ISSN 2181-3187

HUMAN FACTORS IN AVIATION

Najmiddinov Azimjon
The 4-th year student of Tashkent State Transport University
Muhammad Olim Humoyunbek Ulug`Bek o`g`li
Scientific supervisor

Abstract

Human factors in aviation refer to the study of human actions, limitations, and capabilities in relation to aviation activities, including human-machine interfaces, operations, and training. These factors play a crucial role in the design, evaluation, and improvement of aviation systems to enhance safety, efficiency, and effectiveness. Some examples of human factors in aviation include fatigue and sleep patterns, stress management, decision making, communication, situational awareness, teamwork, and workload management. Understanding and addressing human factors are critical for preventing accidents and incidents in aviation operations.

Key words: Human factors, sleep patterns, stress management, decision making, communication, situational awareness, teamwork, aviation, accidents and incidents.

Human factors are critical elements in the aviation sector. When it comes to aviation, the intervention of humans is extensive, ranging from the pilots who handle the planes, the crew, and the air traffic control personnel who are responsible for ensuring safe flight, and the airports from where flights depart.

Therefore, there is an urgent need for aviation industries to understand the human elements involved systematically, analyze the phenomena critically, and institute measures that will mitigate human-based accidents, and provide training on human factors.

Human factors that pose risks in the aviation sector include training, equipment, standard procedures, decision-making processes, and communication breakdowns.

Human Factors in Aviation

The human factor in aviation is any element that influences pilots or crew members that could negatively affect their performance, which could lead to accidents or errors. The following are some of the human factors that influence aviation:

Fatigue

Fatigue among pilots is one of the aspects that is continuously being monitored to avoid accidents. Pilots are required to work for long hours without sufficient sleep, rest, or nutrition, which should not be the case. Fatigue could lead to a lack of concentration, reducing the speed of processing information, resulting in an increased risk of errors that could cause accidents.

ISSN 2181-3187

Workload

Workload is another human factor that could affect aviation. The workload could be classified into cognitive, physical, and psychological categories. The workload could cause fatigue, stress, distractions, and lack of concentration.

Communication

Communication is key in ensuring safe and successful air travel. Human factors in communication could be miscommunication, unclear communication, and a language barrier. Miscommunication among crew members could lead to accidents, especially if crew members misinterpret messages.

Training

Training is a critical aspect when it comes to aviation. Inadequate training or lack of training could pose serious risks, including accidents that could cost lives or result in severe injuries.

Equipment and Procedures

Equipment and standard procedures are critical when it comes to aviation. Equipment that fails to operate as expected could lead to accidents, and standard procedures that are not followed could lead to confusion among crew members.

Decision-Making Processes

Decision-making processes are another human factor in aviation that could negatively affect performance. The wrong decisions made may pose a severe risk to the safety of the entire crew, passengers and may cause incidents.

Stress.

Stress is an inevitable part of aviation, but excessive stress can impair performance and lead to errors. Training in stress management and resilience is essential for aviation professionals, who must be able to cope with high-stress situations.

Teamwork.

The aviation industry is highly team-oriented, and teamwork is essential to safe and efficient operations. Training in teamwork and collaboration is critical for aviation professionals, including pilots, air traffic controllers, and maintenance personnel.

Human factors science, or human factors technologies, is a multidisciplinary field incorporating contributions from psychology, engineering, industrial design, statistics, operations research, and anthropometry. It is a term that covers the science of understanding the properties of human capability, the application of this understanding to the design, development, and deployment of systems and services, and the art of ensuring successful application of human factor principles into all aspects of aviation to include pilots, ATC, and aviation maintenance.

ISSN 2181-3187

Human factors are often considered synonymous with CRM or maintenance resource management (MRM) but is really much broader in both their knowledge base and scope. Human factors involve gathering research specific to certain situations (i.e., flight, maintenance, stress levels, knowledge) about human abilities, limitations, and other characteristics and applying it to tool design, machines, systems, tasks, jobs, and environments to produce safe, comfortable, and effective human use. The entire aviation community benefits greatly from human factors research and development as it helps better understand how humans can most safely and efficiently perform their jobs and improve the tools and systems in which they interact.

