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The main risks of Ukrainian aviation

Aviation incidents result into the risk of human victims, loss of aircrafts, and other additional risks. The activity should be carried out in two directions: preventive measures and strict compliance of Standards and Recommended Practices by aviation employees and policy measures aimed at ensuring safety and reliability of flights.

1. Introduction

At the present stage, all civil aviation operates according to the unified standards and regulations of the International Civil Aviation Organization (ICAO). ICAO cooperates with the 193 Member States and industry organizations that have acceded to the Convention to build consensus on Standards, Recommended Practices (SARPs) and policies for international civil aviation in order to ensure safe, efficient, economically sustainable and environmentally responsible development of the civil aviation sector.

ICAO Member States implement these SARPs and policies to ensure that their civil aviation operations and regulations comply with international standards, which in turn help ensure the safety and reliability of more than 100,000 daily flights in all regions of the world in within the global air transport network [1].

All aviation personnel undergoes medical, psychological selection, and professional training. All aviation equipment is certified. To determine standards, the State Administration of Ukraine sets requirements for educational institutions that train these employees [2]. Researchers are engaged in modeling the typology of exercises for effective mastering of RTF communication among students ab initio [3], and phraseology issues in radio exchange [4].

However, despite the above, in civil aviation today, there are possible risks of aviation threats caused by various factors (temperature, weather conditions, human and physical factors).

2. Methodology

In our research we consider the use of a set of theoretical methods. A method of synthesis helped to reveal risks in Ukrainian civil aviation. A method of analysis of the causes of aviation accidents helped to reveal a human factor (laser blinding, an attack on the civilian aircraft, violation by the pilot of the rules for the use of airspace, distracting the pilot's attention during the flight from performing his professional duties). A descriptive method was used to describe aviation accidents and their risks. Analysis and hypothetical prediction were used to clarify the reason of risks.

3. Results

3.1. Statistics of aviation accidents

The results of the analysis of the causes of aviation accidents over the past 10 years indicate that about 80% of them occur through erroneous actions and violations by aircraft crews of the operating rules (human factor) [5]. Aviation accidents by severity are divided into incidents (no casualties) and disasters. According to the data received by the National Bureau for Investigation of Aviation Events, in the first half of 2020, during the operation of civil aircraft (ACFT) of Ukraine for passenger and cargo transportation, during aviation operations, training flights and during the operation of aircraft of general aviation, entered in the State Register of Civil Aircraft occurred: 3 accidents (1 – during cargo transportation and 2 – during general aviation flights); 9 incidents; 5 violations of the procedure of the use of the airspace [6]. Bird crashes, pilot blindness, congestion and performance problems are among the causes of aviation accidents. According to statistics accumulated from 2013 to the first half of 2020, the impact of the ornithological situation on flight safety increases in the summer during the migration of a large number of birds to the territory of Ukraine, i.e., it is seasonal [6].

According to the National Bureau, in five years (from 2013 to 2018), 102 reports of blinding of Aircraft crews by laser beams were officially registered. According to the results of the analysis, most cases occurred at Kyiv Airport (18), Boryspil (16) [7]. According to the Aviation Safety Network database, as of 2013, seven An-74 aircraft out of about a hundred existed were lost. Five aircraft had problems on takeoff. One case was due to overload and four others were due to failure of power units [8].

3.2. Incidents

Incidents that occurred in the first half of 2020 in Ukraine are divided into categories as follows (in descending order): failure/failure of systems/units (excluding the power plant); collisions with birds; failure or malfunction of systems/units (power plant); events related to aviation security; collisions (threat of collision) of the controlled aircraft with the ground; fuel related events and other/unknown or uncertain.

24.06.2020 at 14:25 (Kyiv time) an incident of violation of the procedure of the use of Ukrainian airspace was recorded. From the senior air traffic controller of the Lviv Regional Structural Division received information about the flight in the area of the village Davydkivtsi (temporarily reserved area for flights of Unmanned Aerial Vehicles - UAVs) of light aircraft at an altitude of up to 1000 m with a course of 120˚ for a time of 14:20. At 2:50 p.m., the assistant on duty of the A1788 military unit received information about the visual observation of the flight of a light aircraft in the area of the village of Shpychyntsi (near the military unit) at an altitude of up to 1000 m with a course of 160˚ at 14:30. It was previously established that at 14:10 a C-172 UR-LKR light aircraft took off from Khmelnytskyi, on the route Khmelnytskyi – Sutysky, which passed through the temporarily reserved area for UAV flights and the area with limited use of airspace UKR 1612 (vlg Shpychyntsi) in the period 14:10-15: 02. Preliminary approvals of the flight on a certain route with

