Australian Government
Civil Aviation Safety Authority

HUMAN FACTORS

WORKBOOK FOR ENGINEERS

Contacts

For further support on how to get the most from this training resource, please contact your local Aviation Safety Advisor via **131 757** or **safetyadvisor@casa.gov.au**

For more detailed advice on human factors or to provide any general feedback regarding this training resource, please contact our human factors specialists via

131 757 | **humanfactors@casa.gov.au** | **www.casa.gov.au/hf**

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For further information or additional copies, visit CASA's website www.casa.gov.au

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safety behaviours
HUMAN FACTORS

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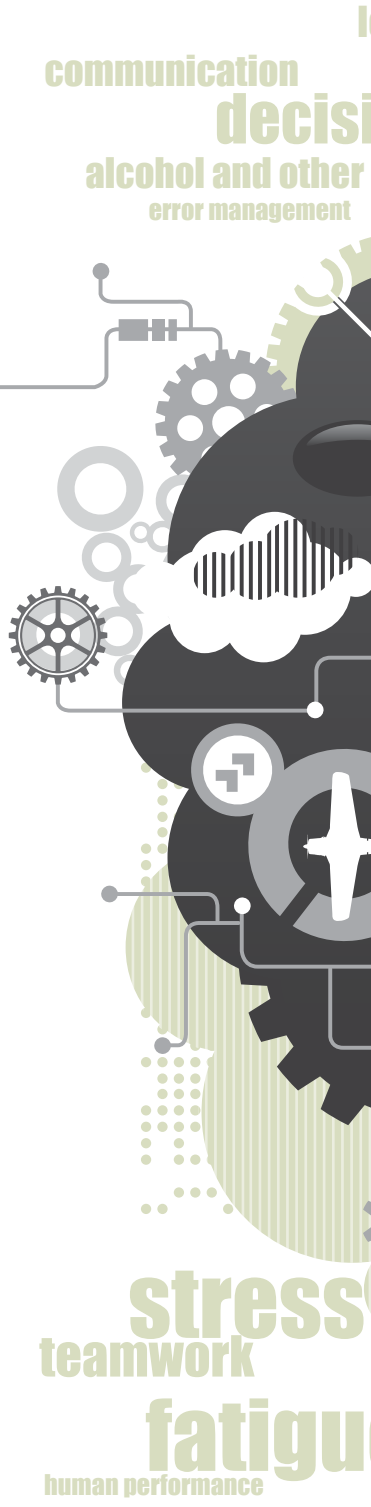


Welcome to the ***Safety Behaviours: Human Factors for Engineers*** resource package, developed by CASA to provide comprehensive human factors (HF) information to further support your learning in this field. For some, this may be your first exposure to human factors theory; for others, it may serve as a good refresher.

Safety Behaviours: Human Factors for Engineers has been developed to provide a stronger focus on the needs of the Australian maintenance industry, and although it is designed with aircraft maintenance engineers and small to medium-sized aviation maintenance organisations (AMOs) in mind, larger organisations may also find it a useful supplement to existing human factors programs. The HF topics included are all relevant to the daily challenges of being a professional engineer.

Why has *Safety Behaviours: Human Factors for Engineers* been developed?

While it is well known that the majority of aviation accidents involve human factors somewhere in the causal chain, it is less well known that between 12 and 20 per cent of aviation accidents may involve maintenance human factors. Managing human factors effectively therefore, is an important issue for all maintenance engineers, regardless of what section of the industry they work in.

CASA recently introduced Civil Aviation Safety Regulation (CASR) Part 145, which includes human factors requirements for maintenance. This requirement is consistent with other aviation safety agencies internationally, such as the European Aviation Safety Agency (EASA) and the International Civil Aviation Organization (ICAO). CASR Part 145 requires maintenance organisations to apply human factors principles to safety and quality, institute a reporting system with a safety reporting policy, and ensure that personnel receive training in human factors principles. Training in human factors is required for all employees involved in maintenance, including contract staff.

