HUMAN FACTOR AS CAUSE OF AVIATION ACCIDENTS

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Summary. Aviation safety should be a highest priority for all subjects involved in civil aviation. As in any other transport system, however, it can´t be ensured that no extraordinary events such as incidents and accidents will occur. Aviation incidents and accidents arise for a variety of reasons, and the human factor plays a key role in its occurrence. The issue of human factor and its relationship to the aviation safety is the subject of this paper which describes safety development and other important aspects of safety in relation to the human factor and then analyzes the number of aviation accidents and their causes.

Keywords: human factor in aviation; safety; accident

1. INTRODUCTION

Safety is aviation's highest priority and therefore the elimination of aircraft accidents and incidents remain the ultimate goal of all subjects interested in the aviation. [1, 2]

Aviation safety might be defined as „the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management." [2]

However it is known that the aviation system can´t be absolutely free of hazards and associated risks since human activities and human-built systems cannot be guaranteed to be absolutely free from operational errors and its consequences. [2]

2. EVOLUTION OF AVIATION SAFETY

The evolution of aviation safety is possible to divide into three different eras that are showed in the figure 1. [2]

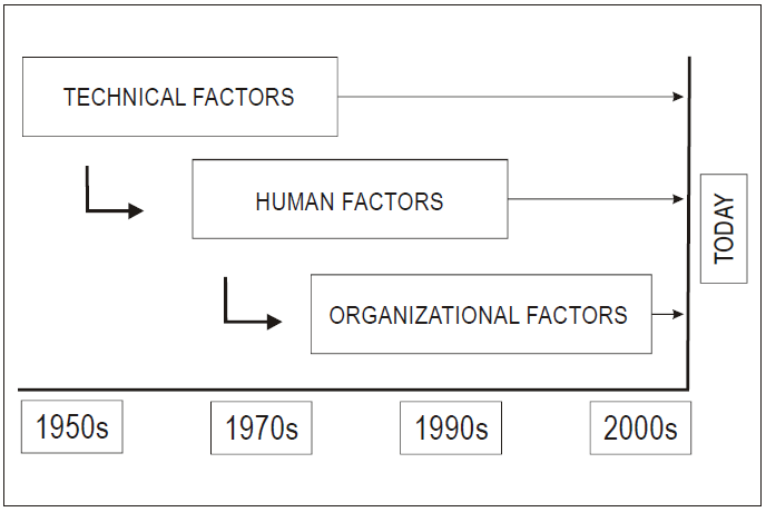

Figure 1 The evolution eras of aviation safety

In the beginnings of aviation the identification of safety deficiencies were related to technical factors and technological failures and efforts to increase safety have been realized through the exploration of technical factors. [2]

During the human factors era was the frequency of accidents significantly reduced thanks to major technological advances and enhancements to safety regulations. However, human performance continued to be cited as a recurring factor in accidents because the scientists focused only on the individual, without fully considering the operational and organizational context. [2]

In the organizational era safety began to be viewed from a systemic perspective, which was to encompass organizational factors in addition to human and technical factors. The term organizational accident was introduced, which considered the impact of organizational culture and policies on the effectiveness of safety risk controls. [2]

3. ACCIDENT CAUSATION

If an accident occurs, it usually involves successive breaches of multiple system defences. These breaches might be triggered by various enabling factors such as equipment failure or operational errors. [2]

It is therefore important to investigate why an accident happened to prevent it from happening again. James Reason is one of many authors who try to explore the problematics of causes of aviation accidents. [2] The model which he created is shown in the figure 2.

