THE ANALYSIS OF FACTORS GENERATING EMERGENCY SITUATIONS IN AIR TRANSPORT

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Abstract. *While conducting our ordinary social and economic activities, we rarely stop to ponder what would happen if air transport opportunities (and its services) suddenly became largely limited. We neither realize the reasons behind it nor are we aware of its potential consequences. That is why – when preparing business strategies – air transport operators develop modern models of company operations, which account for emergency situations. A rapid response to emergency situations and skillful implementation of modern solutions are the foundations of operational and financial sustainability of enterprises. The aim of the article is to present factors generating emergency situations, which may substantially limit air transport operations, and their likely consequences. The Authors are aware there is no one perfect pattern of conduct to be used in every case, however, they hope their work would be of some assistance to those who are responsible for taking decisions in the situations that are both extremely stressful and dangerous.*

Keywords: *air transport; emergency situations; air transport operators; crisis; factor's analysis.*

Introduction

Aviation has developed its response to the growing demand for passenger and freight air transport. The twenty-first century features rapid development of societies who are willing to migrate for work and study purposes, explore the world and grow wealthier. Thanks to the above and the development of a broadly understood communication, including communications and air transport, the concepts of time and distance have disappeared. Space is perishing; the distance is becoming non-distant. We are living in the world that is a global village, where everything is happening at the same time and where everything is affected by events of various origins.

Problem-solving very often requires us to use the most accurate research methods for various disciplines: Economic sciences, management, computer sciences, and statistics. The choice of methods is dependent on the agreed research procedure. Accurate methods are accepted on its every level what allows to aim the goal of given investigation. According to the given information, this paper includes the following research methods:

- System analysis
- Other countries' experience – analysis of the results

- Potential's comparative analysis of chosen air carriers

Basing on the investigation results of other authors who publish their papers in this area of research, it must be said that previous studies contributed to creating advanced research methods. It also showed that the area of the cargo air transport still faces many problems.

The nature of an emergency situation

With a view to delineating the nature of an emergency situation, we should present its definition set forth in the National Programme of Civil Aviation Protection which presents an emergency situation as: "a situation in which safety is jeopardized by an act or an attempted act of unlawful interference in civil aviation" [www.prawo.sejm.gov.pl]. Unlawful interference in civil aviation, in turn, is specified by the legislator as an illegal and deliberate act consisting in:

a) use of violence against a person on board an aircraft in flight;
b) destruction of an aircraft in flight or causing damage to an aircraft preventing the flight or jeopardizing the safety of the aircraft in flight;
c) introduction on board an aircraft of an object, device or substance which may jeopardize the health or life of passengers or crew, or destroy an aircraft or cause damage to an aircraft preventing the flight or jeopardizing the safety of the aircraft in flight;
d) unlawful seizure of an aircraft, with crew and passengers on board or without them, also for the purpose of using the aircraft as a device for an aerial terrorist attack;
e) destruction or damage of onboard or ground equipment, their disruption, or the use of violence against their operator in the event when this seriously disrupts air traffic or jeopardized the safety of the aircraft;
f) communication of false information which poses danger to persons and property in air communication;
g) use of hazardous devices, substances and objects or weapon, the use of which may:

- destruct or seriously damage devices at an airport;
- destruct or seriously damage an aircraft;
- disrupt air traffic or airport operations during the violent act directed against a person at an airport or serving civil aviation, which results in or may result in serious injuries or death (www.nowastrategia.org.pl - date of access: June 30, 2018).

Factors generating emergency situations in air transport

Due to its utility values and the benefits of long-distance passenger and freight transport services, air transport is the leader of the transport sector. Nonetheless, in addition to advantages, transport aviation also has its (major) disadvantages, as demonstrated by the presence of a group of factors disrupting its smooth operation. The morphological analysis of the factors is shown in Fig. 1.