This practical human factors resource may assist engineers and AMOs to meet the above requirements. Importantly, we hope it will serve as part of your ongoing professional development, so that you keep up-to-date with the latest human factors knowledge.

How to use this workbook

The ***Safety Behaviours: Human Factors for Engineers Workbook*** is part of a resource package that also includes:

- A comprehensive resource guide
- Background reading: safety magazine articles, accident reports and other resources
- A facilitator's guide, as well as this participant/student workbook
- A CD containing electronic copies of the resource guide and all the above-mentioned reference material
- A DVD featuring *Crossed Wires*, a drama to promote discussion about some of the key human factors issues outlined in the resource guide, as well as interviews with human factors experts.

These resources are designed for both self-and class-based instruction. Facilitators can incorporate them into their existing training agenda, or organise special self-contained sessions. For more information about ***Safety Behaviours: Human Factors for Engineers***, please email **safetyproducts@casa.gov.au**

Contents

Overview

This workbook contains a number of practical exercises and further case studies to reinforce your understanding of various human factors issues.

It also provides further opportunity to reflect on the videos *Crossed Wires* and the *Right Connection*, and to develop strategies for improving how you manage human factors issues in your aviation maintenance.

Answers to various exercises begin on page 67 of this workbook.

We recommend that you read the *Facilitator's Guide* before starting any of these activities. The *Facilitator's Guide* guides you through this kit, setting out the most logical way to progress through it. If you are having any trouble in working through it, please refer to the contacts listed on the inside front cover of this *Workbook* for assistance.

Overview of topics

Chapter	Activities	Completion
1. **Introduction to human factors for engineers**	▪ Read the *Resource Guide* Chapter 1 Introduction (page 5) ▪ Read the *Workbook* overview and chapter 1 (pages 9–12) ▪ Turn to Exercise 1 in the *Workbook* (page 10) ▪ Play the DVD 'Introduction' and *Crossed Wires* ▪ Discuss with peer, mentor or facilitator ▪ Complete the *Workbook* exercises 1 and 2	Topic complete? ☐
2. **Error management**	▪ Read the *Resource Guide* Chapter 2 'Error management' (page 27) ▪ Read the *Workbook* overview and chapter 2 (pages 13–18) ▪ Play the DVD 'Introduction' and *Error management* ▪ Turn to Exercise 1 in the *Workbook* (page 14) ▪ Complete the *Workbook* exercises 1–4 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
3. **Human performance and its limitations**	▪ Read the *Resource Guide* Chapter 3 'Human performance and its limitations' (page 41) ▪ Read the *Workbook* overview and chapter 3 (pages 19–26) ▪ Play the DVD 'Introduction' and 'Human performance and its limitations' ▪ Turn to Exercise 1 in the *Workbook* (page 20) ▪ Complete exercises 1–5 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
4. **Decision making**	▪ Read the *Resource Guide* Chapter 4 'Decision making' (page 57) ▪ Read the *Workbook* overview and chapter 4 (pages 27–32) ▪ Play the DVD 'Introduction' and 'Decision making' ▪ Turn to Exercise 1 in the *Workbook* (page 28) ▪ Complete exercises 1–3 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐

Chapter	Activities	Completion
5. **Fatigue**	▪ Read the *Resource Guide* Chapter 5 'Fatigue' (page 69) ▪ Read the *Workbook* overview and chapter 4 (pages 33–36) ▪ Play the DVD 'Introduction' and 'Fatigue' ▪ Turn to Exercise 1 in the *Workbook* (page 34) ▪ Complete exercises 1–4 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
6. **Stress, workload and time pressure**	▪ Read the *Resource Guide* Chapter 6 'Stress, workload and time pressure' (page 91) ▪ Read the *Workbook* overview and chapter 6 (pages 37–40) ▪ Play the DVD 'Introduction' and 'Stress, workload and time pressure' ▪ Turn to Exercise 1 in the *Workbook* (page 38) ▪ Complete exercises 1–3 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
7. **Alcohol and other drugs**	▪ Read the *Resource Guide* Chapter 7 'Alcohol and other drugs' (page 109) ▪ Read the *Workbook* overview and chapter 7 (pages 41–46) ▪ Play the DVD 'Introduction' and 'Alcohol and other drugs' ▪ Turn to Exercise 1 in the *Workbook* (page 42) ▪ Complete exercises 1–3 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
8. **Communication**	▪ Read the *Resource Guide* Chapter 8 'Communication' (page 127) ▪ Read the *Workbook* overview and chapter 8 (pages 47-50) ▪ Play the DVD 'Introduction' and 'Communication' ▪ Turn to Exercise 1 in the *Workbook* (page 48) ▪ Complete exercises 1–5 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐