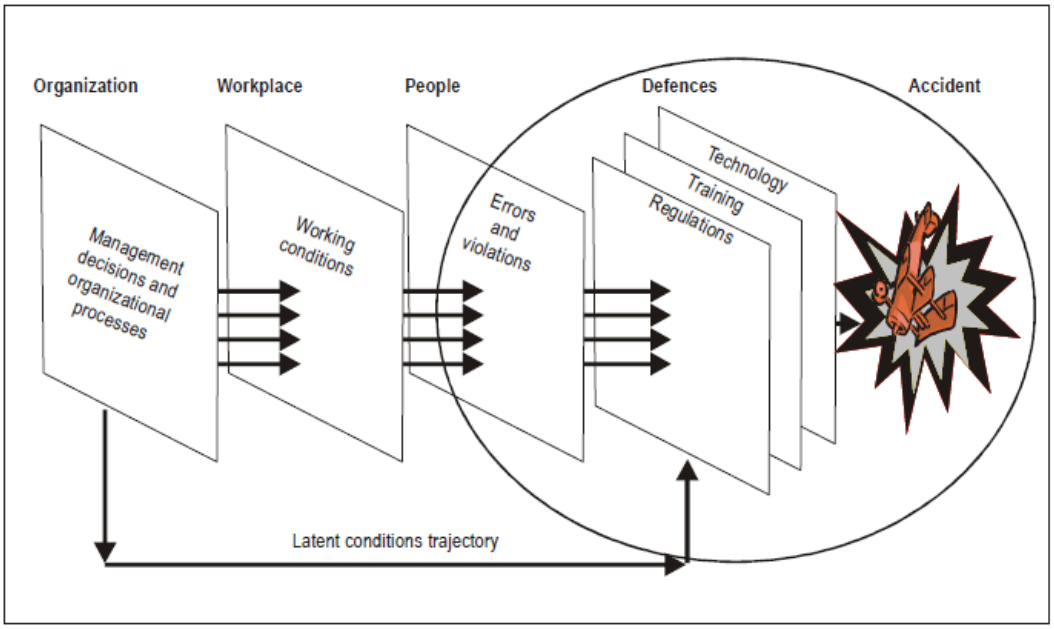

Figure 2 James Reason´s model of accident causation

The figure 2 illustrates Reason´s opinion that there are various defences in the aviation system that should protect it against fluctuations in human performance or decisions at all levels of the system while breaches that penetrate all defensive barriers may result in a catastrophic situation. [2]

The model also proposes that all accidents include a combination of both active failures and latent conditions.

Active failures are defined as errors and violations that have an immediate adverse effect and that are generally associated with the operational personnel (pilot, controller or mechanic). They are generally viewed as unsafe acts. [2, 3]

Latent conditions exist in the aviation system before an incident or accident happens and they create the conditions under which the latent failures can reveal themselves. They are not initially perceived as harmful, but they will become evident if the system's defences are breached. [2, 3]

3. HUMAN FACTOR IN AVIATION

The aviation is a complex system that includes product and service providers and state organizations. That requires an assessment of the human contribution to safety. It is also necessary to understand how the human factor and human performance could be affected by the multiple and interrelated components of the aviation system. [2]

There is a conceptual tool used to analyze the interaction of multiple system components and the relationship between humans and other workplace components called SHELL model. Description of the model is shown in figure 3.

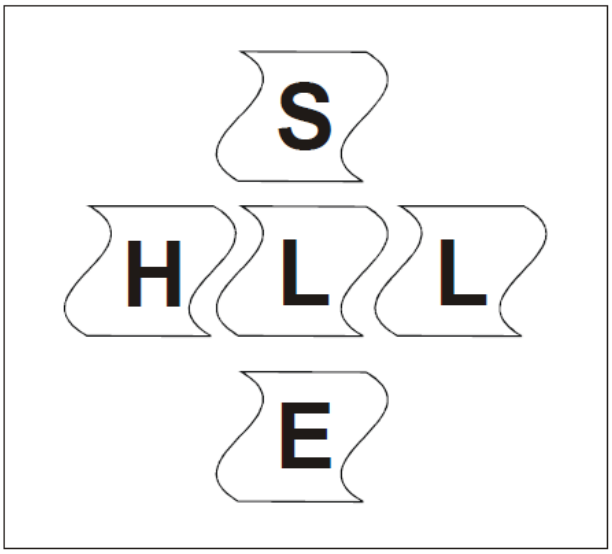

Figure 3 SHELL model

The SHELL model should help to understand a human factor and its interaction with other components of the aviation system. As can be seen from the figure the model contains of the following components which have to be in a compliance to prevent the human error:

- ***Software (S):*** procedures, training, support,
- ***Hardware (H):*** machines and equipment,
- ***Environment (E):*** the working environment in which the rest of the system must function,
- ***Liveware (L):*** humans in the workplace. [4, 5]

