-aisle, twin-engine 737 MAX aircraft. On the other hand, the development of regional air travel could provide an important boost to the nascent electric aircraft technology and revitalize the air taxi industry.

The spread of coronavirus and falling demand for products forced Boeing's American factories to completely halt production and cut workplaces. Another major aircraft manufacturer, European company Airbus, was also forced to adapt production to new conditions. However, given the geographical distribution of production, each specific situation was significantly influenced by a group of measures taken by national government and aimed at combating spread of infection and supporting economy [13].

In the face of a fall in demand for vehicles, many large companies re-equipped their production facilities for health care needs, for the production of personal protective equipment or mechanical ventilation devices, which helped in the fight against the spread and consequences of infection, but did not help to compensate for lost profits. Experts say that one of the potential solutions for the aircraft industry is the possibility of reaching an agreement with governments and regulators to reduce the maximum permissible life of aircraft, which will entail an accelerated replacement by carriers of the fleet of relatively old and expensive wide-body aircraft in operation with new models. This would not only lead to an increase in orders in the aviation industry, thereby reducing the negative effects of the pandemic, but would also have a beneficial effect on the environment, since new aircraft are generally more environmentally friendly [14, 15].

In the short term, passenger demand for air transport services may remain subdued due to the high risk of contamination from vehicles. In addition, businesses are likely to move away from business travel, to reduce costs and to become more commonplace during the crisis to work remotely. Recent expert assessments indicate that the potential impact of COVID-19 on global scheduled passenger traffic, compared to the baseline, will be as follows:

What was happened in 2021:

- overall reduction of 48% of seats offered by airlines;
- overall decrease in the number of passengers from about 2.372 million passengers to 2.886 million;
- approximate financial losses from to \$ 389 billion in passenger operating revenue of airlines.

What was happened in 2022:

- general reduction in the number of seats offered by airlines to 35%;
- overall reduction in the number of passengers to 1.254 million;
- estimated financial losses of airlines will be to \$ 179 billion.

Actual impacts will depend on the duration and magnitude of the outbreak and containment measures, as well as consumer confidence in air travel, economic conditions, etc. (Table 1).

Table 1. Analysis of global and domestic passenger traffic for (Q1-Q4) 2021 and development forecast for (Q3-Q4) 2022

Period of time	Number of seats available for boarding (%)		
	Total	International flights	Russian flights
First quarter of 2021 (Q1)	-38%	-40%	-15%
Second quarter of 2021 (Q2)	-31%	-42%	-19%
Third quarter of 2021 (Q3)	-26%	-55%	-12%
Fourth quarter of 2021 (Q4)	-24%	-45%	10%
Total for 2021	-30%	-46%	-14%
Third quarter of 2022 (Q3)	from -17% to -22%	from -63% to -73%	from -13% to -16%
Fourth quarter of 2022 (Q4)	from -24% to -33%	from -54% to -69%	from 10% to -12%
Period of time	Number of passengers carried (million)		
	Total	International flights	Russian flights
First quarter of 2021 (Q1)	-362	-329	-127
Second quarter of 2021 (Q2)	-284	-318	-122
Third quarter of 2021 (Q3)	-224	-289	-108
Fourth quarter of 2021 (Q4)	-212	-282	-99
Total for 2021	-270,5	-304,5	-114
Third quarter of 2022 (Q3)	from -117 to -122	from -157 to -172	from -59 to -62
Fourth quarter of 2022(Q4)	from -86 to -92	from -102 to -112	from -17 to -26
Period of time	Revenue from passenger transportation (\$ billion)		

	Total	International flights	Russian flights
First quarter of 2021 (Q1)	-55	-122	-25
Second quarter of 2021 (Q2)	-46	-97	-21
Third quarter of 2021 (Q3)	-42	-89	-19
Fourth quarter of 2021 (Q4)	-39	-81	-15
Total for 2021	-45,5	-97	-20
Third quarter of 2022 (Q3)	from -33 to -39	from -79 to -87	from -9 to -13
Fourth quarter of 2022 (Q4)	from -30 to -33	from -73 to -79	from -7 to -11

Source: ICAO Air Transport Reporting Form A and A-S plus ICAO estimates

According to the data shown in the Table 1, international passenger traffic in 2021 experienced a 46% decrease in the number of seats offered by airlines, the total number of passengers decreased 304,5 million, and the approximate loss of potential revenue by airlines, according to some experts, is from 263 up to \$ 264 billion. Russian passenger traffic in 2021 decreased 114 million passengers, the number of seats offered by airlines was reduced by 40%, and approximately the lost profit for airlines is 20 billion dollars.