Chapter	Activities	Completion
9. **Teamwork**	▪ Read the *Resource Guide* Chapter 9 'Teamwork' (page 145) ▪ Read the *Workbook* overview and chapter 9 (pages 51–54) ▪ Play the DVD 'Introduction' and 'Teamwork' ▪ Turn to Exercise 1 in the *Workbook* (page 52) ▪ Complete exercises 1–4 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
10. **Leadership**	▪ Read the *Resource Guide* Chapter 10 'Leadership' (page 153) ▪ Read the *Workbook* overview and chapter 10 (pages 55–58) ▪ Play the DVD 'Introduction' and 'Leadership' ▪ Turn to Exercise 1 in the *Workbook* (page 56) ▪ Complete exercises 1–3 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
11. **Professionalism**	▪ Read the *Resource Guide* Chapter 11 'Professionalism' (page 163) ▪ Read the *Workbook* overview and chapter 11 (pages 59–62) ▪ Play the DVD 'Introduction' and 'Professionalism ▪ Turn to Exercise 1 in the *Workbook* (page 60) ▪ Complete exercises 1–3 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
12. **Human factors within an organisation**	▪ Read the *Resource Guide* Chapter 12 'Human factors within an organisation' (page 171) ▪ Read the *Workbook* overview and chapter 12 (pages 63–66) ▪ Play the DVD 'Introduction' and 'Human factors witin an organisation' ▪ Turn to Exercise 1 in the *Workbook* (page 64) ▪ Complete exercises 1–2 ▪ Discuss with peer, mentor or facilitator	Topic complete? ☐
13. **Answers (where appropriate) can be found on pages 67–92 of this workbook**		

CASA's human factors specialists would like to hear about the strategies individual engineers and maintenance organisations are using to address human factors issues in aviation maintenance, with a view to collating this information and sharing it across industry.

If you have such a strategy to share, please contact us—our details are listed on the inside front cover of this workbook.

Chapter 1

INTRODUCTION TO HUMAN FACTORS FOR ENGINEERS

Make sure you have read the introductory chapter in your *Resource Guide* before tackling these activities.

If eternal vigilance is the price of liberty, then chronic unease is the price of safety.

Professor James Reason

Exercise 1: The PEAR model

We will begin by taking a look at the PEAR model: what it is, how it might be a useful checklist in planning a task, and how it might apply to your workplace. Throughout this workbook, when you're watching the drama *Crossed Wires*, try and match the scenarios with the PEAR model.

Refresh your knowledge of the PEAR model by re-reading pages 10–20 of the *Resource Guide*.

Question 1

Complete the table giving three examples of each human factor area, preferably as they apply in your workplace.

The PEAR model		
P(eople)		
E(nvironment—physical and organisational)		
A(ctions)		
R(esources)		

Question 2

Focusing on the action part of PEAR, think of one task well known to you—one you perform regularly at work. List three examples of the potential for error involved in completing that task.

Common task and potential for error
1.
2.
3.

Question 3 Resources

What are three major resource deficiencies you come across in a typical shift? Complete the table below.

Deficiencies in resources on a typical shift
1.
2.
3.

