Australian Government
Civil Aviation Safety Authority

Safety behaviours: human factors for pilots 2nd edition

Resource booklet 1 Introduction

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The term 'human factors' refers to the wide range of issues affecting how people perform tasks in their work and non-work environments. The study of human factors involves applying knowledge about the human body and mind to better understand human capabilities and limitations, so there is the best possible fit between people and the systems in which they operate.

Human factors are the social and personal skills (for example communication and decision making) which complement technical skills. Understanding and applying human factors is crucial for safety because of the continued threat of accidents, particularly in low capacity and charter air transport operations.

Contents

There is no problem so complex that it cannot simply be blamed on the pilot.

Dr Earl L Weiner, HF specialist, NASA and University of Miami

What are human factors?

Five hundred and eighty-three lives were lost in aviation's worst accident, at Tenerife in 1977, mainly due to miscommunication. One hundred and one were killed in the 1972 Eastern Airlines 401 accident because of the crew's preoccupation with a faulty light bulb. More recently, in 2018, 49 died in the US-Bangla airline accident at Kathmandu Airport suspected to have been caused by pilot/ATC miscommunication. All these accidents are a direct result of deficiencies in human performance—human factors—and are just a small sample of many such accidents that have happened worldwide.

Over the past 100 years or so, we have learned that relatively few accidents result purely from technical failures. In around 70–80 per cent of cases, deficiencies in human performance contributed directly to the outcome. Consequently, 'the greatest potential for reducing aviation accidents lies in understanding the human contribution to accidents.'[1]

Aviation and human factors: past, present and future

Aviation human factors had its genesis in the fledgling years of the Royal Air Force during World War I.

The British found that of every 100 aviation deaths, two were by enemy action, eight by defective airplanes, and 90 for individual defects, 60 of which were a combination of physical defects and improper training.[2]

Concerns over the 'individual defects' figures prompted the first real efforts in aircrew selection and training, which until then had been cursory. Imagine having only two to three hours of flying instruction before being expected to fly solo in today's aviation environment!

By the end of the war, there was progress in better designing aircraft to overcome human limitations. This was the origin of the now well-established field of ergonomics—designing products and equipment to optimise them for human use.

There was also greater recognition of the relationship between pilot error and accidents, on the one hand, and human limitations, both neurological (the brain's cognitive and judgment capacity) and physiological (issues such as sensory perception). This was the origin of two scientific fields now known as aviation psychology and aviation medicine.

World War II provided another leap forward in human factors understanding and prominence because of two challenges.

Firstly, rapid changes in aircraft technology meant that aircraft could fly four times faster than those in World War I and at altitudes of more than 30,000 feet.

Rapidly evolving technologies, such as land-based radio transmitters and ground-based radar, created significant problems, as operators tried unsuccessfully to adapt to often poorly designed equipment.

The number of aircraft accidents rose as pilots struggled to adapt to controls and displays far more complex than anything they had experienced before. The human factors response to these problems was to adopt a more scientific approach to pilot selection—the forerunner of today's airline 'psychometric testing' of pilot cognitive skills and personality.

Secondly, to win the war, both sides needed to mobilise an enormous number of combatants who could adapt easily to new equipment designs, rather than select a very few people for specified jobs. This led to a change in design philosophy, with a focus on designing for general capability rather than choosing special people to fit into existing models.[3]

A notable development during World War II was the link trainer, a rudimentary simulator that used pumps and valves and responded to the pilot's controls, providing accurate readouts on the instruments. The link trainer, which provided the training needed for instrument flying, was the origin of the modern simulator.

From the end of World War II, and during the 1950s and 1960s, human factors application expanded rapidly in the areas of pilot selection, medical standards, fatigue, spatial disorientation and pilot information processing. With the introduction of multi-crew civilian transport aircraft such as the Boeing 727, 737 and 747, the role of the pilot changed significantly from that of being a 'heroic risk taker' to a systems manager and team decision maker.

