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Air accidents, their investigation and prevention

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Abstract

The contribution is dealing with the issue of air transportation safety in view of the potential causes resulting in air accidents and their prevention. It classifies the causes of the accidents by the separate phases of flight. Further it focuses on air accidents investigation and possible prevention. The conclusion characterizes some international organizations dealing with the issue of safety in civil aviation.

Keywords: Aircraft, safety, air accident, prevention, investigation, human factor.

1. INTRODUCTION

Accidents in air transport are dominated by the failure of human factor failure, i.e. that of the aircrew. Despite of a positive development in the trend of accidents recorded since the beginning of the 21st century, the number of air accidents is still insatisfactory. Consequently, it is of paramount importance to do everything that would contribute to substantial reduction of the human factor failure in air trasportation. A system of models appears to be an important tool for overall understanding of the complexity of human factors, serving as starting-points to an analythical and clasificational research of the human factor. At the same time, these models enable qualified investigation and assessment of the causes of air and accidents, thereby preventing them from reapeated occurrence.

2. CLASSIFICATION OF THE CAUSES TO AIR ACCIDENTS

Throughout the world, civil aviation authorities are distributing a large number of publication and surveys on air accidents and incidents, according to which aviation prouds itself in the most favourable statistics in terms of air transoprtation safetyAthe rate of accidents in air transportation is currently representing one accident per million takoffs. It is still alarming that air safety has not improved despite of substantial progress made in many of the areas affecting air transportation. The progress was most remarkable in seclection and training of the aircrew, aircraft design and manufactuiring of aircraft, weather monitoring and forecasting, improving mechanical reliability, system monitoring, communication, precision and scope of navigation aids, cockpit instrumentation and travellers´ compartments, safety equipment, air traffic control, utilization of radars and lighting and other airport equipment.

Here it is considered important to state the defininiton of an air accident and incidents:

- Air accident is an event related to the operation of an aircraft, taking place from the time the passenger boarded the plane with the intention to carry out a flight till all the persons has left the aircraft and during which:
  - Some of the person have been fatally or heavily injured,
  - The aircraft have beeb destroyed or damaged,
  - The aircraft is lost or is at a completely inaccessible place.

An incident is an event quite different form of an air accident related to the operation of the aircraft, which has and could have affected the safety of operation. It is understood mostly as a faulty action of persons or improper operation of airborne or ground-based equipment supporting air operation the consequences of which as a rule do not require premature termination of flight or performing non-routine emergency procedures.

Causes affecting the accident rate in air transportation can classified from various factors and points of view. The most general and probably the most transparent way of classification is dependence on human action or failure, technical and meteroroligcal factors. As far as the organizational or legislative shortcomings are concerned, they could also be instrumental in supporting the factors mentioned , mostly as a result of poor adherence to legislative procedures or mismanagemnt of air operation.

There is a range of causes to air accidents. In view of the fast development taking place in almost all the field of aviations, the occurence of air accidents caused by aiviation technology is reducing. The development, however, is adding to the complexity of systems and raising the level of seriousness, all that to be managed by the aircrew. This very cause appears to be increasing in direct prorportion to the accidents caused by human factors. Currently its contribution is at about 80 %.

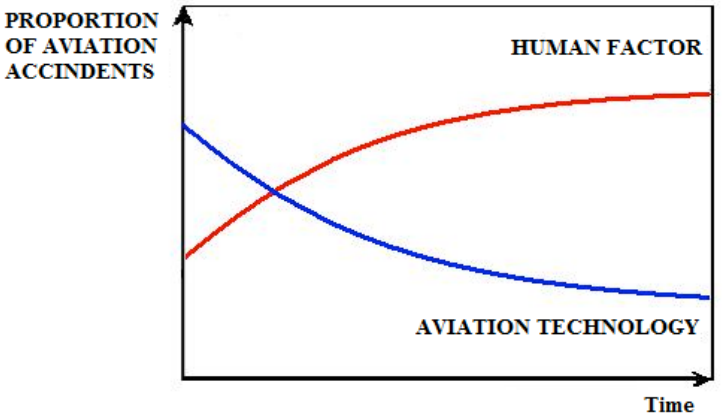

Fig. 1 Factors contributing to air accidents

The graph in Fig. 1 is illustrating the development of air accidents in relation both to human factor and aviation equipment. Based on it, one can conclude that in the light of the development of aviation technical systems, aviation technology is still on the declining course whereas the share of human factor on air accidents is increasing.