To assist states and relevant stakeholders, ICAO has created a website on COVID-19 aviation safety. All states are encouraged to inform ICAO of any current country developments in the context of COVID-19. The electronic resource includes a series of webinars providing updated information and relevant information in the context of pandemic. Webinars, hosted by leading international experts in their field, are free. In addition to its regular COVID-19 advice to national governments, ICAO also acts as a key focal point for member states of Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA). CAPSCA website contains updated recommendations from World Health Organization (WHO), complementing relevant bulletins issued by ICAO, Center for Disease Control and other regional and international organizations. Airports Council International (ACI) has produced a brochure describing a set of standard measures implemented at major international airports. The information was provided by all ACI members. Key topics covered in the publication include the following issues:

- adapting management and planning in response to the impact of COVID-19;
- measures to manage staff, including monitoring the health status of employees;
- procedures for interaction with passengers, including temperature measurement and declaration of health status;
- changes in the management of facilities, including cleaning and disinfection;
- provision of protective equipment;
- security measures (screening of passengers and staff);
- requirements for information technology.

SITA, international provider of IT solutions for airports, has implemented its largest-scale biometric identification project to date, Smart Path, covering the entire air terminal complex at Beijing International Airport. This software solution, using a unique face recognition technology, allows organizing the movement of passengers from check-in counter to boarding the plane without presenting documents. This technology reduces queuing times and eliminates physical contact between airport staff and travelers. The system takes less than 20 minutes to process the data and board 400 passengers on the plane. The system is currently being installed at other international airports, such as airports in Miami and Orlando (USA) and Doha (Qatar). In June 2020, European Commission launched "Re-open EU" web platform that promotes the safe resumption of free movement and tourism in Europe. To help people plan their travel and vacation with confidence, the platform provides an interactive map with information on border opening, available vehicles, travel restrictions, public health and safety measures such as physical distancing or wearing masks and other practical information for travelers. "Re-open EU" is available in 24 official EU languages.

3 METHODOLOGY

The basis of this paper is various methods of theoretical and practical research: analysis, generalization, synthesis and abstraction. The research methodology included economic analysis of data on air traffic in different countries of the world. The theoretical and methodological basis of the study was the complex use of a system of methods used by specialists in the field of management: methodology of structural functionalism, systems approach, structuralism, activity approach and interactionism. In addition to theoretical ones, specific scientific and practical methods of socio-economic research are actively used, first of all, analysis of documentary sources and method of statistical analysis of statistical information. Information sources used here include documentary and statistical materials, special literature on the topic of research and media materials.

The prospects for the development and restoration of world aviation are still very uncertain. If a negative scenario is realized, the chances and funds for the restoration of air transportation will be significantly reduced [16, 17].

The main threat the world faces in 2021 is the prospect that the COVID-19 pandemic will be much more intense and prolonged than experts predict. The fundamental global integration of the aviation industry, interdependence of the world economy and leisure/customer service culture are things that can help rebuild the aviation industry. The recovery scenarios given below are multilevel and can be adjusted (Table 2). The underlying assumption is that in order to determine any pathway for the recovery of the aviation industry, it is necessary to initially mitigate, and largely address, the health crisis.

In the following paragraphs, the authors propose a set of measures for various countries:

Brazil:

- postpone the payment of fees and charges (air navigation, airport concession agreements and air ticket compensation for flight cancellations);
- availability of financial instruments - special credit line;
- refusal to allocate slots until the end of December 2022;
- application of the principle of universal temporary suspension of employment contracts.

European Union: waived the slot usage rule (suspension of «80-20 rule») for the entire summer season, until the end of December 2022.

Norway: government should allocate between \$270 million and \$350 million for loan guarantees for Norwegian Airlines.

New Zealand: government should provide assistance to the main national airline, Air New Zealand, by providing it with about \$500 million as a standby loan.

Singapore: financing package: Singapore Airlines secured up to S\$19 billion (\$13 billion) in government funding. The conditions applicable to this package may require further clarification, in particular as to whether employees of this airline will be able to use the package.