There are humans in the center of the model with the various capabilities and performance. To avoid any tensions the other components of the system must be carefully matched to this center block to avoid stresses in the system. [4, 5]

4. IMPACT OF HUMAN FACTOR ON AVIATION SAFETY

Since the beginnings of air traffic, the human factor has had a significant impact on its safety. The human element represents the most flexible, adaptable and valuable part of the aviation system, but on the other hand the human element is also the most vulnerable to influences which can adversely affect its performance. [6]

Human behavior and performance are cited as causal factors in the majority of aviation accidents. [6] Various statistics indicate that the human factor in total is responsible for 70-85 % of all aviation accidents. [7-9] However, it is mainly the crew of an aircraft that directly affects the safety of each flight due to its knowledge, discipline and moral values. Various statistics indicate that the crew is responsible for 60-65 % of all aviation accidents. [10, 11]

4.1. The development of aviation accidents

For the purposes of the paper the development of aviation accidents was examined in the period 2000-2017. Total number of aviation accidents is described in figure 4. [12]

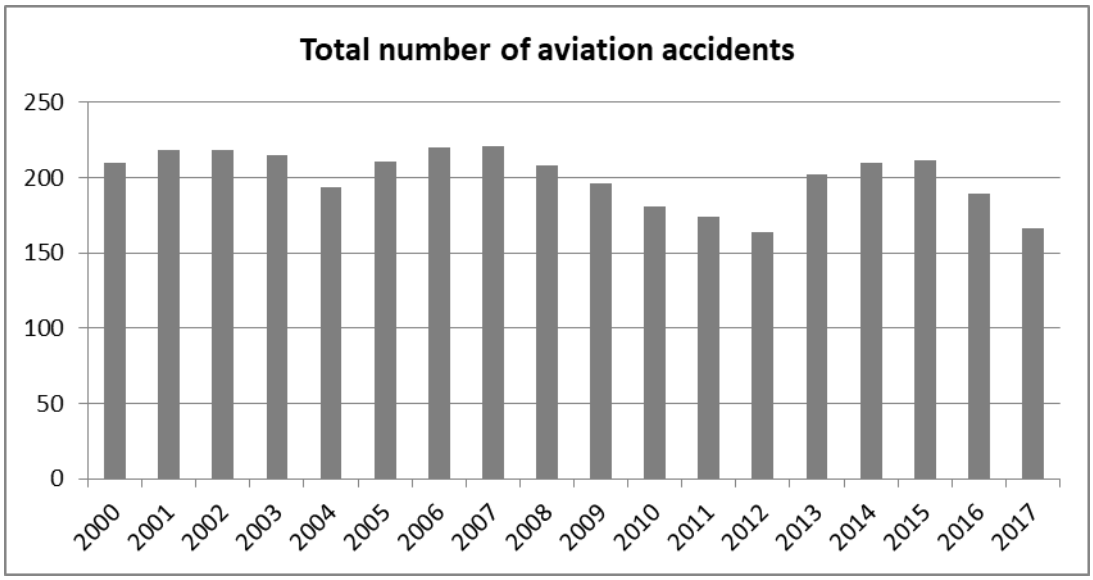

Figure 4 Number of aviation accidents

According to the figure, the number of accidents varies from 164 to 221 in examined time period. The statistics includes all occurences of accidents in the examined time period with no attention to its cause, contributing factor or number of fatalities.

4.2 Aviation accidents caused by human factor

Based on the previous part of the paper, where the influence of human factor on number of accidents was mentioned, the authors show another statistics (figure 5) which describes the number of aviation accidents caused by human factor to confirm or deny this statement. [12]

