

# APPROACH TO THE INVESTIGATION OF AIR ACCIDENTS AND ITS IMPACT ON SAFETY

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*Summary: Air Accident investigation should lead to uncovering the causes that precede the accident. The cause of every accident is a set of factors and sequence of events leading to its creation. During the investigation of air accidents is necessary to understand all these factors and sequence of events. Only in this case, the investigation of accidents has the impact on the safety of the aviation industry. Giving the right name to the causes, circumstances and sequence of events leads to the correct formulation of remedial actions and the creation of security defences. Only in this case, we can also consider building a predictive and proactive approach to safety. This article discusses the current approach to the investigation of aviation accidents and compares the current situation in the Czech Republic, the USA and Great Britain. This work was supported by the Grant Agency of the Czech Technical University in Prague, grant No. SGS10/221/OHK2/2T/16.*

*Key words: final report, safety, air accident, Reason model*

## INTRODUCTION

The main objective of investigation causes of aviation accidents are the findings of all data, circumstances and facts relating to the accident or incident. The detail analysis of information gathered is used to determine the probable cause of this accident. The result of the investigation should not be determining guilt or responsibility for the accident, but through the evaluation of accident suggest effective preventive actions, procedures, rights and obligations. (5) For an overview of current situation there will be presented the legislative basis and the system on which is based the investigation. In aviation, there are other very important tools for building safety. Investigation of air accidents is from the perspective of creating a safety tool the oldest one. In the past, this tool was added as solution of problems of human error. Currently, for increasing the safety of civil aviation there are safety management systems developed - Safety Management Systems (SMS). Despite this, the potential of investigation must be used as far as possible.

## 1. ORGANIZATIONS AUTHORIZED TO INVESTIGATE OF AIR ACCIDENTS

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Investigation of causes of air accidents is performed in according to Law No. 49/1997 and on the basis of professional regulation L13 Aircraft accident and incident investigation. For the investigation of air accidents has been established the Institute for Investigation of causes of accidents (Ústav pro odborné zjišťování příčin leteckých nehod ÚZPLN). Investigation of air accidents during test flights in the airline industry organizations ÚZPLN done in cooperation with the competent authorities of the organization. But if an accident occurs in exceptional circumstances or if special consequences, the Commission carried out the investigation is established by the Department of Transportation. The exception is the air accident or incidents involving aircraft Czech Air Force. (5) These accidents are investigating by joint commission from ÚZPLN and the Ministry of Defence. The professional investigation of the causes of air accidents in which there were no fatal injuries, ÚZPLN may delegate any of the organization who is authorized to professional investigation of causes of air accidents. In Czech Republic e.g. CSA and Travel Service Ltd., ABS Jets, DSA, LAA, etc.). (1) These organizations have permission to investigate their own aircraft accidents some may even investigate the accident of foreign operators.

## **2. CONTENTS OF REPORTS ON RESULT OF THE INVESTIGATION OF AIR ACCIDENT PROCESSED IN THE CZECH REPUBLIC**

The report on air accident investigation includes all the necessary requirements, including description of the situation that preceded the accident, crew qualifications, information about the aircraft, weather information, etc. and analysis of the factors that could affect the creation of an emergency. From this analysis it is finally determined the cause of the air accident. In the final reports issued in the Czech Republic at present is as the cause of the accident almost always referred to only one event in particular the last one in the chain of events that led to the creation of an emergency. Safety recommendations, the most important element in a final report, are not issued in most cases. A new approach to safety issued by ICAO in ICAO Doc. 9859 states that in case of failure of safety assessment is necessary to distinguish strictly between the procedure leading to hazardous events and resulting events themselves. A desirable outcome for improving safety is primarily the creation of recommendations for further security procedures and security defenses.

If there is an accident of aircraft with a MTOW greater than 2250 kg the report is processed into the system ADREP (Accident / Incident Data Report) ICAO. This document contains information about the accident - the type of accident according to severity, date and time of the accident, data about the aircraft - type, manufacturer, weight data, data about flight crew and passengers. In addition, this report contains a brief description of the incident and carried measures.