Human Performance

Human Performance represents the human contribution to system performance and refers to how people perform their work.

Human Performance considerations are key to enabling safe operations, whether focused on flight and cabin crew, air traffic operators, maintenance engineers, or other aviation professionals.

Human Performance Principles

Principle 1: People's performance is shaped by their capabilities and limitations

Principle 2: People interpret situations differently and perform in ways that make sense to them

Principle 3: People adapt to meet the demands of a complex and dynamic work environment

Principle 4: People assess risks and make trade-offs

Principle 5: People's performance is influenced by working with other people, technology, and the environment

The SHEL Model

It can be helpful to use a model to aid in the understanding of human factors, or as a framework around which human factors issues can be structured. A model which is often used is the SHEL model, a name derived from the initial letters of its components:

• Software (e.g., maintenance procedures, maintenance manuals, checklist layout, etc.)

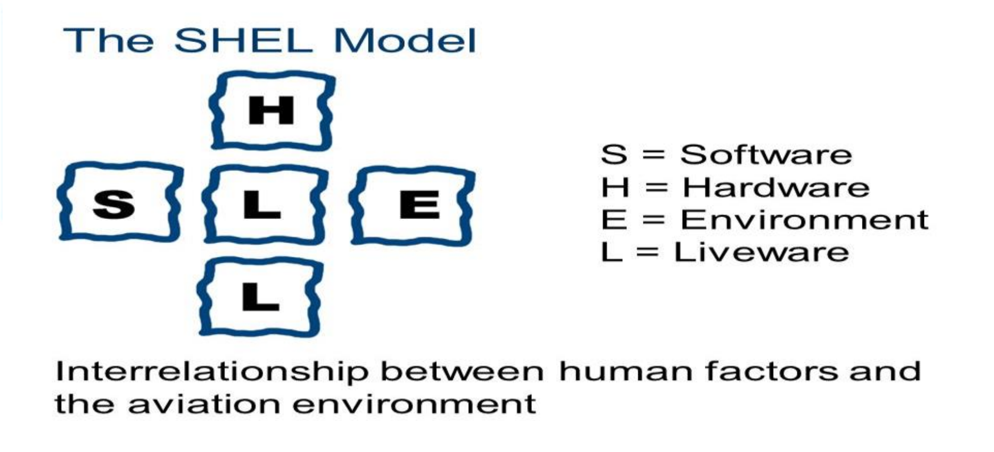
• Hardware (e.g., tools, test equipment, the physical structure of aircraft, design of flight decks, positioning and operating sense of controls and instruments, etc.)

• Environment (e.g., physical environment such as conditions in the hangar, conditions on the line, etc. and work environment such as work patterns, management structures, public perception of the industry, etc.)

ISSN 2181-3187

• Liveware (i.e., the person or people at the center of the model, including maintenance technicians, supervisors, planners, managers, etc.)

Since the shell model is closely related to this article, I will describe this model briefly.



Picture 1 *: SHELL model*

The SHELL model was first developed by Elwyn Edwards (1972) and later modified into a 'building block' structure by Frank Hawkins(1984). The model is named after the initial letters of its components (software, hardware, environment, liveware) and places emphasis on the human being and human interfaces with other components of the aviation system.

The SHELL model adopts a systems perspective that suggests the human is rarely, if ever, the sole cause of an accident.] The systems perspective considers a variety of contextual and task-related factors that interact with the human operator within the aviation system to affect operator performance. As a result, the SHELL model considers both active and latent failures in the aviation system.

Description

Each component of the SHELL model (software, hardware, environment, liveware) represents a building block of human factors studies within aviation.

