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SHEI "Pryazovskyi State Technical University"
87555 Mariupol, vul. Universytets'ka 7
tel. +380629333416; +380629446555
e-mail: office@pstu.edu

Air transport risks during a pandemic COVID-19

Dmytro Bugayko
Vice Director
International Cooperation and Education Institute
Instructor of ICAO Institute, PhD, Associate Professor
National Aviation University (Kyiv, Ukraine),

Olha Shevchenko
Director
Institute of International Cooperation and Education, PhD
National Aviation University (Kyiv, Ukraine)

Civil aviation statistics suggest that the growth of basic air traffic doubles every fifteen years, which is much more dynamic than the growth of most other industries. Since 1960, the demand for passenger, luggage, freight and mail has been steadily increasing.

The development of technological progress and related investments are combined and make it possible to multiply the output of the aviation industry by a factor of more than 30. This expansion of air transport is extremely beneficial for the growth of the world economy, primarily for world production (global GDP), when measured in real terms, multiplied more than five times over the same period.

However, a structural analysis of air traffic volumes suggests that the dynamic growth of air traffic is consistently opposed by recession cycles. The aviation industry is an open system that is affected by a wide range of technical, natural, human and economic threats. For its part, it itself is a generator of significant threats to the environment. Among the most significant threats to civil aviation in the history of development are the fuel crisis (1973), the Iran-Iraq war (1981), the Gulf War (1991), the Asian crisis (1997-98), and the 9/11 terrorist attack, SARS pandemic (2003), global recession (2008) [1].

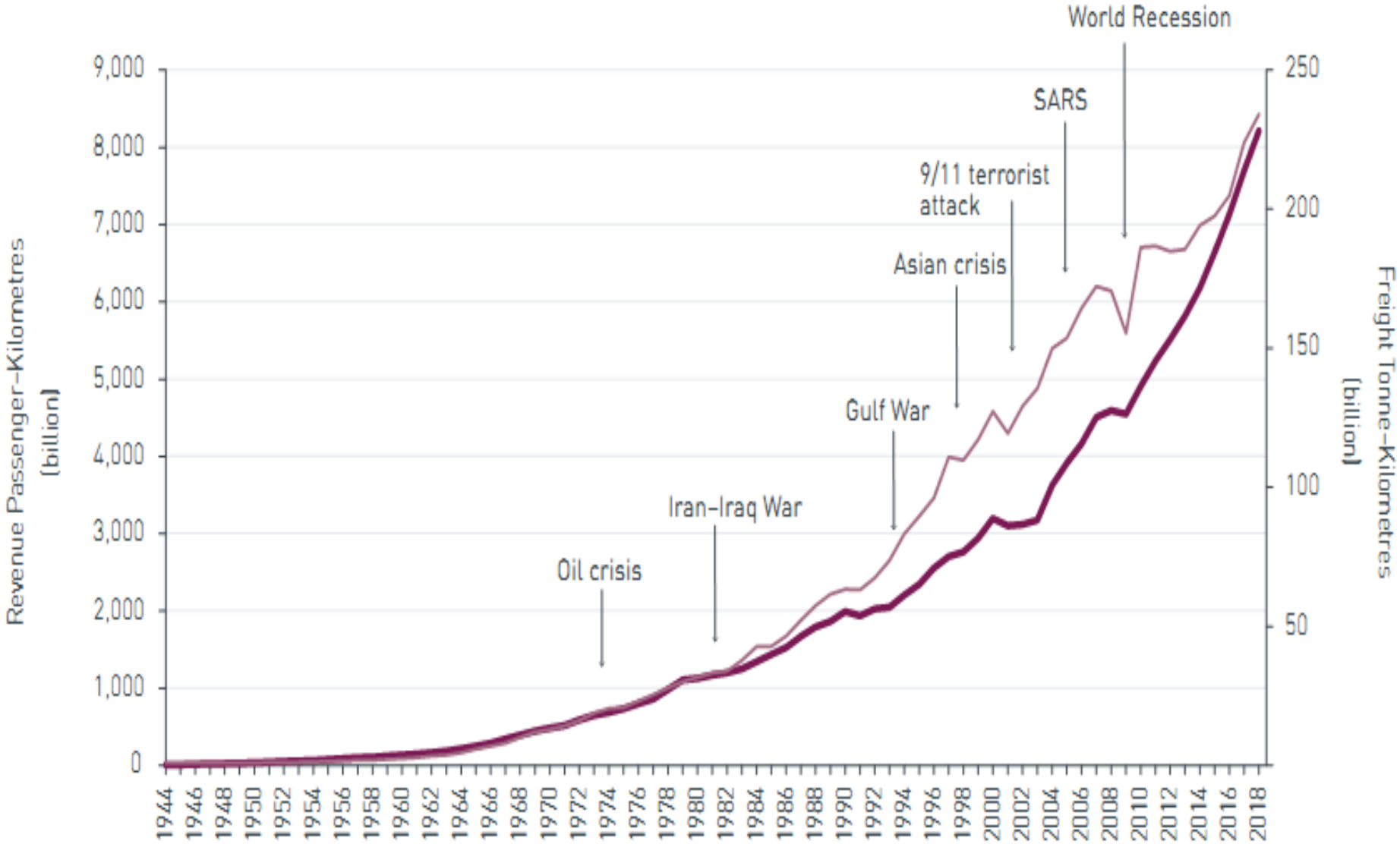


Figure 1. Evolution of the development of world air transportation taking into account the impact of the fuel crisis (1973), the Iran-Iraq war (1981), the Gulf War (1991), the Asian crisis (1997-98), the terrorist attack 9/11 (2001), SARS (2003) , the global recession (2008) [1].
Source: Aviation Benefits Report 2019, ICAO
(Report based on material of ACI, CANSO, IATA, ICAO, ICCAIA, ATAG)

In 2019, Airbus Industry specialists prepared an optimistic forecast for further traffic growth, which correlates with ICAO's forecasts and operates with an expected growth of air traffic - 4.3% per year. The results of Airbus Global Market Forecast (2019 - 2038) are shown in Figure 2 [2].

