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OPTIMIZATION OF RADIO COMMUNICATION FOR PREVENTING HUMAN ERRORS IN FLIGHT PERFORMANCE

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Abstract:

This paper presents the effects of perturbing factors on the pilot's flight performance. The human being is the most flexible, adaptable and valuable part of an organization, but also the most vulnerable one to influences affecting performance. An important role in preventing human error is the involvement of visual and auditory senses in making a decision. Behavior and human performance are regarded as being the cause of most accidents. Using a good example, we have demonstrated that human error can occur at the level of radio communications between the pilot and the air traffic control structures, especially because of the misunderstanding of the transmitted message. The focus of the current study is represented by the importance of engaging the visual sense in messages transmission between the pilot and the air controllers. At the end of this paper, we have formulated an alternative approach to reduce the risk of transmitting and misunderstanding messages between these two cooperating structures. In this sense, optimizing radio communication by stimulating both visual and acoustic analyzers is a solution.

Keywords: human factor, human error, human performances, optimization of radio communication

1. Introduction

When a human starts working, its body adapts to the specific demands of working environment, which leads to functional and sometimes anatomical changes.

The human being is the most flexible, adaptable and valuable part of an organization, but also the most vulnerable one to influences affecting performance. Behavior and human performance are regarded as being the cause of most accidents.

The human factor is the representation of human behavior in the external environment. It is also represented by individual or group behavior, which involves the individual's physiological and psychological processes, and interaction with other people, car/aircraft and equipment that is used.

Frank Hopkins, a famous pilot and human performance specialist at KLM, first defined the notion of “Human factor”, now widely used in aviation. Currently, his description is officially used in ICAO Circular 227. He claimed that the human factor refers to people, to the working environment, to the relation between people and the equipment and to procedures. However, the most important “human factor” refers to the relationships between people.

2. Human error in the context of air transport

The definition of human error

The notion of “human error”, traditionally used in the context of air accidents, and beyond, has become almost commonplace. Beyond the current use, however, it has lost its consistency with modernization concepts on models of the human factor in socio-technical systems. Currently, official documents of ICAO do not refer directly to “human error”, but refer to “deficiencies in human performance” or generic “human factor”. Despite this, the reference to human performance in terms of inadequacy of its statements is still an effective model to be analyzed. People are always



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those who make mistakes. Even when a system works imperfectly, people are those who have failed in the design, manufacture and operation of that system.

Human error is the term used to describe a decision, action or inaction by a pilot or crew of an aircraft that is considered to be the cause of an accident or incident. The term includes errors, judgments, gaps in training, negative habits and pregnancy failure for a pilot.

Psychophysical characteristics of human factor

The main source of dysfunctions that lead to psycho-physical qualities of the human factor can be identified in the continuous complexity of the world that is becoming more unpredictable.

In the military organizational context, the potential of human error gets specific notes: stress, poor ergonomics of the cabin, actions out of time, distractions, which is likely to occur. An environment that is sensitive to error is favorable for air accidents. This environment makes it impossible makes it impossible or reduce chances of error correction. It is also able to experience the vulnerability of the system, which combined with the uncorrected error leads to fatal consequences. We can state that, in terms of human factor, in military air systems appear three basic types of errors:

- A. Failures and lapses;
- B. Proactive control errors;
- C. Retroactive control errors.

A. Failure and lapses

These are grouped into two categories:

- a) by mistake;
- b) because of the excessive attention focused to one or more factors over others.

B. Proactive control errors

Proactive errors refer to the wrong actions taken before producing an aviation event:

- a) misapplication of good rules;
- b) information overload;
- c) applying the wrong rules;
- d) the coding defects.

C. Retroactive control errors

These errors relate to deficiencies that occur when the human factor has to resort to time-based judgments that require the application in real time, despite limited sequential, slow processing capacity of the information received by the crew in case of a special situation.

These errors are influenced by:

- a) limitation of working area into the aircraft cabin;
- b) the excessive confidence in some information, action plans;
- c) the rejection of information.



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3. The influence of visual and auditory stimuli in the context of pilot performances

The eyesight

The eyesight is the sensory way that receives, compared to other modes, the most information about the light energy distribution and the spatial and chromatic properties of illuminated objects. The analyzer is adapted to the wave and corpuscular nature of the light, receiving the projected radiation on the retinal fields.

Visual analyzer provides us valuable information about the environment. It represents the most important receiver used in flight, although messages to the brain are often accompanied by messages from other analyzers. The connection of the optic nerve to the brain is extremely short and the importance of the messages sent from this to the brain is valuable. This is the reason the eyes are considered to be an extension of the brain.

The hearing

Hearing is a way of sensory reception of acoustic stimuli, a process of signaling-reflection in the form of hearing sensations. They are formed as sounds that can be simple or complex, periodic and a-periodic, natural or artificial.

According to Paul Popescu-Neveanu's Psychology Dictionary, we distinguish four types of hearing: absolute, internal, musical and verbal. In the context of this discussion, we will detail the verbal hearing.

Verbal hearing is a sub-modality of the hearing perception appropriate to the reception and pronunciation of language. In the structure of verbal hearing, fundamental is the phonemic hearing that mediates the identification of the phonemes (more easily the vowels than the consonants, and among them the b-p, f-v etc.). Importantly, it is structured in relation to the sound structure of the native language, and the learning of a foreign language mainly involves the development of a new phonetic hearing system.

The peripheral segment of acoustic-vestibular analyzer is the ear. This is a pair-organ and contains the two sensory receptors:

- The sense of hearing assured by the acoustic analyzer;
- The sense of spatial position and body balance provided by the vestibular system.