The human element or worker of interest is at the centre or hub of the SHELL model that represents the modern air transportation system. The human element is the most critical and flexible component in the system, interacting directly with other system components, namely software, hardware, environment and liveware.

However, the edges of the central human component block are varied, to represent human limitations and variations in performance. Therefore, the other system component blocks must be carefully adapted and matched to this central component to accommodate human limitations and avoid stress and breakdowns (incidents/accidents) in the aviation system. To accomplish this matching, the characteristics or general capabilities and limitations of this central human component must be understood.

History of Human factor

Let's take a look at the history of the human factor in aviation. In the early 1900s, Orville and Wilbur Wright were the first to fly a powered aircraft and also pioneered many human factors considerations. While others were trying to develop aircraft with a high degree of aerodynamic stability, the Wrights intentionally designed unstable aircraft with cerebralized control modeled after the flight of birds. Between 1901 and 1903, the brothers worked with large gliders at Kill Devil Hills, near Kitty Hawk, North Carolina, to develop the first practical human interactive controls for aircraft pitch, roll, and yaw. On December 17, 1903, they made four controlled powered flights over the dunes at Kitty Hawk with their Wright Flyer.

They later developed practical in-flight control of engine power, plus an angle of attack sensor and stick pusher that reduced pilot workload. The brothers' flight demonstrations in the United States and Europe during 1908-1909, awakened the world to the new age of controlled flight. Orville was the first aviator to use a seat belt and also introduced a rudder boost/trim control that gave the pilot greater control authority. The Wrights' flight training school in Dayton, Ohio included a flight simulator of their own design. The Wrights patented their practical airplane and flight control concepts, many of which are still in use today.

Incidents and Accidents Attributable To Human Factors / Human Error

In 1940, it was calculated that approximately 70% of all aircraft accidents were attributable to man's performance, that is to say human error.When the International Air Transport Association (IATA) reviewed the situation 35 years later.

A study was car ried out in the USA in 1986 looking at significant accident causes in 93 aircraft accidents. The results of this study are highlighted in Table 1.

Causes/ major contributory factor	% of accidents in which this was a factor
Pilot deviated from basic operational procedures	33
Inadequate cross-check by second crew member	26
Design faults	13
Maintenance and inspection deficiencies	**12**
Absence of approach guidance	10
Captain ignored crew inputs	10
Air traffic control failures or errors	9
Improper crew response during abnormal conditions	9
Insufficient or incorrect weather information	8
Runway hazards	7
Air traffic control/crew communication defeciencies	6
Improper decision to land	6

Table 1 : *Results of study*

ISSN 2181-3187

As can be seen from Table 1, the maintenance errors and omissions have a disproportionately high risk level that results in serious failures on the aircraft. More important is the Fatal and Serious Accident Rating FAR/SAR, details of which can be obtained from the Air Accident Investigation Board (AAIB) or the National Aviation Safety Data Analysis Center (NASDAC) or the National Transportation Safety Board (NTSB). Records from 1972 to the present confirm that maintenance errors related to human factors scores over 0.5 FAR/SAR, well above other accident types. This indicates that in these instances there is a greater loss of life. The following accident reports will demonstrate the significant impact of human factors in accidents. The Civil Aviation Authority (CAA), carried out a similar exercise1 in 1998 looking at causes of 621 global fatal accidents between 1980 and 1996. Again, the area "maintenance or repair oversight / error / inadequate" featured as one of the top 10 primary causes. It is clear from these studies that human factors problems in aircraft maintenance engineering are an important issue needing serious consideration.

