Aviation Human Factors: Conceptual Overview

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ABSTRACT

Investigators and analysts alike continue to face challenges when analysing and reporting the human factors components of aircraft accidents and other complex systems. An alternative approach is suggested and recent attempts to address these challenges are discussed. This paradigm can be used to create a frugal analysis system for the study and reporting of the human factors components of accidents. It is based on a combination of many theoretical models in cognitive engineering that have strong empirical backing. The suggested conceptual framework is clearly articulated and applied to two well-known instances of transportation disasters. As well as I read through a thorough discussion of human aspects in aviation.

Keywords: Aviation, Human factor, Aviation safety, Ergonomics

INTRODUCTION

Human Factors in Aviation, written by Earl Wiener and David Nagel, was published in 1988. This significant book marked a symbolic change in the position of human factors within the aviation sector at a time when the stealth bomber, Hubble telescope, and perestroika were novel concepts. The term "human factors" is not new, and human factors research, which has its roots in aviation, has gradually gained a foothold in enhancing aviation safety. Human factors researchers were only recently starting to play a significant role in the design of aircraft systems at that period in the history of aviation and human factors.Any period in the history of human factors in aviation, one might assess the situation based on the advancements made and the chances that were available going forward.

A system of systems underlies aviation. A "system of systems" is defined in [1] as having the following five fundamental characteristics: operational independence of elements, managerial independence of elements, evolutionary development, emergent behavior, and geographical spread of elements.However, they are constrained by a set of common operating principles and international regulations for design and operation. In the context of aviation, these systems have distinct operational independence (aircraft operations, maintenance, and air traffic management/control), and each of these aspects has managerial independence (they are provided by independent companies or national providers).The technical, interpersonal, and organizational components of flying are all present. It is a sociotechnical "system of systems" that takes important human factors into account, including automation, usability, training, design, maintenance, safety, and processes.

According to Leveson, the control and sharing of constraints is the primary mechanism by which systems of systems maintain a dynamic equilibrium. Accidents are thought to be caused by insufficient control or enforcement of safety-related constraints (occurring during the design, development, or operation of the system), rather than by individual or component failures, according to the Systems-Theoretical Accident Model and Processes. Control mechanisms integrated within an adaptive socio-technical system produce safety. Accidents are seen as instances of poor control.

The focus of accident investigators and safety analysts has shifted to finding the appropriate theoretical and empirical tools to describe, analyze, and communicate the sources of human performance failures now that it is widely acknowledged that human factors are the most significant source of failures in aviation and other complex systems.

In order to increase safety, aviation has evolved a number of defensive tactics over the years with amazing effectiveness. Three well-known authors used aviation as an illustration of a field of practice from which healthcare could learn: "Aviation safety... was not built on evidence that certain practices reduced the frequency of crashes (but) relied on the widespread implementation of hundreds of small changes in procedures, equipment, and organization (to produce) an amazingly strong safety culture and practices," they wrote.Though few of these adjustments were put through controlled studies, they all made sense, were frequently founded on reasonable concepts, technical theory, or experience, and addressed actual difficulties [2]. They continue by highlighting anaesthesia as a field of practice where safety has evolved similarly and arguing that healthcare as a whole should take note [3].

HUMAN FACTORS IN AVIATION

It is impossible to overestimate the importance of human factors in increasing safety. Human factors training was implemented in aviation more than 20 years ago as a result (Fig. 1) [4-6]. Subsequently leading to the creation of the NOTECHS method for assessment utilizing behavioural markers [7]. The utilization of Crisis Resource Management training [8] and the Anaesthetists' non-technical skills framework for behavioural marker assessment [9] have led to advancements in anaesthesia that are similar.

THE IMPORTANCE OF A SAFETY SYSTEM

When using aviation as an example, it often seems to be forgotten that this industry, along with the majority of other high-reliability organizations, achieves results through a systematic approach to safety, despite the interest in and enthusiasm for the development of "human factors" in healthcare. Without this, the efficacy of human factors awareness and training would inevitably be constrained.