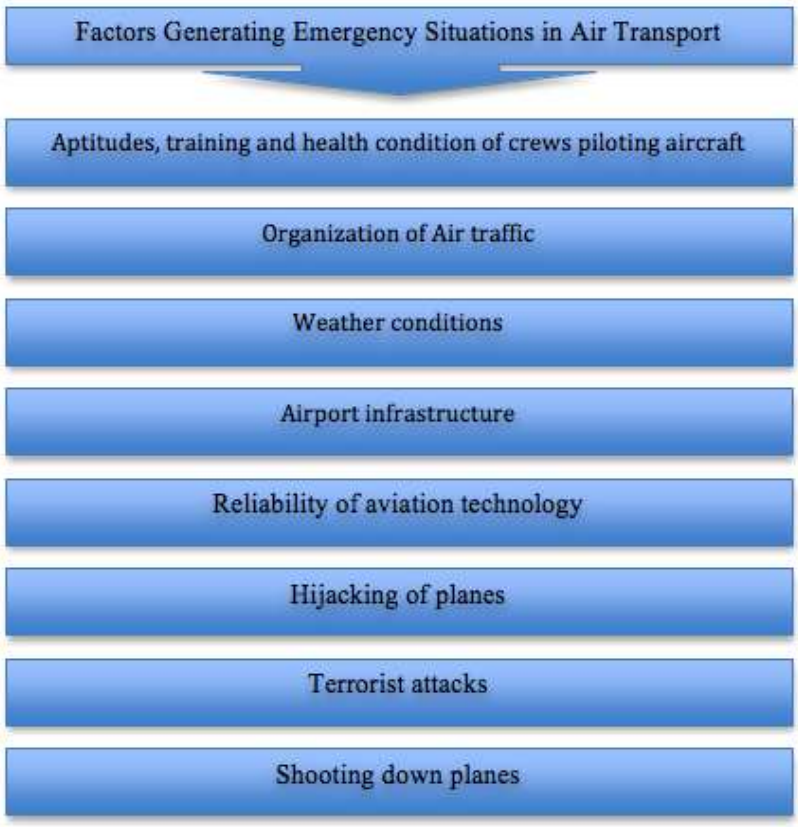

Figure 1. Factors Generating Emergency Situations in Air Transport (Wąsowska, 2015, p.5498)

Aptitudes, training, and health condition of flight crews

In accordance with the binding regulations, the pilots and cabin crew members must be examined by a psychologist at least once every six months (following certain rules and procedures, depending on the scope of responsibilities). Quoting the article by Z. Banachowicz and D. Grześkowiak entitled "Zagrożenia bezpieczeństwa we współczesnych portach lotniczych i na pokładach statków powietrznych" ("Security threats at contemporary airports and on board aircraft"), psychological assessment of pilots should be conducted minimum once per six months as human mental condition is subject to frequent changes and, therefore, a team of psychologists (and psychiatrists, if needed) ought to supervise it. According to the authors, neglecting these affairs led to the Germanwings' Airbus A320 catastrophe in the Alps.

The investigation in the case proved with a high degree of probability that the co-pilot, who locked himself in the cockpit and took over the plane after the captain had gone to a toilet, acted intentionally and had been prepared. His unauthorized and unfounded flying below flight altitudes in the mountainous area of the Alps resulted in the plane crash. The results of the investigation demonstrated that this man had mental problems, which could have triggered his destructive behavior.

Having regard to this event, the authors unanimously highlight that every pilot should have his individual psychological profile drawn up, depending on his age and seniority (as a pilot – as of the time of training, as an employee – as of the start of employment with a given employer and airline) and on one's mental and physical features. Examinations conducted year by year would allow one to detect all and any changes in the profile caused by, for instance, life failures, allowing immediate response to emergency events.

The remaining cabin crew members (flight attendants) are required to comply with their roles. The authors reckon that they too should be given extra training so that, in the event of a permanent or temporary disability of a pilot, they are ready to take over some part of professional responsibilities of pilots, such as to communicate with ground forces/service providers or to control an airplane or its devices, to some extent (Banachowicz & Grześkowiak, 2015, p.669).

Air traffic organization – Air traffic management

Air traffic management is providing an adequate level of air safety by striking a balance between the ever-growing number of flights and the available volume of controlled space.

The term Air Traffic Management (ATM) was created in the process of aviation development and evolution and on the basis of the theory of management. Its essence are "all undertakings accomplished on behalf of the state by a special specialised organization, in cooperation with other entities, aimed at ensuring aircraft safety, maintaining well-ordered air traffic flow, and using airspace in the most efficient manner" (www. mi.gov.pl (date of access: June 30, 2018)).

The underlying elements of air transport management are:

- planning;
- organizing;
- coordinating;
- controlling all resources of air traffic management potential, which includes, above all, ground personnel, cabin crew, and all technical infrastructure of the system of air traffic service providers.

ATM consists of the following activities:

- provision of air traffic service providers;
- management of air traffic flow;
- management of airspace.

Rapidly progressing globalization and integration within the European Union have resulted in the need to take up activities which would synchronize and liberalize civil aviation. Their scope appeared to be very broad, for it covers the rights of passengers, matters relating to safety, environmental protection, infrastructural needs, and air traffic management.