USA:

- conditional financial package: \$58 billion is being offered to US airlines, split evenly between credit lines and payroll subsidies;
- share repurchases and dividend payments are prohibited for at least one year after loans are repaid. The amount of remuneration to the management of airlines is also limited;
- airlines are prohibited from firing or furloughing employees until the end of 2022.

Key concepts for preparing and implementing measures to rebuild the aviation industry include the following:

1. Mechanisms for recovery: responsibilities of states. Every state in the world bears the primary responsibility for the development and rehabilitation of its aviation industry; role of recovery mechanisms and action plans at the national level cannot be overemphasized. All countries of the world need at the state level to adopt urgent anti-crisis plans and measures to restore the global transport system, which includes aviation, road, rail, sea and river transport. It is necessary to go for significant economic costs in this difficult period of exacerbation of the global crisis, in the hope of obtaining, in the foreseeable future, financial profit that will compensate all costs [18].
2. Basic rules of international cooperation. It is necessary to observe real parity between the interests of the two parties: the airport service and air navigation on the one hand; airline workers and passengers, on the other hand. The International Civil Aviation Organization defends the obligation to comply with the following funding clauses: non-discrimination; a reasonable balance of income and expenses; availability of information; joint discussion with customers. It seems to us unacceptable to shift responsibility for the revenues not received by the airport management onto the shoulders of aviation companies and, directly, passengers [19].
3. State support. We believe that in the current difficult situation, all states should provide real assistance to their national aviation companies, carrying out some structural transformations and providing them with potential orders. At the same time, it is necessary to avoid ill-considered decisions so as not to upset the balance of interests in the established market by their administrative actions. The importance for all of the aviation industry can be understood by assessing the scale of tax payments in 2018 - almost \$ 140 billion. This large amount is equivalent to almost half of the gross value added of the entire industry. It would be prudent for all tax payments from the aviation industry to remain under its full control. States can offer a whole range of measures to help an air carrier [20]:
 - Maintaining a constant balance between the interests of airport services and aviation companies. Taking into account the own interests of the participants, which are so different by the nature of the property: completely state air navigation services; partly by state airports; by private airlines.
 - Comprehensive government support measures, without distorting the basic structure of the market.
 - Equivalence of the amounts of support provided by the state and the economic profit received in the future.
4. New innovative solutions. A pandemic of a dangerous disease that swept the whole world, provoked a large-scale economic crisis, which has dire consequences for the entire aviation industry. This crisis allowed us to

see individual shortcomings of air transport in general. Unfortunately, it should be noted: - low operating margin of air carriers; - significant dependence on ultra-high incomes, which are brought by elite passengers of the first and business classes; - strong interdependence between all active participants in the supply chain. It is obvious that the long and difficult path to rebuilding air transport may require very large-scale measures, including the use of new innovative technologies at the interstate level. Many experts and world experts predict the rapid growth of e-commerce, the improvement of a sustainable supply chain using blockchain, the shift of many business models towards the sharing economy, as well as an increase in the number of private business jets by 10-20 passengers.

Table 2. Identifying scenario challenges for aviation industry in COVID-19 crisis