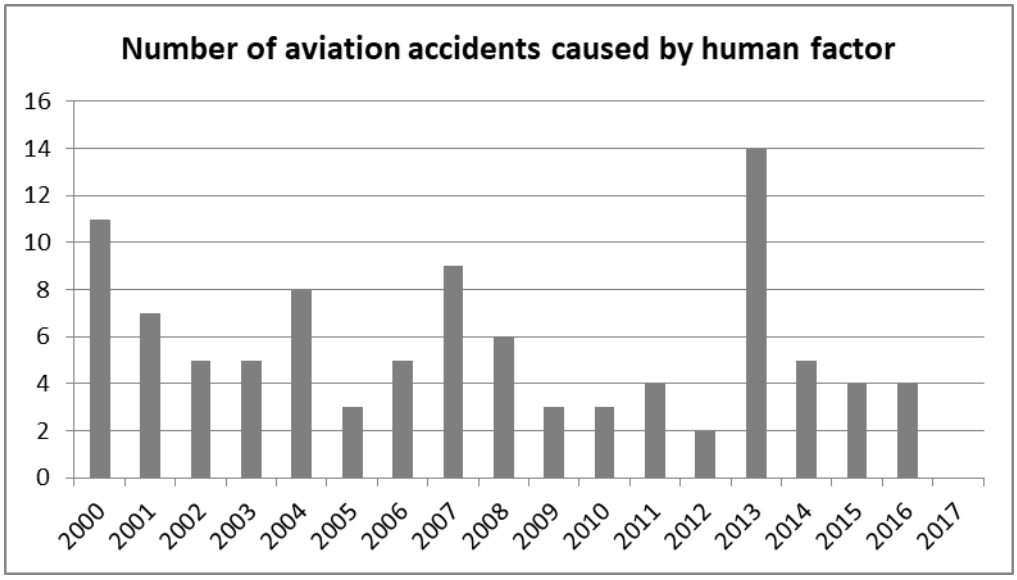

Figure 5 Number of aviation accidents caused by human factor

Based on figure 5 is quite denied the assumption that human factor is responsible for the most of aviation accidents. In examined time period the human factor was responsible just for a few out of many aviation accidents (the results come out of only one database of aviation accidents, so the results might differ if a different database is used).

The aim of the paper is also to discover the specific causes of aviation accidents. To this purpose might be used the figure 6.

