FATIGUE AND STRESS FACTORS AMONG AVIATION PERSONNEL

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Summary: The aim of the paper is to analyze the impact of the human factor on aviation transport. It gives general definition of a human factor, its elements and importance. The paper further describes errors and misconduct in aviation, provides information on error sources and their types. It focuses more on the human factor impact on the selected aviation personnel in terms of workload, fatigue and stress. It draws attention to the importance of health, health care and fitness of a worker. Proper and correct communication is important, too. In the contribution nine factors that mostly influence the performance of selected air personnel (air traffic controllers and traffic pilots) have been listed. The contribution may serve as a basis for carrying out further research and developing intervention programs to improve the performance of the selected aviation personnel to enhance aviation safety.

Keywords: human factor, human reliability, performance, work performance, aviation personnel

1. INTRODUCTION

Safety in air transport has very high importance which is sometimes difficult to keep with the increasing number of aircraft, but at the same time it is necessary to follow the specified safety limits. The requirements for the security measures are increasing with evolving air traffic, and the criteria for an orderly flow of air traffic are growing. Aviation in general utilizes different systems for air transport, but these systems or aircraft have to be operated by someone. We are thinking about people - the airline staff who work with these systems and use them. The demands on people serving different systems and air technical equipment are also increasing with the still higher requirements for the safety and efficiency of air transport. In air transport, although it is a relatively safe mode of transport, there are various incidents, failures or air accidents. It is therefore important to distinguish the causes of faults and errors. The contribution focuses on the importance of the human factor in terms of fluidity and safety in the context of selected aviation personnel.

The human factor failures can have disastrous consequences, loss of life or property damage. Many documented final reports on the investigation of aviation accidents point to the fact that there are more frequent errors caused by a person than failures of systems or technical equipment. To improve the safety system, we need to constantly investigate and analyze knowledge in the field of a human factor which has also been our goal in this research.

2. FACTORS AFFECTING FLIGHT CREW PERFORMANCE

In this section, we analyze factors that have or may affect the work performance of the selected flight crew (pilots and air traffic controllers) - workload, fatigue, stress, attention, vigilance, situation awareness, teamwork communication, confidence that is most critical in air traffic.

2.1. The operational performance of the selected aviation personnel

All the factors have to be observed and recognized. Usually, they are divided into three segments:

- Factors resulting from the interaction between the individual and the environment

workload
fatigue
stress

- Factors relating to cognitive processes
  attention
  vigilance
  situation awareness
- Factors resulting from individuals who work in a team
  communication
  teamwork
  trust

2.2. Interaction between the individual and the environment

Workload is one of the most important factors. Air traffic complexity plays a major role in the workload of an individual. ATC workload, generally, is the mental load rather than physical, unlike other professions.

2.2.1. Workload

Large workloads can have a negative impact on the working performance of the controller as well as on air traffic safety. It also has an economic impact on ATC which is a major limiting factor when capacity in the sector increases. The ATC workload can be defined as a consequence of the complex situation, relation between the task and the way the air traffic controller resolves the situation. In the ATC area, the workload includes external requirements such as a complex image seen on the screen, and internal such as the number of aircraft that the controller has to control, as well as the complexity of the aircraft configuration. The aircraft control strategy can also be considered a workload element if a comprehensive strategy is selected. Choosing a specific control strategy can increase or reduce the complexity of work which would affect the workload of the controller. In general, we could agree that the workload of the controller is the subjective and individual ability of the controller to deal with the tasks and the situation. How an individual manages to handle a given situation is influenced by a variety of personal factors such as the skills and abilities of a person, or related factors such as time pressure, noise, temperature. All this can affect their workload. The workload plays a major role in the economy and safety of air traffic control. There are significant relationships between workload extremes (high load, low load, and overload) and decrease in controller performance, increasing the number of operating errors that have been repeatedly reported. However, the relationship between job requirements, workload and performance is complex and not monotonous. E.g. in the field of air traffic control, the workload is managed by implementing strategies, procedures that mediate a balance between the required tasks, the workload and the performance of the controller.

2.2.2. Fatigue

It is known that fatigue is a major risk to air traffic safety. We could define the notion fatigue as a state between vigilance and sleepiness. Fatigue is multidimensional, can be caused by excessive physical or mental performance. The mental fatigue is caused either by mental effort or poor sleep, while regeneration can only be done through good sleep. *Sleep is* needed to *regenerate* parts of the brain so that it *can* continue to function normally.

There are three main sources of fatigue:

1 Time to perform a task
2 Disturbed sleep
3 Daily rhythm

Disturbed sleep

The performance of aviation personnel working in an irregular shift work may result in worse sleep and cumulating of fatigue over time. Interrupted sleep has an antagonistic effect on cognitive abilities, including visual perception, persistent attention, and is associated with a micro sleep during exercises creating critical concerns in the flight operations.