Suggestions/ Factors	Fast recovery scenario (from 3 to 6 months)	Progressive recovery scenario (from 6 to 12 months)	Slow recovery scenario (from 1 to 2 years)
<i>Introduction of certain types of travel restrictions</i>	All restrictions will be lifted when possible	Gradual easing of restrictions: plausible scenario includes initial lifting of restrictions domestically and regionally, then internationally	Severe restrictions on various international transportations over a long period of time; domestic/regional air traffic prevails
<i>Analysis of current economic environment</i>	Indicators of current economic activity are gradually beginning to recover and go to pre-crisis level	Economy has suffered partial damage; rather slow recovery of commercial activity and level of consumer spending	Global economic downturn; widespread weak economic sector, budget and labor cuts
<i>Airline opportunity assessment</i>	Operational capabilities in this case are practically not affected (air fleet, etc.); workforce is fully available for the recruitment procedure; issuance of various interest-free loans and cash injections from the state to maintain the level of current capabilities	Vast majority of airlines are still operating; airlines remaining on the market significantly reduce their activities to minimize risks, priority is given to Russian flights; loans and cash infusions are an important and necessary condition in order to maintain the minimum acceptable level of opportunity	Possibilities that airlines have are very limited, which in the end will inevitably lead to default (bankruptcy); airlines remaining on the market are curtailing their activities, international passenger traffic will be heavily curtailed or canceled altogether
<i>Air travel demand research</i>	Normalization of level of demand for passenger transportation after a short break, as a result, will lead to a decrease in prices	Travel demand will decline, but higher supply levels, for example, while operating capacity declines, may result in slightly higher prices	The activities of airlines will be reduced or limited, which will inevitably lead to an increase in prices, which means that stimulation of demand, will be impossible.
<i>Assessment of current state of aviation industry</i>	Experts and leading specialists expect a fairly quick recovery of the industry, if all restrictions and rules are lifted	Less air travel will have a negative impact on virtually the entire aviation industry, which will not only reduce its financial income, but also lead to a reduction in staff	Airlines activities will be almost completely reduced, which will lead to disastrous consequences for the industry, the number of players in the market will decrease
Predicting problems for each assumed development scenario			
<i>Assessment of level of financial capabilities of industry/airline</i>	Almost all airlines are experiencing financial difficulties against background of decrease in passenger traffic due to pandemic to varying degrees; state becomes the main driver for maintaining airlines; budget adjustment for sufficiently reduced passenger traffic and significant cost reduction	All international aviation companies are experiencing quite serious difficulties due to restrictions; market recovery process will be long enough; risk of pandemic is unpredictable, which will lead to fluctuations in airline quotes; launch of program packages aimed at subsidizing air transportation within the country	Level of financial capabilities that all stakeholders currently have is in a critical situation, which will inevitably lead to the transformation of all models operating in commercial aviation: state subsidies, elimination of the premium segment, transition from hub model to point-to-point

<i>Determining of level of employment</i>	Hiring process will be suspended for approximately 1 year; decrease in the level of human capital, which means that there will be decrease in the pace of economic, scientific and technical process	Unemployment is projected to be at medium or higher levels due to the ongoing decline in the workforce; also, some employees may not want to return and work in less attractive conditions	Unemployment rate will reach the highest possible level in the industry, which will ultimately lead to a shortage not only of pilots, but also of employees employed in ground services (dispatchers, etc.).
<i>Determination of degree of investment attractiveness</i>	According to various groups of specialists and experts, no additional investments or high-tech projects and no commercial proposals are expected in the near future	Significant reduction in the number of investments within the framework of existing projects, as well as for the maintenance of current activities, for example, sharp reduction in the number of air routes, etc.	Investments in the industry are almost completely absent, main priority is to make only flight safety and aviation security, while all other areas of investment are considered non-priority and are not supported
<i>Forecasting development of trade and tourism</i>	Estimated recovery in trade and tourism is not expected until Q4	Significant financial assistance from states will be required to organize full support and restore the tourism sector	Recovery process in tourism and trade will directly depend on the level and quality of government support, while financial assistance will be just a component of overall assistance programs
<i>Analysis of freight traffic</i>	Sudden reduction in freight capacity has disrupted air traffic flows, but the sector has room for quick adaptation and is able to return to pre-crisis levels in no time; forecast is favorable, there is a possible growth in demand for transportation of goods; in the face of a decrease in the number of flights and passengers, airlines resorted to re-equipment of aircraft to accommodate commercial cargo in the cabin, and not only in the luggage compartment	Recovery scenario assumes a favorable nature, freight transport plays a leading role in the maintenance and subsequent recovery of the entire global supply chain and economy; current rules will be amended, which will return the cargo transportation indicators to the pre-crisis level; air cargo carriers should also have a stimulating effect on air traffic at many airports	Air freight will be virtually a major player in the global economic recovery in the long term
<i>Analysis of standards and procedures</i>	Little or no additional procedures in the industry, i.e. for passengers; all procedures will remain unchanged	Establishment of various temporary and medium-term, including additional procedures, for example, medical examination at airports, keeping distance on airplanes, etc.	Implementation of permanent procedures to prevent similar crises in the future: special training for the crew, cargo standards, etc.
<i>Assessing the level of consumer confidence</i>	Consumer confidence will be restored through a range of effective marketing activities and promotional offers	Passenger confidence will be influenced by a prolonged period of uncertainty and anxiety, as well as a general distrust of international travel	Passenger confidence will be very low, passengers will most likely prefer regional travel or choose other modes of transport