Hearing allows us to perceive sounds and interpret them. The balance is the sense by which we detect the position and acceleration of our body. By sight, balance is very important for a pilot.

How the brain combines the two types of sensory information

Eyes and ears work together to transmit information about the environment to the brain. Even the simplest eye movement produces eardrum vibrations, according to a study by Neuroscience researchers from Duke University, North Carolina. They have noticed that even if we keep our head fixed, the movement of the eyes from one side to the other produces certain vibrations in the eardrum, even in the absence of environmental sounds. Surprisingly, these vibrations of the eardrum begin shortly before the eyes move. This shows us that the two organs are controlled by the same part of the brain.

The study also provides a better understanding of auditory disorders, such as the difficulty of following a conversation in a crowded and noisy environment.



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It is not a discovery that the eyes and the ears work together to help people hear the sounds around them. Most people notice that it is easier to understand what the interlocutor says if they are watching him/her.

3.1 The vulnerability of hearing in extreme cases

Tenerife, 1977: 583 victims

The Los Rodeos Airport catastrophe is considered to be the worst in the history of civil aviation, with the largest number of victims. This took place in 1977 at Los Rodeos Airport (today's Tenerife-North Airport) in Tenerife. Two Boeing 747s, one from Pan Am and the other from KLM, were redirected here, after a bomb threat had been made at Grand Canaria Airport. The airport was covered by dense fog, and a communication mistake led to a tragedy: while one aircraft was on the runway, the other wanted to take off and plunged into the plane on the runway. After the collision, the planes exploded. In this catastrophe 583 people lost their lives.

India, 1996: 349 victims

On November 12, 1996, two aircraft - Boeing 747-100B, belonging to a Saudi Arabia company, and Ilyushin II-76 from Kazakhstan - that wanted to land on the same airport, collided in the air, above the Charkhi Dadri Village, in the western Indian city of New Delhi. This is the most tragic air crash in history, because 349 passengers lost their lives. In the aircraft heading to Saudi Arabia were 312 people, and on the other, 37. There were no survivors. According to the investigation, the cause of this unfortunate event was the fact that the pilot in the Kazakh Plane did not understand the radio communication received from the tower in English.

4. The method of optimizing radio communication

In order to avoid this problem, there are two options: the more rigorous training of pilots, or the simplification of radio communication. This simplification, we refer to the support of auditory stimuli with visual signals.

The concept of supporting audible signals with simplified visual signals refers to the assembling of a screen on the aircraft that represents the connection between the pilot and the air traffic controllers.

So, in case of requesting an approval by the pilot, it only has to select an option in the on-board device menu. In case of a message sent by the controller to the aircraft, the message will appear on the screen, short and significant, accompanied by a light signal to capture the attention of the pilot. Classical conversation would therefore be used only in exceptional cases.

ADS-B (Automatic Dependent Surveillance—Broadcast)

This system is a surveillance technology in which an aircraft determine its satellite navigation position and sends it periodically, allowing it to be tracked. Information can be received from land-based air traffic control stations as a replacement for the secondary surveillance radar, as there is no need for a ground query signal. It can also be received by other aircraft to provide situational awareness and enable self-segregation.

ADS-B is „automatic”, as the name says, because it does not require any intervention from the pilot. It is „dependent” because it depends on the data in the aircraft's navigation system.

ADS-B is a next-generation system for air transport in United State. ADS-B equipment is mandatory for IFR aircraft in Australian airspace, the United States requires aircraft to be equipped by 2020. Equipment became mandatory for some European aircraft in 2017.



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The main benefit of using this system is that the pilot is able to observe air traffic information near the aircraft as long as the other aircraft is equipped with ADS-B. This information includes speed, altitude and distance to the aircraft. In addition on weather information, the system provides additional data on temporary restriction.

Link 16

Link 16 is a military network used by NATO, licensed by the International Office of the MIDS Program. Its specifications are part of the tactical data links.

With Link 16, military aircraft as well as ships and ground forces can change their tactical image in almost real time. Link 16 also supports the exchange of text messages, image data and two digital voice channels (2.4 Kbit / s and / or 16 Kbit / s in any combination). Line 16 is a secure digital connection

The frequency range on which it works limits the exchange of information to users in line of visibility with one another. However, with satellite capabilities and ad-hoc protocols, it is now possible to transmit Link 16 data over long distance protocols.

5. Conclusion

Being the most flexible and valuable part of an organization's system, the human needs to have good working conditions. Disturbing factors, such as stress, routine, fatigue, must be minimized to create the conditions for achieving professional performance.

In aviation, discussion of workplace performance materializes around the terms "human factor". The human factor refers to people being in their working environment, their relationships with equipment and procedures. The term also refers to their relationships with other people.

The profession of a pilot is about making optimal decisions to accomplish the mission. Thus, efficiency during a mission can be increased by lowering the risk of making the wrong decisions. The examples from Tenerife and India are incontestable in the process of defining a stressful working environment, in the absence of mastering the English language, misunderstanding of the message transmitted through articulated language.

By involving the visual analyzer in the process of transmitting and receiving messages, the risk of misunderstanding is diminished. Placing a display to enable conversations through this path eliminates many aspects uncomfortable with the mission.

ASD-B and Link 16 systems are components of future technology. ASD-B allows the pilot access to essential information for flight safety and security. Instead, Link 16, used in the military environment, provides for the exchange of text messages between the categories of forces.

By integrating the two systems into a much more complex system, the work environment would be defined by safety and the human error is diminished. Decision making takes place under conditions favorable to the pilot.

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