Methods to Optimizing Human Error in Aviation Safety

R.S. Pravin, T. Prabha. V. Durai. N. Sivaselva Kumar

Department of Aeronautical Engineering,
Park College of Technology, Coimbatore.

Abstract

In aviation safety system “Human error” has been documented as a primary contributor to more than 70 percent of commercial airplane hull-loss accidents. In aviation, human factors is dedicated to better understanding how humans can most safely and efficiently be integrated with the technology. Surprising if you consider all the effort and expense put into management, research, training and the development of new technologies such as automation. But still human error related accidents occur. If interpreted narrowly, human factors are often considered synonymous with crew resource management (CRM) or maintenance resource management (MRM). However, it is much broader in both its knowledge base and scope. That understanding is then translated into design, training, policies, or procedures to help humans perform better. Despite rapid gains in technology, humans are ultimately responsible for ensuring the success and safety of the aviation industry. They must continue to be knowledgeable, flexible, dedicated, and efficient while exercising good judgment. Meanwhile, the industry continues to make major investments in training, equipment, and systems that have long-term implications. Because technology continues to evolve faster than the ability to predict how humans will interact with it. In Olden days there are many concepts are used to predict human error like “Swiss cheese”, “Shell model”, “HTA”, “HEART”, But still there are many reasons to air crash. So the author introduces ADS-B system. Nowadays mostly this system is employed in all commercial aircrafts and avoids the collision of air crash due to ATC & human mistakes.

Keywords: Safety, Aviation, Human error, ADS-B.
1. Introduction
Human error in aviation is somewhat of a sensitive topic due to the recent tragic events. The goal of this research is to understand human error in aviation, in order to understand how we can assist in making the aviation industry safer for both pilots and passengers, thereby reducing human error. This paper does not attempt to address accidents caused by cowardly acts of terrorism. It is a fact of life. People are not precision machinery designed for accuracy. In fact, we humans are different kinds of device entirely. Creativity, adaptability, and flexibility are our strengths. Continual alertness and precision in action or memory are our weaknesses. We are amazingly errortolerant. We are extremely flexible, robust, and creative, superbat finding ex planations and meanings from partial and noisy evidence. The same properties that lead to such robustness also produce errors. The natural tendency to interpret partial information although often our prime virtue can cause operator storms interpret system behavior in such a plausible way that it is misinterpretation common and difficult to discover.

Errors are an inevitable part of flying. No matter how good a pilot’s training is, we can never hope to eliminate all errors. Nowhere in life can we ever muster enough brainpower and diligence to make mistakes impossible. Even at our very best, we see shadows cast by our own brilliance. This paper will discuss human error in a general sense, human error specific to aviation, maintaining situational awareness in aviation and human error reduction techniques. And comparing the reduction techniques to give more preferable method. The goal is to become educated in human error in order to determine how to reduce, if not eliminate, human error in aviation.

2. Methods to Predict Human Error
2.1. Swiss cheese
The Swiss cheese model of accident causation is a model used in the risk analysis and risk management of human systems. It’s like human systems to multiple slices of Swiss cheese, stacked together, side by side.

- Organizational failure
- Unsafe supervision
- Preconditions for unsafe acts
- Unsafe acts themselves

This method also poses some disadvantages, like Swiss cheese model to the engineering of human systems in the field of firefighting, with the aim of reducing human errors by ”inserting additional layers of cheese into the system”, namely the techniques of Crew Resource Management.
In the Swiss cheese model, individual weaknesses are modeled as holes in slices of Swiss cheese, such as this Emmental. They represent the imperfections in individual safeguards or defences, which in the real world rarely approach the ideal of being completely proof against failure.

2.2. SHELL MODEL

- Software - The rules, regulations that govern operations
- Hardware - equipment, material and other physical resources
- Environmental conditions
- Live ware - the human

According to Edwards theorists system failures occur when there is mismatch between these components or when other environmental tasks occurred. The following factors are affecting the human performance in SHELL MODEL: Physical Size and Shape, Fuel Requirements, Input Characteristics, Environmental Tolerances.

2.3 HEART Technique

“The aspect for dealing with the errors which may have a gross effect on the system to be analyzed in order to reduce the resources usage when applying the technique”. HEART method is based upon the principle that every time a task is performed there is a possibility of failure and that the probability of this is affected by one or more Error Producing Conditions (EPCs) – for instance: distraction, tiredness, cramped conditions etc. – to varying degrees. His main criticism of the HEART technique is that the EPC data has never been fully released and it is therefore not possible to fully review the validity of Williams EPC data base. Kirwan has done some empirical validation on HEART and found that it had “a reasonable level of accuracy” but was not necessarily better or worse than the other techniques in the study. Further theoretical validation is thus required. HEART relies to a high extent on expert opinion, first in the point probabilities of human error, and also in the assessed proportion of EPC effect. The final HEPs are therefore sensitive to both optimistic and pessimistic assessors. The interdependence of EPCs is not modelled in this methodology, with the HEPs being multiplied directly. This assumption of independence does not necessarily hold in a real situation.

