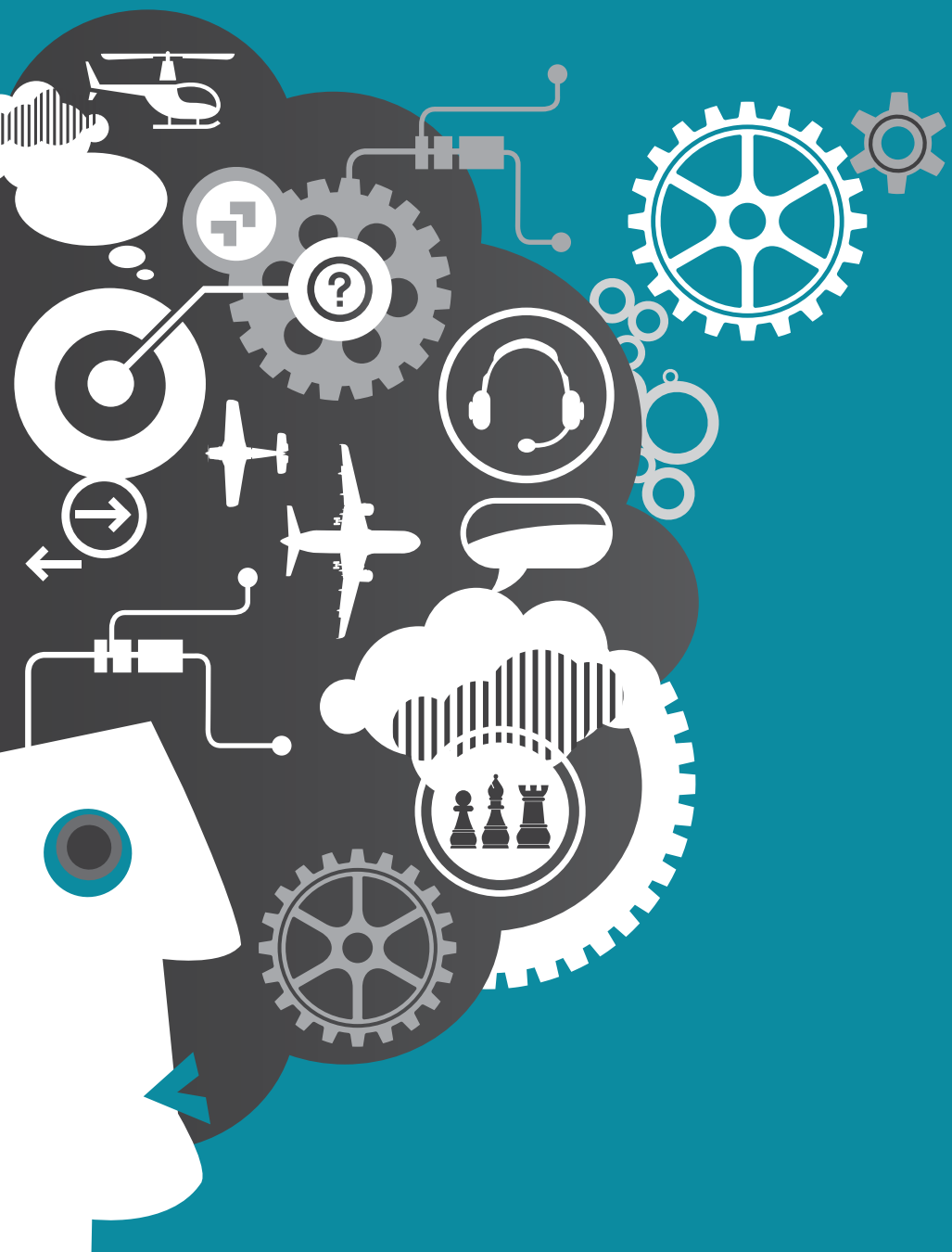
Australian Government
Civil Aviation Safety Authority

Safety behaviours: human factors for pilots 3rd edition
Workbook



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Safety behaviours: human factors for pilots 3rd edition
Workbook

Welcome to the *Safety Behaviours: human factors for pilots Workbook*, which provides case studies and practical exercises to consolidate your understanding of the information in the 10 resource booklets.

While we cannot eliminate human error, understanding human factors principles can help you to mitigate its adverse impact on aviation safety. Recognising when you 'got it right' will also enable you to build on these positive examples of human factors for a safer operation.

This kit focuses on the elements needed to create and maintain a positive safety culture, with an emphasis on supporting low capacity regular public transport and smaller operations.

This second edition of the kit features new booklet topics, as well as a new series of videos to complement the video drama *Airtime*, which appeared in the first edition. These new videos feature interviews with a host of human factors experts, industry operators, pilots and instructors, with a dedicated video covering each of the resource booklet topics (with the exception of Resource booklet 8—*Threat and error management*).

Some of the examples and exercises in this workbook, therefore, appeared in the first edition, while others—such as those on design and automation—are new.

You may already have techniques for managing human performance factors such as fatigue and stress. We encourage you to apply them to the exercises in this workbook.

We hope you find the exercises in the *Safety Behaviours: human factors for pilots Workbook* useful in reinforcing your understanding of this important area.

Contents

Overview

How to use this workbook

This workbook is designed for use in the training classroom or for self-directed study.

The practical exercises are based on material in the resource booklets and the new video series, as well as the drama *Airtime*, which appeared in the first edition of the *Safety Behaviours: Human Factors for Pilots* kit. All the videos are available on the CASA website at www.casa.gov.au/hf.

While you can complete the modules in any order, we recommend that you complete modules 1 and 2 first, as they provide an overview of the topics in the kit.

There are no right or wrong answers to many of the questions. They are designed to make you think: how do these scenarios, real-life and dramatised, apply to you, or to your organisation?

You can find the correct answers to selected questions beginning on page 95.

Table 1: Overview of modules

Booklet	Instructions	Completion
1. Introduction 	• Read Resource booklet 1—*Introduction* • View the videos: *Human Factors Introduction* and *Airtime* • Work through the workbook exercises on pages 7–16 • Discuss with peer, mentor or tutor	Module completed? ☐
2. Safety culture 	• Read Resource booklet 2—*Safety culture* • View the video: *Safety culture* • Work through the workbook exercises on pages 17–22 • Discuss with peer, mentor or tutor	Module completed? ☐
3. Human performance 	• Read Resource booklet 3—*Human performance* • View the video: *Human performance* • Work through the workbook exercises on pages 23–40 • Discuss with peer, mentor or tutor	Module completed? ☐
4. Communication 	• Read Resource booklet 4—*Communication* • View the video: *Communication* • Work through the workbook exercises on pages 41–46 • Discuss with peer, mentor or tutor	Module completed? ☐
5. Teamwork 	• Read Resource booklet 5—*Teamwork* • View the video: *Teamwork* • Work through the workbook exercises on pages 46–54 • Discuss with peer, mentor or tutor	Module completed? ☐
6. Situational awareness 	• Read Resource booklet 6—*Situational awareness* • View the video: *Situational awareness* • Work through the workbook exercises on pages 55–60 • Discuss with peer, mentor or tutor	Module completed? ☐

Booklet	Instructions	Completion
7. Decision making 	• Read Resource booklet 7—*Decision making* • View the video: *Decision making* • Work through the workbook exercises on pages 61–74 • Discuss with peer, mentor or tutor	Module completed? ☐
8. Threat and error management (TEM) 	• Read Resource booklet 8—*Threat and error management* • Work through the workbook exercises on pages 75–82 • Discuss with peer, mentor or tutor Please note: there is no specific video for this module	Module completed? ☐
9. Human information processing 	• Read Resource booklet 9—*Human information processing* • View the video: *Human information processing* • Work through the workbook exercises on pages 83–88 • Discuss with peer, mentor or tutor	Module completed? ☐
10. Design and automation 	• Read Resource booklet 10—*Design and automation* • View the video: *Design and automation* • Work through the workbook exercises on pages 89–94 • Discuss with peer, mentor or tutor	Module completed? ☐

Module 1

Human factors introduction

In the introductory video, Professor Sidney Dekker says,

Aviation is often held up as the paragon of new technology and the future … and yet it's only people, it's only the human, who can hold together this complex, shifting patchwork of technologies, of communication requirements, of pressures and goal conflicts … If we don't understand the human factor, we don't understand safety in aviation at all.

A key theme of this kit is that human error is more likely to have consequences if it is the result of an underlying problem, or *latent condition*, within the organisation.

Another important theme is that safety is the responsibility of everyone in the organisation. It is not sufficient for an individual involved in an error simply to blame the system and leave it at that.

Organisations should strive for a *just culture* in which individuals are encouraged to report honest mistakes without fear of punishment—but where unacceptable behaviour, such as willful violations or gross negligence—is not tolerated.

Everyone in an organisation should be encouraged to seek and implement continual improvements in the workplace, particularly those related to identification of threats, hazards and managing error.

In this module, you'll be applying information from the introductory resource booklet and video and analysing a series of incidents arising in the fictional drama, *Airtime*. You'll also be asked to consider the factors which lead to the real-life incidents and accidents described in the resource booklets.

Before completing the exercises in this module:

- Read Resource booklet 1—*Introduction*
- Watch the Human factors introductory video
- Watch the *Airtime* video, which follows the lives of two young pilots working for a low capacity regional airline.

Exercise 1: Drama in the air

View the *Airtime* video, which runs for 25:31 minutes, and make some notes below about some of the reasons why Robert and Wilko find themselves in the various predicaments they do. You will find these notes useful in answering the questions that follow.

The incidents involving Robert and Wilko in *Airtime* serve as a good starting point to discuss:

- defences needed to protect systems against human or technical failure
- errors or violations committed by individuals and teams
- situational or environmental conditions which can lead to incidents
- organisational factors, such as standard operating procedures and culture.

Defences

Defences are control measures or barriers designed either to prevent an incident or limit its consequences. For example, when driving a vehicle, an airbag is a defence that should protect a driver in the event of a collision.

In aviation, defences might include:

- administrative controls such as written procedures for completing a task, clear requirements for communication between team members, or consistent supervision by management.
- engineered controls such as landing gear or low-fuel warning lights, or stall warning alarms.

Defences can be *failed* (present but ineffective) or *absent* (not in place).

For example, a failed defence at Rover Airlines was the lack of a clear policy and procedure for secondary employment, meaning that pilots like Wilko could work another job, without considering the safety consequences of fatigue.

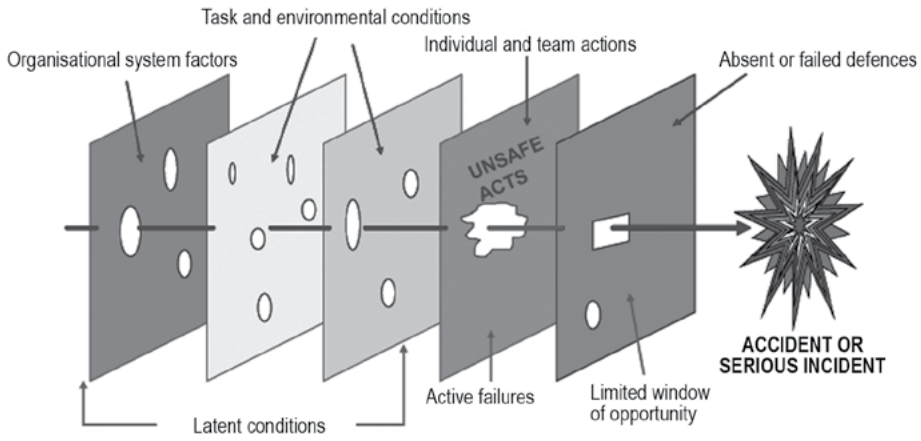
Errors or violations

These are actions by an individual or team at the time of an incident. They can include:

- forgetting a crucial step in a procedure
- misdiagnosing a problem
- breaking a rule or procedure.

For example, Wilko forgets to remove the pitot tube cover in his pre-flight checks.

The Reason model of accident causation



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Task or environmental conditions

Which task or environmental conditions led to the individual or team actions? Task, equipment, environment or human limitations can increase the likelihood of human errors, and can include:

- high workload
- unfamiliar tasks
- excessive noise or temperature
- personal or financial stress
- lack of proficiency.

For example, Robert is tired, and the operating captain gives him little time to obtain and read the NOTAMs. Robert's level of fatigue and the time pressure he is under lead to him missing key information about the glider competition.

Organisational factors

Every organisation will have control processes to manage their operational risk. Some of these are:

- standard operating procedures
- training
- design.

Organisational factors which affect safety also include:

- organisational culture ('the way we do things around here')
- incompatible goals (safety versus commercial pressure).

For example, Rover Airlines had not developed a formal policy or defined program to manage crew fatigue levels or their fitness for duty.

Exercise 2: Analysis chart

The following table is based on James Reason's 'Swiss cheese' model of accident causation, on page 9. Using the notes you took while watching *Airtime*:

- List some of the organisational factors which led to the various incidents at Rover Airlines
- Identify task or environmental conditions affecting the flight crew's performance on the day
- Note the errors and violations caused by individual or team actions
- Make a list of some of the failed or absent defences.

Organisational factors	Task or environmental conditions	Errors or violations caused by individual or team actions	Absent or failed defences

Exercise 3: Recommendations/strategies

Now that you have looked at the series of incidents in *Airtime*, can you identify:

- The measures that Rover Airlines should adopt to prevent these incidents from happening again?
- Some personal strategies for Wilko and Robert?

Use the table below to note these down.

Table 2: List of safety recommendations and personal strategies

Safety recommendations for Rover Airlines	Personal strategies for the crew
Example: The airline should have a documented secondary employment policy and ensure it is communicated to all pilots.	**Example**: As an operating crew member on overnight trips, my personal minimum would be to consume no alcohol to ensure I am fit for duty.