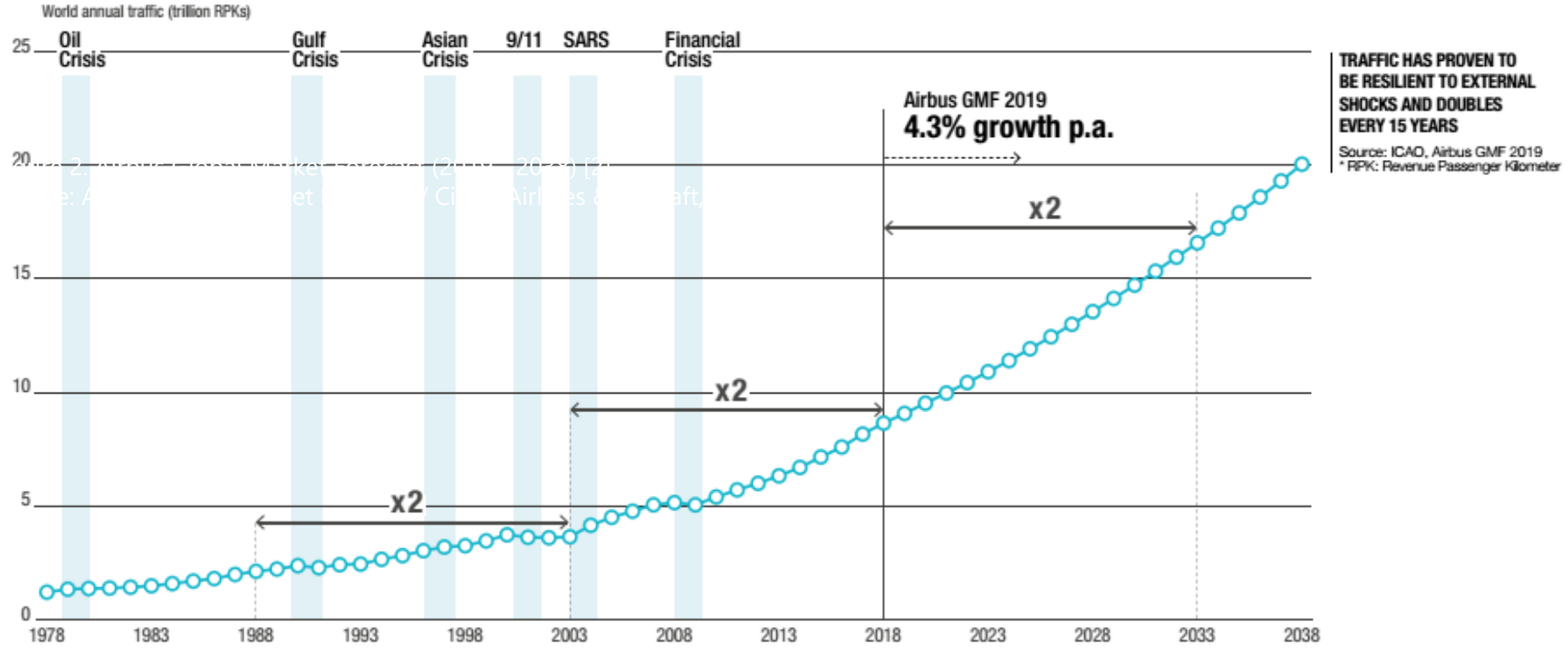


Figure 2. Airbus Global Market Forecast (2019 - 2038) [2].
Source: Airbus Global Market Forecast / Cities, Airlines & Aircraft, 2019–2038.

Until March 2020, these predictions were practically not in doubt among researchers. However, the negative factor of the COVID 19 pandemic, as well as the low level of predictability of the level of its further spread and the effectiveness of the countermeasures, will definitely lead to serious adjustments to the optimistic forecast data.

In response to the Covid-19 pandemic, air traffic has slumped in a manner not seen since the aftermath of the 9/11 attacks on the United States in 2001 [3].

When assessing the economic impacts on civil aviation, ICAO works with many different scenarios [4] in order to reflect the very uncertain nature of the current situation and the rapidly changing environment. In order to explore the potential economic implication of the COVID-19 pandemic for the near future (Figure 3), the full report is built around 6 different recovery paths under two indicative scenarios.