Did you include time? Most maintenance engineers say they don't have enough time, people and 'stuff' (manuals, support equipment, lighting) to do the job. Time is an important resource, but one which is often forgotten in planning tasks.

Exercise 2: Recommendations and strategies

Identify the inappropriate work practices that increased the total risk of error at Perfect Twins Maintenance.

Inappropriate work practices

Refer back to Exercise 1. Identify an error-prone task in your organisation—what errors occur due to deficiencies in procedures? Describe the deficiencies, and what you can do to improve the situation.

Deficiencies in procedures	Strategies to improve

Chapter 2

ERROR MANAGEMENT

This section provides some practical activities on managing error.

Make sure you have read Chapter 2: 'Error management' in your *Resource Guide* before tackling these activities.

The point of learning about human error is not to find out where people went wrong; it is to find out why their assessments and actions made sense to them at the time.

Sidney Dekker, Professor of Human Factors and Aviation Safety

Exercise 1: The three levels of error management

1. What are the three levels of error management?

Three levels of error management
1.
2.
3.

Exercise 2: Error management role of maintenance work practices

Identify the error management functions of the various maintenance work practices seen in *Crossed Wires*. Make sure you have at least one example for each error management level.

For example:

1. What aspect of error management do briefings or inspections fulfil?
2. What error management function does documentation fulfil?

Work practices	Error management function
Documentation	Error reduction

Exercise 3: Error management at Perfect Twins Maintenance

In *Crossed Wires*, ultimately these error management functions were ineffective. What individual actions or decisions by Perfect Twins personnel directly or indirectly compromised their effectiveness? Again, give examples of how Perfect Twins personnel actions related to each of the three levels of error management.

Perfect Twins' work practices	Error management level/category

Exercise 4: Safety recommendations and personal error management strategies

Safety recommendations for Perfect Twins	Personal strategies for engineers
Hint: Have a look at your PEAR model chart and ensure that your safety recommendations address all the deficiencies AND organisational factors you have identified.	**Hint:** Make sure all the individual/team actions that you have noted in your PEAR model chart are addressed.
Example: The organisation should have a documented policy on shift handover that is communicated to all engineers.	**Example:** As a LAME, my personal minimum would be to report for my shift allowing enough time for an effective handover.