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Safety recommendations for Rover Airlines	Personal strategies for the crew

Exercise 4: Identifying factors in real-life incidents and accidents

It's too simplistic to think that good decisions are those which produce good outcomes and that bad decisions produce negative outcomes. There's a huge difference between deciding what to do in a non-threatening, low-risk, controlled environment, and making decisions in an operational environment where there is little margin for error, and time is limited.

(Resource booklet 7—*Decision making*, page 4)

Airtime illustrates how individual, team and system errors can have serious safety consequences. Let's apply what we have learned from *Airtime* about error to the analysis of some real-life incidents and accidents.

The following pages refer to some of the incidents and accidents from the resource booklets. Each row lists a key human factor issue discussed in this kit.

Put a (SCF) in the table cell if, *on the information given,* you believe the item at the top of the table (for instance *poor* communication) was a **significant** contributing factor.

Put a (M) if, on the information given, the factor (for instance good communication) helped prevent an accident, or mitigated the seriousness of the incident.

Leave the cell blank if you don't think the item was significant.

Be prepared to discuss your answer with an instructor or a peer.

For comparison, you may find it useful to repeat this exercise when you have completed the remainder of this workbook.

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Factor	Fatigue	Stress/health	Time availability	Skills/training	Workload	External pressure	Distraction	Disorientation	Communication	Teamwork	Decision making	Organisational culture
Booklet 1—Introduction												
Tenerife: ground collision between two Boeing 747s (see also booklets 4 and 5)												
Booklet 2—Safety culture												
En route Lord Howe Island: Seaview Aero Commander crash												
Blue Mountains: Glenbrook rail accident												
Holsworthy: Unimog troop carrier rollover												
Booklet 3—Human performance												
North Queensland: Fatigue faux pas												
Booklet 4—Communication												
Normanton, Qld: Beech 58 fuel exhaustion												
Long Island, USA: Avianca Flight 52 fuel exhaustion												
Sydney: Boeing 727 near-disaster on take-off												
Booklet 5—Teamwork												
Iowa USA: United Airlines Flight 232 engine failure												
Gove, NT: Gear failure and wheels up landing												
New York: US Airways Flight 1549 ditching												
Booklet 6—Situational awareness												
Kerang, Victoria: Truck collision with train												
Antarctica: Aérospatiale Squirrel helicopter, collision with terrain (see also booklet 9)												
Flinders Island: Airvan forced landing and collision with terrain												

Factor	Fatigue	Stress/health	Time availability	Skills/training	Workload	External pressure	Distraction	Disorientation	Communication	Teamwork	Decision making	Organisational culture
Broome: VFR into IMC												
Booklet 7—Decision making												
Short charter flight crashes shortly after takeoff												
England: Hillsborough Football Ground tragedy												
Sydney: Lindt Café siege												
Singapore: QF32 engine explosion												
North Queensland: Charter to pick up live seafood												
Booklet 8—Threat and error management												
USA: Cessna 210 pilot makes wheels-up landing												
Britain: Cancer patient given wrong chemotherapy drugs and dies												
Booklet 9—Human information processing												
Mt Gambier, SA: RFDS aircraft crash on approach at night												
Moree, NSW: Aircraft crash on night approach												
PA-28 crash off Point Lonsdale, Vic												
Bathurst Island, NT: Crash into mangroves												
Darwin, NT: Overshoot and crash												
Booklet 10—Design and automation												
USA: Crash of Boeing model 299												
Antarctica: Mt Erebus crash (booklet 10)												
Melbourne: Emirates EK407 take-off miscalculation												
Atlantic Ocean: Air France Airbus A330 disaster												

Module 2

Safety culture

Safety culture may be difficult to define; as Dr Graham Edkins says in the video, 'safety culture has as much definitional precision as a cloud'. Nevertheless, having a positive safety culture is critical to aviation safety.

Transparency, openness, trust, a healthy sense of unease, dealing with risks, building relationships, no blame, being vulnerable, 'a culture which allows the boss to hear bad news' ... these are some of the words and expressions people use in the video to describe the characteristics of a positive safety culture.

Qantas captain, Richard de Crespigny, puts it this way:

The safety culture is what people think, act and communicate to be safe when no one is watching them.

In this module, you'll explore how organisations learn from and act upon what went wrong—and importantly, what went right, because as Dekker points out in the video, 'things go right a lot more than they go wrong'.

To complete this module, you will need to:

- read or re-read Resource booklet 2—*Safety culture*
- watch the video: *Safety culture*
- review the *Airtime* video.

Exercise 5: Your organisation's system for managing safety

In the video, *Safety culture*, Toll Aviation's Mark Delany, Executive General Manager, Defence and Government makes the following comment:

For all operators the safety management system should be the tier one document for their business … When the challenges come round costs, rather than focusing just on margin when they're talking with the client, focus on talking about safety and the systems … bring them in and make them part of the story.

Briefly describe the main features of your organisation's system for managing safety, or safety management system (SMS) if your organisation has one. How does your organisation identify hazards, manage risks, communicate about safety, and evaluate how well it is managing safety?

Who would you go to in your organisation if you had concerns or questions about safety or the SMS?

image: Civil Aviation Safety Authority

Exercise 6: Demonstrating a safety culture

A safety culture pervades all aspects of an organisation's operations. In the video: *Safety culture*, Trevor Wright, owner and director of Wrightsair in William Creek, talks about what happened when the main windsock at the airstrip fell over.

Describe what actions you took (or would take) when a piece of equipment in an aircraft or on the ground failed. Who did you tell, and what else did you do to ensure that the problem was fixed and did not recur?

How would you go about putting forward suggestions for improving safety in your organisation?

Exercise 7: Cultural change at Rover Airlines

Airtime opens and closes with scenes depicting a social barbeque for the staff, partners and families of Rover Airlines.

Describe in your own words the changes in culture between the first and second barbeque scenes.

If you were the chief pilot, what steps would you have taken to bring about these changes?

How might these changes translate to safer operations? You may wish to take in account the comments and advice from experts in the video: *Safety culture*.

Now that you have looked at some dramatised and real-life examples, what do you think are the critical elements of a good safety culture?

What steps could you take to promote them in your organisation?

Exercise 8: Rover Airlines safety reporting

Consider the issue of safety reporting in the *Airtime* drama, and use the following discussion points as a guide.

Wilko, on his last flight, had bogged the aircraft in soft mud at the end of the runway. He takes his time reporting the incident.

- When should Wilko have reported the incident?
- Is this incident a routinely reportable or immediately reportable incident? (See the Australian Transport Safety Bureau's website [www.atsb.gov.au] for definitions of these.)
- What is a just culture, and does your organisation practise one?
- What are some of the factors that influence flight crews' willingness to report safety incidents? Think about a just culture.
- Discuss the relevance of the factors you have identified above for your own organisation.

Now that you have discussed some of the issues from *Airtime*, make a list of any strategies that you would recommend to improve the level of safety reporting in your organisation.

Exercise 9: Safety reporting and your workplace

Does your organisation encourage safety reporting without the risk of recrimination or bullying? Describe the process.

Does this differ from the reporting mechanisms discussed in the video: *Safety culture*? If so, describe the differences.

Write down and discuss with your colleagues or peers any situations where you have been unsure about whether to submit a safety report. Discuss the implications of these situations and identify if you would do anything different next time.

How would you describe your organisation's safety culture? What effect does it have on your safety as a pilot?

If you believed a fellow pilot was unfit for duty, what would you do?

Module 3

Human performance

How effectively we perform in our professional and private lives depends on our mental and physical wellbeing. Our physical and mental wellbeing, in turn, is directly related to factors such as fatigue, stress, what we eat, and our consumption of alcohol and other drugs.

As a pilot, you have responsibilities to yourself, your passengers, and your colleagues, to be at the top of your game whenever you fly. The more fatigued you are, for example, the less able you will be to cope with stress and workload. But it's not always easy to recognise your own fatigue, or when your performance is affected by stress, or a poor diet.

This section provides some practical activities and exercises about human performance factors such as fatigue, stress, physical and mental wellbeing, alcohol and other drugs, and peer support.

To complete this module, you will need to:

- read or re-read Resource booklet 3—*Human performance*
- watch the video: *Human Performance*
- review the *Airtime* video.

Exercise 10: Pre-flight fitness

Before each flight, you should make a go/no-go decision based on a pre-flight check of your own fitness to fly, as well as that of the aircraft.

You should ask, 'Could I pass my medical examination right now?' If you are uncertain, then you probably should not fly.

Here are some self-assessment questions.

Table 3: Flight wellbeing checklist

Question	Y/N
Is there anything wrong with me which is making we feel unwell?	
Have I taken any medication in the last 12 hours?	
Have I had any alcohol in the last 8 hours?	
Am I tired? Do I need more sleep?	
Am I under undue stress? Am I emotional right now?	
Have I eaten a sensible meal and taken in a good load of protein? Do I have a protein snack, such as cheese, meat or nuts, aboard?	
Am I dehydrated? Do I need to take noncarbonated liquids such as water or fruit juices?	
Do I have sunglasses, ear protectors and appropriate clothing?	
To help avoid distractions, have I turned off my mobile phone?	

Fatigue

You are probably suffering from some level of fatigue if, for example, you:

- wake up feeling tired
- feel irritable
- regularly avoid physical exercise
- feel less sharp than usual
- hesitate when driving in traffic.

As you will see from the video: *Human Performance*, and Resource booklet 3—*Human Performance*, a prerequisite for avoiding fatigue is getting enough good quality sleep.

Research and then discuss with colleagues your personal strategy to ensure you have a good night's sleep, especially away from home.

Exercise 11: Fatigue and flying behaviours

Think of a recent flight in which you were an operating crew member. Did you or any other crew members show signs of any of the symptoms below?

Fatigue symptom	Y/N
Lack of awareness: radio calls unanswered or failing to complete checklists	
Diminished motor skills: sloppy flying, writing which trails off as weather reports or clearances are written down	
Obvious tiredness: drooping head, staring or half-closed eyes	
Diminished vision: difficulty in focusing	
Slow reactions	
Short term memory problems: unable to remember a clearance long enough to read it back or write it down	
Channelled concentration or distraction: fixating on a single, possibly unimportant issue while neglecting other matters, including an overview of the flight	
Poor instrument flying: difficulty focusing on the instruments, concentrating on one instrument while neglecting others, diminished motor skills including poor hand-eye coordination.	
Drifting in and out of sleep	
Increased number of mistakes: errors, poor judgment and poor or no decisions, even simple ones such as 'will I turn left or right to avoid this thunderstorm?'	
Abnormal moods: erratic changes in mood, depression, periodically elated and energetic, diminished standards	

Remember: the only cure for fatigue is sleep!

image: Civil Aviation Safety Authority

Stress: how much is too much?

'At moderate levels, [stress] generates alertness and focused performance. But in excess it has many negative physical and mental effects.' (Resource booklet 3—*Human performance*, p14.)

The symptoms of acute stress vary from person to person. But the more of the following behaviours a person exhibits, the more likely it is that they are not mentally fit to fly.

> Think of a recent flight and identify whether you, or a colleague, exhibited any of the behaviours below.

Table 4: Pilot stress test: mental fitness to fly

Behaviour	Y/N
Anger or irritability: the person appears agitated, restless and shows a low tolerance of others.	
Low energy: the person appears fatigued, sluggish, and physically drained, and may be slow to complete tasks.	
Self-loathing: the person may harshly criticise themselves for faults and mistakes.	
Concentration problems: difficulty focusing, making decisions, or remembering things.	
Loss of interest: people under acute stress may show up for flying duties neglecting basics such as their physical appearance.	

Exercise 12: Is stress making you ill?

Life events can have a significant impact on your stress levels. Assign a score to those life events which have happened to you in the past year, or which you are experiencing now, and total them in the right-hand column.

Table 5: Significant life event score

Life event in past 12 months or currently		Your score
Death of spouse	100	
Divorce	60	
Menopause	60	
Separation from living partner	60	
Jail term or probation	60	
Death of close family member other than spouse	60	
Serious personal injury or illness	45	
Marriage or establishing life partnership	45	
Fired at work	45	
Marital or relationship reconciliation	40	
Retirement	40	
Change in health of immediate family member	40	
Generally work more than 40 hours per week	35	
Pregnancy or partner becoming pregnant	35	
Sexual difficulties	35	
Gained new family member	35	
Business or work role change	35	
Change in financial state	35	
Death of a close friend (not a family member)	30	
Change in number of arguments with spouse or partner	30	
Taken out a mortgage or loan for a major purpose	25	
Foreclosure of mortgage or loan	25	
Sleep fewer than 8 hours per night	25	
Change in responsibilities at work	25	
Trouble with in-laws, or with children	25	

Life event in past 12 months or currently		Your score
Outstanding personal achievement	25	
Spouse began or stopped work	20	
Began or ended studies	20	
Change in living conditions (visitors in the home, change in roommates etc.	20	
Change in personal habits (diet, exercise, smoking, etc.)	20	
Chronic allergies	20	
Trouble with boss	20	
Change in work hours or conditions	15	
Moving to new residence	15	
Presently in pre-menstrual period	15	
Change in schools	15	
Change in religious activities	15	
Change in social activities (more or less than before)	15	
Taken out minor financial loan	10	
Change in frequency of family get-togethers	10	
Have been or are about to go on holiday	10	
Presently in Christmas season	10	
Minor violation of the law	5	
Total score		

What your score means

Although individuals' capacity to cope with stress varies, everyone has personal stress-adaptation limits. When they exceed them, the result may be poor health or illness.

For the average person, a score of 250 points or more may indicate high levels of stress. Studies have revealed that people who had become ill had accumulated a total of 300 stress points or more in a single year.