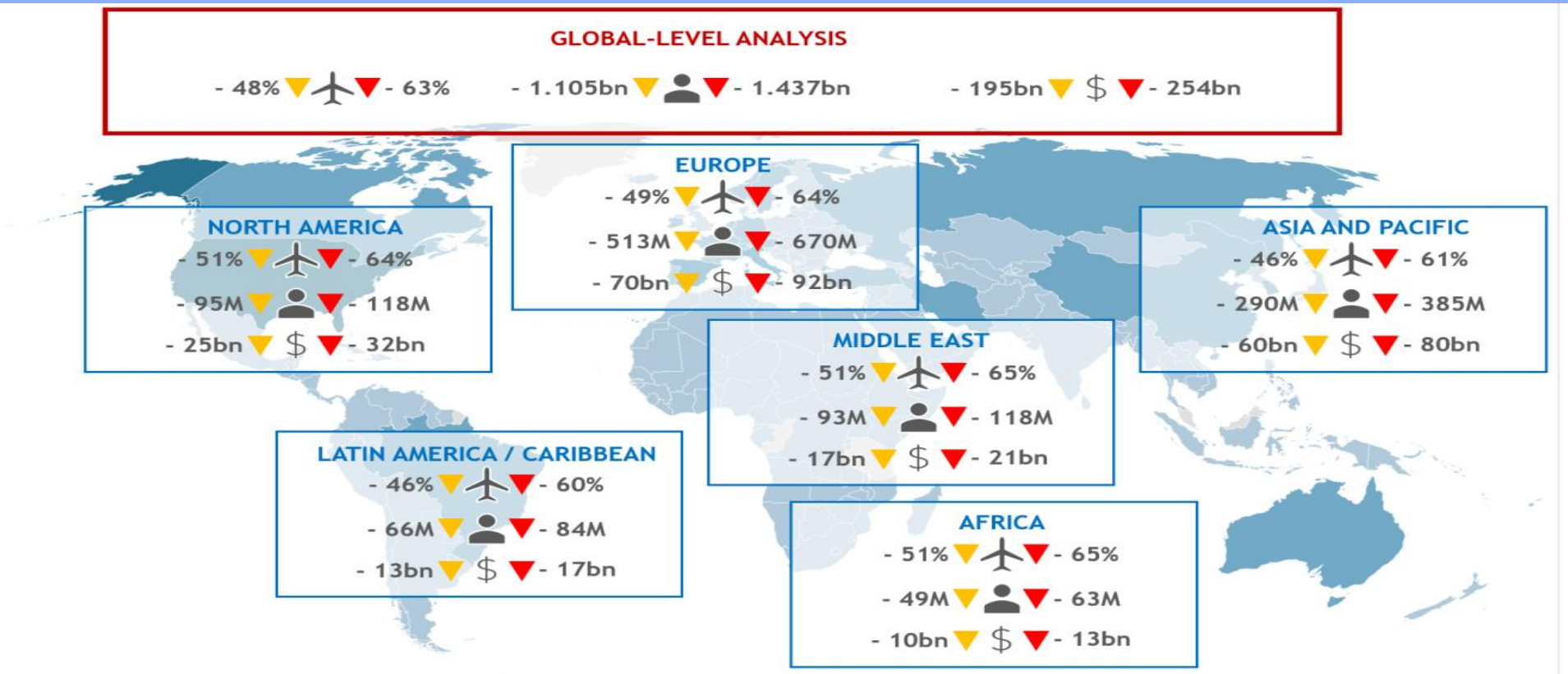


Figure 3. Global-level Analysis
Source: https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx (The data are valid to 25 of July 2020) [4]

The actual path will eventually depend upon various factors, inter alia, duration and magnitude of the outbreak and containment measures, availability of government assistance, consumers' confidence and economic condition:

- ***Baseline :*** **hypothetical situation without COVID-19 outbreak with forecasts as originally planned;**

- ***Indicative Scenario 1 - "V-Shaped"*** **: follows the normal shape for recession where a brief period of contraction is followed by quick/smooth recovery - most optimistic path indicated with a**

- ***Indicative Scenario 2 - "U-Shaped"*** **: indicates prolonged contraction and muted recovery with a possibility of no return to trend line of growth (L-shaped) - most pessimistic path indicated with a**

Scenario 1: **V-shaped path (normal shape for recession, a brief period of contraction followed by quick/smooth recovery a first sign of recovery in late May):**

- **Overall reduction ranging from 38% to 55% of seats offered by airlines;**
- **Overall reduction of 861 to 1,292 million passengers;**
- **Approx. USD 151 to 228 billion potential loss of gross operating revenues of airlines.**

Scenario 2: **U-shaped path (prolonged contraction and muted recovery, possibility of not to return to trend line growth (L-shaped) bottom out and pick up in third quarter or later):**

- **Overall reduction ranging from 48% to 71% of seats offered by airlines;**
- **Overall reduction of 1,108 to 1,524 million passengers;**
- **Approx. USD 194 to 269 billion potential loss of gross operating revenues of airlines.**