Safety recommendations for Perfect Twins	Personal strategies for engineers

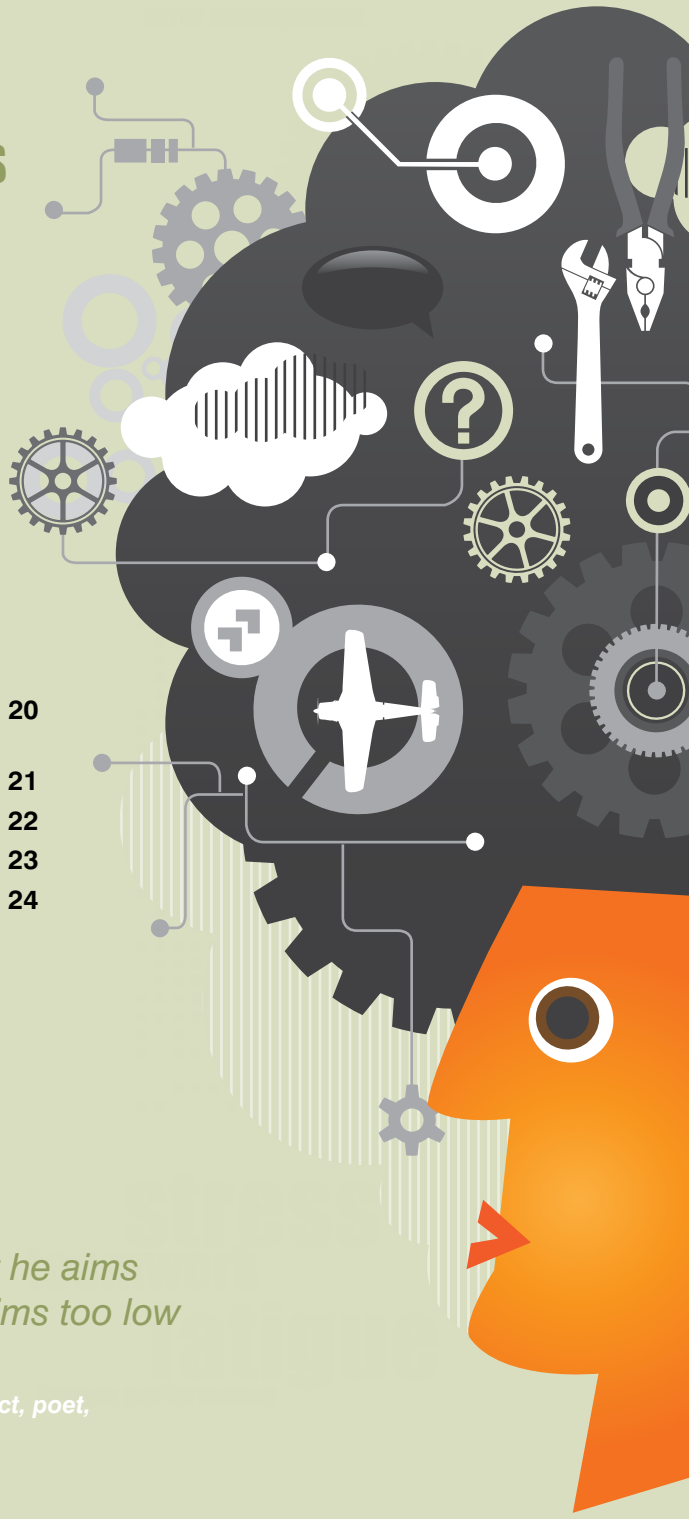
Notes:

Chapter 3

HUMAN PERFORMANCE AND ITS LIMITATIONS

This section provides some practical activities on human performance.

Make sure you have read Chapter 3 'Human performance and its limitations' in your *Resource Guide* before tackling these activities.



The greatest risk to man is not that he aims too high and misses, but that he aims too low and hits.

Michelangelo, Italian Renaissance painter, architect, poet, sculptor and engineer

Exercise 1: *Crossed Wires*—perceptions of experienced maintenance personnel and apprentices

1. What difference/s is/are there between how an experienced LAME perceives a task and its requirements, and an apprentice's understanding?

2. In *Crossed Wires*, there are several examples of where this happened. Where did the LAME identify a task differently to the apprentice, and what impact did it have?

Exercise 2: Information storage and retrieval—memory

1. The way we perceive information can depend on the way in which it is presented. Try the following exercise to see this in practice.
   - Quote your own mobile number as if it were a landline. What did you notice?
2. At handover, you are often relying on memory for what needs to be done. What dangers are there in such reliance?
3. What memory prompts are used in your organisation to ensure you don't forget to carry out critical tasks? List them in the following table.

Memory prompts used in our organisation

Exercise 3: Impact of environment on performance

The 'E' in the PEAR model is for environment, which affects human performance. List the environmental conditions affecting our senses, and describe what impact they might have on performance.

Environmental conditions affecting senses	Impact on performance

Exercise 4: Distraction

This activity highlights the effect of distraction on performance—our ability to pay attention and stay focused. Working with a partner, try to remember a string of numbers, such as 01 5453 6291, while your partner describes in great detail a program they watched on TV the night before.

- How does this translate to the hangar? What do you do, for example, if the boss interrupts during a safety-critical task?
- In *Crossed Wires*, the apprentice is listening to music on his smartphone. What effect does this have on his performance?

Exercise 5: Situational awareness

1. List three critical steps in developing and maintaining your situational awareness in a maintenance task.

Three critical steps in maintaining situational awareness
1.
2.
3.