While automation and intelligent systems continued to advance, the human factors focus remained narrow; that is, the focus was on the concept of pilot error resulting from individual human performance limitations. Social, situational and broader organisational influences were not really considered as they are today.

The period from World War II to the early 1970s is often referred to as the 'technical era', where the aviation safety focus was on improving technology.

The 'human factors' era emerged in the 1970s and 80s with significant work on error mitigation, the evolution of cockpit (now crew) resource management (CRM), and line-oriented flight training (LOFT).

Despite these efforts, human performance issues continued to dominate accident statistics. In part, this was because 'human factors' tended to focus on the individual, rather than on how organisational and operational influences affected performance.

However, by the early 1990s, the role of individual, social, operational and organisational factors in shaping human error, and the idea that human error does not occur in a vacuum, were finally acknowledged. By the mid-90s, the 'organisational era' saw safety from a systemic perspective and embraced the notion of the organisational accident. More recently, from 2010 onwards, the 'total system era' is based on the understanding that there can be a failure across the entire system—aviation service provider, regulator and wider government. These stages are shown on the following page.

image: Library of Congress, Prints & Photographs Division, photograph by Wilbur & Orville Wright, [reproduction number, LC-DIG-ppprs-00626]

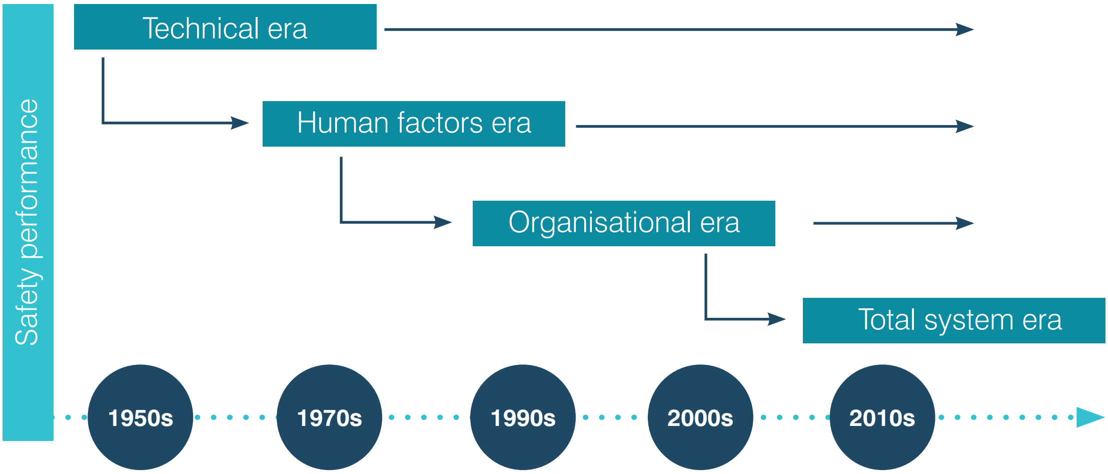


image reproduced from ICAO (2018) *Safety Management Manual* (4th Edition)

Timeline of aviation human factors evolution

While military conflict had driven human factors development in the 70s and 80s, it was accidents on both sides of the world which led the civilian sector to begin investing heavily in this area.

- In the United States, on 29 December 1972, an Eastern Airlines Lockheed L-1011 TriStar crashed into the Florida Everglades, resulting in 101 fatalities. The entire flight crew had become preoccupied with a burnt-out landing gear indicator light and failed to notice that the autopilot had been disconnected. The aircraft gradually lost altitude and crashed.

image: Eastern Air Lines Lockheed L-1011 Tristar | GNU Free Documentation License, Version 1.2

- Six years later, a similar accident occurred on 28 December 1978. A United Airlines Douglas DC-8 ran out of fuel and crashed at Portland, Oregon. The crew members were so engrossed in attempting to diagnose a landing gear indicator malfunction that they did not monitor their fuel and the aircraft crashed due to fuel exhaustion.