2.4. HTA Technique

The HTA (Hierarchical Task Analysis) starts with then top and full goal of the task, which can be decomposed into sub-goals. Meanwhile a series of plans should be involved to indicate the sequence of the human activities. The plans are determined according to system design and operation guidance. When the analyst approves of the task analysis of this level, the development of next level may be undertaken.

3. Proposed Method

ADS-B Creates a New Standard of Aviation Safety:
What is ADS-B?
ADS-Bistheacronym for Automatic Dependent Surveillance-Broadcast—anew technology that allows pilots in the cockpit and air traffic controllers on the ground to "see" aircraft traffic with much more precision than has been possible before. ADS-B can make flying safer and can allow more efficient use of air space.

ADS-B-equipped aircraft broadcast their precise position, speed, and altitude via a digital data link. ADS-B receivers that are integrated into the air traffic control system or installed onboard aircraft provide users with an accurate depiction of real-time aircraft traffic, both in the air and on the ground. Unlike conventional radar, ADS-B allows organizations and on the ground to see the same real-time information as onboard pilots in aircraft and cockpit controllers, so that for the first time, they can both "see" the same data.

How does it work?
ADS-B relies on a satellite-based GPS system to determine an aircraft's precise location. The position data is combined with other information such as the type of aircraft, speed, altitude, and flight number. The information is converted into a digital message and broadcast via a radiotransmitter. Other aircraft and ground stations within about 150 miles receive the radio broadcasts and display the information in user-friendly format on a computer screen. Pilots in the cockpit can see the traffic on a Cockpit Display of Traffic Information (CDTI). Controllers on the ground can see the ADS-B targets on their regular traffic display screen, along with other radar targets.

Advantages of ADS-B

- ADS-B technology is the cornerstone of future air traffic control systems. It will improve aviation safety by giving pilots in the cockpit and controllers on the ground reliable, accurate, real-time information about aircraft traffic.
- By using existing, proven, digital communication technology, ADS-B can be implemented rapidly at a relatively low cost.
- ADS-B provides a system that is currently unavailable to them. Because the system has an effective range of more than 100 miles, ADS-B provides a much greater margin in which to implement conflict detection and resolution than is available with any other system.
- Pilots and controllers using ADS-B data will be able to determine not only the position of conflicting traffic, but will clearly see the traffic's direction, speed, and relative altitude. As the conflicting traffic turns, accelerates, climbs, or descends, ADS-B will indicate the changes clearly and immediately.
• ADS-B system can further enhance aviation safety through features such as automatic traffic call-out for warning of imminent runway incursion.
• ADS-B technology can be used in both aircraft and ground vehicles. This will provide affordable, effective surveillance of all air and ground traffic, even on airport taxiways and runways, and in airspace where radar is ineffective or unavailable.
• ADS-B can improve airport capacity by allowing more efficient operations at airports that don't have radar service.
• General aviation aircraft can use ADS-B to receive flight information services such as graphical weather depiction and textual flight advisories. In the past, these services have been unavailable or too expensive for widespread use in general aviation.

4. Results and Conclusion
Human errors are not fully predictable, but preventable. So the research shows that human error identification methodology such as SHERPA and HEART are suitable for flight crew's mistakes analysis and quantification in the aviation domain but they have disadvantages. The author proposed ADS-B is more preferable to avoid collision. ADS-B technology is the cornerstone of future air traffic control systems. It will improve aviation safety by giving pilots information about the ground, reliable, accurate, real-time information about aviation traffic. The processes in the project, employed from HEI techniques, are actually comprehensible and convenient to conduct. Every coin has two sides on it, surface. The current human error prediction approaches come from their development background, where mostly the first generation comes from the nuclear industry. The human model and working environment used in these HEI techniques are different from those of an aircrew. Therefore, the human error models and HEI calculation methods are still under discussion. However, the validation included in these projects shows the failure rate of preventing human error is very close to the frequency computed using operational record data. That means if a flight crew makes an error, database like CORE-DATA is always available, the pilot error prediction can be performed accurately. In ADS-B also having some disadvantages. It will be corrected for further ongoing project.

5. Acknowledgement
The authors would like to thank the many people who helped make this paper possible. First of all, thanks to Dr. SHANMUGARAJA, Head Department of Aeronautical Engineering, at Park College of Technology. For helping this project. We are grateful for the efforts of many people at Park College of Technology including, but not limited to, Mr. N. Sivaselva Kumar, Mr. N. Ashokpandian especially...
Mr. S. Aravind for copy editing the final manuscript. Special thanks to Dr. Shanmugaraaj and Mr. R. Arulalagan at the Park College of Technology, Mr. S. Aravind, Mr. R. Andrews, Mr. S. Ramu, and Mr. Sridhar whose review of our material fort ech nical accuracy. Thank s to all the staffs and friends who are helping for this project. Apologies to anyone we missed. Any factual errors are the authors’ responsibility. We made an attempt in good faith to get the facts straight by using the best available source material.

References