Data can be sent into the system as a "hand" filled in the appropriate form or electronically. Upon receipt of this report is first checked whether it contains all the information required and then entered into the database system. Saved messages are data base of events around the world and are used for:

- a) monthly summaries of reports received, provides Member States the actual picture of significant occurrences on a world-wide basis

- b) annual ADREP statistics, presenting statistical information under broad categories such as the types of events which took place and the phases of operation in which they occurred
- c) replies to States' requests for specific information in the form of an "ADREP Information Request"

All information about how to be processed data into the system provides ADREP ICAO ICAO Accident / Incident Reporting Manual (ICAO Doc 9176)

### **3. CONTENTS OF THE REPORTS AND THE INVESTIGATION RESULTS IN REPORTS PROCESSED BY NTSB (USA)**

The National Transportation Safety Board (NTSB) is an independent organization with the task of investigation of accidents in civil transport in the United States of America. One of the NTSB departments is also dedicated to the investigation of the air accidents. This department prepares final reports of investigation containing cause of the air accident and makes safety recommendations. However, implementation of safety recommendations to regulatory standards does not fall within the competence of the organization this is for the other federal authorities.

The final report of the accident has more or less the same content as a formal report prepared in the Czech Republic. The first part of the report describes the flight before the accident, accident description, qualification of the crew and description of the aircraft with a focus on systems that could be related to the cause of the air accident. Then follow weather conditions, data from the ATC, the description of the accident and a description of components that could affect the creation emergency aviation event (functional testing, etc.). Then they are mentioned safety recommendations related to the probable cause of the air accident and, if possible, is mentioned several accidents that happened under similar circumstances and are stored in ASRS (Aviation Safety Reporting System). The second part of final reports addresses the conduct of the air accident investigation. The flight is there analyzed in very detail taking into account the factors that led to the creation of the air accident. In conclusion, there are results of the investigation and probable cause of the air accident described as a chain of events. The last point is safety recommendations, according to the nature of the air accident and its recurrence in the future. Includes newly issued safety recommendations or safety recommendations that have been revised according to this accident.

In this procedure, it is clear that the investigation of accidents abroad may have a greater effect on the safety situation. There are also influences on building safety culture and safety climate, leading to a general improvement in safety awareness.

### **4. COMPARISON THE RESULTS OF FINAL REPORTS**

Final reports issued by the National Transportation Safety Board are at first sight different in their complexity and inclusiveness. These final reports contain on average 90 pages. This report is far more detailed than the reports issued by organizations responsible for

the investigation in the Czech Republic. There are described in more detail all aspects leading to elucidate the cause of the air accident. The report describes a chain of events that led to the accident. In conclusion, the cause of those the air accident is also often described as a chain of events. Each message contains the following safety recommendations which are issued in connection with an accident, whether it is a completely new safety recommendation, revised recommendations, which is needed to be updated due to new realities or reminded of the previously issued safety recommendations related to this incident.

To compare the final reports, the content of final reports issued by the Air Accident Investigation Branch in the UK was also studied. Final reports issued by this organization have similar content and value as the final reports issued by NTSB. They reported in detail the flight before the accident and the course of the accident. There are analyzed all possible influences on an air accident. Finally, there is a list of all causes of the air accident and there are also listed safety recommendations. These are either newly issued or there are listed the recommendations that have been valid from earlier times and have an influence on the occurrence of an incident described in final report.

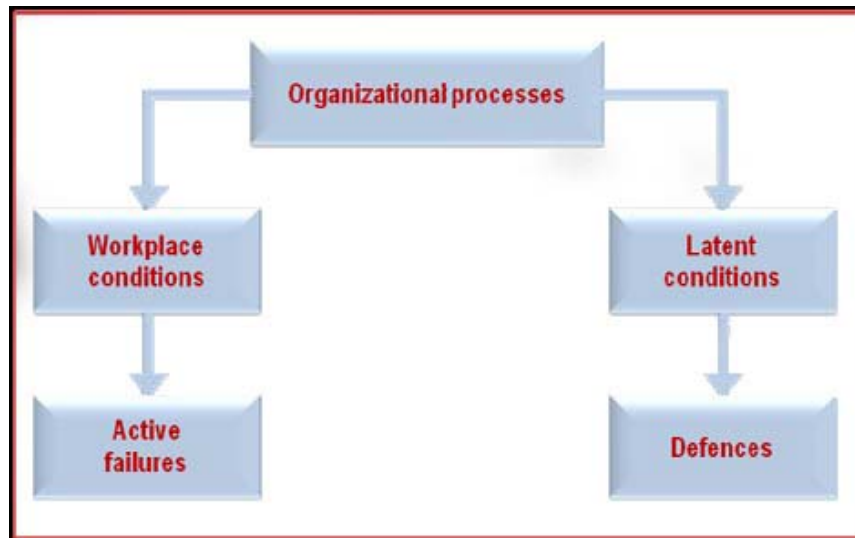
## **5. TOOLS FOR THE RIGHT TREATMENT OF FINAL REPORT**