The category of most serious air accidents is made up of the so called: CFIT (Controlled Flight Into Terrain). It involves accidents at which the aircaft is flying on a final approach course for landing at poor visibility or when flying in clouds, or even by night. Despite of the perfect status of the aircraft, it hits the ground. The fact that high-capacity aircraft are most involved in them results in very high numbers of casualties, as a rule.

Another category of serious accidents is loss of control over the aircraft (against caused by human factor). With the majority of accidents, more than one factor or cause is involved. There often comes to the so-called cumulation of errors, whereas the single errors by themselves appear to bear almost no importance (statistics prove that at every flight of an aircraft the comes to an occurrence of errors, at an average of 1,9 attributed to the aircrew. As soon as the aircrew by taking appropriate measures fails to eliminate or stop further negative development of events, control over the aircraft is doomed to be lost.

Based on ICAO statistics, the classification of errors is as follows:

- Procedural errors 40,8 %,
- Communication errors 9,7 %,
- Knowledge, experiences 9,2 %,
- Incompetence of the staff 40,3 %.

The cause to failures and the follow-up loss of control over the aircraft can be attributed to the incompetence of the aircrew (lack of experiences, insufficient training or errors in the cooperation, lack of attentiveness, misunderstandings etc.).

Further important types of accidents are caused by e.g. windshear, frost or collision of two aircraft. These and the causes meantioned earlier came into the focus of the ICAO programme of prevention.

It is important to point out that at air accidents are not only monitored in terms of their direct causes, but also in terms of the phase of flight when they occur.It has been found out that as much as 50 % of all the accidents took place during the approach to landing, which represents only 4 % of the total flight time. Another 27 % of accidents occured during takeoffs and initial climbs representing only some 2 % of the flight time. A simple addition of the percentages reveas that more than ¾ of all air accidents occur wtihin a relatively short legs of flight.

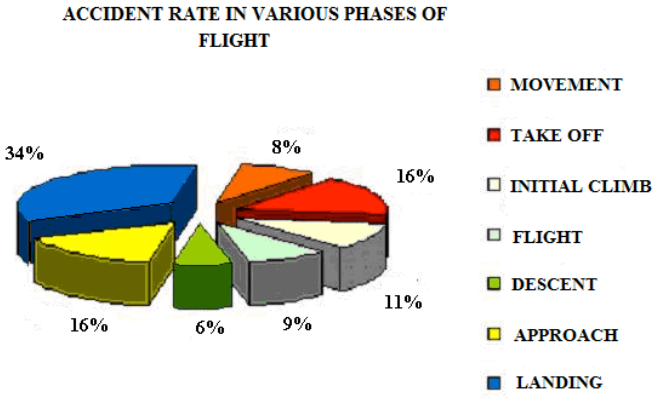

Fig. 2 Accident rate by phases of flight

3. INVESTIGATION OF AIR ACCIDENTS

Determining of the causes of air accidents and preventing them from occurence is an important part of the flight safety system.

The most serious consequences of air accidents are those related to losses of human lives, while those of material are of secondary nature. For airline companies, even material loses are very importatnt. To them an air incident or accident means high financial load, as not small ammounts are payd out as compensations for victims, and the average price of a transport aircraft is in excess of 50 mil. USD, an amount representing a serious problem to tackle. As a more, each air accident can cause loosing thrustworthiness, causing drop in the volumes of customers interested in air travel.

From the manufacturer´s point of view, an air accident is the predecessor of a costly lawsuit. However, it can on the one hand became a stimulus for increasing the level of safety while on the other hand it might lead to involuntariness in eliminating the error, as admitting such an accident can be interpreted as admitting an error in aircraft design or manufacturing. Regardless of the insurance companies and further persons or organizations affected by the accident, one can state the an air accident with its consequences belongs to the worst disasters in transportation.

Investigation of air accidents is a complex process focused on a mosaic of specific phenomena, the consequences of which and mainly their causes as objects of investigaion. Only a consistent and an all-round investigation of an air accident enables accepting and realizing a system of efficient measures for preventing accidents and incidents from reoccuring, thereby maximizing the efficiency of effect in improving the overal level of flight safety.

The act of investigation is left to the competence of appropriate state authorities, whereby their jurisdiction is given predominantly by the area where the accident happened. Coordinated effort in this regard is expected from the manufacturer of the type suffering losses, the airline as the operator of the aircraft, local civil aviation authorities registering the aircraft as well as further subjects involved, depending on the circumstances of the accident. As a rule, the authority to investigate the air accidents and incidents falls to the civil aviation authority, however, there are countries where special organisations enjoy the exclusive right to investigate such accidents. At any rate, participation of organs of criminal investigation is a matter of course, should a suspicion of criminal cause of the accident arises.