Circadian rhythm

Frequently, a source of fatigue identified is disruption of daily rhythms. The circadian rhythm takes one day, which is 24 hours. These circadian rhythms affect sleep, but also manage many intricate functions in our body. Waking up at the same time regularly for seven days a week helps keep the circadian rhythm throughout the day.

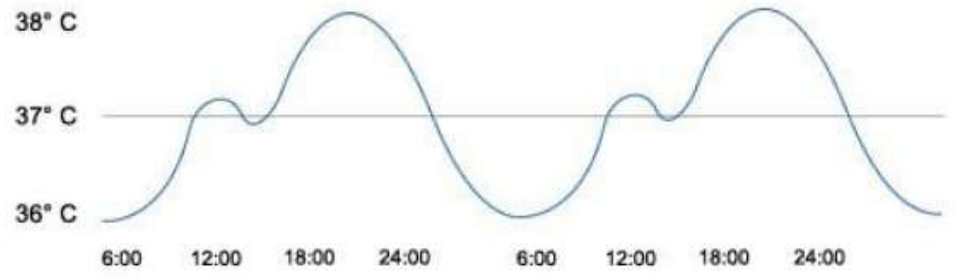

Figure 1 Circadian rhythm of a person depending on body temperature
Source: < http://www.seitler.cz/blog/7-tipu-jak-spat-mene-efektivneji/>

Body temperature also affects how we feel, whether we feel tired or vigilant. Figure 1 shows that body temperature rises and reaches the top in the evening. We also notice a slight drop in temperature in the afternoon. This temperature reflects our performance. The lower the temperature, the more we feel tired and the higher the temperature, the less fatigue we get (Table 1).

Table 1 Fatigue signs divided according to the fatigue type

Mental fatigue	Visual fatigue	Physical fatigue
Subjective feeling of fatigue, sleepiness	Heavy eyelids	Physical symptoms such as muscle pain
Impaired ability to concentrate and recognize important information	Pain, irritated or pricking eyes	Feeling of fatigue, need to sit down or to have a rest
Longer decision time, longer reaction time	Eye tears	
Irritability, moodiness	Difficulties with eye focusing, double vision	
Increased carelessness		

Source: https://www.skybrary.aero/index.php/File:Signs_of_fatigue.jpg

2.3. Warning signs of staff fatigue

1) Forgetting routine tasks such as handing over an aircraft to another control station
2) Impaired planning ability, being in a situation, or being surprised by the situation which would normally be foreseen in sufficient time
3) Ignoring the warning signals
4) Impaired teamwork or leadership - improper communication with colleagues, or if it takes a long time to tell others what to do
5) Heavier focusing on the air traffic control situation and be easy distracted
6) Significant irritability and moodiness caused by common or trivial stimuli

It is important for air traffic controllers to recognize the symptoms of fatigue, to respond appropriately, and thus maintain the performance and safety of operation.

2.4. Recognition of fatigue of operating personnel

Operating managers or leaders should be responsible for tracking and recognizing fatigue in the staff they manage. They are in a position to watch out for the signs of fatigue in their staff, and if one of the employees shows signs of fatigue, they should alert him and somehow resolve such a situation. AS an individual may not recognize the signs of fatigue, or simply does not want to admit that his work performance is impaired by fatigue, there are signs the supervisor, for example, of the ATC workplace should observe and be careful. That includes:

• Yawning and, looking at an individual generally, seems to be tired, closing eye,
• Less communication, becomes more silent and more closed
• Asking for easier and more peaceful tasks
• Atypical execution of tasks, inability to perform tasks with a normal level of load and an increase in errors
• Atypical behaviour such as irritability or reduced motivation.

The work performance of an individual may also be affected for other reasons, but it is always reasonable for a senior flight staff member to notice signs of fatigue on his staff, and if he notices one or more of the above, it is important to find out whether the reason for the reduced performance is fatigue or something else. They must be prepared to take the appropriate steps and give the employee an opportunity to rest, if possible.

2.5. Actions to minimize fatigue

Every employee should be responsible for being ready to perform the work after entering the workplace. Activities that can help avoid fatigue during working hours:

• plan a reasonable time to sleep,
• eat healthy,
• have enough rest to regenerate after some physically demanding activities,
• avoid drinking alcohol,
• create a convenient workplace,
•ensure regular intake of food and fluids.