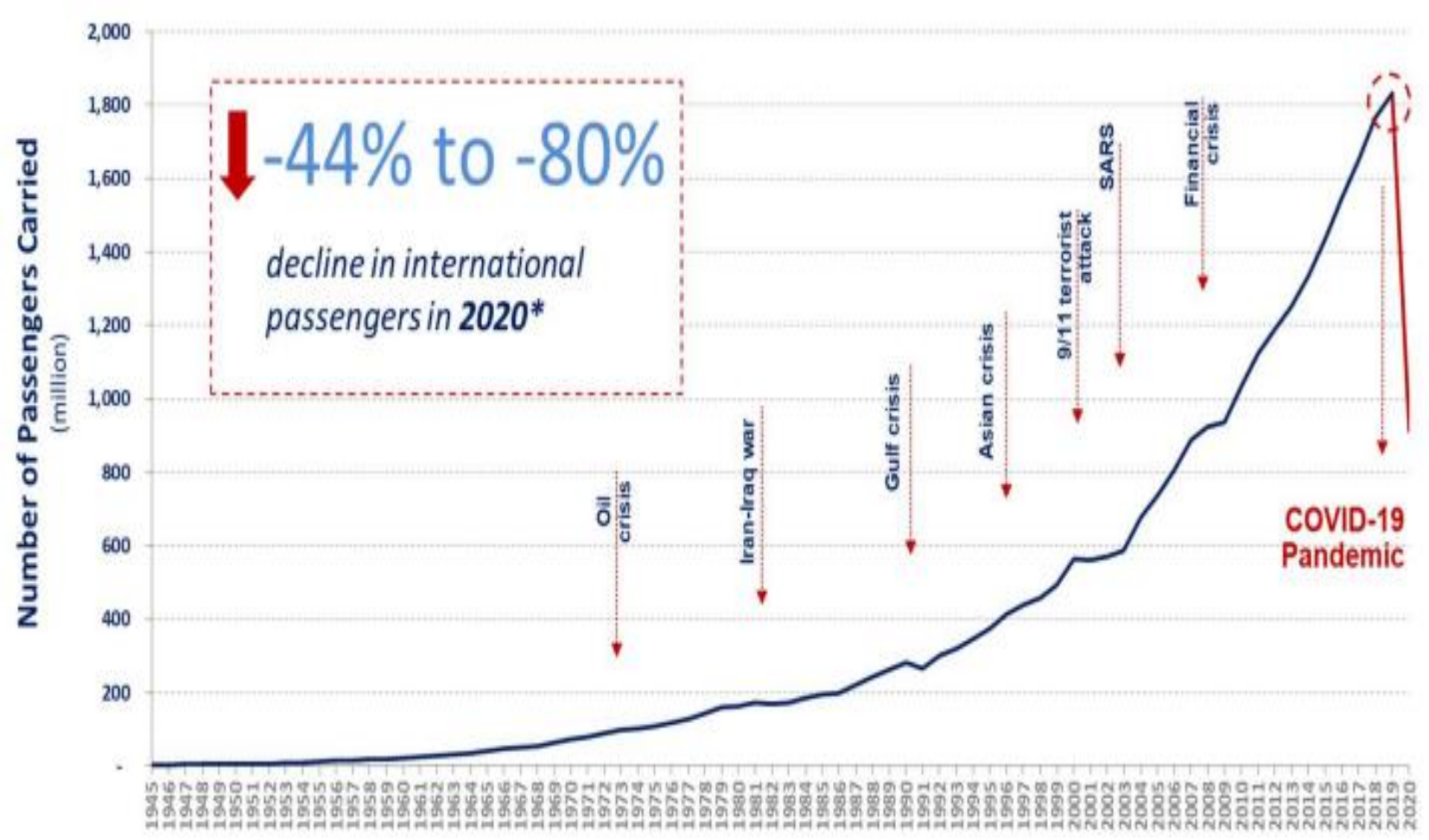


Figure 4. World international passenger traffic evolution 1945 – 2020
Source: https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx[4]

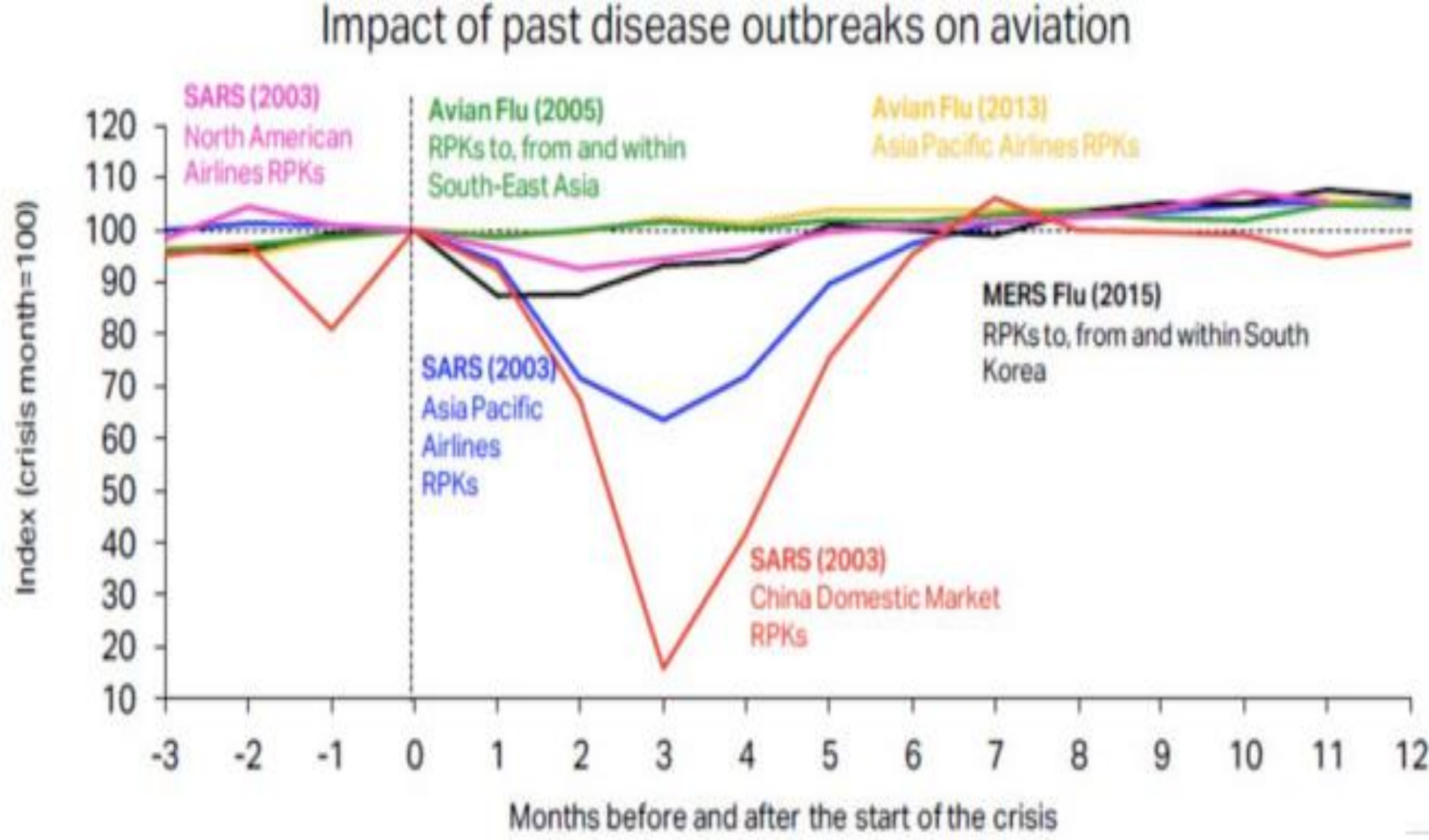


Figure 5. V-shaped and U-shaped paths
Source: https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx{4]