3.1 Prevention of air accidents

Investigation is focused on determining and analysing the circumstances of the accident, flight proficiency of the aircrew, organization of the flight, status of the aviation equipment, medical status and professional competence of the aircrew as well.

Measure to prevent accident rate from increasing are developed by operators as a result of an analysis focused on activities and causes of them. Prevention should primarily focus on traning and education of the aircrew, care for the aviation equipment, technical support to air traffic , organizational and control issues as well as the field of care for the labour force etc. However, pPrevention should prove inefficient if not carried out on a basis of planning and steadiness . As its substantial part is made up of the analyses of air accidents, the operator is liable to make constant use of all the technical tools of objective control mostly flight data recorders, magnetophone tapes etc.).

The tools must be held in perfect technical status and follow innovation in time. Some airlines may find it financially too demanding , but investments into prevention are not meant as money throughn out of the window. It it can be said for sure that any air accident is much more expensive than the costs of the preventive measures.

Air accident is seldom a result of a single cause. It is typical for them to originate from a combination of factors. It is the cumlation of these events, which will eventually result in air accident. Thus, by prevention of accidents is meant timely detection and elimination of the causes before it developes into an event.

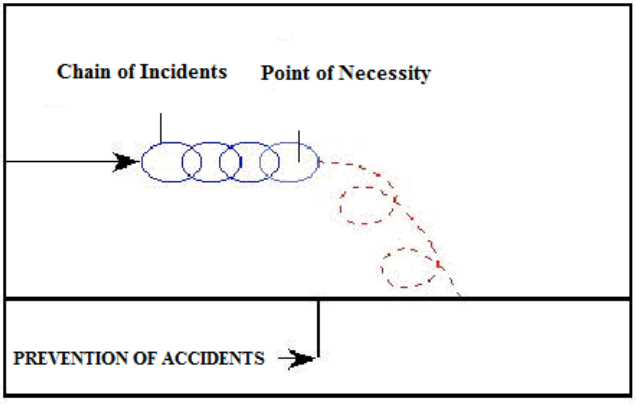

Figure 3 Cummulation of the causes of an air accident

4. INTERNATIONAL ORGANIZATIONS INVOLVED IN THE AREA OF CIVIL AVIATION SAFETY

Every air accident or incident must be apropriately and consistently investigated by organs of Professional investigation with the pourpose of determinig, as precisely as posible, the most probable cause of the air fatality. The conclusions of the investigation are then analyzed by appropriate international organizations, resulting in the development of safety recommendations addressed to airline companies, air operators, manufacturers of aircraft and components or the civil aviation authorities of the states involved.

The most important organization involved in safety and prevention in civil aviation is known as the International Civil Aviation Organization, the ICAO. The beginnings of its foundation can be traced back to the Conference on international civil aviation, which was held in Chicago, in 1944, when it was signed and came into force in 1947.The conference was attended by the representatives of 54 countries following and invitation from the United States of America.

The most elementary articles ustanovenia regarding safety of air transportation can be found in Chapter five of the Chicago Convention, in Articles 31 and 32, which make provisions for the certificates of airworthiness, to be hold by all aircraft carrying out international air transportation and licences of aircrew airworthiness. These certificates and and licences are issued and validated by their respective states. The main emphasis and starting point of the wide-scope international legislation regarding civial aviation safety is however laid down in the Annexes. Each of the 19 annexes (Annex 19 Safety Management – adopted in 2013) is more or less contributory to the improvement of safety standards mostly by way of standards and recommended practices (SARPs) contained in them. These norms and procedures are subjected to continuous revisions and if necessary and required to modifications several times in a year. The most important areas of safety dealt with in the Annexes can be divided into three groups:

1. Certification and Airworthiness of Aircraft and the Aircrew.
2. Safety of Air Operations.
3. Investigation of Air Accidents and Incidents.

All the provisions of the Annexes are of preventive nature, i.e. their unconditional observance by states is aimed to reduce accident rate in air trasnportation. The Annexes can be defined as generally applicable framework provisions, which direct states in their development of safety measures and programmes and in implementation to individual legal rrules. Some of the specific norms addressed to airline companies or aircraft manufacturers can also be objecs of their provisions. As one of the many examples, we can present provisions of part of the Annex 6 to the Convention (Operation of aircraft), which stipulate that the individual states adopt legal acts regarding the maximum allowable times of flights, flight services, and minimum times of rests for the active pilots and the rest of the aircrew, whereas in the legal rules of the Slovak republic these provisions have been implemented in the form of the Guidelines of the Ministry of Transportation, Post and Telecommunication No. 18/96 MDPT SR as of 4th of September 1996 on Norm of flight safety, time of flight service and time to rest for the aircrew of civil aircraft. The notion of the flight safety norm can be defined as an upper limit of the sum of all the times of flights in a determined period of time. Distinguished are daily, monthly and yearly norms of flight safety.