- **Human performance and limitations (HPL)**
  - Relevant physiology and psychology
  - Initial training only (didactic)
- **Crew Resource Management (CRM)**
  - Techniques for adapting to limitations
  - Cognitive and team-working skills
  - Mandatory since 1992
  - Initial and recurrent training (3 y cycle—facilitative)
  - Six-monthly recurrent simulator training —assessment using NOTECHS

Fig 1.Human factors training in aviation

This manifests itself organizationally as a Safety Management System (SMS), which the majority of airlines already use and is in the process of becoming a requirement for all commercial air carriers [10 -11]. Clinical governance elements are quite similar to those of an SMS, with the essential inclusion of an organizational handbook (Fig. 2).

This leads to safety practices that are increasingly already in place or are emerging in healthcare settings at the operational and individual levels (Fig. 3). But in order to attain and maintain safer healthcare, there must be a systematic reform across companies that makes safety a part of all medical procedures.

Safety policy
- Senior management accountable for safety
- Hazard identification and Risk management
- Organization manual
- Trained and competent personnel

Reporting system
- Compliance monitoring system

Fig 2.Features of an SMS

Training, testing, licensing, revalidation

Standard operating procedures

Briefings

Checklists and other aids

Automation

Non-normal strategies

Fatigue risk management system (FRMS)

Fatigue awareness and countermeasures training (FACT)

CRM—cognitive and team-working skills

Fig 3.Aviation safety practices at the operational level

These are formal procedures that are crucial to aviation because they enable the creation of ad hoc teams, the adoption of best practices, and the facilitation of monitoring, education, and punishment. Pilots generally welcome them since they make life easier and safer, even though we may not always agree with them.

Standard operating procedures (SOPs) are frequently discussed in medical settings, particularly in the operating room, but there appears to be some reluctance to implement them in daily practice. This may be due to a concern about being restricted in the use of clinical judgment and practical skills.

The role of the operations manual and checklists

The Airline Operations Manual is a significant tool for implementing and expressing the elements of the aviation safety system (AOM). This includes the SOPs in addition to a variety of current, easily accessible, and well-structured information and recommendations. Pilots should be able to quickly find any necessary information even though they are not expected to know and recall everything in the AOM.

The AOM is currently typically published electronically, however it can also be made available on physical media or a company intranet for ease of dissemination, access, and change. It will be updated on a regular basis and, for urgent changes in between revisions, regular "crew notices" will be included. Newsletters, flight safety periodicals, training seminars, and, of course, repeated simulator and line training are all used to supplement and reinforce knowledge even though the AOM is the official source of operating information.

A single, accessible, up-to-date reference

Defines authority, accountability, and responsibility

Incorporates Department of Health, College and governance requirements

Standard procedures made explicit

Origin of derived tools—e.g., checklists

Allows learning and (rapid) implementation of change

Facilitates monitoring and sanction

Fig 4.Features and benefits of a hospital operations manual

I've previously mentioned that a Trust-wide operations manual would be a crucial instrument for delivering systematic patient safety improvement inside the NHS (Fig. 4) [12].

Human factors and current problems in flight safety

The creation of thorough reporting and learning systems has been one of aviation's greatest successes. These offer a significant amount of flight safety data, which is augmented by monitoring and recording of flying characteristics, notwithstanding the possibility that their efficacy may be limited to a varying extent by the perceived existence or absence of a "just culture".

Because of this, flight safety is constantly monitored and re-evaluated not only locally but also nationally and internationally. This ongoing review is partly due to the fatal accident rate, which, while still very low (at about 35 per year worldwide), appears to have stopped declining year-over-year [13].

There is little doubt that human factors concerns are important in this situation, and a global push to increase air transport safety is working to address these concerns as well as other difficulties. The European Strategic Safety Initiative, a 10-year initiative that focuses on 18 commercial aviation safety issues, including Safety Management Systems and Safety Culture, is how this is done in Europe.