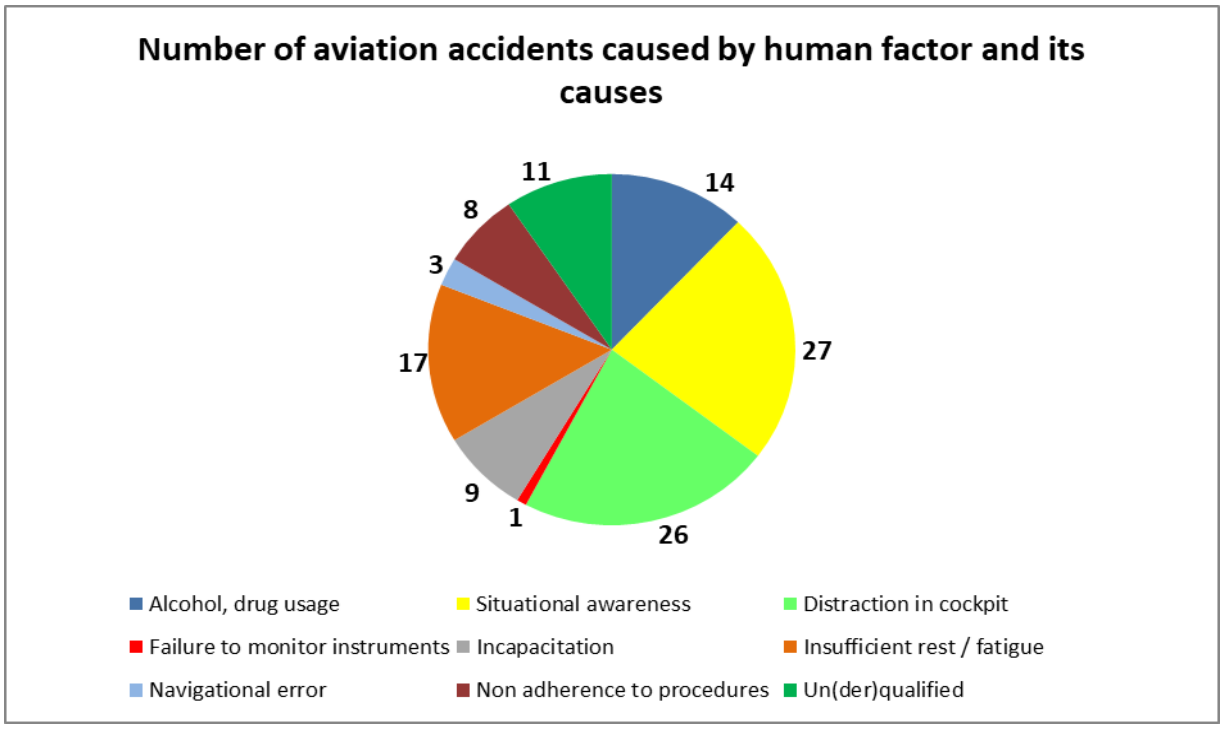

Figure 6 Number of aviation accidents caused by human factor

Figure 6 describes the specific causes of the occurrence of aviation accidents involving the human factor. Therefore it better illustrates why accidents occurs and gives the opportunity to avoid the accident to happen in the future if the appropriate measures are taken.

The most common causes of aviation accidents are Situational awareness, Distraction in the cockpit, and Non adherence to given procedures. On the other hand among the least frequent causes of aviation accidents is the Failure to monitor instruments with one proven occurrence in the examined period as well as the Communication problems, Mental condition and misjudgement of the pilot with no occurrence in the examined time period.

5. CONCLUSION

This paper focuses on the problematics of the human factor in aviation and how safety of air transport might be affected by the influence of the human factor.

The statistic which describes the number of aviation accidents and its causes were made and it was discovered that it is not always the human factor that is responsible for the tragic event that with no doubt aviation accident is. The most common causes of aviation accidents were mentioned to highlight which areas still need to be addressed to maintain and improve the level of aviation safety.

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References

[1] *International Air Transport Association, 2017. IATA safety report 2017.* 54th Edition. IATA: Montreal-Geneva. ISBN 978-92-9229-644-5.

[2] INTERNATIONAL CIVIL AVIATION ORGANIZATION, 2013. *Safety Management Manual*. Doc 9859 AN/474. 3rd edition. ICAO: Montreal, Canada.

[3] INTERNATIONAL CIVIL AVIATION ORGANIZATION, 1993. *Human Factors Digest No. 10. Human Factors, Management and Organization.* Circular 247-AN/148. ICAO: Montreal, Canada.

[4] INTERNATIONAL CIVIL AVIATION ORGANIZATION, 1991. *Human Factors Digest No. 3. Training of Operational Personnel in Human Factors*. Circular 227-AN/136. ICAO: Montreal, Canada.

[5] INTERNATIONAL CIVIL AVIATION ORGANIZATION, 1993. *Human Factors Digest No. 7. Investigation of Human Factors in Accidents and Incidents.* Circular 240-AN/144. ICAO: Montreal, Canada.

[6] INTERNATIONAL CIVIL AVIATION ORGANIZATION, 1989. *Human Factors Digest No 1. Fundamental Human Factors Concepts*. Circular 216-AN/131. ICAO: Montreal, Canada.

[7] HOOPER, Brionny a David O´HARE, 2013. Exploring Human Error in Military Aviation Flight Safety Events Using Post-Incident Classification Systems. *Aviation, Space, and Environmental Medicine.* Vol. 84, No. 7. ISSN 0095-6562.

[8] CIVIL AVIATION SAFETY AUTHORITY, 2017. *Module 1: Introduction to human factors in sport, recreation and general aviation*. Available at: https://www.casa.gov.au/education/landing-page/elearning-catalogue

[9] WU, Ya-Rong et al., 2014. Aviation Human Factors Accident Causation Model Based on Structure Entropy. *Applied Mechanics and Materials.* Vol. 488-489, s. 1354-1357. ISSN 1662-7482.

[10] ŠUMANOVAC, Darko, 2008. Critical Situations and the Flight Safety System. *PROMET - Traffic&Transportation.* Vol. 20, No. 4, s. 223-229. ISSN 1848-4069.

[11] CIVIL AVIATION AUTHORITY, 2002. *Flight Crew Training: Cockpit Resource Management (CRM) and Line-Oriented Flight Training (LOFT).* Safety Regulation Group. ISBN 0-86039-881-1.

[12] *Aviation Safety Database.* Aviation Safety Network. Flight Safety Foundation. 2018. Available at: https://aviation-safety.net/