the controlling body of airspace use were not carried out. During a telephone conversation, the pilot confirmed that he had flown near these settlements during this period. The flight through the flight restricted zones was explained by pilot in order to bypass the storm front. The relevant supervisory bodies of the Air Force of the Armed Forces of Ukraine, the bodies of the joint civil-military system of Air Traffic Control, which control the use of the airspace of Ukraine, were not informed about this activity by the airspace user. The requirements of paragraph 8 of Article XII of the Aviation Rules of Ukraine "Rules for the use of airspace of Ukraine" approved by a joint order of the State Aviation Service of Ukraine and the Ministry of Defense of Ukraine from 11.05.2018 № 430/210 and registered with the Ministry of Justice on 14.09.2018 № 1056/32508. The National Bureau of Air Accidents Investigations of Ukraine tracks violations of the procedure of the use of airspace [9].

According to statistics, the closest disposed to damages units of the aircraft during collision with birds are (in descending order): the engines, the wing, the fuselage, cabinet glass, radar fairing. Therefore, ensuring the protection of the aerodrome area from birds is one of the most important tasks to ensure flight safety. The most dangerous stages of the flight are the take-off and landing of the aircraft, as the aircraft are at their altitudes accessible to birds, as well as the close proximity of birds to human settlements, which allow them easier access to food. Airport services are known to provide precautionary measures to ensure flight safety (e.g., dispersal of birds).

In aviation, there is a certain group of risks faced primarily by pilots of aircraft. An example of this risk is the blinding of pilots by laser beams, which pose a threat to health and safety. The National Bureau received 3 reports of blinding of aircraft crews by laser beams. The largest number of cases of blindness occurs in areas of major airports in Ukraine. The most dangerous stages of flight, during which crews are blinded, are the stages of takeoff and landing, during which the aircraft are relatively close to the aerodrome and the ground. These allow the attacker is more likely to successfully hit the windshield of the cockpit, and the short distance to the aircraft does not allow the beam to lose power due to too little atmospheric influence.

The crew of the passenger plane A 320 of the Italian airline "Ernest Airlines", which was making an evening flight from Naples, when landing at the airport "Kyiv" was blinded by a laser beam. Such blindness occurs mainly in the evening, so some airlines choose to avoid nighttime flights. Although commanders and pilots have repeatedly reported blindness when approaching Boryspil Airport, but not all facts have been provided to the National Bureau of Air Accidents Investigations of Ukraine, which also tries to record such data on a regular basis.

3.3. Acts of illegal interference as the main threats and risks to aviation security

The main threats and risks to aviation security include acts of unlawful interference. According to the Law of Ukraine "On the State Program of Aviation Safety of Civil Aviation" [10], acts of unlawful interference mean acts or attempted

acts such as to jeopardize the safety of civil aviation and air transport in the air or on the ground. Such threats include:

- unlawful seizure of aircraft in flight,
- unlawful seizure of aircraft on the ground,
- hostage-taking on board an aircraft or on aerodromes,
- forcible intrusion on board an aircraft, at an airport or on the premises of an aeronautical facility,
- introduction on board an aircraft or at an airport of a weapon or hazardous device or material intended for criminal purposes,
- providing false information as to jeopardize the safety of an aircraft in flight or on the ground, of passengers, crew, ground personnel or the general public, at an airport or on the premises of a civil aviation facility.

According to the "Risk Management Methodology"[11], the risks and threats to aviation security include:

- dangerous devices, materials, weapons transported by humans on their bodies, in hand luggage;
- dangerous devices, materials, weapons in the cargo;
- dangerous devices, materials, weapons transported on board in food, on-board supplies (accessories);
- dangerous devices, materials, weapons transported by the passenger in the checked baggage;
- dangerous devices, materials, weapons transported by vehicles;
- placing of dangerous devices, materials, weapons on the aircraft maintenance by personnel;
- shelling / damage of the aircraft during the stay at the airport;
- hijacking / hijacking of an aircraft while at the airport;
- MANPADS (man-portable anti-aircraft missile system) in the armed conflict conflicts;
- MANPADS outside of armed conflicts;
- the use of an aircraft as a weapon;
- shelling of an aircraft with the use of small arms during take-off/landing of an aircraft;
- aircraft shelling during a flight near / over an area of armed conflict;
- remotely controlled aircraft systems;
- the use of an aircraft for the purpose of harming the environment, private property.