A simple graphical model for analysis of accidents was published by Professor James Reason as early as 1990. The impetus has been exploring various major events such as the Bhopal Gas Tragedy, the Challenger Tragedy, Chernobyl etc. This graphical model captures the causes of accidents from the consequences to mistakes that are made in determining the organization. These errors are usually hidden from the beginning. The executive staff of aviation organizations is exposed to the effects of incorrect decisions in the final stage in the development of safety-related problems. This model has been adopted by all major airline organizations, including ICAO, IATA, EASA, FAA, NTSB etc.

The model works via the block diagram in Figure 1:

The upper block represents the organizational processes. These are activities which are used in each organization to perform direct management and control. Typical examples of such organizational processes are: creation of strategies, decision making, planning, communication, resource allocation, supervision etc (7).

Incorrect management decision making can lead to weaknesses in training, time poor planning, neglect of attention at the workplace, lack of knowledge and skills of staff and a lack of operational procedures. During management decision making we have to detect the adverse effects and reduce them. Management shall manage the organization with regard to achievable targets, organization of work and resource, daily problems management, internal and external communication, etc.



Source: (7)

Fig. 1 – Block diagram for the to work with Reason model

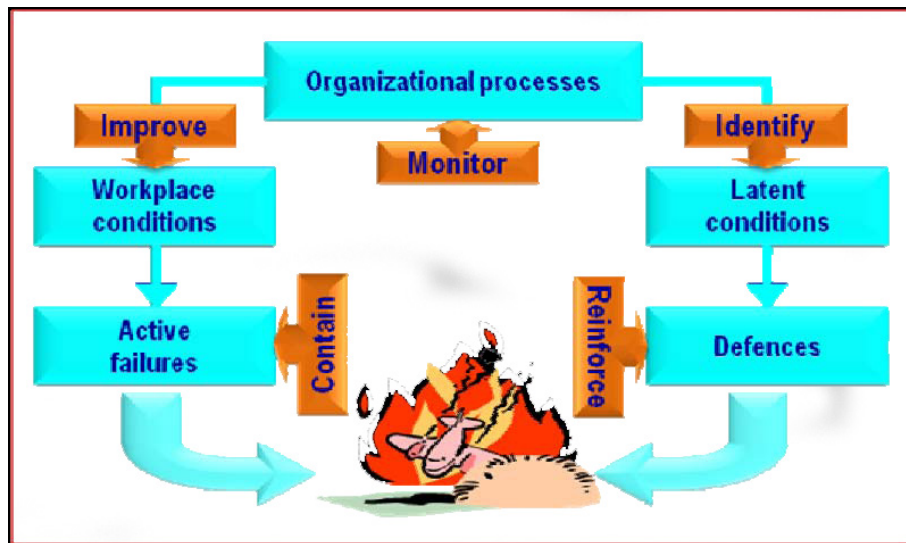
Block of hidden circumstances includes deficiencies in equipment, incomplete/incorrect standard operating procedures, shortcomings in training, etc. The conditions for the creation of hidden circumstances are divided into two characteristic groups. The first one is the insufficient identification of hazards and safety risks, which are then not kept under control, but move freely in the system and eventually can become a trigger pulse to create a sequence of events. The second group is about creating shortcuts and deviations from operating procedures, which then become the unwritten rules for employees. Hidden circumstances have potential to breach defenses of system. Block of defenses is the last safety net, which should absorb the hidden circumstances and human errors so that they cannot connect to the sequence of events (7). Most of the reduce risks strategy is focused just on strengthening the existing one and creating new ways of defenses. Defenses are creating via the implementation of technology, strengthening of training and prescription.