You were asked to look at the last 12 months of changes in your life, but it is important to understand that 'ripples of stress' can circulate a long time after the actual change has taken place.

High stress levels will adversely affect your immune system and lead to mental or physical illness if something is not done about it. It is very important to lighten your stress load and develop mechanisms to cope with the stress before something gives.

The message for flight crew is clear: if stress brought on by life events is not well managed, and is added to the stress of operating an aircraft, your performance might be affected.

Exercise 13: *Airtime*: Robert and Wilko's fatigue

Consider the following scenarios in *Airtime* and discuss the following questions. You may wish to replay the scenarios to refresh your memory.

Scenario 1

Robert (Metro first officer) and a near mid-air (start: 00:00 – end: 06:17)

How did Robert's level of fatigue affect the safety of the operation?

At what stage should Robert have declared he was fatigued?

How would you describe the level of support provided by John, the operating captain?

Given the level of help provided by John to Robert, what options did Robert have for improving the situation?

Scenario 2

Wilko (Chieftain pilot) arriving at work in a taxi (start: 06:18 – end: 08:12)

What impact did Wilko's 'moonlighting' have?

Does your organisation have a secondary employment policy? If so, what are your responsibilities as a crew member?

Wilko allowed himself to be distracted, and as a result missed an important pre-flight check. What could have happened if the chief pilot hadn't noticed the pitot tube cover was still in place?

Are there barriers in your organisation to open discussion or reporting of fitness-for-duty issues, such as fatigue? If so, what are they?

Exercise 14: Managing stress and fatigue

Now that you have looked at some of the causes of stress and depictions of it in the drama *Airtime*, make a list of any strategies you use (or could use) to:

- minimise and mitigate your stress levels.

- reduce the chance of a serious incident or accident resulting from your or a colleague's fatigue level.

- contribute to an effective fatigue policy in your organisation.

Alcohol and other drugs (AOD)

Pilots and anyone else undertaking safety-sensitive aviation activities, including air operator certificate (AOC) and certificate of approval (CoA) holders and contractors, are subject to random AOD testing.

Before undertaking the exercises below:

- Read the alcohol and other drugs (AOD) section of Resource booklet 3—*Human performance*, pages 19–24
- View the video: *Human performance*.

Exercise 15: Test your alcohol IQ

Take this simple test to find out how much you really know about alcohol.

Table 6: Your knowledge of alcohol

Statement	T/F
A 285 ml glass of full-strength beer, a 100 ml glass of wine and a 30 ml nip of spirits all contain about the same amount of alcohol.	
A couple of drinks before bed improves sleep quality.	
Women react differently to alcohol than men, and generally can expect greater impairment from the same quantity of alcohol.	
Pilots change their drinking patterns when away on a duty.	
Modest amounts of alcohol don't affect your flying.	
If your blood-alcohol level returns to 0.0%, you can still be impaired.	

See the answers section on page 96.

Exercise 16: How risky is your drinking?

The most widely used screen for alcohol use in Australia is the AUDIT (Alcohol Use Disorders Identification Test), developed and validated by the World Health Organization.

AUDIT is used by Australian health professionals to help them make decisions about appropriate treatment options for individuals using alcohol in excess of low risk levels. You can complete the AUDIT below to work out your level of risk.

NOTE: this is for your personal reference only as a self-report measure, so please answer the questions honestly for a valid score.

Simply select the option that describes your answer and place in the score box (e.g. if your answer to question 1 is 2–4 times per month—place a 2 in the corresponding 'Your score' box).

Table 7: The World Health Organization's alcohol use disorders identification test (AUDIT)

	0	1	2	3	4	Your score (0–4)
1. How often do you have a drink containing alcohol?	Never (go to question 9)	Monthly or less	2–4 times a month	2–3 times a week	4 + times a week	
2. How many standard drinks containing alcohol do you have on a typical day when you are drinking?	1–2	3–4	5–6	7–9	10 or more	
3. How often do you have six or more standard drinks on one occasion?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
4. How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
5. How often during the last year have you failed to do what was expected of you because of drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	

	0	1	2	3	4	Your score (0–4)
6. How often during the last year have you needed a drink in the morning to get yourself going after a heavy drinking session?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
8. How often during the past year have you been unable to remember what happened the night before because of your drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
9. Have you or someone else been injured because of your drinking?	No		Yes, but not in the past year		Yes, during the past year	
10. Has a relative, friend, doctor or other health care worker been concerned about your drinking or suggested you cut down?	No		Yes, but not in the past year		Yes, during the past year	
Your total score						

Questions 1-8 are scored 0, 1, 2, 3, or 4.

Questions 9 and 10 are scored 0, 2, or 4 only.

If your score is 0-7: Congratulations! Your alcohol consumption is low-risk.

If you scored 8 or more: You are drinking in excess of low-risk levels and might benefit from speaking to your GP or other health professional about ways to cut down your drinking.

Staying safe with alcohol

At about 17 minutes into the video: *Human performance*, Peter Gash from Seair Pacific on the Gold Coast discusses his company's alcohol testing at the start of each shift.

How do you ensure that you, and other crew you fly with, manage your alcohol consumption safely?

Need to cut down or quit drinking? Here are some quick tips

1. Identify good reasons for cutting down (or stopping).

Think of some good reasons for reducing your alcohol consumption. These might include losing weight, avoiding hangovers, having a clearer head and better memory, or minimising relationship problems. Choose some reasons that make sense to you, and write them down (perhaps in your diary) so that you can refer to them later.

2. Set some goals.

Pick a day when you plan to start cutting down and set your daily consumption goals each week. Then record your consumption, in a diary, to help work out whether you're on track to meet your goals. If you don't achieve your goals, work out some practical strategies to help you next time.

3. Be aware of high-risk times.

There will be times when you will find cutting down difficult, no matter how much you want to change. Common high-risk times might be after work, at a party, watching sports events, or when you feel lonely, stressed or depressed. Think of some high-risk times for you, and write them down in the place where you have recorded your reasons for cutting down.

4. Manage high-risk times.

Now that you have identified your high-risk times you need to work out how to manage them and deal with the situation. Some ways of coping with high-risk times might include planning to do other things at times when you would usually use alcohol or other drugs, making sure you eat before drinking, alternating non-alcoholic drinks with alcoholic drinks, or just avoiding high-risk places and people. Think now about practical and sensible ways to deal with the high-risk times that you wrote down at step 3. Then, on a daily basis, think about each of your high-risk times and imagine how you will manage those times using these ideas.

5. Identify someone you trust to support you.

Often people find it is easier to cut down if they have someone they can talk to and be honest with, someone who supports them and their decision. This person might be your partner, a friend, or perhaps a colleague who also wants to cut down. Your doctor or other health professionals can also support you.

6. Stick to your goals.

Some habits are difficult to break. Using the tips here will help you. Talk to your support person to help you get through the times when you are finding it hard to stick to your goals. Each time you stop yourself from doing something by habit you are another step closer to breaking that habit altogether. Your cravings will pass more easily if you're occupied doing something else.

Exercise 17: Alcohol and other drugs in *Airtime*

Consider the following scenarios from *Airtime*:

Robert takes some strong pain medication to treat a severe headache and cold prior to his flight as an operating crew member (start: 08:13 – end: 15:15).

Research and list some medications you can and can't take before flight as an operating crew member.

Discuss what is meant by 'approved' medications.

If you are were not sure about your physical fitness to fly and were taking any prescription or non-prescription medication, what would you do?

What strategies do you use to manage periods of higher stress, such as balancing family commitments with work demands?

What are the main features of your company's alcohol and other drugs policy?

Help is at hand: peer support

Many pilots with an AOD problem have successfully returned to flying through confidential peer support, such as the human intervention motivational study (HIMS) program.

The HIMS video in the Extras section features an interview with Lyle Prouse, a US pilot who regained his licence after a jail term for flying an airliner with a blood-alcohol level of 0.13 per cent. Resource booklet 3—*Human performance* also contains a number of Australian case studies.

Exercise 18: Diet, health and wellbeing

Mental health

Depression, often described as the 'invisible illness', is the second most common mental health issue, second only to anxiety. The Australian organisation, Beyond Blue (beyondblue.org.au), says that around one million Australian adults live with depression each year. On average, one in six people will experience depression over their adult lifetime, with varying degrees of severity.

Depression and men

Although it is changing slowly, the majority of pilots are still men. (According to Centre for Aviation—CAPA figures, in the US women comprise seven per cent of all FAA pilots [12.9 per cent student pilots and 4.4 per cent of airline pilots]). Australian figures are similar.

Although 80 per cent of people with depression who have sought help will find relief through therapy or medication (or both), the majority do not seek help.

- Because many men grow up believing that depression is primarily a women's illness, and perhaps a sign of weakness, they are much less likely to admit to depression or to seek help for it. Fewer than one in four men who are depressed seek help.
- Men have a tendency to deal with their symptoms by using alcohol and other drugs which can often make the symptoms worse.
- Men are not as likely to show the typical signs of depression. They do not usually cry, show sadness, loss of will, or state an intention to hurt themselves. As a result, their depression is hidden from caring friends and family who might insist that they seek help. For this reason, according to Beyond Blue, men are about 3.5 times more likely than women to commit suicide.
- Men who experience the loss of a significant supportive relationship are at serious risk of depression. This type of loss can be either a romantic relationship or, as is often the case, the loss of a father who has been particularly supportive of them.
- Job loss is another trigger for depression, as is physical illness such as cancer, heart disease, and low thyroid function. The link to depression is a feeling of loss in terms of earning potential, virility, strength, control, and self-definition.
- Age: suicide in men peaks in the 20s and again in the 60s and 70s. With a history of depression, the risk of suicide increases substantially.

In the video: *Human performance*, Dr Ian Hosegood talks about the importance of positive attitudes and behaviours such as optimism and gratitude, and learned skills such as mindfulness and social connectedness.

For smaller operators who do not have such in-house expertise, there are also organisations like Beyond Blue (beyondblue.org.au), or RU OK? (ruok.org.au) which can help.

> Go to the ruok.org.au website. Why is it important to ask that question: 'Are you OK?' of a friend or work colleague?

> How might you help a colleague whose behaviour appeared to be affected by stress?

> What resources are available to you through your organisation to encourage good mental health? Is there room for improvement?

Physical health

Mental health and physical health are interrelated: what we eat and drink can have a significant effect on our mood, and exercise, not only maintains physical fitness, but also releases the so-called 'feel-good' chemicals: dopamine, endorphins and serotonin.

In the video: *Human performance*, Dr Hosegood says:

'Helping people help themselves can sometimes be challenging. We're not all as good at planning for our health and wellbeing as we might be, for example, planning for our finances.'

Resource booklet 3—*Human performance* contains a number of diet and wellbeing tips, as do the websites of organisations such as the National Heart Foundation (www.heartfoundation.org.au), Diabetes Australia (www.diabetesaustralia.com.au) and Health Direct (www.healthdirect.gov.au).

While both have some limitations, body mass index (BMI) and waist circumference can be a useful guide to a healthy weight.

Research your own health and lifestyle. A helpful starting point could be to complete the 'Healthy eating quiz' (healthyeatingquiz.com.au), ongoing research undertaken by the University of Newcastle, which will give you a guide as to the quality of your diet.

You could also keep a food (and drink—alcoholic and non-alcoholic) diary for a week.

	Breakfast	Lunch	Dinner	Snacks	Calories
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

Compare notes with colleagues, and develop an action plan for improvements you might make.

What are the particular challenges of maintaining a healthy diet when operating away from home? How might you overcome them?

Module 4

Communication

This module provides some practical activities and exercises about effective communication in aviation operations, based on case studies and information in the resource booklets and videos.

To complete this module, you will need to:

- read or re-read Resource booklet 4—*Communication*
- watch the video: *Communication*
- review the *Airtime* video.

Exercise 19: Are you a good listener?

Being a good listener is an important part of being a good communicator. Effective listening helps build relationships, solve problems, ensure understanding, resolve conflicts, and improve accuracy. At work, effective listening means fewer errors and less wasted time, and for pilots, effective listening is critical to aviation safety. Test yourself with this quick quiz.

Table 8: Listening self-test

This questionnaire will help you think about your own listening skills.

Question	Y/N
Do you tend to talk far more than other people?	
Do people say you speak too quickly?	
Do you often have to repeat what you said because you were thinking about something else?	
Do you tend to pose 'closed' questions, requiring only 'yes' or 'no' as a reply?	
Do you often feel you know what somebody is going to say to you before they have finished talking?	
Do you often interrupt others when they are speaking?	
Is it difficult for you to recognise when you have made a mistake?	
Do you often state an opinion without thinking of how others will react?	
Do you feel satisfied when you have had the last word in a discussion?	
Do you find it difficult to calmly continue reasoning after being contradicted?	
Is it difficult for you to quickly name the person with whom you most worked with yesterday?	
Is it unusual for a co-worker to explain their difficulties to you and ask for advice?	

See the answers section on page 96 to assess your score. To help get a better idea of how others perceive your listening skills, discuss your answers with peers, colleagues or family members.

Exercise 20: Communication at Rover Airlines

In the *Airtime* drama, listen carefully to the conversations between the various employees at Rover Airlines.

Identify some of the *negative* conversations. How could they have gone better?

Write down some examples of *effective* conversations in the *Airtime* drama and how these contributed to a positive result.

Refer to pages 15 and 16 of booklet 4—*Communication*, which outline the various types of nonverbal communication. Identify the *nonverbal* communication, such as gestures, facial expressions, tone of voice, exhibited by the characters in *Airtime*.

At the first BBQ (1.02 mins – 3.07 mins), for example, what do facial expressions, gestures, tone of voice tell about the relationships between the crew?