Discussing aviation risk assessment, especially in the context of airlines, there is a natural tendency to focus on the risks of flight operations, in particular the risk of multiple casualty accident and fuselage destruction. However, in practice, a single event may involve more than one risk and airlines must manage different types of risks in parallel. These additional risks include:

• Financial risks − risks of significant financial losses.

• Environmental risks − risks of harm to the environment.

• Reputation risk − the risk of damaging the airline's reputation. For example, problems with spontaneous in-flight announcements regarding postures in

an emergency landing do not pose a safety risk, but may attract increased passenger attention and anxiety.

• Operational risks − risks arising from delays in departures caused by the shutdown of the aircraft or the entire fleet of aircraft. It can also be seen as a part of financial risks.

• Aircraft Maintenance Risks − risks that may cause problems with the airworthiness of the aircraft as a result of improper maintenance or ground maintenance.

• Aviation safety risks – for example, the risk of harm as a result of intentional actions threatening flight safety [12].

4. Discussion

The pilot's disregard for the country's airspace rules (the incident of violation of the procedure of the use of Ukrainian airspace in June 2020) could lead to a number of risks. Risk means the possibility of a negative event. Among the risks could be: the simultaneous death of a large number of people who were on board and became victims of such events; environmental consequences; loss of flight crew, the training of which is complex, lengthy and requires high financial costs; losses of aircraft, which carry significant financial losses due to the high cost of equipment [13, c. 88].

According to ICAO requirements, pilots who have been blinded must report the incident to the doctors they are supervised, and then they have to go through an appropriate medical commission. However, in practice such an incident looks completely different. Some airlines prefer not to talk about laser attacks. And pilots avoid consulting with the doctors. It seems that everything will be well (landed normally, the liner is safe, passengers are satisfied). Pilots need to spend a lot of time to register such a case. And a visit to an ophthalmologist threatens to cancel flights. Therefore, it is easier for pilots to avoid consulting doctors about laser beam blinding. But there are some risks to crew health and job loss. Therefore, ICAO has dedicated a large-scale treatise on this subject – Doc 9815, AN/447, which states that a conventional laser beam can be deadly to aircraft [14].

According to leading experts, this type of blindness is considered a risk of a plane crash with human victims. The blinding beam has a strong stimulus and carries a potential threat. It immediately attracts the attention of pilots, distracting, impairs vision and as a result leads to a short-term blindness and retinal burns. The trouble is that no offender who blinded the plane during landing was detained. Laser blinding in aviation has become the global problem and such facts are recorded by airlines every month. And there were no personal appeals of pilots. Such blindness is manifested not at once, but systematically, at different airports it is a reason to think about this problem, to find some counteraction to this fact. However, Ukrainian law does not clearly state that blindness should be considered a criminal offense. And important thing is maintenance conditions of the aircraft, the mode it flies, also depends on the degree of danger, if it is in the automatic mode then the risk is less, you can minimize the negative impact on vision.

Thus, the problem of blinding with a laser beam remains a very important issue in aviation, because it is unknown for what purpose laser attacks are carried

out. It is alleged that in this way, residents of the surrounding areas are trying to force the management of some airports to suspend flights in the evening and at night for peace and quiet. And there are no means of protection against such blindness; the exception is for glasses with tinted glass, as pilots say. Because the aircraft is flying at high speed, it is not possible to establish the exact location of the emission point.

4.1. COVID 19: threats and risks to aviation

At a time when society is facing a global pandemic, aviation has become one of the potential ways for COVID 19 to be spread. Also, healthy people are at risk of contracting the virus due to the fact that during the flight they are in a confined space with other people who may be sick with COVID 19. In addition, the pandemic has led to the development of such dangerous factors as:

- decreased skills of employees, due to the fact that in the previous period of global quarantine, aviation was suspended. Aircraft pilots were able to train only on the appropriate simulators in order to maintain qualification, however, not all simulators create real flight conditions, which can lead to a decrease in the level of qualification skills, and as a result – a decrease in the level of aviation safety;
- loss of skilled personnel – under quarantine, most of the world's population tried to find new ways to earn money because air services were suspended, airline personnel may also have had to look for new sources of income, so they had to change place of work, which led to the loss of staff;
- shutdown of airlines and reduction of the number of flights due to the reduction of the number of passengers, and it causes large financial losses. The number of flights performed in Ukraine was less than 90% of the average annual value [15].