Source: made by authors

International labor standards provide a proven and credible framework for making strategic decisions and ensuring a sustainable and fair recovery from the crisis. At present, international labor standards and International Labour Organization (ILO) Decent Work Agenda, addressing aspects such as jobs, social protection, social dialogue and

rights, are the main elements of the 2030 Agenda for Sustainable Development. ILO has a wealth of experience in providing advisory services in the world of work in the context of labor market shocks, including in the civil aviation sector. However, ILO does not have separate instruments for this sector.

There are four key elements to fight COVID-19 based on international labor standards.

Main element 1.

- stimulation of the economy and employment;
- active fiscal policy;
- favorable monetary policy;
- lending and financial support to certain sectors, including the healthcare sector.

Main element 2.

- support for businesses, jobs and incomes;
- expansion of social protection for all;
- implementation of employment retention measures;
- provision of financial assistance/tax incentives and other types of assistance for enterprises.

Main element 3.

- protection of workers in the workplace;
- strengthening measures in the field of occupational safety and health;
- adaptation of work modes (for example, remote work);
- prevention of discrimination and social exclusion;
- providing access to health services for all;
- expanding the use of the mechanism of paid leave.

Main element 4.

- counting on social dialogue in order to make decisions;
- strengthening the capacity and viability of employers' and workers' organizations;
- strengthening the capacity of governments;
- strengthening institutions and processes for social dialogue, collective bargaining and labor relations.

4 RESULTS AND DISCUSSION

COVID-19 is a global crisis that tests the resilience of not only aviation industry, but the entire global economy. Now airlines in the most countries are experiencing double-digit declines in demand, and traffic has collapsed on many routes. The planes remain on the ground and employees are asked to take unpaid leave or leave from the work. In this emergency, governments need to consider maintaining air transport. The suspension of 80/20 slot rule and exemption from taxes at airports where demand has disappeared are two critical steps that can provide support to airlines during the crisis and, ultimately, recovery. COVID-19 pandemic has affected the airport industry a lot. 110 countries significantly restricted air traffic, which accounted for about 98% of the world aviation market. COVID-19 caused a global economic recession, decline in international trade, which significantly affected the entire airport industry. Business activity went online due to quarantine, in addition to this, business will cut travel budgets in the future. The growth of passenger traffic will also be constrained by new requirements for observing the minimum distance between passengers in the terminal and the plane, new visa restrictions, as well as concerns of the passengers. The devaluation of national currencies and limited government support for businesses and population will lead to additional decrease in the purchasing power of population. The financial cushions of the vast majority of airports will be exhausted by that time, and obligations to staff and banks will need to continue to be fulfilled. The result of the analysis of the current economic situation in the airport industry is the conclusion that the restoration of passenger traffic will take at least two years.

Airports have formed a consolidated industry position on the package and have turned to the government for support. The set of measures includes state guarantees for 10 largest airlines to fulfill their obligations, full or partial subsidies for the cost of airport services and fuel complexes for airlines, abolition of rent for the use of state airfield infrastructure for 2020 and also tax deferrals and exemptions, financial incentives for staff retention and suspension of dividend payments to the government where applicable. A number of states have released amounts equal to 11% of Gross Domestic Product (GDP) to support economy, a considerable part of which is the support of the airport industry. Canada has allocated \$ 331 million to support the airport industry, United States: \$ 58 billion, Singapore: \$ 7 billion, New Zealand: \$ 4 billion, etc.

The most effective measures to support the airport industry are tax incentives and government guarantees. Leading world experts call tax incentives and provision of government guarantees to independent players, first of all, airlines, as the most effective and most feasible measures to support the airport industry. When passenger traffic begins to recover, this will help overcome the crisis of confidence in the industry and gain the maximum possible pace for

situation. The forecasts for the recovery of the airport industry in Russia are non-optimistic, according to a positive scenario, recovery in passenger traffic at the level of 2019 can be expected only in 2022, and losses will amount to about \$ 1,42 billion. However, according to the negative scenario, i.e. if economic activity does not recover in 2022, passenger traffic may decrease by 70% per year, and the aviation industry will lose \$ 2,91 billion [18].