The National Transportation Safety Board's (NTSB) investigation of the United Airlines accident identified a breakdown in cockpit management and teamwork and urged airline operators to implement flight deck resource management programs. This was the birth of cockpit resource management (CRM) programs in the United States, a term credited in 1979 to NASA psychologist John Lauber. United Airlines became the first airline in the world to provide CRM training to cockpit crew in 1981. Later, cockpit resource management became the more generalised crew resource management.

On the other side of the globe, Europe followed this CRM initiative, prompted again by tragedy.

- On 27 March 1977, a KLM Boeing 747 collided with a Pan Am B747 on a foggy runway at Tenerife in the Canary Islands. Five hundred and eighty-three people died in the accident. It was the result of a series of communication failures between the two flight crews, air traffic control and the KLM captain, who believed he was cleared for take-off, despite the Pan Am aircraft not having vacated the runway.

image: Tenerife accident

Because of this accident, KLM introduced the KLM human factors awareness course (KHUFAC) in late 1977. CRM was adopted by most airlines around the globe in the 1980s and 1990s. In Australia, Ansett adopted a version of the KHUFAC program into its operations in the early 1980s, and Qantas followed soon after with a similar program.

Unfortunately, tragedy continued to drive the refinement and expansion of cockpit-focused programs. A series of accidents involving cabin crew, maintenance and air traffic control prompted generational changes in CRM training. This transitioned from a narrow focus on pilots' interpersonal behaviour and leadership in first-generation CRM, to a broader, holistic focus to include organisational culture and crew resource management in the current fifth, or 'last-generation' CRM—so-called because it has now largely been replaced by a broader human factors training and assessment focus.

Fifth generation CRM was based on the premise that human error could not be eliminated entirely, but people could be taught to recognise and trap errors before they become consequential. The concept of threat and error management (TEM) was born from this and is still widely used today.

Throughout the 1990s, human factors regulations for flight crew licensing, flight operations, cabin crew, maintenance and air traffic controllers were introduced. The non-technical skills evaluation (NOTECHS) program developed in Europe in 1998 attempted to assess crew collectively and individually on various behavioural elements such as teamwork, decision making and situational awareness.[4]

While Europe took on NOTECHS, psychologists at the University of Texas developed a framework for TEM, which trains flight crew to actively detect and respond to threats such as weather, time pressure and fatigue which, if not well managed, are likely to result in errors.

TEM was complemented by the line-oriented safety audit (LOSA) initiative which used trained observers to assess crew performance on a non-jeopardy basis. The observers identified the strategies used by crews to recover from errors, which could then be used for ongoing recurrent human factors training.

Have the various generations of CRM and current human factors/NTS approach been effective at improving overall aviation safety and minimising the threat of human error? Data from the University of Texas' LOSA program indicates that 98 per cent of all flights face one or more threats, with an average of four per flight. Errors have also been observed on 82 per cent of all flights, with an average of 2.8 per flight. These figures suggest that despite the constant nature of threats and errors, the vast majority of errors are well managed through operational controls, including effective TEM.

Since the early 2000s the discipline of human factors has recognised that human failure can occur at any stage of a system's lifecycle. Human inputs ranging from initial design, manufacturing and construction phases to operational management, maintenance and even regulatory oversight mean that there is always the possibility of errors. Making organisations more resilient by adopting error-tolerant systems which defend against human error and remove weaknesses, will continue to be a focus in the future.

The future for human factors

While aviation safety continues to improve, new threats, complex in nature and often not neatly labelled or transparent, will test the effectiveness of the human factors approach.