When Wilko arrives at work (6.35 mins – 7.47 mins), what do his gestures, appearance, tone of voice indicate about his state of mind?

Why is awareness of nonverbal communication important, in the case of Rover Airlines, and in your daily operations?

Exercise 21: Communication methods

Consider the examples in the video: *Communication*, and the following paragraph from page 15 of Resource booklet 4—*Communication*:

'In flight operations, as elsewhere, communication takes place via several channels, not just the spoken word. We convey information and create shared meaning through speech, nonverbal and written communication and visual communication/visualisations.'

Sometimes we need to convey information quickly to a large group, but there are other times when face-to-face meetings or briefings are essential, either one-on-one or to a group. At other times, a group text message or email may be more appropriate.

For each of the following scenarios, describe the communication method or methods you think would be most appropriate. You should take into account the urgency of the communication.

Scenario	Appropriate communication method/s
A small operator needs to alert company pilots about bad weather	
The company needs to let personnel know about a forthcoming procedural change	
The chief pilot needs to have a difficult conversation about a pilot's performance	
A pilot or engineer identifies a hazard which needs to be discussed and resolved	
A pilot has concerns about a peer's performance or actions	
The company safety manager needs to convey and receive information from maintenance and aircrew	
Pilots need to communicate in flight during a period of high workload	
A pilot feels fatigued because of disturbed sleep from a young child's crying	
A pilot needs to remind herself to cancel SARTIME	
An aerodrome operator needs to alert operators about planning for forthcoming taxiway works	
A pilot working for a small operator needs to give feedback on noisy overnight accommodation	
A drone is flying in the vicinity of your regional aerodrome base.	

Make a list of any strategies you use (or could use) to improve the effectiveness of your communication in your day-to-day work as a pilot:

Exercise 22: Radio communication

In a paper on radio miscommunication of aviation English by trainee pilots, Dominique Estival and Brett Molesworth state:

'Aviation is a high hazard industry. However, it remains one of the safest modes of transportation, largely due to the ingenuity of design and the resilience of key personnel such as pilots. That said, improvements in safety can always be achieved and communication is one area requiring particular attention … it is clear from the present research that greater focus needs to be directed towards improving pilot communication skills.'

They go on to say:

'Cases of ATC not understanding pilots and of pilots not understanding ATC occur when the message is less predictable from the context: this is the well-known factor of "hearing what you expect to hear",' and give a humorous example of an exchange between a pilot and ATC:

- Tower: Juliet November Bravo. Bankstown Tower. Follow a *Cherokee* turning downwind.
- JNB: Looking for traffic. Juliet November Bravo. Unable to locate the *turkey*.

But misunderstandings can have tragic consequences, as with the Tenerife disaster when the Dutch crew misinterpreted an airways clearance as a take-off clearance and used the non-standard phrase 'at take-off'. The controller, whose native language was Spanish, understood the phrase to mean 'at take-off point', and used the non-standard phrase, 'OK', in response. The full transcript of this conversation is in Resource booklet 4—*Communication* on pages 12–13.

Homonyms (two words which sound the same but have different meanings) can also be a source of confusion. Fortunately, in the case below, the co-pilot had correctly understood an ATC landing clearance:

- Pilot in command to co-pilot: Cleared **to seven** (i.e. descend to 7,000 ft)
- Co-pilot to PIC: Negative, cleared **two-seven** (i.e. clearance to land on runway 27)

On page 9 of Resource booklet 4—*Communication*, read the case study on Avianca where the pilots didn't express the urgency of the situation. How should they have communicated this more clearly?

Think about a flight where you or a fellow pilot called, or in retrospect should have called, PAN PAN or MAYDAY. What led to the decision to make (or not make) the call?

Think about the animation in the video: *Communication*, where pilots practised their radio calls while riding pushbikes in a hangar. What are some ways in which you could practise your radio calls?

Exercise 23: The use of slang and non-standard phrases

Here are some real-life examples of phrases which could be misinterpreted:

- a controller who, knowing the pilot of an aircraft requesting a clearance, used the colloquial expression 'cleared for the Smoke'
- the misunderstanding by a trainee pilot, who was in a run-up bay, of an ATC instruction to 'go to tower'.

What misunderstandings may have resulted from the use of such language?

What phraseology might have avoided the misunderstanding?

Sometimes phrasing or emphasis can alter the meaning of a sentence. For example, how can the following phrase be interpreted?

Instructor to student (on landing): 'back on the power'.

'No, your other right'—NASA Aviation Safety Report

'Cleared for take-off runway 17 at Colorado Springs. Took runway to use total length, required back-taxi approximately 300 feet. We were at maximum weight. Turning left on runway for short back-taxi, tower said, 'Turn right on runway for departure.' (In my mind, what other direction would we turn [after turning left to back-taxi]?) Light aircraft turning final for runway 12. As we back-taxied, tower sent light aircraft around, and we began take-off roll. Tower chastised us for not complying with his instructions to 'turn right on the runway'... If tower had wanted us to take off from the intersection, perhaps he should have cleared us for an intersection departure or depart from the intersection..." (# 197294)

How could both ATC and pilots have avoided this miscommunication?

Module 5

Teamwork

In the video: *Teamwork*, Trevor Wright, of Wrightsair at William Creek, South Australia, says, 'If you take one part out of a motor, it won't go … and it's the same with a team'.

The video and Resource booklet 5—*Teamwork* contain numerous examples of high-performance teams, both within the aviation environment and beyond.

In this module, you will look at the components of a good team culture, and discuss ways in which you can apply them in your organisation to build strong and effective teams.

To complete this module, you will need to:

- read or re-read Resource booklet 5—*Teamwork*
- watch the video: *Teamwork*
- review the *Airtime* drama if you have not done so recently.

Exercise 24: Westwind accident: what went wrong?

Background

The crew of a Westwind cargo flight was conducting a practice locator/NDB approach to Alice Springs, at night, in clear moonless conditions. The approach involved a stepped descent in three stages using three navigation aids. The pilot in command had earlier briefed the co-pilot that the 'not below' altitude after the final approach fix for the approach (2,780 feet) would be used as 'the minimum' for their purposes.

The flight proceeded normally until the aircraft passed overhead the final approach fix, when the pilot in command asked the co-pilot to set the 'minima' in the altitude alert selector. The co-pilot responded by calling and setting '2300 feet'. This altitude was the Category A/B aircraft minimum descent altitude as depicted on the Jeppesen chart for the approach.

The minimum descent altitude for the Westwind, a category C aircraft, was 3,100 feet. The 2,300 feet called by the co-pilot was acknowledged by the pilot in command, and the aircraft then descended to that altitude. Shortly after levelling at about 2,250 feet, the aircraft struck the top of the Ilparpa Range and was destroyed.

The crew had descended to the incorrect minimum descent altitude before reaching the appropriate sector of the approach. The investigation revealed a number of factors relating to the performance of the crew.

Crew coordination

There was evidence of difficulties in the relationship between the two pilots before the flight, at least from the co-pilot's perspective. Reports indicate the co-pilot raised the issue with the captain in Darwin before departure, although the outcome of this meeting was not established.

However, the cockpit voice recording revealed that the difficulties between the crew continued during the accident flight. The recording indicated that these difficulties affected the co-pilot's willingness to communicate with the pilot in command. There were also indications that his task performance was affected and that he was reluctant to query the instructions or the performance of the pilot in command.

For example, there were no questions from the co-pilot concerning the approach briefing, even though a number of significant items were omitted. Also, he did not comment on the performance of the pilot in command during the approach, even though tracking and descent rate limits had been exceeded.

The investigation concluded that in such a cockpit environment, the ability of the pilots to operate as an effective team was reduced.

Discuss the flight crew co-ordination issues, and in particular the role of crew resource management in the crew's decision making.

What actions could, or should, the aircraft's operator have taken to reduce the risk of such an accident?

image: plan view showing the track of VHS-AJS during the approach | ATSB Investigation report 9501246

Exercise 25: Teamwork in single pilot operations

Refer to the case study: *Wheels-up landing involving Beech 58, VH-UZO, at Gove Airport, Northern Territory, on 8 August 2016*. It's on pages 13 and 14 of Booklet 5—*Teamwork*.

Who were the members of the pilot's team in this case study?

Who else might the pilot have called on for assistance? How might they have helped?

What actions would you take if you had a system failure on an aircraft type you fly as a single pilot?

Exercise 26: Teamwork in multi-crew operations

In the video: *Teamwork*, Dr Graham Edkins talks about the importance of having clear standard operating procedures, and a defined leader.

The *Airtime* drama depicts examples of good and poor teamwork and leadership.

How would you describe the effectiveness of the teamwork between Robert and John (Metro captain)?

What impact does the quality of their teamwork have on the flight?

image: Civil Aviation Safety Authority

Exercise 27: Leadership and followership

Which of the characters in *Airtime* do you believe shows good leadership, either in the air or on the ground? Describe the behaviour associated with that leadership.

How could they improve the quality of their leadership?

In the video: *Teamwork*, Todd Mickleson discusses the need for a cockpit authority gradient in multi-crew operations which is neither too steep nor too flat.

Describe what actions you would take if, as a first officer in a multi-crew flight, you discovered a system failure.

How would they differ from those you would take if you were alone in the cockpit?

Good leadership and followership apply both to colleagues and to clients such as passengers.

Read the first scenario on page 16 of Resource booklet 5—*Teamwork*. As a first officer, how would you deal with concerns about your captain's cavalier pre-flight inspection?

Read the second scenario, on page 17, where you are a single pilot under time pressure flying newlyweds, and having to deal with a domineering father of the bride and an angry groom.

What would you say to the bride's father, and to the groom? Who else might you call on for assistance?

How could you apply some of the examples in the video and resource booklet, and your own experience, to improve teamwork in your organisation?

Exercise 28: Followership—'The 10 rules of good followership'

Colonel Phillip S. Meilinger (writing an article in *Concepts for Air Force Leadership*) identified 'The Ten Rules of Good Followership' as:

1. Don't blame your boss for an unpopular decision or policy: your job is to support, not undermine.
2. Fight with your boss if necessary, but do it in private, avoid embarrassing situations, and never reveal to others what was discussed.
3. Make the decision, then run it past the boss; use your initiative.
4. Accept responsibility when it is offered.
5. Tell the truth and don't quibble; your boss will be giving advice up the chain of command based on what you said.
6. Do your homework; give your boss all the information needed to make a decision; anticipate possible questions.
7. When making a recommendation, remember who will probably have to implement it. This means you must know your own limitations and weaknesses as well as your strengths.
8. Keep your boss informed of what's going on in your team; people may be reluctant to tell them of their problems and successes. You should do it for them, and assume someone else will tell the boss about yours.
9. If you see a problem, fix it. Don't worry about who would have been blamed, or who now gets the praise.
10. Put in more than an honest day's work, but don't ever forget the needs of your family. If they are unhappy, you will be too, and your job performance will suffer accordingly.

How do these relate to you and your operations?

How do they relate to the leadership and followership skills shown in *Airtime*?

Module 6

Situational awareness

Situational awareness (SA) is critical for pilots. Time after time, Australian and international accident investigators cite loss of situational awareness as a contributing factor to incidents and accidents. Being aware of what has happened, what is happening, and what might happen when you're flying is a critical cognitive skill for all pilots.

This module has some practical activities and exercises about situational awareness, particularly in the aviation environment.

To complete this module, you will need to:

- read or re-read Resource booklet 6—*Situational awareness*
- watch the video: *Situational awareness*
- review the Airtime drama if you have not done so recently.

As the introduction to the situational awareness video puts it, one way to think about SA is to ask three questions:

- What has happened?
- What is happening?
- What might happen?

Some of the terms and concepts in the video are:

- good situational awareness is the forerunner of sound decisions
- stay ahead of the aircraft
- ask 'am I still where I think I am?'
- use social and environmental cues
- ensure that you have spare capacity to deal with emerging situations
- avoid distraction and fixation.

More formally, Dr Mica Endsley developed the accepted model for studying SA in aviation. She describes the three levels of situational awareness as being:

- Perception (noticing stimuli or inputs around us)
- Comprehension (understanding these)
- Projection (projecting ahead to plan and predict.)

The following exercises are designed to have you:

- think about how and why you can lose situational awareness
- analyse the underlying causes of SA loss and
- look at ways in which you can improve your SA.

Exercise 29: SA—contributing factors

What proportion of Endsley's three levels of situational awareness do you believe contributes to individuals (or teams) in your workplace losing the bigger picture? Express each contribution as a percentage.

Table 9: Percentage of contribution towards loss of situational awareness

Contribution	Percentage
Perception (noticing stimuli or inputs around us)	
Comprehension (understanding the inputs or stimuli)	
Projection (projecting ahead to plan and predict)	

See the answers section on page 97 for what the research shows.

Describe a flight when you felt your SA was compromised.

Which of the following checklist items applied on that occasion?

Table 10: Your situational awareness checklist

Area	Question	Tick if yes
Ambiguous information	Do you have information from two or more sources that did not agree?	
Confusion	Are you uncertain or uneasy about a situation?	
Primary duties	Are all crew focused on non-flying duties?	
See and avoid	Is there too much heads-down time with nobody looking outside for conflicting traffic?	
Compliance	Is there non-compliance with aircraft performance limitations, minima etc?	
Standard operating procedures (SOP)	Are standard operating procedures (SOPs) not being followed by everyone?	
Fixation	Are you focused on any one task to the exclusion of others?	
Communication	Have you heard or made any vague or incomplete statements?	
Contradictions	Have you failed to resolve any discrepancies or contradictory information?	
Navigation	Have you failed to meet an expected checkpoint on the fight plan?	

What can you do/did you do to ensure you didn't have a repeat of this event?