5 CONCLUSIONS

According to experts from Eurocontrol, if mass vaccination of travelers becomes available in summer or at the end of 2021, European air traffic will be able to return to the 2019 level as early as 2024. The second scenario provides for mass vaccination in 2021-2022, in this case, until 92% of the volume of 2019 is restored, it will take two years more, and if events develop according to the most pessimistic forecast, aviation sector in Europe will return to pre-pandemic level only by 2027 year. In forecasting, Eurocontrol was guided by the experience of previous crises. So, in 2001, about 200 thousand flights were lost in Europe and it took 1.5 years to restore the market, and the global crisis of 2008 already "ate" 600 thousand flights: in order to return to the former volume of transportation, it took 8 years. In 2020, Europe lost 6 million flights, and it is possible that events will develop just according to the pessimistic scenario. As for Russia, experts find it difficult to forecast. However, the volume of passenger traffic has dropped significantly: according to Federal Air Transport Agency, in 10 months of 2020, 59.44 million people were transported in the Russian Federation. (46.1% less than in the same period in 2019), and in October, 2020, Russian companies served 6.78 million passengers (39.2% less than in 2019). At the same time, Pobeda Airlines, subsidiary of Aeroflot, even increased the number of customers served to 1.04 million (+ 10.6%).

Globally, the aviation industry is doing really badly. Based on the open data, Bloomberg experts have compiled a list of airlines that, due to the difficult financial situation, may declare default before the end of 2022. It mainly contains mid-level companies from Asia, Africa and Latin America (there are no European ones in this black list yet), for example, Thai Airways, which put up for sale at once a third of its fleet: 34 passenger aircraft. These are mainly long-haul Boeing models: 747-400, 777-200 and 777-300, built in 1993-2000, as well as, less age, Airbus A340-600 airliners that rolled off the assembly line in 2005-2008. However, the fact of trying to sell every third aircraft is seen as a sure sign that the carrier is on the edge of a financial abyss.

If we assume that 2020 was the peak of the negative, then the business has reason to be optimistic. Of course, V-shaped growth is an unlikely scenario, but the prerequisites for improving performance do exist. The global aircraft industry is expected to grow by 10% in 2022, from \$298 billion to \$327 billion. The positive dynamics will be driven by the optimization of business processes and the gradual recovery from the impact of the viral pandemic. In addition, overall economic growth in emerging economies will have a positive impact on the commercial aircraft market.

Aircraft corporations are using artificial intelligence (AI) to improve the safety and quality of aircraft assembly, as well as to increase productivity in factories. Machine learning algorithms collect data and analyze it to make effective decisions. As a result, production operations are streamlined and costs are reduced. GE Aviation uses end-to-end technology to troubleshoot engine problems. Timely diagnosis increases the life of components and eliminates the need for unscheduled maintenance. Boeing is successfully using AI to design aircraft and automate industrial tasks. However, Per Se digitalization is only a tool to overcome the crisis at the corporate level. The authors are sure that the best results can only be achieved by coordinated work at the level of the entire industry with the involvement of the state, namely:

- finding a consensus on a new normal in terms of the pace of production;
- development of a roadmap to bring the industry to a state of new normality;
- identifying elements of risk and strengthening positions in problem areas.

After the implementation of this set of measures, the aircraft manufacturing sector may need state support to help manage the transition to a new normal, experts conclude.

6 REFERENCES

- [1] Iacus, S.M., Natale, F., Santamaria, C., Spyratos, S., Vespe, M. (2020) Estimating and projecting air passenger traffic during the COVID-19 coronavirus outbreak and its socio-economic impact. *Safety Science*, vol. 129, 104791.
- [2] Suau-Sanchez, P., Voltés-Dorta, A., Cugueró-Escofet, N. (2020) An early assessment of the impact of COVID-19 on air transport: Just another crisis or the end of aviation as we know it?. *Journal of Transport Geography*, vol. 86, P. 102749.
- [3] Bureau, A.T. (2020) *Effects of novel coronavirus (COVID-19) on civil aviation: economic impact analysis*. International Civil Aviation Organization (ICAO), Montréal, Canada.
- [4] United Nations Conference on Trade and Development (2020) The Coronavirus Shock: A Story of Another Global Crises Foretold and What Policymakers Should Be Doing, from https://unctad.org/system/files/official-document/gds_tdr2019_update_coronavirus.pdf, accessed on 2022-07-06.
- [5] Pierce, B. (2020) *Covid-19: Cash Burn Analysis*. IATA Publication, Montreal, Canada, from <https://www.iata.org/en/iata-repository/publications/economic-reports/covid-19-cash-burn-analysis/>, accessed on 2022-07-06.