Current and emerging issues include:

- **Over-reliance on automation**, raised by recent accidents such as Air France 447 in 2009. While pilot training continues to improve, there is a growing argument that there should be more focus on continuous training, with pilots hand flying and with automation, to mitigate degradation of manual flying skills and ensure mastery of new flight deck technology.
- **Pilot shortage:** the increasing demand for cheaper and more accessible air travel presents the challenge of having to find hundreds of thousands of new pilots in the future. The commercial jet fleet is forecast to almost double to 40,000 by 2030; Boeing's most recent (2017) report estimated that 637,000 new pilots will be required over 2017–2036.[5] Pressure to provide high-quality training for new pilots in less time could produce ill-equipped pilots with insufficient experience to deal with potential operational challenges.
- **Terrorism**, and the threat to security of aircraft and airports arising from extremist groups.
- The exponential **growth in the development and use of remotely piloted aircraft or drones**. Drones have many uses, including aerial mapping and monitoring, aerial photography, aerial application—this use is only likely to expand. Developments in unmanned traffic management and integration of drones into airspace, for example, are on the horizon —with corresponding implications for human factors application for both manned and remote pilots.

Background to this kit

In 2009, CASA produced the first edition of *Safety Behaviours: Human Factors for Pilots*, a resource kit designed for the general aviation and low-capacity regular public transport (RPT) sectors to provide practical support for the human factors training and assessment requirements of the day visual flight rules (VFR) syllabus and Civil Aviation Order (CAO) Part 82.3 amendments.

A corresponding resource guide for engineers, *Safety Behaviours: Human Factors for Engineers*, was produced in 2013.

This fully revised second edition of *Safety Behaviours: Human Factors for Pilots*, while including human factors issues relevant to all pilots, has a special focus on the unique charter environment. It is designed to help their operators and pilots meet the human factors requirements of Part 119 of the Civil Aviation Safety Regulations 1998 (CASR 1998). Part 119 deals with the certification and management of air transport operators. It applies to all operators with an air operator's certificate (AOC) for current charter, RPT or air ambulance operations.

The deadly 2015 crash into terrain of an Alaskan Otter floatplane shows how a revenue-focused culture can subvert safety.

The sightseeing charter aircraft carrying eight passengers from a cruise ship took off at 12.07 pm for what was normally a 30-minute flight. Passengers were supposed to be back on the cruise ship at 12:30 pm for a non-negotiable 1 pm departure. The tour plane company was liable to meet the cost of getting the passengers to the next port if the flight was late.

Overcast clouds, mist and visibility-reducing rain were rolling in, but the pilot had seen his fellow pilots—and his boss—take off in worse conditions. In their report, the NTSB noted he'd heard the deputy chief pilot say, 'You're flying in Alaska now, you're gonna have to bend the rules'.

The pilot had the choice of a coastal route, which offered options to turn back if conditions deteriorated, or a shorter and more scenic run through the mountains. The decision should have been easy, but the five-minute time saving was decisional candy to the pilot.

Probably disoriented by the deteriorating visual cues, the pilot turned left when he should have stayed straight. The flight data recorder (FDR) registered that about two seconds before impact with a mountain, there was rapid engine acceleration and maximum elevator movement. The pilot's avoidance action was at least 10 seconds late and a few hundred feet short. He and his eight passengers died.

The NTSB determined the probable causes were: (1) the pilot's decision to continue visual flight into IMC, and his resulting disorientation; and (2) Promech's company culture, which tacitly endorsed flying in hazardous weather and failed to manage the risks associated with the competitive pressures affecting Ketchikan-area air tour operators (and) … its lack of a formal safety program.

Adapted from 'Culture and the clock' by Adrian Park, *Flight Safety Australia* https://www.flightsafetyaustralia.com/2018/10/culture-and-the-clock/'

In September 2016, New Zealand charter operator, The Helicopter Line, had its fourth serious landing accident in three years.[7] The New Zealand Transport Accident Investigation Commission (TAIC) found after that accident:

The two main reasons for the crash were that the landing approach was made with a tailwind when the pilot was expecting a crosswind; and the relatively fast, low and close landing approach may have limited the pilot's ability to correctly judge actual wind direction and usable escape routes

In a media release about one of the operator's earlier, fatal, accidents, in August 2014, the TAIC identified two safety issues:[8]

First, the operator's pilots weren't routinely required to calculate the performance capabilities of their helicopters for the intended flights. Second, there was a risk of pilots not knowing their aircraft's capability when using standard passenger weights, and therefore a risk of exceeding the limits of their aircraft's performance. The [TAIC] report notes these two issues have now been addressed.