4.2. Causes of plane crashes

The cause of the crash of the Airbus A320 passenger plane of the company "Pakistan International Airlines", which crashed in a residential area of Karachi in May 2020, is considered to be the human factor. 97 people died, people living in the houses on which he fell were injured. According to the preliminary report, the plane was fully operational. On the first attempt to land, he did not release the landing gear and touched the runway three times. This damaged the engines. ” Both the pilots and the controllers did not follow the protocol. The pilot ignored the instructions of the air traffic controllers, and they, on the other hand, did not inform the pilot about the collision of engines with the ground", said Pakistan Aviation Minister Ghulam Sarwar Khan during a speech on the plane crash in the National Assembly. He noted that the flight recorder worked all the time and recorded all the conversations in the cockpit. The Minister personally listened to a recording of a conversation between the pilot and the air traffic controller, who violated the instructions several times. The pilots discussed the coronavirus that affected their families. As a result, they were unable to concentrate on the plane, which led to the tragedy. Experts named the preliminary cause of the crash in May in the Airbus A320 Karachi [16].

An-74 cargo plane, flight number UR-CKC, of the Ukrainian airline CAVOK Air (licensed for air transportation to the United States, Canada, the

Caribbean, Brazil, etc.) on take-off, allegedly collided with a flock of birds and was in the ditch. The aircraft was gutted. Four of the six crew members were injured and hospitalized, two more were bruised.

Flight experts immediately suggested that getting birds into one engine could not cause such consequences. The commission usually finds out what happened, whether there was a tragic coincidence or something else, but in 99% of such cases, the causes of accidents, according to experts, are different.

An-74 is a modification of the Soviet transport aircraft An-72 created in the ASTC named after O.K. Antonov in the early 80's of last century, designed to transport cargo, equipment and people on short and medium range airlines in all climatic conditions from − 60 ° C to + 45 ° C and at any latitudes. Placing the engines above the wing virtually eliminates the ingress of foreign objects into the engines from the surface of the runway during take-off and landing.

It was established that this Ukrainian plane was no longer young. It made its first flight 25 years ago, flying 2598 hours (almost a third part of its flight life). In 2000, the aircraft was sold to Latvia, 8 years later resold to “Swift solution FZC” from the UAE. In 2011, it was spotted in Kyiv, at the airport of the 410th repair plant.

According to the Airworthiness Directive issued by the State Aviation Service of Ukraine SE Antonov, it turns out that one of the aircraft manufactured by the Kharkiv State Aviation Production Enterprise found a lack of engine components that could change the parameters of the takeoff mode. The document recommended all operators of these aircraft models to check the components before the next take-off, and in case of detection of a defect to notify the State Enterprise "Antonov" and the State Aviation Service. Therefore, it is possible that in this event the cause could be not only birds. Although this ultimately does not cancel the skills of Ukrainian pilots who have coped well with the emergency situation [17].

A large number of accidents and catastrophes is especially related to the increasing number of military conflicts on our planet. Iran's Civil Aviation Agency has published a report on the investigation into the crash of the Ukrainian Boeing 737-800 of Ukraine International Airlines in January 2020, which crashed and killed 176 people minutes after taking off from Tehran airport. The cause of the accident is a human error, it was shot down by the Iranian military. No system adjustment was made after the relocation of one of Tehran's air defences. Due to the lack of readjustment, it incorrectly reflected the geography of the departure of the Ukrainian Boeing. The air defence system operator analyzed the information received and identified the civilian aircraft as a hostile target. There was no connection between the Tor-M1 anti-aircraft system and the air defence command post, and according to the instructions, "if the defence system could not contact the coordination centre and did not receive a firing squad, it had no right to fire" [18].

5. Conclusions

Thus, it can be concluded that the incident and the plane crash carry not only the risk of casualties and loss of aircraft, but also other additional risks (financial, environmental, reputation of the airline, operational, risks of maintaining airworthiness). Acts of unlawful interference also pose risks to aviation security.

COVID 19 poses a threat to reduced aviation safety; loss of qualified personnel; financial losses and threats to human life due to the rapid spread of the pandemic over long distances.

The risk analysis shows that the work should be carried out in two directions: preventive measures and strict adherence of SARPs by aviation employees and policy measures aimed at ensuring safety and reliability of flights.

However, there are unresolved issues (blinding pilots with laser beams, attacks of civil aircraft by the military, pandemics, cases of negligent performance of their professional duties).

So, there are many factors that depend on the training of pilots, their experience and coordinated work of staff.

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