Air transport development spurs growth throughout the economy – the idea of sustainable development. This is the main objective of the European Commission, in line with which a reform of the system of air traffic management in Europe was developed

under the name Single European Sky (SES). Given the significant fragmentation of airspace in Europe and the need to cooperate in terms of operations and system adaptation to the present-day movement situation in the airspace, the concept turns out to be extremely important.

The multi-aspect approach to air navigation is an opportunity to attain the following goals within a few-year period:

- increase in airspace capacity;
- the decrease in costs of air navigation service providers;
- the decrease of aircraft operations' negative effect on the natural environment;
- safety [Ibidem] .

Weather conditions

The specificity of air transport is its dependence on temporary weather conditions rather than climate changes, for the current meteorological situation is most important, above all, at airplane take-off and landing. Aviation infrastructure, in turn, is subject to the same climate changes as a building or technical infrastructure. The primary risk for on-ground planes are gusts of strong wind and icing. The remaining atmospheric phenomena, such as downpours or heavy snow, may delay operations and have a negative effect on transport regularity – but they are not a real threat. Nowadays, air transport is prepared to operate under the above conditions.

Fog or volcanic ash emission results in a complete loss of visibility, which as a consequence may lead to discontinuance of transport functions [www.klimada.mos.gov.pl] - this happened at the end of March/beginning of April 2010. The year 2010 did not call for optimism. The economy only started to have a chance of being profitable after an unexpected economic downturn, and here a new crisis– the so-called volcanic crisis - emerged, particularly affecting the air transport. The effects of volcanic eruption covered nearly all Europe, grounding not only air transports but also European Union economies and communities.

The Agency of Aviation Supervision – Eurocontrol – announced that around 300 of 29 thousand flights in Europe were canceled. The International Air Transport Association (IATA) estimated that daily downtimes cost airlines 200 million USD. Tim Clark, the head of the Air Emirates flying passengers from Asia to Europe said: ..."Should the ban on flights be upheld, the aviation industry will collapse" (www.wyborcza.pl (date of access: August 2, 2018)). Lufthansa lost – 200 mln Euros, British Airways – 20 mln GBP, whereas the above mentioned Air Emirates – 50 mln USD.

Air transport is used in the economy primarily for long-distance shipment of fresh foods, medicines, electronics and car parts for production lines, etc. Particular impediments were seen in the movement of goods along the following routes: Asia - Europe and Europe - America.

Losses were recorded not only by the aviation sector. Alcohol manufacturers, such as Johny Walker or Hennessy, and a luxury shoes and bags producer Salvatore Farragamo with over 130 stores across all airports, also experienced difficulties.

BMW car manufacturer announced that in view of the situation the production of X5 and X6 models in the South Carolina factory (USA) may have been withheld because they were not receiving any gearboxes from their German plants. The same declaration was made in China by Japanese Nissan, as it was not getting its parts from Ireland. Such production halting was also intended by Daimler.

In Hong Kong, commonly referred to as the window overlooking the South-Eastern industrial districts of China, the goods waited between 10 and 14 days before they could be loaded on board of aircrafts. The luxury Hong Kong districts lacked French cheese and Belgian chocolate. LG plants' warehouse was full of electronic devices due to zero transport opportunities across Europe. Thousands of roses died at Kenyan airports and tons of pineapples and papayas intended for Europe went off in Ghana. In China, in the Guangdong province, many plants manufacturing jewelry and watches ceased operations.

In Poland too we could face a shortage of medicines which were not registered in the country but imported upon the consent of the Minister of Health, upon request. These medications include American and Canadian preparations for drug-resistant tuberculosis patients, interstitial cystitis and tumors. As airlines did not take on any new orders, at the time of service renewal the rates could have doubled.

In accordance with the European Commission's 2008 data, air transport includes only 0.6% of the total mass of goods in the EU foreign trade; nonetheless, as their value was 576 billion Euros – in reality, it accounted for 20% of the value of total EU foreign trade.

In the face of danger, the German Minister of Economy Rainer Bruederle said: "Many industry sectors rely on air transport. If in a global world, supply chains are suspended for longer periods, we will have a serious situation [www.wyborcza.pl]". Germany, as the largest European exporter, has special reasons to be concerned for – to quote the main economist of the German Economic Chamber, Volker Treier, ..." a tie-up in flights may cost Germany as much as one billion Euros per day" [Ibidem].