The Commission also found that this accident and others suggest that a culture exists among some helicopter pilots in New Zealand of operating their aircraft beyond the published and placarded limits. Such a *culture* adversely affects the safety performance of the helicopter sector.

Structure of this resource guide

The *Safety Behaviours: Human Factors for Pilots* resource guide includes 10 booklets.

Booklet 1(this booklet): Introduction

- What are human factors?
- Aviation and human factors: past, present and future
- Charter case studies
- Structure of this resource guide
- Models for human factors
- The SHEL(L) model

Booklet 2: Safety culture

- Origin of the term 'safety culture'
- Definitions of safety culture
- Characteristics of safety culture
- Elements and types of safety culture
- Benefits of an effective safety culture
- Building a positive safety culture

Booklet 3: Human performance

- Fatigue
- Stress
- Mental health
- Diet, health and wellbeing
- Alcohol and other drugs (AOD)
- Peer support

Booklet 4: Communication

- When communication fails
- Types of communication
- The communication process
- Why does communication fail in flight operations?
- Improving communication

Booklet 5: Teamwork

- High-performance teams
- Teamwork lessons from sport
- Teamwork in safety-critical industries
- Team composition and dynamics
- Teamwork lessons across industries
- Improving teamwork

Booklet 6: Situational awareness

- Why does good situational awareness matter?
- What is situational awareness?
- Factors that can reduce situational awareness
- How do you know when you've lost situational awareness?
- Managing situational awareness
- Situational awareness and decision making

Booklet 7: Decision making

- Defining decision making
- Naturalistic decision making
- The decision-making process
- Errors in decision making
- Common challenges in decision making
- Operations versus safety
- Decision-making tools/acronyms
- Improving decision making

Booklet 8: Threat and error management

- What is TEM?
- Threats
- Errors
- Undesired aircraft states
- Applying TEM and countermeasures
- Assessing the application of TEM

Booklet 9: Human information processing

- Sensing: sight, hearing and balance
- Perceiving and countering illusions
- Short- and long-term memory
- Deciding and acting

Booklet 10: Design and automation

- Advances in safety
- Evolution of cockpit technology
- Cockpit design
- Implementing automation
- The pilot's role
- The automation paradox
- Mode awareness errors and confusion
- Technologically advanced aircraft in general aviation
- Considerations for training

Together, these booklets make up key human factors topics which will assist individual pilots and organisations alike meet the human factors requirements of Part 135 of the *Civil Aviation Safety Regulations 1998* (CASR 1998).

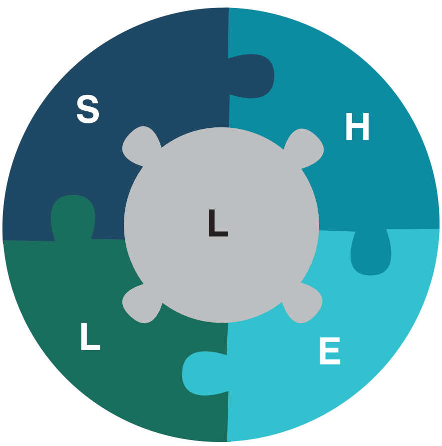
Models for human factors

There are a number of models for human factors, each with an acronym. They include:

- PEAR: people, environment, actions, resources[9]
- PEEPO: people, environment, equipment, procedures, organisation[10]
- 5M: man (people), machine (equipment), medium (environment) mission (purpose), management (leadership)[11]
- SHEL(L): software, hardware, environment, liveware individual, liveware group[12]
- SCHEL(L)O, which adds culture and organisation to the SHEL(L) model

The SHEL(L) model, first developed in the early 1970s, is described in more detail below.

A simple model of human factors—SHEL(L)



The SHEL(L) model

The SHEL(L) model describes the different components of human factors involved in aviation. It represents software, hardware, environment and liveware (the interaction between people and software). A second 'L' liveware is often included and refers to the interaction between people and other people—such as in teamwork, leadership and communication.