The impacts depend on duration and magnitude of the outbreak and containment measures, the degree of consumer confidence for air travel, and economic conditions (Figure 6), etc. Analytical focus, for the time being, on:

- **Near-term, i.e. monthly profile from January to December 2020;**
- **Scheduled international passenger traffic*.**

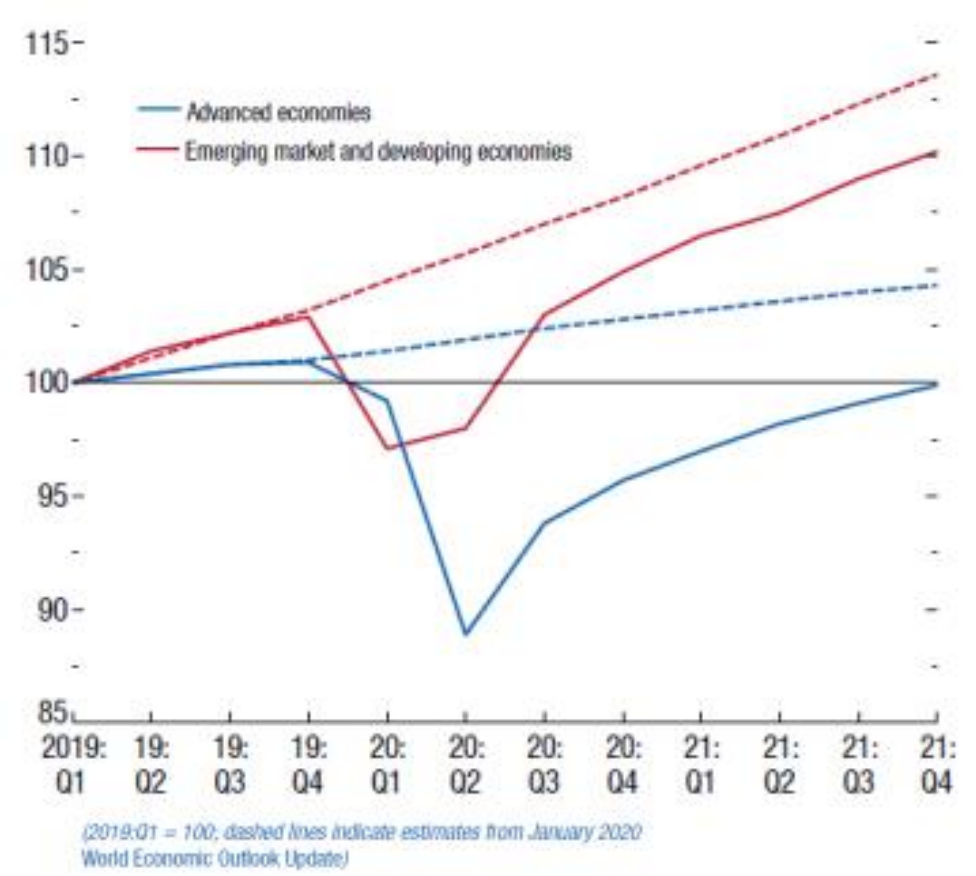


Figure 6: World's GDP Projections (by IMF)

Source: https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-april-2020 [5]

Global impact of COVID-19 on aviation, tourism, trade and economy:

- ***International air passenger traffic*: An overall reduction of international passengers ranging from 44% to 80% in 2020 compared to 2019 (by ICAO);**
- ***Airports*: An estimated loss of over 50% of passenger traffic and 57% or over USD97 billion airport revenues in 2020 compared to business as usual (by ACI);**
- ***Airlines*: A 48% decline of revenue passenger*kms (RPKs, both international and domestic) in 2020 compared to 2019 (by IATA);**
- ***Tourism*: Decline in international tourism receipts of between USD 910 to 1,170 billion in 2020,compared to the USD 1.5 trillion generated in 2019, with 96% of worldwide destinations having travel restrictions (by UNWTO);**
- ***Trade:* A fall of global merchandise trade volume by between 13 and 32% in 2020 compared to 2019 (by WTO);**
- ***Global economy:* A projected -3% contraction in world GDP in2020, far worse than during the 2008–09 financial crisis (by IMF).**

Due to extreme uncertainty, 6 different paths up till 4Q 2020 are consi dered:

- ***Baseline (counterfactual, no COVID-19 pandemic):***
  - **Originally-planned or business as usual: trend line growth from 2019 level**
- ***Scenario 1 (V-shaped path, a first sign of recovery in late May):***
  - **Path 1: Gradual capacity recovery to 80% of Baseline level by December but weak demand return;**
  - **Path 1a: Swift capacity rebound to 90% pushed by pent-up demand;**
  - **Path 1b: Slow progression to recover 60% capacity with downside risk in demand;**
- ***Scenario 2 (U-shaped path, bottom out and pick up in 3/4Q or even later):***
  - **Path 2: Slow progression of capacity recovery to 50% of Baseline with sluggish demand growth;**
  - **Path 2a: Swift capacity rebound to 90% by December, outpacing demand recovery;**
  - **Path 2b: Prolonged downturn towards 2021 with marginal seasonal adjustments.**

COVID 19 Pandemic Impact: Ukrainian Civil Aviation Scale

The number of flights that UkSATSE provided air navigation services in 2020 is **142,047 flights**, which is **57.6% less** than in the twelve months of 2019. In 2020, **21,102 domestic flights (31.5% less than in 2019)**, **68,870 international flights (-57.7%)** and **52,075 transit flights** were operated in the airspace under Ukraine's responsibility flights **(-63.2). Ukrainian airlines** performed 49,733 flights last year (this is **54.7% less than in 2019**), **foreign airlines - 92,314 flights (-59.1%)**. 2020 has become an unprecedented challenge for the aviation industry of Ukraine and the world due to the impact of the COVID coronavirus infection pandemic and the consequences of the crisis will have to be overcome for a long time [5].