In the case of night shifts, it is normal that we feel sleepier. Night shifts or flights will greatly disrupt the daily rhythm, and the sleepiest will feel in the early morning hours around 03:00 to 05:00 hours. Nevertheless, it is important for airline staff not to sleep during night-time and to be vigilant. It is good to be aware of this and therefore they should do some things to simplify night activities such as:

• Take a nap before the night shift begins
• Eat light meals before starting a night shift
• Keep your attention during the night-time shift through dialogues with colleagues, if possible
• Not to do activities excessively diverting our attention from monitoring the situation
• If possible, to have regular break,
• If possible, to take a nap

Sleeping and resting needs are individual, so everyone should be responsible for themselves and, if they feel fatigued, do all the necessary steps to maintain air traffic fluency and safety. In summary, we could say that fatigue and its effects, according to a large number of sources, are present in each area of aviation activities. The staff should manage the risk of fatigue successfully if they carefully manage the lifestyle outside work and the fatigue during working hours, It is the responsibility crew members to be aware that they are tired and not to deny because their work performance and air traffic safety could be affected.

3. Stress

Working in the field of air traffic is very demanding and requires a high level of responsibility and resistance to stress due to the complexity and nature of the tasks. Pilots and air traffic controllers are the staff facing a high level of stress. Aircraft piloting and air traffic control could be characterized as a complex set of challenging tasks based on knowledge and expertise, as well as practical application of specific capabilities relating to:

- Spatial perception, information processing, prioritization, logical thinking and deciding,
- Communicational aspects such as the use of correct phraseology,
- Interpersonal relationships (teamwork).

3.1. Types of stress

There are several types of stress known. The four basic types of stress include:

1. *Positive stress* - allows a person to cope with stressful stimuli and thus perform his/her work without limitations. Positive stress helps even improve the performance and creativity of a person
2. *Negative stress* - occurs when a person is exposed to a situation that causes fear. It is accompanied by feelings of anxiety, discomfort and panic. Negative stress usually causes the impaired person's performance which may have a negative impact on flight safety
3. *Anxiety* - is the stress caused by an unpredictable situation, or if the person under this situation poses a threat. It's a feeling of expectation of something dangerous, and these people think that they will not be able to cope with such a situation
4. *Remembered stress* – the stress caused by a situation that has already happened. It reminds the individuals of a stressful situation or their past negative experience. In such a situation, the stressor may not be present, but the memories activate the nervous system and the stress associated with the unpleasant period is resurfacing.

3.2. Sources of stress

Stressor - is a stress stimulus, or a stress-inducing activity. Stressors can be divided into:

1) internal stressors, such as heat, noise, vibration, or extreme cold,
2) External stressors include hunger, thirst, fatigue, and pain. Some of these stressors we can control and it is important to eliminate these stress stimuli.

Among the frequent sources of stress among air traffic control pilots are the following:

- Increased air traffic density,
- Time to perform a task,
- Operational procedures (must be adapted to the situation),
- Emergency situations, non-standard situations,
- Unfavourable working conditions,
- A stress response and its symptoms.

Stress can affect everyone individually. When stress occurs, it depends on various factors such as our knowledge, skills, and everybody else is stressed otherwise.

The most common symptoms of stress are:

1) Physiological - blushing, nail biting, strong heartbeat, sweating.

2) Emotional - changes in mood, fear, irritability, limited communication.

3.3. Dealing with stress

Stress management is a very important skill for pilots and air traffic controllers. It is important for them to learn how to cope with stress and prevent them from affecting their ability to respond properly at work. Stress is difficult to control, but it is not impossible. The first step in managing stress is to identify the stressor and the symptoms that occur after exposure to this stressor. Here are some examples of stress management:

- necessary to reduce stress stimuli,
- if possible - avoid stressful situations (for example, if we are in a difficult situation in the ATC area, call colleagues for help),
- modify your lifestyle (predatory lifestyle),
- recognize symptoms of stress,
- be familiar with all current workplace rules and procedures,
- identify priorities.

4. CONCLUSION

The aim of this paper has been to analyze and describe the factors that may affect the safety, efficiency and smoothness of air transport. The contribution does not include any physical measurements of individual factors. The human factor is not just a notion, but it is a complexity factor that deals with the exploration of man's mental and physical aspects, and also includes elements of industrial design. In 1900, Frank and Lillian Gilbreth began to tackle the elimination of human errors and described a call-response system which was used to eliminate communication errors. It is important to analyze errors and misconduct when dealing with the aviation personnel. Here we have come to the conclusion that the errors are usually cumulative, which means that the occurrence of one error leads to the emergence of another, many times resulting in the occurrence of an aviation emergency. When examining these factors, we have come to the conclusion that some factors may affect the performance of the staff positively but also negatively. At the same time, we have found that individual factors affect an individual in dependence on their experience and personal qualities.

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