

Human Performance and its Impact on Aviation Safety

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Abstract

Human factor is essential element of the aviation system and therefore has a huge impact on aviation and its safety. Human factor might be defined as social and personal skills (communication and decision-making skills) that complement technical skills and are important for safe and effective aviation. The aim of the paper is to describe the specifics of human factor in aviation and human abilities and weaknesses which may affect the safety of each flight.

KEY WORDS: *aviation safety, human factor in aviation, human performance and abilities*

1. Introduction

Aviation safety is perceived as the state in which the possibility of harm to persons is reduced and maintained at an acceptable level, which is assured by the never ending process of hazard identification and safety risk management. As any other human activity or human-built system, nor aviation can be absolutely free of hazards because operational errors and their consequences will always occur. It is therefore important to determine the acceptable level of safety performance. [1]

The organizational era of the safety that lasts from the mid-1990s to the present day introduces the concept of organizational accident that considers the impact of organizational culture and company policies on the effectiveness of safety risk controls compared to the beginnings of aviation when technical factors, technological failures, human and its interaction with the plane were responsible for serious incidents and accidents to occur. [1]

2. Human factor in aviation

Aviation accidents and incidents will always occur since human activity can't be free of hazards as mentioned above. According to the technical and technological level of aviation we came back to the human factor as a major cause of many types of emergencies in aviation.

The human element is perceived as the most flexible, adaptable and valuable component of aviation system, on the other hand is also the most vulnerable to many influences that could possibly affect its performance. [2]

Taking into account a huge importance of the human factor in aviation it is no surprise it is given great attention and a number of authors explores the human factor itself and also its influence on aviation safety.

Well known is for example James Reason and his Swiss-Cheese model, which helps to understand the interplay of organizational and managerial factors in accident causation. It is also necessary to mention the SHELL model, the tool used to analyse the interaction of multiple system components. It describes the relationship between humans and workplace components such as software (procedures, training, support), hardware (machines and equipment), environment (the work environment in which the rest of the system works) and liveware (humans in the workplace). [1]

3. Errors and error management

Error is a normal and natural part of everyday life as human make errors on a daily basis. The most of them don't have any serious consequences as they are automatically self-corrected or don't involve a potential safety hazard. [3]

In the event of accidents, it is necessary to point out that errors are caused by healthy and properly trained, certified individuals. At the same time, it is necessary to draw attention to the human competence and its limitations, which might contribute to an accident. [2]

Human error is often defined as the outcome or consequence of human performance limitations. [3] We can distinguish between two basic types of human error, intentional and unintentional actions. These types of errors are described at Figure 1. [3]

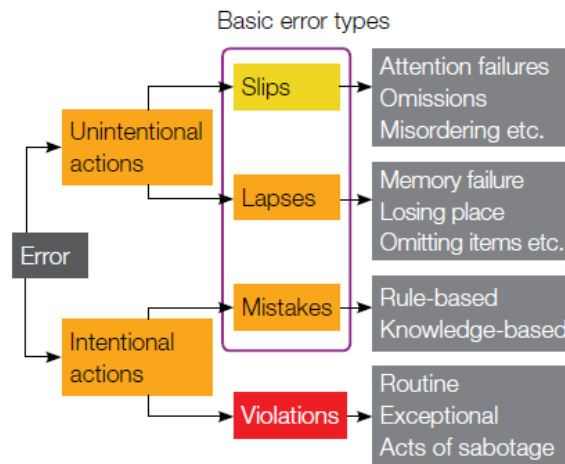


Fig. 1 Unintentional and intentional actions

Intentional actions – these actions involve conscious choices and are based on judgement or motivational processes. Mistake might occur because of inadequate knowledge or setting inappropriate rules applied in deciding. Violations on the other hand are deliberate and conscious deviations from established rules or procedures. [3]

Unintentional actions – actions in which the right intention or plan is incorrectly carried out or failure to carry out an action. It usually happens because of attention or memory failures. [3]

More detailed human error framework used by the US Air Force to investigate and analyse human factor aspects in aviation was developed by Scott Shappell and Doug Wiegmann. It is called Human Factors Analysis and Classification System (HFACS) and it is based upon the James Reason's Swiss-Cheese model. [4] The framework is shown in Figure 2.