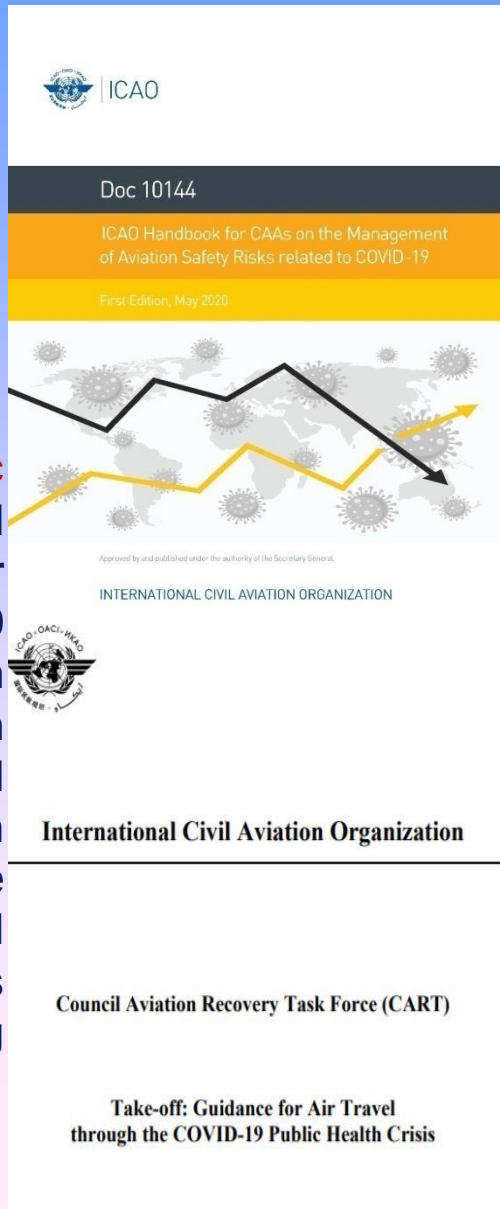
ICAO REGULATIONS

Management of Aviation Safety Risks Regulations related to COVID-19

Advanced management of risks arising from COVID-19 is carried out at the global, regional and national levels

Handbook for CAAs on the management of aviation safety risks related to COVID-19. A new Handbook for Civil Aviation Authorities (CAAs) on the Management of Aviation Safety Risks related to COVID-19 (Doc 10144) was developed with the support of experts serving on the ICAO Safety Management Panel. The guidance can be applied by States at different levels of State Safety Programme (SSP) implementation [6].

Take-off: Guidance for Air Travel through the COVID-19 Public Health Crisis. The ICAO Council adopted a new report and recommendations aimed at restarting the international air transport system and aligning its global recovery. The COVID-19 report and guidelines were produced by the Council's Aviation Recovery Task Force (CART). They were developed through broad-based consultations with countries and regional organizations, and with important advice from the World Health Organization and key aviation industry groups including the International Air Transport Association (IATA), Airports Council International (ACI World), the Civil Air Navigation Services Organisation (CANSO) and the International Coordinating Council of Aerospace Industries Associations (ICCAIA).



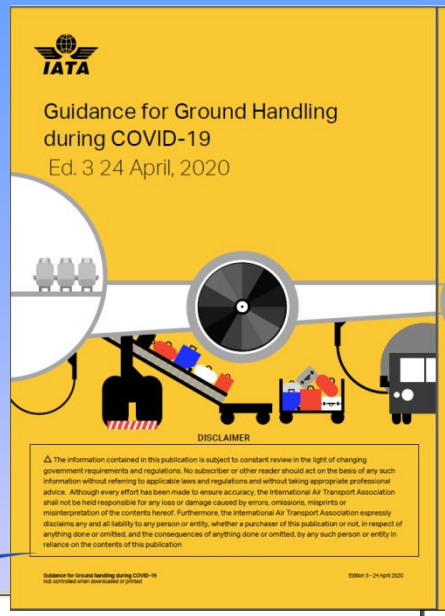
AIRPORT COUNCIL INTERNATIONAL (ACI) AND INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA) REGULATIONS

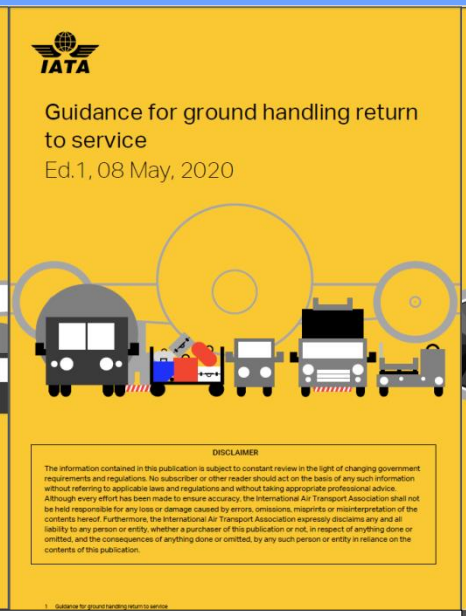
Management of Aviation Safety Risks Regulations