Examples of Incidents and Accidents

I can cite several examples of flights that crashed with the human factor :

The first aircraft accident in which 200 or more people died occurred on March 3, 1974, when 346 died in the crash of Turkish Airlines Flight 981. As of April 2020, there have been 33 aviation incidents in which 200 or more people died. The aircraft, registered TC-JAV, was a McDonnell Douglas DC-10 that crashed into a forest situated northeast of Paris. The London-bound plane crashed shortly after taking off from Orly airport; all 346 people on board died. It was later determined that the cargo door detached, which caused an explosive decompression; this caused the floor just above to collapse. The collapsed floor severed the control cables, which left the pilots without control of the elevators, the rudder and No. 2 engine. The plane entered a steep dive and crashed. It was the deadliest plane crash of all time until the Tenerife disaster in 1977. It is currently the deadliest single-aircraft crash with no survivors.

Japan Air Lines Flight 123

The crash of Japan Airlines Flight 123 on August 12, 1985, has the highest number of fatalities for any single-aircraft accident: 520 people died onboard a Boeing 747. The aircraft suffered an explosive decompression from an incorrectly repaired aft pressure bulkhead, which failed in mid-flight, destroying most of its vertical stabilizer and severing all of the hydraulic lines, making the 747 virtually uncontrollable. Pilots were able to keep the plane flying for 32 minutes after the mechanical failure before crashing into a mountain. All 15 crew members and 505 of the 509 passengers on board died. Japanese military personnel inaccurately assumed, during a helicopter flyover of the impact site, that there were no survivors. Rescue operations were delayed until the following morning. Medical providers involved in rescue and analysis operations determined that several passengers likely survived the impact and probably would have survived the incident had rescue operations not been delayed. Four passengers survived the incident in its entirety, meaning that they were alive when discharged from the hospital.

Tenerife disaster

The Tenerife airport disaster, which occurred on March 27, 1977, remains the accident with the highest number of airliner passenger fatalities. 583 people died when a KLM Boeing 747 attempted to take off and collided with a taxiing Pan Am 747 at Los Rodeos Airport on the Canary Island of Tenerife, Spain. All 234 passengers and 14 crew of the KLM aircraft died and 61 of the 396 passengers and crew of the Pan Am aircraft survived. Pilot error was the primary cause, as the KLM captain began his takeoff run in the mistaken belief he had obtained air traffic control clearance. Other contributing factors were a terrorist incident at Gran Canaria Airport that had caused many flights to be diverted to Los Rodeos, a small airport not well equipped to handle aircraft of such size, and dense fog. The KLM flight crew could not see the Pan Am aircraft on the runway until immediately before the collision. The accident had a lasting influence on the industry, particularly in the area of communication. An increased emphasis was placed on using standardized phraseology in air traffic control (ATC) communication by both controllers and pilots alike. "Cockpit Resource Management" has also been incorporated into flight crew training. The captain is no longer considered infallible, and combined crew input is encouraged during aircraft operations.

Importance of Human Factors

The greatest impact in aircraft safety in the future will not come from improving the technology. Rather it will be from educating the employee to recognize and prevent human error. A review of accident related data indicates that approximately 70–80 percent of all aviation accidents are the result of human error. Of those accidents, about 12 percent are maintenance related. Although pilot/co-pilot errors tend to have immediate and highly visible effects, maintenance errors tend to be more latent and less obvious. However, they can be just as lethal. Our focus is on human factors as it relates to improper actions. Note, however, that human factors exist in both proper and improper actions. [Figure 1] Since improper actions usually result in human error, we should also define that term.

Human error is the unintentional act of performing a task incorrectly that can potentially degrade the system. There are three types of human error:

1) **Omission**: not performing an act or task.
2) **Commission**: accomplishing a task incorrectly.
3) **Extraneous**: performing a task not authorized.

There are also four consequences of human error:
--- Little or no effect.
--- Damage to equipment/hardware.
--- Personal injury.
--- Catastrophic.

Aviation safety relies heavily on maintenance. When it is not done correctly, it contributes to a significant proportion of aviation accidents and incidents. Some examples of maintenance errors are parts installed incorrectly, missing parts, and necessary checks not being performed. In comparison to many other threats to aviation safety, the mistakes of an aviation maintenance technician (AMT) can be more difficult to detect. Often times, these mistakes are present but not visible and have the potential to remain latent, affecting the safe operation of aircraft for longer periods of time.