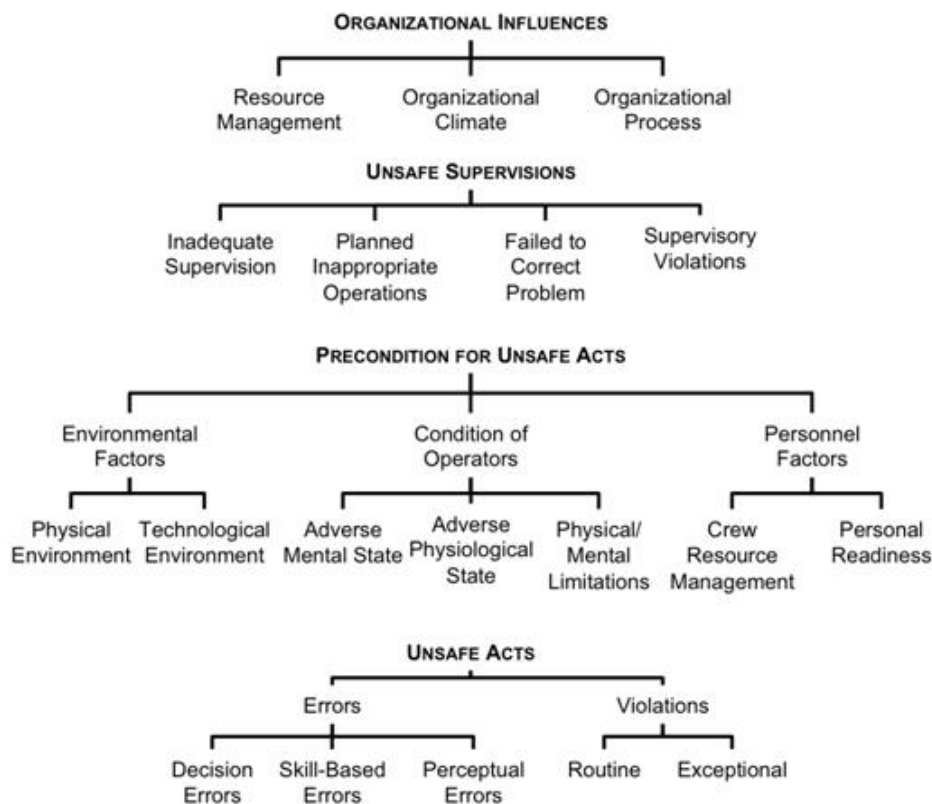


Fig. 2 Human Factors Analysis and Classification System Framework

The HFACS framework assists with the investigation of emergencies, sets training and prevention efforts and helps to identify active and latent failures within an organization that might lead to an accident. **Active failures** usually have an immediate adverse effect on the flight and its safety. They are associated especially with pilots, air traffic

controllers and aircraft mechanical engineers and their actions and inactions. **Latent conditions** are present long time before harmful outcome occur, they become evident when the system's defences are breached. They are created by the safety culture, poor equipment, conflicting organizational goals or management decisions. [4]

The framework also describes basic types of errors. **Decision error** occurs when the behavior or action of the personnel proves inadequate to achieve the longing state (e.g. exceeded ability, rule-based error, inappropriate procedure). **Skill-Based error** might occur in the execution of a routine task relating to procedure, training or proficiency and result in an unsafe a situation (e.g. fail to prioritize attention, checklist error, negative habit). **Perceptual error** which may arise due to wrong sensory input and decision made based upon faulty information. [4]

The HFACS framework also shows the types of violations. **Routine violations** might be frequent and known habitual actions which are often tolerated by the authority (e.g. relying on memory to perform a checklist) or the **Exceptional violations** on the other hand represent exceptional diversion from the authority. [4]

Beyond the HFACS framework are defined two more types of violation. **Situational violations** which occur if there is a gap between requirements of rules and procedures and what pilot think is possible at that moment. **Optimising violations** (personal or organizational) which make people do something for personal goals or for the associated thrills, or there might be organizational optimising violations (incentives for meeting production targets). [3]

4. Aviation accidents and incidents

Despite various efforts to minimize number of incidents and accidents in the aviation its occurrence can't be absolutely eliminated but only reduced on an acceptable level.

Number of aviation incidents and aviation accidents in last period of time when data were available is shown in Figure 3. [5]