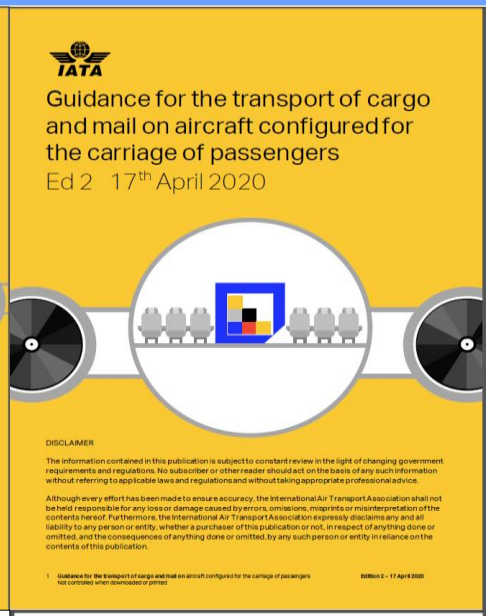
IATA

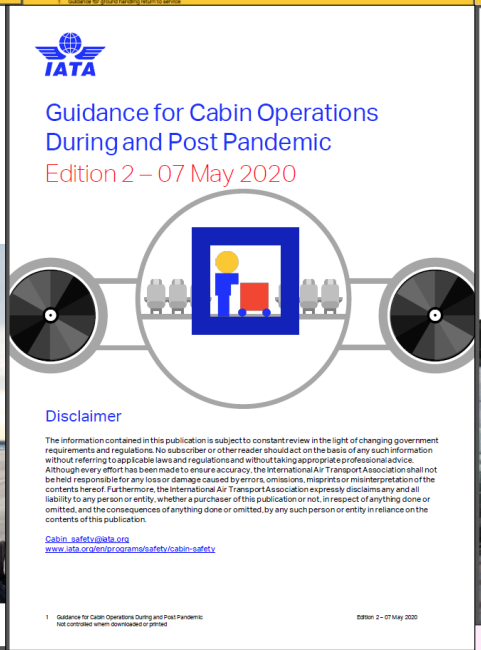
ACI

AIRPORTS COUNCIL INTERNATIONAL



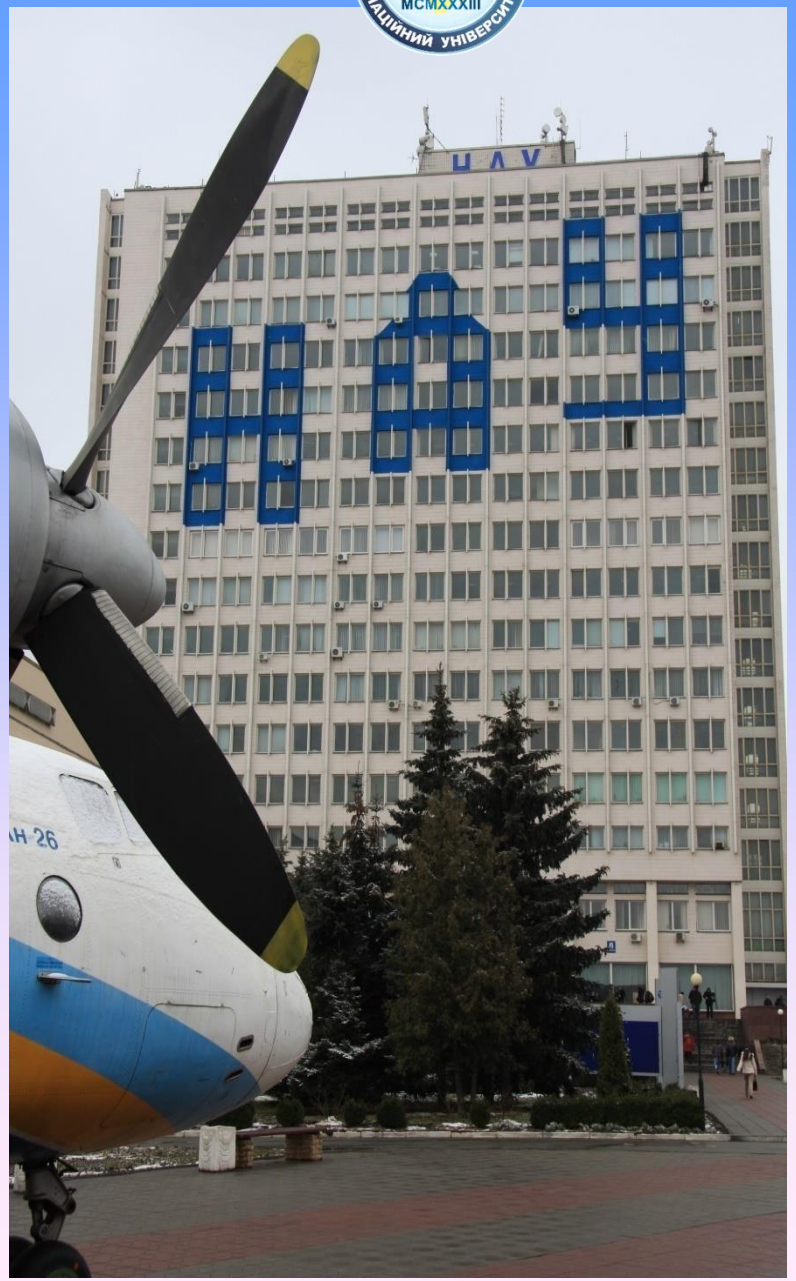






At the regional level: The European Aviation Safety Agency (EASA) has prepared and published **COVID-19 Aviation Health Safety Protocol Guidance for the management of airline passengers in relation to the COVID-19 pandemic** [7]. The protocol ensures the application of a single approach to counteracting the spread of the pandemic in the European Union.