The main body of the ICAO with a mandate to develop safety and preventive recommentdations is the Authority for Air Transportation of the Secretariat. Its competence entails the realization of the adopted safety measures, development of safety prorammes and issuance of safety manuals concerned with practical procedures for solving and preventing safety problems and direct cooperation with regional representatiions of the ICAO. The authority is made up of eight sections and one department of programmes for united strategy.

ICAO has established a Global Aviation Safety Plan. Appart from the ICAO, which is to be considered as the major and crucial organization in the field of civil aviation safety, with several regional international organization active in this field. Among their priority tasks of this organizations are developing norms of safety, standards and procedures, which are defined by the ICAO and the jurisdiction of these organization at their mandatory implementtion into their legal rules with member states. Also important is the role of specialized civil aviation authorities of the individual states, which are to serve among others as organs responsible for the execution of supervision of regular adherence of these safety measures.

The Global System of Aviation and Transport is to great extent dependent on the quality of international coordination and standardization of the aviation and transport related activities and the airlines, of airlines, joint financial systems terminology, performance monitoring and evaluation of air transport, its representation at negotiations with state organs and the ICAO as well. The main of representative of global competence is the International Air Transport Association, is a voluntary, non-governmental organization of airlines, operators of international regular air transortation. Similarly to the ICAO, this organization is dealing with a whole spectrum of issues related to air transportation, however, from the airlens´point of view. It is an association of the regular airlines, which have to fulfill the newly-established criteria in the field of safety and exology.

On the European continent, the most important organization in the field of safety is known as the European Air Safety Agency – the EASA), which was established in 2002 by the Directive of the of the European Parliament and Cuncil No. 1592/2002. Its activities were launched as late as on 28th of September 2003. The Directive No. 1592/2002 was cancelled by issuing a new Directive of the European Parliament and Council (EU) No. 216/2008 of 20th February 2008 on Joint Rules in the Civil Aviation and on Establishing the Eauropean Air Safety Agency. The EASA is the executive body for 31 states. It is the successional organization of the Joint Aviation Authorities, the JAA, which pursued the ICAO in the field of joint safety policy and planning, representing the authorities, regulating civil aviation in the individual European countries, cooperating in the field of

development and implementation of the joint safety an regulatory standards and procedures known as the Joint Aviation Requirements – JARs). The EASA is converting these regulations of the JAR into the Directives of the EU. Currently the JAA is fulfilling the function of a training centre only.

One can speculate that the EASA has been established as a counter-pole to its American model, the Federal Aviation Administration – FAA, which is an agency of the Air Transport Authorities of the United States of America. Among the main activities ensured by the FAA is the development and execution of regulations and minimum standards relating the manufacturing, operation and maintenance of aircraft, certification of active pilots and airports, airspace and air traffic control, building, establishing and maintenance of air navigation aids, cooperation with other organizations in the world, research and develoment of safety systems and registration of aircraft.

Among further regional organization acting in the field of air transport safety can be e .g. the Russian Interstate Committee for Civil Aviation, Economic and Monetary Union of West Africa, the UEMOA, and the Central American Agency for Aviation Safety, the ACSA.

5. CONCLUSION

For a substantial progress in air transportation safety to be achieved, ittis necessary to focus on the most frequently occuring and types of air accidents, such as the CFIT and loss of control over the aircraft. It is also importatnt to focus on the phases of flight especially on its beginning(takeoff) and end (landing) .

When assessing the development in accidents it follows that despite of an enormous progress made in the field of air traffic, its safety fail to develop to satisfaction, with causes identified as incomprehensive approaches to learning and appreciation the human factor.

It is comforting that since the beginning of the 21st century, a remarkable improvement has been recorded and the curent tendency in the development of air transport safety is positive. A view on the air transportation taken from the aspect of the shares of the continents in terms of accidental rate shows that safety of air transportation in the USA, Canada and EUrope is more favourable compared to the world average, however, even at these continents it is still necessary to accelerate efforts for further and substantial improvements.

In vief of the complexity of investigating air accidents and its importance for the measures focused on eliminating the reoccurrence of the idenfied caused, as well as the activity of international organizations of aviation in this field it unambiguously follows that objective determination of the causes of each air accident and consitent anti-accident prevention represent the way that ensure decline in the accident rate of air traffic despite of its estimated growth in performance, all that making air transportation more thrustworthy and attractive for its users.

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