Air postal services also faced multi-hour (between 24 and 72) delays in air mail deliveries across Europe and few-day delays in mail sent both from and to Europe elsewhere. At present, airmail accounts for 70% of all mail shipped from and to Poland. The delivery of all domestic correspondence and courier packages was halted. The carrier in charge of mail-air flights for Poczta Polska also ceased them. Against such background, Poczta Polska tried to substitute air transport with road transport services whenever possible and – across the country – it partly succeeded. Upon the implementation of emergency procedures, similar solutions could be adopted in the countries with road-based postal routes, i.e. in Germany, Russian, Czech, Slovakia, Lithuania, and Latvia.

Travel agencies are yet another group suffering from the closure of airspace. The Vice-President of the Polish Chamber of Tourism (PIT), Paweł Niewiadomski, estimated that during one weekend 20 charter planes did not take off and, consequently, some customers terminated their agreements, other waited for departures, and yet others rescheduled their trips. Travel agencies were incapable of conducting an exact assessment of their losses. Alfa Star calculated its daily losses at 200 – 400 thousand PLN, whereas Rainbow Tours – at around 100 thousand PLN.

Another group facing losses consists of hotel owners. The Head of the Economic Chamber of Polish Hotel Industry, Krzysztof Wojtkiewicz, stated: ..."the hotels will be hit hardest by lower numbers of business customers –the group that is most profitable for hotel owners in large cities. This week we were to be fully booked here in the capital city but now customers are canceling their stays[Ibidem]".

Airport infrastructure

Airport infrastructure is composed of everything related to the fitting of the area referred to as the "airport", i.e. parameters of the runway – its length, width, surface condition, other taxiways, signs and lighting, radio-detection devices, communications equipment, devices protecting against unauthorised access to manoeuvring areas of-of people, animals, and vehicles. Boeing 737 – the most popular communication airplane – may safely land on or take off a ground runway (e.g. grass) of only 1,500 m in length, without the support of any airport equipment. Thus, modern planes are not so closely related to airports anymore – the only exception is refueling. Modern airports are highly complicated organisms which are not limited to airplanes as such. A key issue for all departing and arriving planes may be airports' immediate surroundings, such as nearby mountains, high buildings, chimneys, masts, power lines, or a motorway crossing the runway, as in Gibraltar (www.polot.net - June 26, 2018).

Aircraft seizures

One of the most interesting aspects of air transport threats is hijacking planes. The reasons behind the below-described events depend largely on the ingenuity of those committing air offenses. What should be underpinned is that they do not always have a tragic end – sometimes they are even quite amusing. With respect to the above, we may ask ourselves the following question: What would make one hijack a plane? Well, everything depends on the purpose, but the objectives have changed over the years. Over the period 1945-1989, it was the willingness to escape West, to lead a more normal life. It mainly affected the countries of the so-called people's democracy, i.e. Europe, People's Korea, People's China, and Cuba. Hijackers were madmen who intended to do no harm to anyone.

A different case is an incident that happened on board the McDonnell Douglas DC-10-30 plane during the FedEx Express 705 flight on 07/04/1994. The aircraft carried electronic devices from Memphis, Tennessee to San Jose, California. En route there was an attempt to seize the plane by a dishonest employee of FedEx – Auburn Calloway, who wanted to crash it. He developed a plan to claim compensation on his life insurance (about 2.5 million USD) on the basis of false data, which he wanted to spend on his children's education. One condition of obtaining this amount was Calloway's death as a result of an accident. He smuggled on board the unlucky flight a set of hammers and a crossbow in his guitar cover, thinking that any injuries done with their help would be impossible to detect during possible autopsies of the crew members. The catastrophe was to take place by heading the plane to the main FedEx seat in Memphis. During the flight, the assailant violently entered the flight deck. He attacked the co-pilot with his hammer, who then lost consciousness. However, he did not manage to make a blow to the captain, as he attacked Calloway instead. They started hand to hand combat. The co-pilot regained consciousness and rapidly steering the plane tried to knock down the

attacker with the hammer, scuffling with the captain. Luckily, they managed to restrain the assailant and land. Auburn Calloway was sentenced to a life sentence. The three crew members survived the attack of the madmen, their injuries, however, were so serious that they could not return to flying.

Terrorist attacks

In a contemporary world, a terrorist attack is something passengers fear most. A history of aviation provides numerous examples of such attacks – I will present just two of them.

On December 7, 1987, an Avro RJ 100 plane was serving a scheduled flight from Los Angeles to San Francisco. Shortly after the aircraft departed from the airport, one of the passengers, David Burke, entered the cockpit and shot two pilots. Within 25 seconds, the airplane crashed in a field nearby Paso Robles. Forty-six people died. At the scene of the disaster FBI found a Magnum 44 pistol, still in hands of a terrorist – a previous US Airways employee, who had been dismissed a few days before for stealing a cocktail. The investigation proved that the plane was not chosen randomly because that was the flight which his superior, Raymond F. Thomson, who personally dismissed Burke a few days earlier, flew to work every day. That day Thomson was also a passenger on a 1771 disastrous flight.