Another important factor resulting from organizational processes is introduced by a block of workplace conditions. The workplace conditions are factors that have a direct impact on the performance of workers in aviation. The workplace conditions are ergonomic factors (lighting, temperature, noise, etc.), conditions for a stable workforce, skills and experience at the workplace, moral assumptions, reliability, etc (7). Poor workplace conditions support the active failure of operations staff. Active failures can be divided into errors or intentional violations. The difference between errors and violations (insubordination) is in the nature of motivation. In case of errors a person tries to best accomplish the task, under the rules and procedures, according to training, but they make a mistake. By the violation is a man voluntarily differs from the rules and procedures and make mistake. The basic difference between errors and violations of rules is given by intention.

After finding all relations leading to the realization of security risks it is necessary to issue a recommendation. In order to prevent accidents, it is necessary to strive for continuous monitoring of organizational processes in order to identify hidden conditions, and thus strengthen the block of defenses. The safety efforts should provide an adequate level of

workplace conditions. There is a need to take into account that workplace conditions caused primarily active failures that lead in greater concentration to serious safety failure.

Therefore, foreign investigative authorities in their final reports state recommendations for corrective measures that are consistent with the approach expressed in Figure 2



Source: (7)

Fig. 2 – A process leading to the prevention of accidents

## CONCLUSION

As mentioned above, it is evident that the predictive value of the final reports issued by organizations in Czech Republic complying with the formal requirements for final reports of the investigation of air accidents, but in terms of content page and to continuously improve the operational safety of air transport is necessary to involve other safety management tools. The absence of safety recommendations is a serious deficiency. Another point of consideration is access to the investigation of air accidents, where there are no tragic consequences. These accidents can be investigated directly by the aircraft operator, what in many cases may not be consistent with the independence of the investigating authority.

## REFERENCES

- (1) List of authorized companies for the years 2010 – 2013.  
[online] Available at <[http://www.uzpln.cz/upload/setreni/seznam\\_osob.pdf](http://www.uzpln.cz/upload/setreni/seznam_osob.pdf)>
- (2) UZPLN final reports. [online] Available at <[http://www.uzpln.cz/cs/ln\\_incident](http://www.uzpln.cz/cs/ln_incident)>
- (3) NTSB final reports.  
[online] Available at <[http://www.nts.gov/investigations/reports\\_aviation.html](http://www.nts.gov/investigations/reports_aviation.html)>
- (4) AAIB final reports.  
[online] Available at  
<[http://www.aaib.gov.uk/publications/formal\\_reports/formal\\_report\\_archive/formal\\_reports\\_2000\\_onwards.cfm](http://www.aaib.gov.uk/publications/formal_reports/formal_report_archive/formal_reports_2000_onwards.cfm)>
- (5) Regulation about professional investigating of air accidents and incidents. [online]  
Available at <[http://www.uzpln.cz/upload/dokumenty\\_legislativa/L13\\_cely.pdf](http://www.uzpln.cz/upload/dokumenty_legislativa/L13_cely.pdf)>

- (6) Aircraft accident and incident investigation. [online] Available at [http://dcaa.slv.dk:8000/icaodocs/Annex%2013%20Aircraft%20Accident%20and%20Incident%20Investigation/an13\\_9ed.pdf](http://dcaa.slv.dk:8000/icaodocs/Annex%2013%20Aircraft%20Accident%20and%20Incident%20Investigation/an13_9ed.pdf)
- (7) ICAO. *Safety Management Manual (DOC 9859)* [online] Available at [http://www.icao.int/anb/safetymanagement/DOC\\_9859\\_FULL\\_EN.pdf](http://www.icao.int/anb/safetymanagement/DOC_9859_FULL_EN.pdf), ISBN 978-92-9231-295-4.
- (8) Vittek, P. - Němec, V. - Kurtulík, Lukáš; UML AND RISK ASSESSMENT TOOLS - SAFE AND SECURE FUTURE; In: *Acta Avionica*. 2010, vol. 12, no. 20, p. 73-75. ISSN 1335-9479.