Exercise 30: Wilko has a rough time

Airtime sequence (start: 20:06 – end: 25:30)

Chieftain pilot, Wilko, is preparing for his next flight and encounters some pressure from the passengers to get airborne quickly. The flight encounters severe turbulence and the passengers become airsick.

Use the following discussion points as a guide:

- How would you describe Wilko's situational awareness?

- How could he have managed the situation more effectively?

image: Civil Aviation Safety Authority

Exercise 31: Your analysis—don't be caught off guard

Resource booklet 6—*Situational awareness* (page 16) points out that by itself, the statement 'loss of situational awareness' to describe what has happened in an accident or incident is often of little use because it does not analyse the events which caused the behaviour. Todd Mickleson reinforces this point in the video: *Situational awareness*.

Taking this into account, describe a flight (if possible a different one from that in Exercise 29) during which you believe you or a colleague lost situational awareness.

How did you know (at the time, or later) that you had lost situational awareness?

Analyse carefully what happened, and any steps you or your colleague took to rectify the situation. You may wish to refer to the checklist on page 60.

In the video: *Situational awareness*, HF specialist, Ben Cook, and Red Bull aerobatics pilot, Matt Hall, discuss the dangers of fixation and tunnel vision. What tips would you give others to avoid such situations?

Now that you have considered issues raised in Resource booklet 6—*Situational awareness*, *Airtime*, the video: *Situational awareness* and your own experiences, list strategies **you** use (or *could* use) to improve your situational awareness.

Review: 10 tips for good situational awareness management

1. Predetermine crew roles for high workload phases of flight
2. Develop a plan for handling problems and distractions and assign responsibilities for implementing it
3. Ask for input from flight and cabin crew members, as well as ATC, maintenance and ground crew
4. Shift your attention from plane to path to people, and back again—don't fixate
5. Monitor and evaluate the current status of your plan
6. Project (think ahead) and consider contingencies
7. Focus on details and scan the big picture
8. Create visual and/or aural reminders of interrupted tasks
9. Watch for clues of degraded situational awareness
10. Speak up when you see situational awareness breaking down.

Source: Vince Mancuso, Pete Wolfe and SA Tiger Team www.crm-devel.org/resources/article/flyingcareers.htm

Module 7

Decision making

A number of factors, such as organisational culture, are important in decision making. In the video: *Decision making*, Adrian Park describes decision making as both an art and a science.

In the video, Melanie Todd, principal human factors advisor at The Keil Centre says, 'It's not a matter of flipping a coin and saying, "I'm choosing this outcome, I'm choosing to do this" necessarily. People work with the facts they have at the time and they will make the best decision from the facts they have. The goal they have and what in the broader scheme they're trying to achieve, what has the biggest pressure at that point in time—you're going to get that wrong every now and again.'

Decision-making mnemonics such as SAFE (**S**tate the problem, **A**nalyse the problem, **F**ix the problem and **E**valuate the result) may help, but it isn't possible to apply a single model to every problem.

The exercises in this module are designed to help you make better decisions, on the ground and in the air.

To complete this module, you will need to:

- read or re-read Resource booklet 7—*Decision making*
- watch the video: *Decision making*
- review the *Airtime* drama if you have not done so recently.

Exercise 32: Robert's decisions

In *Airtime*, Robert is suffering from a migraine and the effects of flu and poor sleep. He decides that he is OK to fly.

What are the impacts of Robert's decision?

At what stage/s did Robert have an opportunity to review his decision?

What do you think he should have done?

Exercise 33: A precious cargo

The true-life scenario on pages 13–16 of Resource booklet 7—*Decision making*, puts you in the pilot's seat of an ill-fated Cessna 206 freight charter flight, gives you the result of the ATSB investigation, and asks what you would have done in the circumstances.

What resources were available to help the pilot make decisions?

What were the pilot's responsibilities to himself, his passenger, the owner of the cargo and the pilot's company?

If you had been the pilot, at what point would you have made a go/no-go decision to begin or continue the flight, and why?

How would you have communicated your decision to the various people concerned?

Exercise 34: Decisions, decisions

The following hypothetical scenarios ask you to provide a response which you believe most accurately reflects the reasoning behind the decision described. Rank the five reasons, even if you do not think any are acceptable, or you would not have made the decision yourself.

Instructions

- There are no correct answers.
- Decide which of the five choices is the most likely reason for the decision made. Use the number 1 for the most likely reason, then rank the remaining reasons in declining order (from 2 to 5).
- After you've finished, discuss your answers in small groups if possible.

VFR flight not recommended

A pilot is on a flight to an unfamiliar, rural airport. A colleague advises against VFR flight since heavy coastal fog is forecast to move into the destination airport area about the time the pilot is expected to land. He considers returning to his home base where visibility is still good, but decides instead to continue as planned and lands safely after some problems. Why did he reach this decision?

Table 11: VFR flight not recommended

Possible reasons for decision	Rank
He hates to admit that he cannot complete his original flight plan.	
He resents the suggestion by the colleague that he should change his mind.	
He feels sure that things will turn out safely, and that there is no danger.	
He reasons that since his actions would make no real difference, he might as well continue.	
He feels the need to decide quickly, so he takes the simplest alternative.	

Soft brake pedal

While taxiing for takeoff, a pilot notices that her right brake pedal is softer than the left. Once airborne, she is sufficiently concerned about the problem to radio for information. Since strong winds are reported at the destination, an experienced pilot who is a passenger recommends that she abandon the flight and return to her departure airport. She instead chooses to continue the flight and experiences no further difficulties.

Why did she continue?

Table 12: Soft brake pedal

Possible reasons for decision	Rank
She felt that suggestions made in this type of situation are usually overly cautious.	
Her brakes have never failed before, so she doubts they will this time.	
She feels that she can leave the decision to the tower at her destination.	
She immediately decides that she wants to continue.	
She is sure that if anyone could handle the landing, she can.	

Unfamiliar aircraft

A pilot's regular aircraft has been grounded because of an airframe problem. The pilot is scheduled in another aircraft and discovers it is a model he is not familiar with. After the pre-flight, he decides to take off on his business trip as planned. What do you believe was his reasoning behind this decision?

Table 13: Unfamiliar aircraft

Possible reasons for decision	Rank
He feels that a difficult situation will not arise so there is no reason not to go.	
He tells himself that if there were any danger, he would not have been offered the aircraft.	
He is in a hurry and does not want to take the time to think of alternatives.	
He does not want to admit that he may have trouble flying an unfamiliar aircraft.	
He is convinced that his flight instructor was much too conservative and pessimistic when he cautioned him to be thoroughly checked out in an unfamiliar aircraft.	

Icing conditions

A pilot was briefed about possible icing conditions, but did not think there would be any problem since his departure airport temperature was 15 degrees C. As he nears his destination, he encounters freezing precipitation, which clings to his aircraft. His passenger, who is a more experienced pilot, begins to panic. He considers turning back to the departure airport, but instead continues. Why did he not return?

Table 14: Icing conditions

Possible reasons for decision	Rank
The pilot has made it this far. He is thinking, 'what is the use in turning back now?'	
The panic of the passenger makes him think, 'it will not happen to me - I have encountered ice before and nothing has ever happened.'	
The pilot is thinking, 'why is he panicking? I can handle this situation just like I have done before.'	
CASA regulations exaggerate the dangers of icing. He can handle this situation.	
He has got to do something. Descend! That will make everyone realise that he is in control.	

Fuel and headwinds

A pilot does not bother to check weather conditions at her destination. En route, she encounters headwinds. Her fuel supply is adequate to reach her destination, but there is almost no reserve for emergencies. She continues the flight and lands with a nearly dry tank. What most influenced her to do this?

Table 15: Fuel and headwinds

Possible reasons for decision	Rank
Being unhappy with the pressure of having to choose what to do, she made a snap decision.	
She did not want her friends to hear that she had to turn back.	
She felt that flight manuals always understated the safety margin in fuel tank capacity.	
She believes that all things usually turn out well, and this will be no exception.	
She reasoned that the situation had already been determined because the destination was closer than any other airport.	

Incomplete preflight

A pilot is 40 minutes late for a trip in a small aircraft. Since the aircraft handled well on the previous day's flight, the pilot decides to skip most of the pre-flight check. What leads him to this decision?

Table 16: Incomplete preflight

Possible reasons for decision	Rank
He simply took the first approach that came to mind for making up time.	
He felt that his reputation for being on time demanded that he cut corners when necessary.	
He believed that some of the pre-flight inspection was just a waste of time.	
He saw no reason to think that anything unfortunate would happen during this flight.	
If any problems developed, the responsibility would not be his. It is the maintenance of the aircraft that really makes the difference.	

The FAA flight risk assessment tool

The following tool is designed to help pilots and operators make safe pre-flight decisions.

It cannot guarantee a safe flight, because safety is ultimately the responsibility of the pilot and operator. Adapt it as required to suit your operating conditions; for example, wildlife hazards at regional aerodromes, availability of fuel, tropical thunderstorms etc.

Table 17: The FAA flight risk assessment tool

		Risk value	Risk value for proposed flight
Pilot qualifications and experience			
1	Captain with less than 200 hours in type	5	
2	First officer with less than 200 hours in type	5	
3	Single pilot flight	5	
4	Captain with less than 100 hours last 90 days	3	
5	First officer with less than 100 hours last 90 days	3	
6	Duty day greater than 12 hours	4	
7	Flight time (more than 8 hours in the duty day)	4	
8	Crew rest (fewer than 10 hours prior to the duty day)	5	
	Total Factor Score—Section 1		
Operating environment			
9	VOR/GPS/LOC/ADF (best approach available w/o vertical guidance)	3	
10	Circling approach (best available approach)	4	
11	No published approaches	4	
12	Mountainous airport	5	
13	Control tower not operational at ETA or ETD	3	
14	Uncontrolled airport	5	
15	Alternate airport not selected	4	
16	Elevation of primary airport greater than 5000ft MSL	3	
17	Wet runway	3	
18	Contaminated runway	3	
19	Winter operation	3	
20	Twilight operation	2	
21	Night operation	5	

		Risk value	Risk value for proposed flight
Operating environment ... cont.			
22	Stopping distance greater than 80 per cent of available runway	5	
23	Repositioning flight (no passengers or cargo)	5	
24	Pop-up trip (fewer than 4 hours crew notice)	3	
25	International operation	2	
26	No weather reporting at destination	5	
27	Thunderstorms at departure and/or destination	4	
28	Severe turbulence	5	
29	Ceiling and visibility at destination less than 500ft/2sm	3	
30	Heavy rain at departure and/or destination	5	
31	Frozen precipitation at departure and/or destination	3	
32	Icing (moderate-severe)	5	
33	Surface winds greater than 30 knots	4	
34	Crosswinds greater than 15 knots	4	
35	Runway braking action less than good	5	
	Total factor score—section 2		
Equipment			
36	Special flight permit operation (ferry permit)	3	
37	MEL/CDL items (items related to safety of flight)	2	
38	Special flight limitations based on aircraft flight manual equipment limitations	2	
	Total factor score—section 3		
Total risk value			

FOR EXAMPLE:

- a night flight with the destination airport experiencing windy, rainy conditions.
- the captain has fewer than 200 hours on type and the first officer has flown fewer than 100 hours in the past 90 days.
- If the total risk value for the flight is more than 15, company policy requires the chief pilot to decide whether to accept, mitigate or reject the risk.
- company policy also prevents the operation of a flight if the risk value exceeds 25.

Step 1: Complete a system and task analysis

- The captain is not highly experienced with less than 200 hours on type (risk value 5).
- The first officer has fewer than 100 hours in the last 90 days (risk value 3).

Step 2: Identify the hazards

- The runway is wet (risk value 3).
- The flight will operate at night (risk value 5).
- The destination crosswinds are greater than 15 knots (risk value 4).

Step 3: Analyse the safety risk

The combination of the risk factors associated with this flight generates a risk value of 20 using the sample tool.

Step 4: Assess the safety risk

Company policy requires that the chief pilot assess and approve any flight risk value greater than 15. Since the risk value of 20 exceeds the company operational threshold risk of 15, the chief pilot decides to operate the flight by reducing the flight risk value.

Step 5: Control the safety risk

The chief pilot decides to allow the scheduled captain to operate the flight, but assigns the flight to a first officer who has flown more than 100 hours in the last 90 days. This reduces the flight risk factor by 3.

The chief pilot changes the destination airport to an airport where no crosswind is expected, reducing the risk factor by a further 4.

By controlling the risk value of these hazards, the chief pilot has elevated the level of operational safety and reduced the overall flight risk value to 13, as can be seen in the table on the next page.