At the national level: civil aviation authorities must take into account the possible consequences of their decisions for the risks faced by other public authorities. The State Aviation Service of Ukraine continues systematic work on the development of a set of measures to combat the spread of the COVID-19 pandemic, namely, published: a protocol on safety and health in aviation related to COVID-19 and operational guidance material on air passenger management and aviation personnel in connection with the COVID-19 pandemic [8,9]

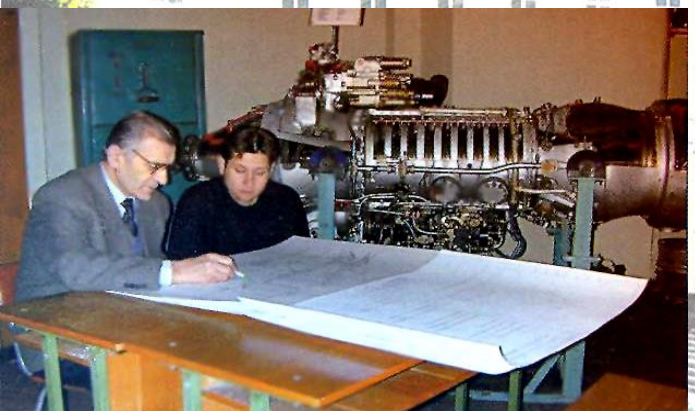


Universities play an important role in the fight against the spread of the pandemic CHOVID - 19. National Aviation University (NAU) is among them.

NAU is the largest aviation university in Ukraine. During 85 years of its existence, the University has trained tens of thousands of specialists for more than 140 countries and continues to provide training in promising areas and various specialities.

Scientific – Teaching Staff

The academic process at the University is provided by highly skilled teaching staff (2000 lecturers), including 45 Academicians and Corresponding Members of the Academy, 200 Doctors of Sciences and Professors, 800 PhD holders and Associate Professors.



Campus of the University

The area occupied by the University is about 100 hectares.

Facilities of the University

The University has got all necessary facilities and equipment: 14 buildings, training aerodrome, a unique hangar, radio equipment and aviation ground equipment facilities, aerodynamic and training complexes, the State Museum of Aviation.

For answer for this challenges nowadays University provides high-quality education for 25 thousand students from 55 countries.

The list of specialties of the University covers almost whole aviation specialties. The university trains future *pilots, operators of unmanned aerial vehicles, specialists of aircrafts and engines maintenance, air traffic controllers and engineers, avionics specialists, radio electronics, modern airport designers, airport handling specialists, air transportation managers and logistics, cyber security specialists, aviation systems diagnostics, aviation ecologists, economists, lawyers, psychologists and other specialties.*

The National Aviation University is a unique conglomerate of aviation education and science that fully meets the needs of the aviation industry of Ukraine and many countries of the world.

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The ICAO Training Institute **was established at the National Aviation University on the basis of the ICAO training centers to coordinate their activities. The ICAO methodologies are being widely used in the teaching process at the University. Also educational courses include practical recommendations and are based on documents of** ***European Civil Aviation Conference (ECAC), European Aviation Safety Agency (EASA) and EUROCONTROL*****.**

Science & Innovations

To optimise scientific activity at the University, five scientific directions of top priority were determined:

- **Aviation and Space Technologies.**
- **Information Technologies.**
- **Ecological Biotechnology.**
- **Energy-Saving Technologies.**
- **Science of Materials.**

The National Aviation University (NAU) also applies the approaches of proactive aviation bio safety management system in conditions of COVID-10 pandemia.

SYSTEMS OF LUNGS ARTIFICIAL VENTILATION OF THE SERIES "MOLFARKA-CORONA"

a - «Molfarka-Corona NAU -159-A»

b - «Molfarka-Corona NAU -159- BISS»

Systems of lungs artificial ventilation of the series "Molfarka-Corona" are specially designed to supply and remove decontaminated by biologically-active composites air under a given pressure and of a required volume in the lungs of a patient with coronavirus disease, and are designed for rapid deployment of mass production at non-specialized factories.

It is “last-chance” systems for use in critical extremal conditions in the absence or lack of complex scarce stationary LAV systems.

SYSTEM FOR ACOUSTIC DIAGNOSTICS AND SYMPTOMATIC ASSISTANCE TO COVID-19 PATIENTS FOR USE IN EXTREMAL CONDITIONS "TREMBITA-CORONA NAU"

The appearance of the acoustic receiver unit and block diagram of the operation of the module "Trembita-Corona M"

Specially for solving problems of remote diagnosis and symptomatic assistance to COVID-19 patients with acoustic methods, the system "Trembita-Corona NAU" is created, which consists of separate modules.

The Trembita-Corona M module is designed for remote acoustic pulmonary monitoring with a remote acoustic information processing center.

The Trembita-Corona BISS module is a more powerful system of acoustic pulmonary monitoring with the possibility of localization of the areas of lesions, including in the areas behind ribs.

Module "Trembita-Corona P" is actually an automated complex that has the ability to assess the lungs of patients by percussion in the absence of direct contact of the doctor's fingers with the patient.

The "Trembita-Corona AS" module provides symptomatic assistance to patients with pneumonia by influencing the affected areas of the lungs with acoustic vibrations of a certain frequency spectrum.

Promising line of drones designed and manufactured in the design bureau of the National Aviation University

UAV-SYSTEM FOR REMOTE ASSISTED MEDICAL DIAGNOSTICS AND PULMONOLOGICAL MONITORING OF POTENTIALLY INFECTED WITH COVID-19 PATIENTS "TREMBITA-CORONA UAV NAU"

An example of the use of a monitoring camera of a delivery UAV for remote monitoring of a patient by medical personnel of the "Trembita-Corona UAV NAU" system.

Figure. shows a photograph of an example of using a UAV's monitoring video camera, which delivered the developed complex of equipment for acoustic monitoring of lungs to a patient for his remote monitoring by medical personnel. In this case, the medical staff tracks the actions of the patient or his assistant during the procedure for monitoring of lung damage with single-point single- or multi-channel or multi-point receivers of acoustic information.

CONCLUSION

The COVID - 19 pandemic is one of the most serious challenges to humanity in the 21st century.

Biological threats do not have national and regional boundaries; they are relevant on a global scale.

Only by combining the forces of physicians, designers, researchers and scientists from different universities of many countries of the world the humanity will be able to give a worthy response to this challenge [10-11].

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