At the centre of the model is liveware—you. How do your various attributes—physical, skill levels, knowledge, attitude, culture and beliefs, relate to software—for example, a pre-flight checklist? When we are performing a given task, such as a pre-take-off checklist, how reliable are we? Do we always get it right? We know from human reliability research that most of the time, individuals perform various tasks and achieve their desired performance.

You (the liveware) complete your pre-take-off checklist (software) and are then ready for take-off.

However, we know that in the workplace, people make errors at the rate of about one per 100 steps for routine procedure-based tasks, and one in 10 steps for more complex non-routine work, such as critical alarm diagnosis and response. As task complexity increases, so does the error rate.

As you are running through the pre-take-off checklist items you miss an item. The good news is that most of the time, errors are self-corrected and have little consequence. As you begin your final checks, you determine that you must have forgotten to set the aircraft trim.

We cannot expect even highly experienced pilots to be reliable constantly when faced with situations of high workload, time pressure or being given confusing information. As a result, the errors we make have the potential to result in events and near misses. So, if you failed to set the trim correctly as part of your pre-take-off checklist and do not realise it, several things will determine whether you experience a near miss or an event.

Software, hardware, environment and liveware, the human in the model, all interact to affect how likely it is that the liveware (the individual) will perform a task effectively or make an error that might lead to an undesirable outcome.

Liveware

Liveware is about human performance, including our limitations. Liveware includes individual physical characteristics such as human sensory limitations, as well as our knowledge, attitudes, skill, culture and beliefs. Unsurprisingly, therefore, several booklets in this kit have a liveware focus.

These are:

- **Booklet 3** *Human performance* discusses individual health and wellbeing factors, such as fatigue, stress, alcohol and other drugs, psychological health and nutrition, and how they affect our performance.
- **Booklet 4** *Communication* explorers the critical role effective communication plays in aviation safety.
- **Booklet 5** *Teamwork* looks at how people work together and the essential characteristics of effective teamwork.
- **Booklet 9** *Human information processing* discusses some of the factors influencing our ability to take in information correctly (sensing), process it to see how relevant it is (perception), and then do something with the information (deciding and taking action).

Software

Software is about standard operating procedures (SOPs), policies, rules, manuals, charts, and includes the availability and quality of procedures and task requirements. **Booklet 7** *Decision making* outlines the importance of planning, preparation and the level of knowledge needed for effective decision making.

Hardware

Hardware is about equipment and technology and includes consideration of cockpit layout and design of controls—the human-machine interface. **Booklet 10** *Design and automation* discusses how automation can be invaluable to pilots but can also bring over-reliance on technology.

Environment

Environment is about our physical working environment, weather and location factors, lighting, noise, vibration levels, as well as broader environmental factors—organisational, socio-political and economic. These issues are discussed in several booklets in this kit:

- **Booklet 2** *Safety culture* which examines how safety culture develops, types of safety culture and their evolution. This booklet also provides information to demonstrate that pilots do not live in a vacuum, but rather their performance is significantly influenced by organisational factors such as management commitment, company expectations and accepted habit patterns—the ‘way we do things around here’.
- **Booklet 6** *Situational awareness* talks about the important of planning, and maintaining the ‘big picture’ at all stages of flight.
- **Booklet 8** *Threat and error management* describes a formal process for identifying and managing potential hazards.

Although humans will always make errors, there is clear evidence from accident statistics, line observations and research studies, of the benefit of human factors-based mitigation measures. Aircraft systems and equipment, documentation, procedures and training which have had human factors inputs have been successful in limiting the number and effect of errors, thereby making the whole system more resilient.

This kit is designed to help pilots and operators understand key human factors issues, and, using this knowledge, anticipate problems and develop efficient countermeasures.