Date: any day	**Departure**: DAL		
Release/trip #: 153	**Destination**: PDK		
Tail #: N123		Risk Value	Flight Value

		Risk value	Risk value for proposed flight
Pilot qualifications and experience			
1	Captain with less than 200 hours in type	5	5
2	First officer with less than 200 hours in type	5	
3	Single pilot flight	5	
4	Captain with less than 100 hours last 90 days	3	
5	First officer with less than 100 hours last 90 days	3	3 (0)
6	Duty day greater than 12 hours	4	
7	Flight time (more than 8 hours in the duty day)	4	
8	Crew rest (Less than 10 hours prior to the duty day)	5	
	Total Factor Score—Section 1		**8(5)**
Operating environment			
9	VOR/GPS/LOC/ADF (best approach available w/o vertical guidance)	3	
10	Circling approach (best available approach)	4	
11	No published approaches	4	
12	Mountainous airport	5	
13	Control tower not operational at ETA or ETD	3	
14	Uncontrolled airport	5	
15	Alternate airport not selected	4	
16	Elevation of primary airport greater than 5000ft MSL	3	
17	Wet runway	3	3
18	Contaminated runway	3	
19	Winter operation	3	
20	Twilight operation	2	

		Risk value	Risk value for proposed flight
Operating environment ... cont.			
21	Night operation	5	5
22	Stopping distance greater than 80 per cent of available runway	5	
23	Repositioning flight (no passengers or cargo)	5	
24	Pop-up trip (fewer than 4 hours crew notice)	3	
25	International operation	2	
26	No weather reporting at destination	5	
27	Thunderstorms at departure and/or destination	4	
28	Severe turbulence	5	
29	Ceiling and visibility at destination less than 500ft/2sm	3	
30	Heavy rain at departure and/or destination	5	
31	Frozen precipitation at departure and/or destination	3	
32	Icing (moderate-severe)	5	
33	Surface winds greater than 30 knots	4	
34	Crosswinds greater than 15 knots	4	4 (0)
35	Runway braking action less than good	5	
	Total factor score—section 2		**12 (8)**
Equipment			
36	Special flight permit operation (ferry permit)	3	
37	MEL/CDL items (items related to safety of flight)	2	
38	Special flight limitations based on aircraft flight manual equipment limitations	2	
	Total factor score—section 3	0	
Total risk value			**20 (13)**

image: Civil Aviation Safety Authority

Exercise 35: Visualisation

In the video: *Situational awareness*, Matt Hall describes the pre-visualisation routine he uses as an air race pilot.

"When I'm in my race environment we always look at what we want to happen, what can happen and what we don't want to happen.

That means when I'm in my race plane I've thought about it so much that no matter where I am in the track, I'm very aware of the altitude I should be, I'm very aware of where the next pylon should appear and I'm very aware of what my next action is going to be, so if something else pops up I've got the capacity to identify it and then take action against it."

CASA's OnTrack and Out-n-back videos can help you with visualisation.

> Think about a route you've never flown before and apply pre-visualisation technique to plan and 'fly' the route. Consider the decisions you need to make at each point and what will impact your decision-making.

Exercise 36: Decisions and consequences

In the video: *Decision making*, Mark Delany from Toll describes a virtual reality exercise in which a paramedic decided not to don a wet suit for an offshore rescue mission.

Why do you think the decision not to wear a wetsuit made sense to the paramedic at the time?

What might have influenced him to make a different decision?

Tips for making better decisions

The following tips improve the quality of decision making, reduce the possibility of errors and help ensure a considered approach to resolving issues or problems.

1. A good decision cannot be improvised; it must be prepared. The final decision will be better and taken more quickly if all options have been considered in advance. Hence, the importance of good briefing practices and appropriate prior planning.
2. Use decision-making aids, including operational checklists, to ensure that you have not forgotten any important steps.
3. Always keep capacity in reserve to react to unexpected events. You must declare 'Mayday Fuel' if you expect to be landing with less than the required fuel reserves
4. Delegate your workload to other team members when time is critical.
5. Maintain your focus on the 'big picture' rather than focusing on one aspect of a problem.
6. Where possible, tell your co-workers about what you intend to do. This increases the chances of your decision being acted upon correctly and ensures people are not caught unawares.
7. When time is not so critical, involve other team members in decision making. This ensures that everybody has a vested interest in the decision and will be more likely to support it.

image: © Civil Aviation Safety Authority

Personal strategies to improve my decision making

> Make a list of any strategies you use now (or could use) to improve your decision-making effectiveness.

Module 8

Threat and error management (TEM)

This module presents a number of activities and exercises to develop your ability to look for, and manage, potential flight operation threats in a structured way, using TEM. Managing the threats and errors which are part of everyday operations, before they lead to undesired aircraft states, helps to maintain flight safety.

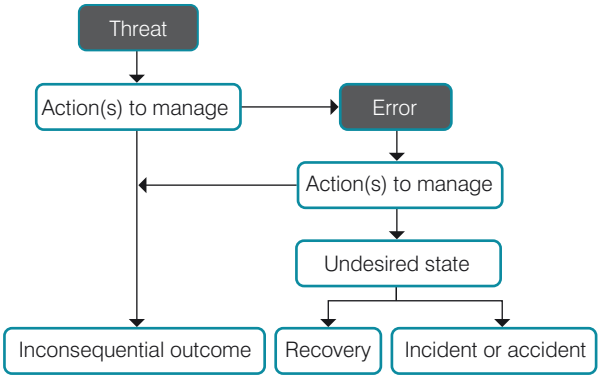
To complete this module, you will need to:

- read or re-read Resource booklet 8—*Threat and error management*.
- review the *Airtime* video if you have not done so recently.
- Please note: there is no dedicated TEM video for this module.

Introduction: Managing threats and errors

Operationally, the cycle of threats and errors and the way airline pilots and pilots flying for smaller operators deal with them occur in the following way:

Figure 1: Threat and error model



Identify three operational events that you have experienced in commercial flying that fit into this model.

> What could you have done better to prevent threats and errors from developing into an undesired state from which you must recover if you are to prevent a potentially major safety occurrence?

Event 1

Event 2

Event 3

Exercise 37: Threat and error management quizzes

Studies examining how flight crews manage threats and errors in normal flight operations reveal some interesting facts about threat frequency and error prevalence. The line operation safety audit (LOSA) tool observes how flight crew manage a 'normal' line flight.

The following questions are based on 4500 LOSA observations across 25 airlines. In the third column, mark your choice of the possible answers (A–D). Compare your responses with the correct answers, provided on page 98.

Threats

Table 18: Threat and error management quiz

Question	Possible answers	Your choice
On average, how many threats per flight (regularly scheduled, normal operations) are encountered by flight crews?	A. One threat every 2–3 flights B. One threat per flight C. 1–3 threats per flight D. 4–6 threats per flight	
During which phase of flight do most threats occur?	A. Pre-departure/taxi-out B. Take-off/climb C. Cruise D. Descent/approach/land	
What are the most frequently encountered threats by flight crews?	A. Adverse weather (e.g., thunderstorms) B. ATC (e.g., challenging clearances) C. Aircraft (e.g., malfunctions/ anomalies) D. Airport (e.g., poor signage/ construction)	
What percentage of threats are successfully managed by flight crews (i.e. percentage of threats not contributing to a flight crew error)?	A. 95–100 per cent B. 85–95 per cent C. 75–85 per cent D. Less than 75 per cent	
Of all threats encountered by flight crews in the LOSA archive, which are the most problematic?	A. Adverse weather (e.g. thunderstorms) B. ATC (e.g. challenging clearances) C. Aircraft (e.g. malfunctions/anomalies) D. Airport (e.g. poor signage/ construction)	

Errors

Table 19: Flight crew error management quiz

Test your knowledge of flight crew errors and their management. In the third column, mark your choice of the possible answers. Compare your responses with the correct answers provided on page 99.

Question	Possible answers (circle correct one)	Your choice
How often do flight crew errors occur on average on a typical flight?	A. About 5 per cent of flights have an observable crew error B. About 50 per cent of flights have an observable crew error C. About 80 per cent of flights have an observable crew error D. All LOSA flights (100%) have at least one observable crew error	
In what phase of flight do most flight crew errors occur ? When do the mismanaged errors occur? (The answer is the same phase of flight for both)	A. Pre-departure/taxi-out B. Take-off/climb C. Descent/approach/land D. Taxi-in/park	
What are the most frequently committed flight crew errors?	A. Aircraft handling (e.g., wrong automation setting) B. Procedural (e.g., omitted callout) C. Communication (e.g., incorrect ATC readback)	
What are the most common procedural errors?	A. Briefing B. SOP cross-verification C. Callout D. Checklist	
What percentage of errors are mismanaged by flight crews (i.e. are linked to an additional error or undesired aircraft state)	A. 20–30 per cent B. 30–40 per cent C. 40–50 per cent D. More than 50 per cent	
What are the most frequently mismanaged flight crew errors?	A. Manual handling/flight control B. Automation C. System/instrument/radio D. Checklist	

Undesired aircraft states

Table 20: Undesired aircraft states and their management

Test your knowledge of flight crew errors and their management. In the third column, mark your choice of the possible answers. Compare your responses with the correct answers provided on page 100.

Question	Possible answers (circle correct one)	Your choice
How common are undesired aircraft states (UAS)?	A. Less than 1 per cent of flights have a UAS B. 15 per cent of flights have a UAS C. 35 per cent of flights have a UAS D. 50 per cent of flights have a UAS	
What are the most frequent UAS observed?	A. Incorrect systems configurations (e.g. wrong anti- ice setting in icing conditions) B. Speed deviations C. Lateral and vertical deviations D. Incorrect automation configurations (e.g. wrong altitude dialled after cross-check)	
How common are unstable approaches and how often do they result in a missed approach?	A. Less than one per cent of flights have an unstable approach; of those, 95 per cent result in a missed approach B. Five per cent of flights have an unstable approach; of those, five per cent result in a missed approach C. More than 15 per cent of flights have an unstable approach; of those, 50 per cent result in a missed approach	
How many UAS can be linked back, via mismanaged crew error, to a mismanaged threat?	A. Virtually all UAS come about because of a threat that was mismanaged (95–100 per cent) B. About 70 per cent of all UAS are linked to a mismanaged threat; the rest emerge from 'spontaneous' crew errors that were mismanaged (i.e. not linked to a threat) C. About 30 per cent of all UAS are linked to a mismanaged threat.	

Exercise 38: TEM at Rover Airlines

Think about the *Airtime* drama and the threats and errors confronting the Metro crew (John and Robert) and Wilko's rough ride in the Piper Chieftain.

Categorise the events in these two scenarios into threats and errors and determine what could have been done to avoid the undesired states.

Scenario	Threats	Errors	UAS
The Metro crew			
Wilko's rough ride			

If an undesired state occurred, how did the crew recover?

Exercise 39: The wrong switch

The following account of a rejected take-off (RTO) was published in the article 'Think Quick' in *Flight Safety Australia*, October 2015.

In January 2011, a crew operating a Boeing 777 for an international airline rejected a take-off at an Asian airport, and did about $US600,000 damage to its tyres and brakes.

An internal investigation found the rejected take-off (RTO) on that January night had a long genesis. It began with an auto-thrust problem that meant take-off/go-around mode could not, at first, be engaged at the runway threshold. Auto-thrust had dropped out on a previous flight when the aircraft was in mild turbulence, but this problem could not be found when the module was tested later.

The captain reached up to the mode control panel and pushed a switch in a similar position to one that engaged auto-thrust on the Boeing 767 that he had flown for thousands of hours. On the 777 however, this similarly placed switch turned on the autopilot.

Take-off proceeded and at 174 knots the captain called 'rotate'. The first officer pulled back on the control column and felt resistance—from the autopilot, trying to keep the aircraft straight and level. After continuing to pull against resistance, he said words to the effect of 'it won't fly'. The captain immediately took over and moved the levers back to idle reverse while engaging autobrake.

At that moment the first officer was able to break through the autopilot and the nose wheel came off the ground briefly. The aircraft stopped more quickly than its published data said it would, but damaged its brakes and tyres. Nobody was hurt.

A broader investigation found there had been both precedent and warning. In 2009, Boeing had issued a multi-operator message to 777 operators regarding 'autopilot inadvertent engagement on the ground'. This had been bundled into a technical bulletin and issued to the airline's flight crews on a CD-ROM, containing the airline's manuals, technical bulletins and memos. There was nothing to alert crews to new and significant information. Another airline had had a similar RTO just days earlier.

Soon after, avionics maker, Rockwell Collins, issued a service letter announcing revised software that would prevent the autopilot from operating on the ground. The airline's 777 fleet adopted the software less than eight weeks after the incident.

Using the threat and error management (TEM) model, describe the threats, errors, undesired aircraft states and outcomes in this incident.

What steps should have been taken, and by whom, to avoid this incident?

Exercise 40: Your TEM strategies

From this and the *Airtime* examples, make a list of any strategies you use now (or could use) to improve your own threat and error management processes.

Strategies to improve your threat and error management

Module 9

Human information processing

In the video: *Human information processing*, Todd Mickleson talks about the importance of having a system for receiving information, processing it, making sense of it and then acting upon it.

In this module, we will discuss the strengths and limitations of human perception, including the way we react in unfamiliar circumstances when we have limited information on which to base our decisions.

To complete this module, you will need to:

- read or re-read Resource booklet 9—*Human information processing*
- watch the video: *Human information processing*
- be familiar with the *Airtime* video.

At the conclusion of this module, also have a look at the series of three short videos: *Balls-up in the hangar, Bits and pieces* and *Delayed flight*, which run for approximately one minute each.

Exercise 41: Unfamiliar territory

The way we perceive information can depend on the way in which it is presented. Try this:

> Quote your own mobile number as if it were a landline, and have a friend or colleague write it down. What do you notice?

The human information processing video depicts a man trying to reverse-park a car, while talking hands-free on his phone.

> What advice would you give someone in that situation, and why?

Let's now take ourselves to the Lake Eyre (Kati-Thanda) region, in South Australia. Wrightsair, the small tourism operator that features in several of the videos, is based at William Creek, about 120 km from Lake Eyre. It's a physically remote and hostile environment, and one which poses challenges to safe operation.