The most popular case of a terrorist attack was the one over Lockerbie, Scotland. On December 21, 1988, a bomb was placed in a suitcase on a flight of Pam Am Boeing 747. During a detailed and expensive investigation, the reasons and a course of the attack were established. There are no doubts regarding the method of the attack, but there are still some questions unanswered left. Two agents of the Libyan intelligence service were blamed for the attack - Abdelbaset Ali Mohmed Al Megrahi and Al Amin Khalif Fhimah. The attack was conducted in retaliation to American bombardments of Tripoli and Benghazi in April 1986, which nearly killed Muammar al-Kadafi. After the attack, the Pan Am airline was massively claimed for damages by lots of passengers what resulted in declaring bankruptcy by the airline. This is the attack which caused the tightening up of air transport safety procedures. Subsequent procedures were drawn after a series of attacks on the WTC and the Pentagon.

On October 31, 2015, a Russian airline plane departing from Sharm-el-Sheik to Petersburg crashed on a desert of Sinai Peninsula. 224 people were on board, no one survived. The cause of the catastrophe was a bomb placed by the members of the Islamic Country (IS). This statement was not confirmed by the Egyptian Ministry of Civil Aviation. However, the Federal Security Service of the Russian Federation confirmed in its report that there was an explosion on board (www.fakty.interia.pl (date of access: June 26, 2018)).

Aircraft shot down

The history of aviation marks six aircraft shoot downs three of them will be presented in this publication.
The first one happened on July 27, 1995. Two Bulgarian fighter aircraft MiG-15 shot down a Lockheed L-149 Constellation (4X-AKC) El Al airline plane, flying from London to Tel Aviv, with stopovers in Vienna and Istanbul.

At 2.53 am the plane departed from Vienna, heading towards Tel Aviv. While flying over Yugoslavia, heavy storms caused an inappropriate change of direction finder. The crew was convinced they were flying over Yugoslavia, being within the reach of the Skopje radar. Meanwhile, the plane accidentally entered the territory of Bulgaria, as much as 60 km to the east of the intended airway. The same moment the plane was taken over by the Bulgarian fighters who started to shoot down the plane. As a result of extensive damage, the airplane crashed near the town of Petricz, near the Yugoslavian-Greek border. 58 people died altogether, passengers and the crew.

At the beginning of the investigation, Bulgaria did not want to take responsibility for the catastrophe, accusing Israeli pilots of unlawful invasion of Bulgarian airspace. Finally, Bulgarian authorities assumed responsibility for the catastrophe, admitting that the pilots acted too hastily shooting down the plane. Eventually, the authorities decided to pay compensation to the families of the victims.

The other shoot down took place on September 1, 1983. Boeing 747-200A flying from Anchorage, Alaska to Seoul, South Korea strayed off its intended course due to a navigational error and entered several dozen km on a territory of Soviet Union (Kamchatka) airspace. That was the area of big military bases and installations so the plane was shot down soon afterward by Soviet fighters Su-15, not even allowing it to leave Kamchatka airspace. No one decided to identify the plane or to attempt to bring it down to the airport or to bring it back to its course. 269 people died. Moscow authorities claim that it was a reconnaissance aircraft. Neither aircraft wreckage nor human remains have been returned.

The third shoot down took place on July 3, 1988. The American cruiser USS Vincennes shot down Iranian passenger airplane Airbus A300 carrying 290 people, over the Persian Gulf. Not a single person survived. By analogy to the above-mentioned catastrophe, in this case, no one decided to identify the plane carefully. In this case, the same scenario- first do, then think – was repeated. This incident brought disgrace upon the USA [Ibidem].

Conclusions

The rapid development of our civilization has a number of positive consequences. Nonetheless, we must bear in mind that its effect on safety is also noteworthy. Experience to date gained by the aviation industry with regards to safety is, on the one hand, to increase the level of safety of air transport travel, and on the other hand, to actively participate in the organization of the system at a broadly understood human-contemporary technology cooperation.

The events presented here above confirm the validity and rightness of the use of factors generating emergency situations in air transport to fight threats of various origins. Therefore, we can see a better future, though we ought to bear in mind that contemporary problems are the result of our previous choices, whereas our generation can take decisions today which will allow future societies to live in a safe and resourceful world.

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