How to use this resource guide

Professional pilots

Individual pilots can use the booklets in this resource guide and associated reference material to improve their knowledge of human factors at their own pace. The videos on the USB illustrate key themes in the booklet, show examples of human factors programs and feature interviews with industry experts. Use the workbook exercises as a guide to ensure you have understood the key points for each topic.

Charter operators

Charter operators can use this resource guide as part of initial or refresher awareness training in human factors for their safety critical personnel. You can print additional workbooks and use them for interactive sessions on particular topics. Use the USB resources and accompanying resource material to generate discussion and relate the topics to your own environment and operations.

Resources

KEY TERMS

air transport operation An aircraft operation conducted for hire or reward or which is otherwise publicly available; or a passenger transport, cargo transport or medical transport operation.

charter operation Carriage of passengers or cargo on non-scheduled operations by the aircraft operator or their employees for hire or reward, but excluding publicly available scheduled services.

error tolerance The ability of a system to remain functional even after an error.

human error Those occasions in which a planned sequence of mental or physical activity fails to achieve its intended outcome.

human factors Describes the many aspects of human performance which interact with their (aviation) environment to influence the outcome of events. It is a field of knowledge that involves optimising the relationship between the human operator and this environment.

latent conditions These are 'traps' which may lay dormant within the system and have the potential to increase safety risk and error-producing conditions in the workplace.

organisational accident Rare but catastrophic events that occur in safety-critical industries and have the potential to cause harm to both employees and the public.

organisational factors People's behaviour in the workplace is affected by the characteristics of the business or organisation for which they work. Organisational factors are these organisational characteristics—the overall environment, such as work practices, and management decisions and practices.

person approach Tends to focus on the errors and violations of individuals; e.g. as in the term 'pilot error'.

safety culture Is about people's values, attitudes, beliefs and bahaviours. In organisations with a good safety culture, there is a focus on safety, which pervades the organisation—from the boss to all employees.

system approach Traces accident/incident causal factors back to the system, rather than focusing on individual error.

References

1. Wiegmann, D. and Shapell, S. (2001). A Human Error Analysis of Commercial Aviation Accidents using the Human Factors Analysis and Classification System (HFACS). U.S. Department of Transport/FAA report DOT/FAA/AM-01/3.
2. US Army Technical Manual (1941). Quoted in Australian Transport Safety Bureau (ATSB) Research and Analysis Report (2006). A Layman's Introduction to Human Factors in Aircraft Accident Investigation.
3. Australian Transport Safety Bureau (ATSB) Research and Analysis Report (2006). A Layman's Introduction to Human Factors in Aircraft Accident Investigation.
4. Avermaete, J. and Kruijsen, E. (eds.) (1998). NOTECHS. The evaluation of non-technical skills of multi-pilot aircrew in relation to the JAR-FCL requirements. National Aerospace Laboratory (NLR) final report NLR-CR-98443, Amsterdam.
5. Boeing (2017) Boeing: Pilot and Technician Outlook 24 July 2017.
6. Australian Transport Safety Bureau (ATSB) (2018). Aviation occurrences statistics: 2007–2016. ATSB Canberra.
7. New Zealand Transport Accident Investigation Commission, 2018. TAIC releases report on 2016 helicopter crash on Mt Sale, Central Otago. See https://taic.org.nz/news/taic-releases-report-2016-helicopter-crash-mt-sale-central-otago
8. TAIC 2017, TAIC releases report on 2014 helicopter crash on Mt Alta.See https://taic.org.nz/news/taic-releases-report-2014-helicopter-crash-mt-alta
9. Skybrary. PEAR model. See https://www.skybrary.aero/index.php/PEAR_Model
10. Safety Wise (2016). Developing PEEPO for your incident investigation. See https://www.safetywise.com/single-post/2016/08/29/Developing-PEEPO-For-Your-Incident-Investigation
11. AviationKnowledge. 5-M Model Approach To Accident Investigation See http://aviationknowledge.wikidot.com/aviation:5-m-model
12. Skybrary. ICAO SHELL model. See https://www.skybrary.aero/index.php/ICAO_SHELL

Notes

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