The circumstances of a helicopter accident at Lake Eyre, which killed the pilot and two passengers, highlight human information processing limitations, especially when operating in this challenging environment. You can find the case study on page 4 of Resource booklet 9—*Human information processing*:

'On 18 August 2011, an Aerospatiale Twin Squirrel helicopter took off under VFR in dark night conditions near Lake Eyre, South Australia. Shortly after it entered a gentle right turn and the descent rate rapidly increased, until 38 seconds later, the helicopter hit terrain at high speed with a bank angle of about 90°. The pilot and the two passengers were fatally injured. 'Distraction and dark night disorientation—a fatal combination' (ATSB report AO2011-102)

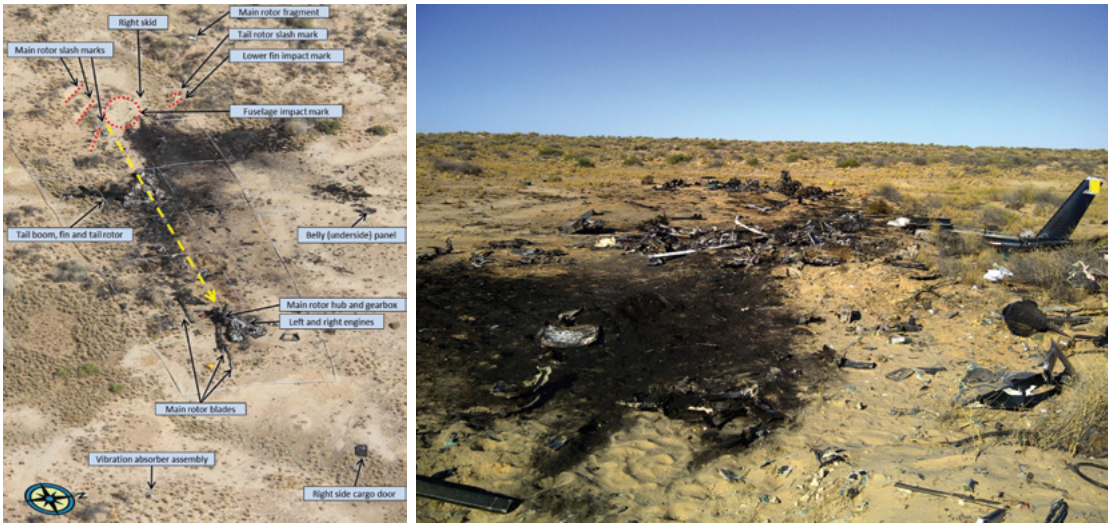


image: Australian Transport Safety Bureau

In your own words, describe the limitations of information processing which are likely to have led to the pilot's spatial disorientation and the ensuing accident.

Flying in cloud or at night means that we lose a significant amount of information about our external environment.

Describe appropriate scanning techniques for flying day- and night-VFR, and IFR (in cloud).

What proportion of time do you believe should be spent in each case looking inside and outside the aircraft?

Table 21: Looking inside and outside the aircraft

	IFR	Night VFR	Day VFR
Percentage outside			
Percentage inside			

What do you do in your pre-flight planning to minimise the risk of information or task overload in the air? Compare notes with your peers if possible.

image: Civil Aviation Safety Authority

In light of this case study and the information in the resource booklet, how could you improve your pre-flight planning?

What are the risks of relying on memory when undertaking pre-flight checks?

Exercise 42: Perceptual illusions

Pilots are susceptible to a range of perceptual illusions, particularly at night. The first column of the table below lists a series of illusions. Write 'true' where you believe the cause and appropriate action are stated correctly. Where one or both are incorrect, complete the table below with the correct information.

Illusion or phenomenon	Cause or symptom	Appropriate action	T/F
Autokinesis	The impression that a stationary light is moving	Move your eyes or look to the side of a lit object	
Black hole approach	Approach over large unlit area	Avoid long straight-in approaches	
False horizon	Banking caused by 'the leans'	Initiate turn in opposite direction	
Flicker vertigo	Flashing lights near primary wind indicator	Reactivate runway lights	
Impression that aircraft is lower than it actually is	Bright runway lights	Dive for the runway	
Night approach feels too high	Narrower than usual runway	Avoid temptation to push forward and increase descent on final	
Aircraft feels too low	Upward sloping terrain before approach end of runway	Increase power	
Runway may appear closer or further than it is	Precipitation	Avoid 'ducking under' the approach path	

Write the correct description for statements you believe are false

Illusion or phenomenon	Actual cause or symptom	Appropriate action

Module 10

Design and automation

'There's so many examples of how automation has made our life easier, but there's plenty of examples out there we can find where automation has led to tears.' Peter Gash, Seair Pacific.

The video: *Design and automation*, and this workbook, cover topics including the development of the glass cockpit, the need to maintain basic flying skills, the impact of automation on pilot workload, and interpreting what your aircraft systems are telling you—and not telling you.

This module asks you to reflect on how and when to use automated systems, and also the need to be aware of how to deal with potential automation pitfalls, such as complacency, distraction and false indications.

A key message of this module is that technology is a great servant, but a bad master. Use it wisely.

To complete this module, you will need to:

- read or re-read Resource booklet 10—*Design and automation*
- watch the video: *Design and automation*
- be familiar with the *Airtime* video.

Exercise 43: How automation makes a difference

Consider the following quote in the video from Professor Sidney Dekker, pilot and aviation safety academic:

'Automation in the cockpit doesn't make human work go away, it doesn't replace human work—it changes human work, and so all of a sudden now the pilot now has different tasks—tasks for which he or she perhaps is not even trained that well.'

Identify the key automation technologies you use in your day-to-day flying operations. What are their strengths, weaknesses and limitations?

Automation technologies	Strengths	Weaknesses/limitations

Dekker again: [Automation] 'makes pilots busier in times that were traditionally already busy, like an approach or setting up for an approach, because now all of a sudden the automation needs inputs as well, or needs to be set up, or in fact can spring surprises on pilots which then need to be managed. And it gives pilots even less to do in those periods in which they already had little to do like cruise.'

How has the automation you identified above changed your workload and the way you do things?

Exercise 44: Dealing with surprises

Dekker says in the video: 'If automation wants to spring a surprise, it isn't very clear about communicating its intentions. It just says, "I'm in this mode" and that's all you'll get to see, but you don't know what it's going to do, or what being in that mode really means.'

Qantas captain, Richard de Crespigny, gives an example of an incorrect sensor indication in the cockpit, even though the system itself was operating normally.

> Discuss how you would go about troubleshooting what you suspect might be a false indication, or when you are unsure what your automated system is telling you.

image: Civil Aviation Safety Authority

Exercise 45: Back-up and training

Throughout the video, experts stress the importance of maintaining manual flying skills and knowing when to use them. Richard de Crespigny talks about having ‘a sense of reasonableness’ and asking yourself ‘does this seem right?’

What opportunities do you have to practise manual flying skills?

What procedures and strategies do you and your organisation have in the event of automation failure or uncertainty?

What policies, procedures and training does your organisation have in place for the introduction of new technologies?

What changes or improvements would you like to see?

What advice would you give a fellow pilot who is making the transition from traditional 'six-pack' analogue instruments to a glass cockpit?

Conversely, what advice would you give a colleague who has been trained in a glass cockpit, but who is now required to fly an aircraft with traditional 'six-pack' analogue instruments?

Exercise 46: Programming your GNSS receiver

Now that you have considered automation systems more generally, let's look at satellite navigation systems in particular. Different countries/federations have their own satellite navigation systems: the Russian federation has GLONASS; the European Union Galileo; China has BeiDou, and the US has the NavStar global positioning system (GPS). Of these systems, GPS is the most widely used in Australia. All IFR aircraft, and many used only for VFR, are equipped with GPS receivers.

Describe how you use your GPS before you take off, and in flight.

If you were uncertain about the way a particular GPS unit operates, what would you do?

What are some of the limitations of GPS, particularly VFR-only hand-held units, including iPads and other tablet devices?

Answers

This section provides the answers to the quizzes and tables throughout this workbook.

Table 6 Your knowledge of alcohol

1. A 285 ml glass of full-strength beer, a 100 ml glass of wine and a 30 ml nip of spirits all contain about the same amount of alcohol.
   TRUE. You can get just as drunk by drinking beer or wine as you can by drinking distilled spirits.

2. A couple of drinks before bed improves sleep quality
   FALSE. A drink may help you fall asleep faster, but suppresses the hours you spend in REM sleep, reducing overall sleep quality. This causes subjective feelings of tiredness and impaired concentration the next day.

3. Women react differently to alcohol than men, and generally can expect greater impairment from the same quantity of alcohol.
   TRUE. For a number of reasons, women are more susceptible than men to the harmful effects of alcohol. Body size, body composition and metabolism all play a part.

4. Pilots change their drinking patterns when away on a duty.
   TRUE. A NASA study found that short-haul pilots consumed three times more alcohol on trips than at home.

5. Modest amounts of alcohol don't affect your flying.
   FALSE. Even modest amounts of alcohol can impair your flying, and lead to disorientation and other medical effects. For more information about the effects of alcohol on human performance, go to www.aod.casa.gov.au/aod/health_information/alcohol.html

6. If your blood-alcohol level returns to 0.0%, you can still be impaired.
   TRUE. Alcohol impairment, generally known as a hangover, can affect you for up to 72 hours after a major drinking bout. See comments by Qantas' Dr Ian Hosegood at about 20 minutes into the video: *Human performance*.

Table 8 Listening self-test

Count how many times you answered 'no'. If there are:

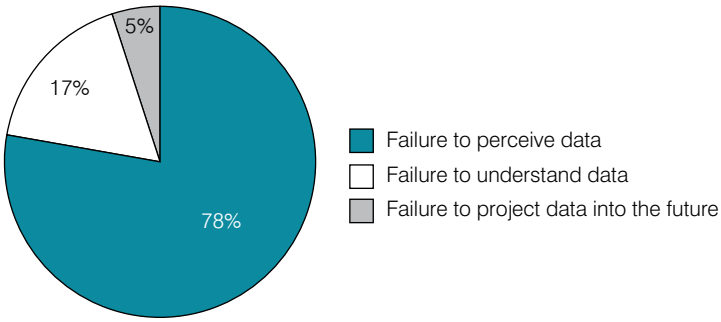
- more than 10—you are a good listener
- 8–10—you need to make more effort
- fewer than 8—you might need to do another human factors' course.

Remember: you shouldn't ignore nonverbal cues, such as the set of someone's shoulders, their facial expression, or tone of voice, which will speak volumes about their enthusiasm or boredom for what is being said. When listening, remember that words convey only a fraction of the message.

Exercise 23

According to NASA: 'The reporter could have prevented any misunderstanding by informing the controller prior to reaching the runway that full length would be required for take-off. In many situations, pilots and controllers giving each other as much advance information as possible will reduce the likelihood of miscommunication. In this case, the phraseology in question occurred at a busy time for the flight crew. Unfortunately, last-minute changes often occur at the highest workload phases of flight. In these situations, a sense of urgency can often cause pilots and controllers to neglect to clarify misconceptions as they might have done if there were no apparent time constraints.'

Table 9 Percentage of contribution towards loss of situational awareness



A failure to perceive accurate information contributes to incidents and accidents in 78 per cent of the occurrences. Often pilots believed they were performing actions appropriately and making sound decisions given the situation. This is often because they failed to perceive what is really going on around them.

Table 11: Threat and error management quiz

1. The correct answer is (D).

Based on data from more than 4500 flights, the typical flight (regularly scheduled, normal operations) encountered an average of 4.2 threats. Of those, three are likely to be environmental threats and one is likely to be an airline threat. Only three per cent of flights encounter no threats whatsoever, while 17 per cent of flights encounter seven or more threats per flight.

In other words, multiple threats are the standard and should be considered as such in every flight.

2. The correct answer is (A).

Overall, about 40 per cent of all threats occur during pre-departure/taxi-out and 30 per cent occur during descent/approach/land.

Different types of threats are more prevalent during different phases of flight.

- For environmental threats (weather, ATC, terrain, traffic, airport conditions), the busiest phase of flight is descent/approach/land, while
- for airline threats, the busiest phase is pre-departure/taxi-out. In percentage terms, 43 per cent of all environmental threats occur during descent/approach/land, while 73 per cent of all airline threats occur during pre-departure/taxi-out.

3. The correct answer is (A or B).

There were 19,000 logged threats in the LOSA archive, (an average of 4.2 threats per flight for each of the 4500 flights).

Adverse weather and ATC each accounted for about one quarter of all observed threats, followed by:

- aircraft threats (about 13 per cent of all observed threats) and
- airport conditions (about seven per cent of all observed threats).

4. The correct answer is (B).

- Eighty-five to ninety-five per cent of all threats are successfully managed. The average across the LOSA archive is 90 per cent.
- Put another way, about one-tenth of all threats are mismanaged by the crews, leading to some form of crew error.

5. The correct answer is (B), though mismanagement rates are very close for the first three.

- Thirteen per cent of aircraft threats, 12 per cent of ATC threats, and 11 per cent of adverse weather threats are typically mismanaged.
- However, when you combine these mismanagement rates with the frequency with which different threats occur, ATC threats emerge as the most problematic. In particular, challenging clearances and late changes from ATC are the most problematic of all threats for flight crews.

Source: Merritt, A. & Klinect, J. (2006). *Defensive Flying for Pilots: An Introduction to Threat and Error Management*. University of Texas Human Factors Research Project & The LOSA Collaborative homepage.psy.utexas.edu/homepage/group/HelmreichLAB/Publications/pubfiles/TEM. Paper.12.6.0 6.pdf

Table 12: Flight crew error management quiz

1. The correct answer is (C).

- About 80 per cent of the more than 4500 flights had one or more errors—the average was about three. Twenty per cent of flights had no observable error.

2. The correct answer is (C).

- The busiest phase of flight for errors is descent/approach/land, with about 40 per cent of all observed errors occurring during this phase.
- Another 30 per cent of errors occur during pre-departure/taxi-out.
- But if you look at the sub-set of errors that are mismanaged, the rate for descent/approach/land jumps to 55 per cent. Therefore, the most problematic phase of flight where more errors, and more mismanaged errors, are likely to occur is descent/approach/land. This makes sense intuitively, since errors on the ground aren't as difficult to manage as those on descent, approach or landing.