Ergonomics and Human Factors (E/HF)

The safety and effectiveness of commercial airlines, passenger, freight, and military operations, as well as the wellbeing of their passengers, depend on ergonomics and human factors (E/HF). It also includes maintenance, regulatory organizations, policy makers, and air traffic management and control. E/HF has a lengthy history of theoretical, methodological, scientific, and practical advances.

Crew Resource Management

Non-technical skills are just as crucial in aviation as technical ones (i.e., those that aren't directly related to controlling or operating the aircraft but are needed to communicate with others and make choices). Although Crew Resource Management has been successful in developing non-technical abilities, it has come under fire for failing to include these into the development of technical skills. Normally, non-technical skill training begins after technical skill training has been completed. These abilities are interdependent, so it could be argued that they should be learned together. The training of both sets of abilities should ideally be integrated into the operational setting, as is the case with commercial airlines (LOFT).

In the aviation sector, Crew Resource Management (CRM) has grown into a "way of life." This is a result of a number of accidents, the primary cause of which was a failure to efficiently utilize the human resources on the flight deck. CRM brought management science and applied social psychology into the pilot's seat. Bennett used a method uncommon in Human Factors studies to assess CRM in practice in his article, "The training and practice of crew resource management: recommendations from an inductive in vivo study of the flight deck."

Helicopters Operation

Since they lack an Instrument Landing System (ILS), which is a precision runway approach aid based on two radio beams that together give pilots both vertical and horizontal guidance during an approach to landing, helicopter operations are overrepresented in aviation accidents and are severely constrained by low visibility conditions [15]. Without this assistance, helicopter pilots must rely heavily on cues from outside the cockpit to safely land their aircraft.

During high altitude flying, hypoxia poses a serious threat to all facets of the cognitive function of the pilot. At the cruising altitudes typical of modern commercial aircraft, cabin depressurization can also quickly cause a loss of consciousness. It can also cause issues with psychomotor control and memory.Pilots of transport airplanes, combat pilots, and helicopters all performed differently on cognitive tests while under the effects of hypoxia. Their findings demonstrated that hypoxia affected working memory tests as well as matching to sample tests. According to physiological responses to hypoxia, transport pilots were more adversely affected than helicopter pilots in terms of their higher heart rates and decreased breathing muscle function, suggesting that this may be related to differences in their prior training and providing some insight into how a degree of tolerance may be induced in pilots.

Design of input/output devices

Touchscreens, which may both show information and serve as the input interface for controllers, offer a lot more versatility than conventional hard mechanical controls and displays. Layered displays and controls are made possible by this dual purpose, which may allow for a reduction in the amount of space needed on the flight deck. However, because it is a part of a moving platform, the flight deck may experience turbulence when in flight.

Turbulence frequently causes repeated variations in the air velocity in which the airplane is traveling and is typically short-lived, produced by natural phenomena or other aircraft. In choppy situations, touchscreen controls can be trickier to use than conventional, firm mechanical controls.

Passenger comfort

Airlines' seating plans have changed as a result of increased financial strain. While people are getting bigger, airlines are narrowing the seats to increase revenues. The aircraft cabin's cramped space is designed to hold as many passengers as possible. Airlines are continuously looking for innovative ways to fit more passengers into the aircraft while maintaining a minimum degree of comfort, which has resulted in load factors on flights reaching a record high.

CONCLUSION

Since the last aviation-focused special issue [16] ten years ago, there have been numerous advancements in E/HF theory and application. It is fair to state that over those 10 years, the theory and methods have evolved, and it is nice to see that E/HF has been used to solve a variety of issues. These E/HF applications have produced several intriguing discoveries and good outcomes thus far.The first 60 years of human factors research in the aviation industry have significantly improved safety. For the next 60 years, the task will be to continue to raise safety standards while also attempting to employ ergonomic principles to improve organizational effectiveness and performance.

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