- [6] International Air Transport Association (2020) *Covid-19 Puts Over Half of 2020 Passenger Revenues at Risk*. Press Release No. 29. Geneva, Switzerland, from <https://www.iata.org/en/pressroom/pr/2020-04-14-01/>, accessed on 2022-07-06.
- [7] Airports Council International (2020) *Policy Brief Covid-19: Relief Measures to Ensure the Survival of the Airport Industry*. ACI World, Montreal, Canada, from https://asianaviation.com/wp-content/uploads/Policy_Brief_COVID19_Relief_Measures_to_Ensure_the_Survival_of_the_Airport_Industry_2020.pdf, accessed on 2022-07-06.
- [8] International Civil Aviation Organization (2022) *Effects of Novel Coronavirus (COVID-19) on Civil Aviation: Economic Impact Analysis (2020)*. Air Transport Bureau, Montreal, Canada, from https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf, accessed on 2022-07-06.
- [9] Holland, J. (2019) *ACI Report Illustrates "Importance of Non-aeronautical Revenues for Airports' Financial Stability"*. The Moodle Davitt Report, Brentford, United Kingdom, from <https://www.moodiedavittreport.com/aci-report-illustrates-importance-of-non-aeronautical-revenues-for-airports-financial-sustainability/>, accessed on 2022-07-06.
- [10] Achou, B., Boisclair, D., d'Astous, P., Fonseca, R., Glenzer, F., Michaud, P. C. (2020) Early impact of the COVID-19 pandemic on household finances in Quebec. *Canadian Public Policy*, vol. 46, no. S3, 217-235.
- [11] Chaika, N.K. (2019) The agreement granting the use of exclusive rights as a tool to recover creation costs. *IOP Conference Series: Materials Science and Engineering*, vol. 537, no. 4, 042058.
- [12] Tikhonov, A., Sazonov, A. (2021) Digitalization and application of artificial intelligence in aircraft. *AIP Conference Proceedings*, vol. 2402, no. 1, 030036.
- [13] Button, K. (2020) Aviation. In: *Encyclopedia of Big Data*. Springer, Cham.
- [14] Queiroz, M.M., Ivanov, D., Dolgui, A., Wamba, S.F. (2020) Impacts of epidemic outbreaks on supply chains: mapping a research agenda amid the COVID-19 pandemic through a structured literature review. *Annals of operations research*, 1-38.
- [15] International Civil Aviation Organization (2019) *Safety Management Manual, Doc 9859*. Montreal, Quebec, Canada, from https://www.icao.int/APAC/Meetings/2019%20COSCAPSEA%20iSTARS/9859_cons_en.pdf, accessed on 2022-07-06.
- [16] Veas Iniesta, D.S., Estay Sepúlveda, J.G. (2021) Development of methods and tools of the commercialization of high-tech projects on the example of Moscow Aviation Institute (National Research University). *Amazonia Investiga*. vol. 10, no. 43, 83-95.
- [17] Kalugin, A.A., Kalugina, G.A., Ryapukhin, A.V. (2021) Informational support for the sale of passenger aircraft. *Russian Engineering Research*, vol. 41, no. 2, 183-187.
- [18] Kraev, V.M., Siluyanov, M.V., Tikhonov, A.I. (2020) Creation of Supersonic Civil Aviation in Russia. *Russian Engineering Research*, vol. 40, no. 9, 755-758.
- [19] Tikhonov, A.I., Sazonov, A.A., Kuzmina-Merlino, I. (2022) Digital Production and Artificial Intelligence in the Aircraft Industry. *Russian Engineering Research*, vol. 42, no. 4, 412-415.
- [20] Kraev, V., Tikhonov, A., Kuzmina-Merlino, I. (2022) Economic and ecological aspects of the use of new cryogenic aviation fuels. *Journal of Applied Engineering Science*, vol. 20, no. 2, 351-357.

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