3. The correct answer is (B).

- About one-half of all observed errors are procedural errors,
- one-third are aircraft handling, and
- one-sixth are communication errors.
- However, this ratio changes dramatically for mismanaged errors. Procedural errors make up half of all errors, but a little fewer than one-quarter of the mismanaged errors. Three-quarters of all mismanaged errors are aircraft handling errors, with communication errors comprising the remaining few per cent.

4. The correct answer is (D).

- Checklist errors are the most common procedural error, followed closely by callout and SOP cross-verification errors. Briefing errors are less common.

5. The correct answer is (A).

- About 25 per cent of all errors are mismanaged—six per cent of all errors lead to additional error, and 19 per cent result directly in an undesired aircraft state.

6. The correct answer is (A).

- Manual handling/flight control errors make up 36 per cent of all mismanaged errors.
- Automation and system/instrument/radio errors each make up 16 per cent of the mismanaged errors,
- checklist errors five per cent, and
- crew-ATC communication errors three per cent.

Source: Merritt, A. & Klinect, J. (2006). *Defensive Flying for Pilots: An Introduction to Threat and Error Management*. University of Texas Human Factors Research Project & The LOSA Collaborative homepage.psy.utexas.edu/homepage/group/HelmreichLAB/Publications/ pubfiles/TEM.Paper.12.6.0 6.pdf

Table 13: Undesired aircraft states (UAS) and their management

1. The correct answer is (C).

- A third of all flights in the LOSA archive have an undesired aircraft state.

2. The correct answer is (A).

- Almost 20 per cent of all UAS involve an incorrect aircraft system configuration, which occurred on about nine per cent of flights.
- Speed deviations accounted for 16 per cent, and
- lateral/vertical deviations and incorrect automation each about 13 per cent. These types of UAS occurred on about seven per cent of flights.

3. The correct answer is (B).

- In regularly scheduled normal operations, five per cent of flights involved an unstable approach. However, disconcertingly, only five per cent of these resulted in a go-around.

4. The correct answer is (C).

- About 30 per cent of UAS occur as part of a chain of events which starts with a badly managed threat and leads to a crew error, which in turn is mismanaged to a UAS.
    - » An example would be poor or faded airport signage (threat) which confuses the crew and leads it down the wrong runway (error) resulting in a runway incursion (UAS).

Source: Merritt, A. & Klinect, J. (2006). *Defensive Flying for Pilots: An Introduction to Threat and Error Management*. University of Texas Human Factors Research Project & The LOSA Collaborative homepage.psy.utexas.edu/homepage/group/HelmreichLAB/Publications/ pubfiles/TEM.Paper.12.6

Flight Safety Australia resources by topic

CASA's flagship aviation safety magazine, *Flight Safety Australia*, is an extremely valuable resource for pilots and operators wishing to develop, and maintain the currency of, their human factors understanding.

In the following section you will find references to articles from the past few years of *Flight Safety Australia* grouped by topic. You can find these, and an archive of articles from 1996–2014, on flightsafetyaustralia.com Use them to expand your knowledge of the various resource booklet topics.

You can read these articles online, (and access any embedded video), or if you would like a hardcopy, simply scroll to the end of the article, and click on the 'print' icon to the left of your screen under the 'Share this article' heading.

1. Introduction to human factors

2015

'Safety: it's getting weird'

- Discusses Patrick Hudson's thesis that the safety triumph of air transport in the past sixty-or-so years, has led to a paradox: far fewer accidents, but a disturbing lack of pattern and predictability in those that still occur. They are, literally, weird.

2016

'Operating theatre: how medicine does human factors'

- Some corners of medicine have learned valuable lessons to offer back to aviation. Lessons passed from the cockpit to the ground may now need to travel in the other direction.

'Human and other factors—systems, situations and awareness'

- Discusses the battle around the concept of situational awareness, an idea linked to human factors training by crew resource management. Some say the term situational awareness has become no more than a new way of allocating blame.

'Safety in mind: Swiss cheese and bowties'

- The ideas that support safety.

2017

'The myths of human error.'

- Looks at the myths surrounding human error, and calls for a more nuanced approach to the subject of human error.

'Oh, the humanity: why smart people do dumb things.'

- The role of human factors in sport and recreational aviation.

2018

'Bouncing, not breaking: resilience as the foundation of safety'

- Looks at the eight elements of resilience people can develop: 'knowledge, training, experience, teamwork, leadership, crisis management, decision making and risk'.

'"Soft" skills the key to future safety'

- Reports on the importance of human factors in training for aviation safety.

2. Safety culture

2014

'The Seaview disaster: conscience, culture and complicity'

- Twenty years on, this article examines a watershed Australian accident, with grim but important lessons about safety culture.

2015

'All over the place—the 2011 crash of Manx2 Flight 7100'

- Examines the organisational culture which led to the crash.

2016

'Locked into error'

- An experienced crew makes a simple, yet deadly mistake, fostered by a complacent organisational culture.

'Safety in mind: making sense of it all'

- Insights into the nature of organisations, and how they can improve themselves, from organisational psychologist Karl E. Weick.

'Rendezvous at midnight'

- Dissects a rotary wing crash that, because of organisational failings, seemed to happen with a disturbing inevitability.

2017

'Safety in mind: high-reliability organisations'

- The contribution of high-reliability principles to safety culture, guiding individuals and organisations in more effective management of risk.

'Safety in mind: normalisation of deviance'

- The impact on safety culture when deviations from rules and practices becomes the norm. Uses the example of the *Challenger* disaster, where a deviance was normalised in NASA culture.

'Safety in mind: Hudson's culture ladder'

- The final in the 'Safety in mind' series looks at Hudson's 'evolution of safety culture' ladder in more detail, and discusses the challenges of developing an effective generative safety culture.

'Dirty secrets'

- Cautions readers about the mudguard organisation: shiny on top, but filthy underneath, using the examples of the US Valujet flight 592 and the Australian Seaview crash.

'Truth and consequence'

- The Hawker 700A that crashed into an apartment block in the US state of Ohio in November 2015 was airworthy, but the organisation that operated it was broken.

2018

'Fire and fury—the destruction of *Piper Alpha*'

- On the thirty-year anniversary of this watershed disaster, this article discusses how 'the offshore oil industry's culture had both tolerated and created human shortcomings, and how the systems that were meant to assure safety had been allowed to decay'.

'Bad day at Blackbushe'

- The fatal accident which killed the occupants of a Phenom 300 charter highlights organisational failures, including constantly ignoring safety lessons.

'Culture and the clock'

- An Alaskan accident involving a de Havilland DHC-3 Otter, which crashed in 2015 killing the pilot and eight sightseeing passengers was attributed by the NTSB to the ' ... air company's culture and its lack of a formal safety program'.

3. Human performance and its limitations

2015

'Flying beyond the blue'

- Depression and mental health

'Dying of thirst?'

- The dangers of dehydration, includes a urine colour scale showing levels of dehydration.

'Fatigue faux-pas'

- A young commercial pilot tells of his close call with fatigue.

'Cold comfort'

- The perils of flying with a head cold.

2016

'More than a mouthful'

- The links between oral health and general health—why it's important for anyone who files to keep their teeth and gums in good order.

2017

'Living the older pilot experience'

- How relevant is age as a predictor of performance?

'Sleep hygiene: art, science and common sense'

- 'Habits that help you have a good night's sleep.

'A second chance—drinking or drugs need not end your career'

- Discusses the human intervention motivation study (HIMS), a program for pilots which helps them deal with substance abuse.

2018

'A fine balance—the link between personal life and aviation'

- A commercial pilot discusses the insidious nature of stress, and how to manage it.

4. Communication

2012

'Aviation English: mind your language'

- Discusses the importance of effective communication.

2015

'Instructors—the art of communication'

- The nature of the relationship between student and instructor, and the importance of communication in fostering that relationship

2017

'Radios—it's a big sky, but are you listening?'

- A reader's close call about making assumptions, and compromised SA.

'Fatal misunderstanding brought down Flying Tiger'

- Non-standard communication led to the deaths of four crewmembers on a cargo flight.

2018

'Point it, call it, get it right'

- How a Japanese railway technique—shisa kanko—using verbal and nonverbal communication, could make aviation safer.

5. Teamwork

2014

'My captain, my killer'

- A first officer's deference to his captain cost him his life, and killed 10 other people.

2015

'Hudson River pilot defends human skill'

- Sullenberger on the importance of teamwork in managing aviation crises such as the ditching on the Hudson River.

2016

'Partners in safety'

- For single-pilot operations, the benefits of using your passengers as a safety resource.

2018

'When it all just gelled'

- Looks at how the crew of Cathay 780 rose to the challenge of managing a compounding fuel system problem.

'The importance of being humble'

- How being humble can contribute to effective team work.

6. Situational awareness

2016

'Metres and milliseconds: an almost catastrophic near hit'

- Analyses the multi-level breakdown in situational awareness which also led to the near hit of two Japanese airlines JAL flight 907 and JAL flight 958.

'Human and other factors—systems, situations and awareness'

- Discusses the ongoing usefulness of SA as a concept in aviation.

'Mental as anything'

- Explores the process of visualisation in aviation.

'A bubble in a blizzard'

- A fatal ground collision between two German police helicopters teaches hard lessons on situational awareness, and situational response.

2017

'Keep focus, keep your head'

- The dangers of distraction and the myth of multi-tasking.

2018

'The unanswered question'

- The limitations of see-and-avoid.

'Flying to distraction'

- Distraction in the cockpit, from the well-known case of the Lockheed L-1101 Tristar's burnt-out bulb, to the contemporary mobile phone.

7. Decision making

2015

'Workload and helicopters'

- Looks at the impact of workload on decision making for rotary pilots.

'Force of habit'

- Habit—it's part of your mind, but it can kill you.

'Mission impossible'

- The CEO of the Helicopter Association International, Matt Zuccaro, describes a case of poor decision making on the part of a helicopter charter operator.

'When I can't is a positive'

- Analyses the events surrounding an Agusta Westland 109E accident, where commercial pressure influenced a helicopter charter pilot's decision making.

2016

'Arcing up'

- A close call describes an experienced pilot's less than optimal decision making on a flight of a Pilatus PC-12 from Adelaide to Port Lincoln.

'As you wish, my lord'

- A state-of-the-art Agusta Westland 139's technology is subverted by human factors as old as Biggles: judgement, training and governance.

2017

'Anything to oblige'

- In 2013, the captain of a South Korean Sikorsky S-76 helicopter faced a difficult decision—go or no-go for a VIP flight involving his boss, the CEO of LG Electronics, with the weather worsening.

'Control, confusion and obsession: three unsettling parables'

- The fragility and fallibility of aviation decision making.

'Decisions, decisions: Deep thinkers' thoughts on how we decide'

- Psychological insights into how we make decisions.

2018

'Growth without discomfort'

- Discusses the importance of knowing your personal limits, and setting them—setting guidelines that define the worst conditions you will accept for flight.

8. Threat and error management

2016

'The men who fell to Earth.'

- The in-flight break-up of *SpaceShip Two*, which shows that 230 years after a fatal balloon accident, the deadliest human factor continues to be our proclivity to over-estimate our abilities and under-estimate our fallibility.

2017

'Wire, the invisible enemy.'

- Threat and error management when operating in the wire environment.

'Complacency is the hunter.'

- Complacency can bring down even experienced pilots—this article describes pilots' three-phase development path: the learning phase, the complacency phase and, finally, the professional phase.

'Drift, shift and crash.'

- Discusses the importance of humility as a counter to over-confidence in assessing threats and errors.

2018

'When the moment comes.'

- TEM challenges for a 737 which hit multiple Canada geese.

9. Human information processing

2014

'Don't believe your ears'

- Discusses seven types of spatial disorientation.

2015

'The fatal five'

- Looks at five psychological traps affecting how human beings function, and some potentially life-saving insights from cognitive psychology—the study of how and why we think as we do.

2016

'Be afraid of the dark'

- Analyses the Lake Eyre (Kati-Thanda) Squirrel helicopter crash in 2011.

2018

'One thing at a time: a brief history of the checklist.'

- Discusses the usefulness of the checklist in overcoming our human information processing limitations, as well as six dangerous types of deviation from using them effectively.

'Inside knowledge: neuroscience and the future of aviation.'

- Knowing how the machine works is widely accepted to be essential for safe flight. Recent developments in neuroscience mean this principle can now be applied to the most complex and inscrutable component in any manned aircraft—the pilot.

10. Design and automation

2014

'Who's the boss?'

- The human side of automation.

2015

'Design for living—why the human-machine interface matters'

- Discusses the role of the pilot in an age of automation.

'For one brief horrid moment—the Eindhoven incident'

- Automation was one of the factors implicated in this incident.

'Without warning: the startle factor.'

- Looks at the relationship between decision making, automation and human performance.

'Monitoring matters'

- Discusses the role of pilots in monitoring automation.

2017

'Getting smart—artificial intelligence and aviation.'

- Discusses some of the things computers now do which used to be done by people, and what form this might take in (future) aviation.

'Seeing things.'

- An incident on an Pilatus PC-12 aircraft equipped with a synthetic vision system raises unsettling questions about technology, insidious failure and tunnel vision.

'When advice isn't the same as guidance.'

- Advice to IFR pilots about using their GPS receiver for baro-VNAV (LNAV/VNAV) approaches. Just because your GPS says it's baro-VNAV capable doesn't mean you're ready to entrust your safety and that of your passengers to your GPS receiver.

'The finger of fate'

- Discusses the Emirates flight EK407 incident, which exposes some uncomfortable truths about automation, redundancy and the role of human pilots.

2018

'All in your head'

- The new technology of virtual reality has much to offer aviation, with applications in training and simulation.

'Transitions'

- Making the transition to a new aircraft, or new avionics.

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