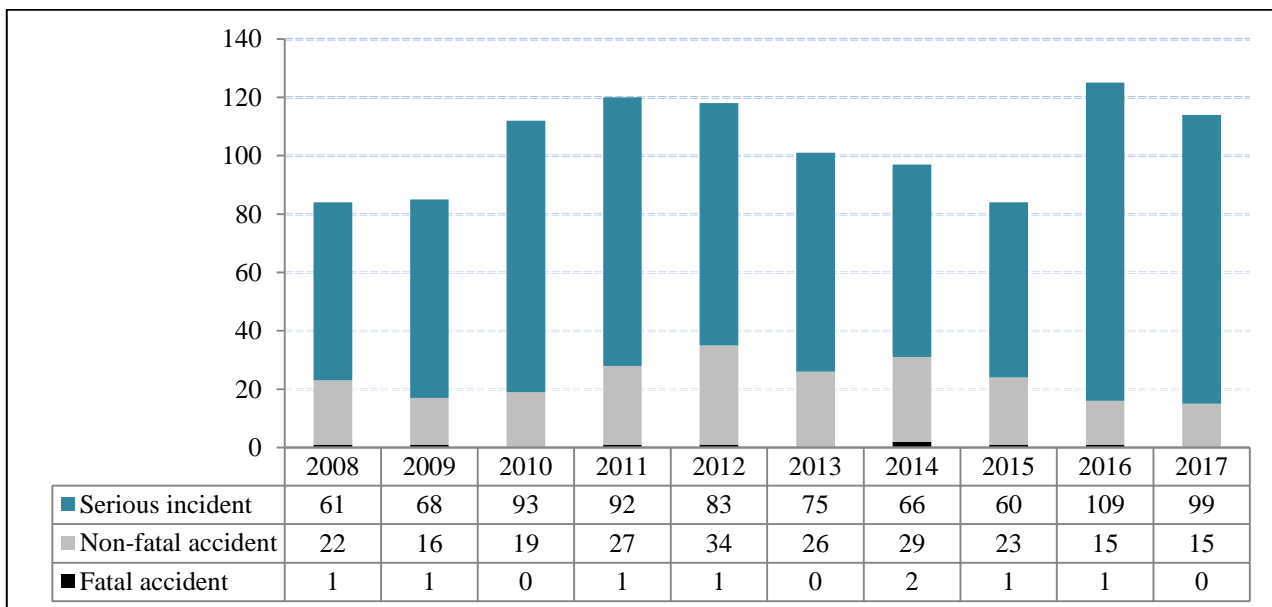


Fig. 3 Number of fatal accidents, non-fatal accidents and serious incidents of commercial airlines

Figure 3 shows number of aviation emergencies which occurred in last decade. The number of fatal accidents is fortunately at a low level while number of non-fatal accidents remains quite higher. The biggest category of emergencies is serious incident but this is especially due to more stringent classification of separation minima infringements after the Regulation (EU) 376/2014 went into force. [5] However if its take into account the total number of flights which went from 26 million in 2008 to more than 36 million in 2017, the number of emergencies does not seem to high and makes the aviation the safest mean of transport. [6]

As the most common cause of aviation accidents and incidents is referred human error. There is a large amount of resources interested in assembling statistics of accidents and their causes, the most of them makes human factor responsible for 70-85 % of all aviation accidents. [7, 8, 9] Other resources points out that it is primarily a crew of aircraft that directly affects the safety of each flight, thanks to its knowledge, discipline and moral values. These resources make the crew and therefore pilots responsible for 60-65 % of all aviation accidents. [9, 10, 11, 12]

5. Human specifics which may affect safety of the flight

As mentioned earlier in the paper, errors are caused mainly by healthy and properly trained individuals. The issue is human performance and its limitations, which might contribute to an accident. The eligibility for aviation activities is determined by the fulfillment of health, sensory and psychophysiological prerequisites (coordination and

responsiveness), as well as personality (discipline and motivation) and professional prerequisites (training and practice). [13]

Among the influences that reduce pilot performance and reliability belong changes in body condition (illness and especially fatigue), changes in mental conditions (personal problems), changes caused by age, environmental factors (noise, vibration, hypoxia), situational influences (unexpected changes in flight conditions) or imperfect interaction with other traffic participants. [13]

Research has shown that emergencies have a number of common characteristics and are often associated not only with human as an individual but mainly with poor crew decision making, inefficient communication, lack of guidance and motivation of the whole crew. [11]

For this reason there are approaches that focus on improving crew performance. For example Threat and Error Management (TEM) which is an overarching safety concept regarding aviation operations and human performance. [14] Another safety concept is Crew Resource Management (CRM) which focuses on factors affecting crew coordination and ensures efficient use of all available resources including human resources, hardware and information. [15] To improve crew's performance are established Standard operating procedures (SOP) as a guide in decision making process, a way to standardize crew activity as well as creating the environment necessary for crew resource management. [16]

6. Conclusions

Human factor and therefore human error is not only about one particular person. Human factor in aviation is about all people in their work situations, their relationship with machines, procedures and environment around them and also about their relationship with other people. Therefore, not only human being itself is responsible for an accident, although all human characteristics mentioned above have significant influence on it air transport safety. The aim of the paper was to introduce human factor with its specifics and also weaknesses. Number of aviation accidents and incidents is described with the statistics which says that 60-85 % of all accidents are caused by the human error. In the end of the paper are mentioned some of the methods which might reduce the negative impact of human factors on aviation safety.

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