AMTs are confronted with a set of human factors unique within aviation. Often times, they are working in the evening or early morning hours, in confined spaces, on platforms that are up high, and in a variety of adverse temperature/humidity conditions. The work can be physically strenuous, yet it also requires attention to detail. Because of the nature of the maintenance tasks, AMTs commonly spend more time preparing for a task than actually carrying it out. Proper documentation of all maintenance work is a key element, and AMTs typically spend as much time updating maintenance logs as they do performing the work. Human factors awareness can lead to improved quality, an environment that ensures continuing worker and aircraft safety, and a more involved and responsible work force. More specifically, the reduction of even minor errors can provide measurable benefits including cost reductions, fewer missed deadlines, reduction in work related injuries, reduction of warranty claims, and reduction in more significant events that can be traced back to maintenance error.

In this my article, I tried to explain how the human factor in aviation and small mistakes can lead to accidents or various incidents.

Thank you for your attention.

List of literature

1) "Annex 13 to the Convention on International Civil Aviation". The Investigation Process Research Resource Site. October 12, 1993. Chapter I, Definitions. Archived from the original on April 27, 2012. Retrieved July 19, 2018.
2) "Definitions of Key Terms: Industry Definitions". AirSafe.com. July 2, 2017. Archived from the original on March 19, 2022. Retrieved July 20, 2018.
3) Flammarion, Camille (writing as Fulgence Marion) (1870). "The Necrology of Aeronautics". Wonderful Balloon Ascents; or, The Conquest of the Skies. Cassell, Peter & Galpin. pp. 181–86. Archived from the original on July 21, 2018. Retrieved July 20, 2018. Translated from the original French by the publisher.

ISSN 2181-3187

4) "A Visual Timeline of What Inspired the Wright Brothers – First Fatal Airplane Crash in 1908". thoughtco.com. Archived from the original on April 18, 2019. Retrieved July 6, 2017.
5) "Fatal civil airliner accidents by region 1945-2020". Statista. Archived from the original on April 23, 2022. Retrieved April 8, 2021.
6) Tonyleather. "The Deadliest Airplane Accidents in History". Archived from the original on November 14, 2013. Retrieved May 7, 2012.
7) Sebastien Freissinet. "The Tenerife crash-March 27th, 1977". 1001Crash.com. Archived from the original on April 11, 2022. Retrieved May 7, 2012.
8) "ASN Accident Description". Aviation Safety Network. Archived from the original on April 2, 2011. Retrieved July 14, 2013.
9) "The Tenerife Airport Disaster – the worst in aviation history". The Tenerife Information Centre. Archived from the original on April 11, 2022. Retrieved October 29, 2014.
10) "Aircraft Accident Investigation Report Japan Air Lines Co., Ltd. Boeing 747 SR-100, JA8119 Gunma Prefecture, Japan August 12, 1985" (PDF). Japan Transport Safety Board. June 19, 1987. Archived (PDF) from the original on September 24, 2015. Retrieved July 7, 2017.
11) AviationSafetyNetwork. "Accident description". Archived from the original on September 6, 2011. Retrieved May 7, 2012.
12) "Aircraft Accident Investigation Report Japan Air Lines Co., Ltd. Boeing 747 SR-100, JA8119 Gunma Prefecture, Japan August 12, 1985 Archived February 4, 2016, at the Wayback Machine." 22 (33/332). Retrieved August 18, 2010.
13) AviationSafetyNetwork. "Accident description". Archived from the original on June 21, 2010. Retrieved May 7, 2012.
14) Klein. "Top 10 plane crashes in the world". Archived from the original on September 25, 2018. Retrieved June 11, 2013.
15) "Semicircular Cruising Level System (ICAO)". Flight Crew Guide. September 10, 2013. Archived from the original on March 19, 2022. Retrieved January 10, 2017.