2. List the processes which help in doing this.

3. In percentage terms, where does situational awareness fail most?

Your situational awareness checklist	
Area	**Question**
Ambiguous information	Do you have information from two or more sources that do not agree?
Confusion	Are you uncertain or uneasy about a situation?
Primary duties	Is anyone not focused on the task at hand?
Standard procedures	Is anyone not following standard processes/procedures?
Fixation	Are you focused on any one task to the exclusion of others?
Communication	▪ Have you heard, or made, any vague or incomplete statements? ▪ Have you ensured thorough and accurate feedback—that instructions are clear and understood?
Contradictions	Have you failed to resolve any discrepancies or contradictory information?

However, there are limitations to the effectiveness of feedback in the maintenance environment. The lack of immediacy is an important limitation. The consequence of failing to perform a task correctly may not be apparent for some time after the event; for example, the system failure resulting from a failure to fit a split pin can be quite remote from the actual event, happening months or even years later.

4. Ambiguous or contradictory information, and inaccurate or incomplete feedback contribute to compromised situational awareness. Review *Crossed Wires*.

   – Identify examples of incorrect perception/interpretation of feedback.

Feedback
Examples of where feedback has been misheard/misinterpreted are:

   – What could the LAME have done to mitigate this?

Feedback

Chapter 4

DECISION MAKING

Exercises in the decision-making section may not have 'right and wrong' answers. This section aims to make you think about the way you make decisions, and to help you identify ways to improve your decision making.

In a moment of decision, the best thing you can do is the right thing to do. The worst thing you can do is nothing.

Theodore Roosevelt, American president

Exercise 1: The decision-making process

A mobile tool rep turns up at the hangar, and has stock of the replacement socket you need for $25. However, your mate tells you that the local hardware store has a similar socket for sale at $15, but you would need to leave work 10 minutes early to catch them before they close.

What do you do?

Explain the reason for your decision.

The rep also has a new seven-drawer tool chest for $600. You know that your same local hardware store has a similar chest for $580. As above, though, you would have to leave work early to buy it.

What do you do?

Explain the reason for your decision.

Did you take the time to go through each step of the sample decision-making process in the *Resource Guide* to analyse and explain the reason for your decision?

Discuss with others who may have made a different decision. After the discussion ask yourself, 'would I still make the same decision?' If not, why?

Exercise 2: Decision making and releasing an aircraft to service

Read pages 62–63 in your *Resource Guide*, which describe a scenario faced by a LAME in releasing an aircraft to service.

What are the risks associated with a decision to release the aircraft?

(Example) Failure of the component, leading to control difficulty.

What would you do in that situation given the information provided?

(Use the decision process to assist your analysis, then discuss your reasons with others)

What other information could you look for to improve your decision?

Exercise 3: Decision-making scenarios

Consider the following scenarios. Read through the list of reasons for the decision/s made in the scenario and nominate bias or human factors limitations associated with each of the possible reasons. At the end of the table list the possible risks associated with the decision, and a more appropriate alternative.

Scenario 1

A LAME is installing the oil return and oil breather fluid hoses to a customer's helicopter engine after an engine change. Although he notices there are no markings on the hoses to indicate which is which, he looks at the bends, and determines the correct installation based on this. He considers opening compartments aft of the firewall bulkhead to see if he can physically identify the hoses, but decides against it. The test engine run is performed and the after-run compartment inspection does not reveal any leaks.

Reasons for decision	Bias and/or HF limitations associated with the reason
The LAME hates to admit that he's not sure which hose is which.	
He doesn't want to refer to the manual for what could be seen as a straightforward answer he should know.	
Based on the pre-existing bends, he's sure which hose goes where.	
He reasons that since looking at the fluid lines on the other side of the firewall would make no real difference, he might as well continue.	

What risks are associated with scenario 1?

What should he have done in scenario 1?

Scenario 2

An apprentice has to move a customer's aircraft into the hangar at the end of an afternoon shift. The ramp staff had already knocked off for the evening when the decision was made to move the aircraft. Although the apprentice and another engineer are still on shift, they know it is company procedure to move aircraft with no fewer than three personnel to ensure the wing tips are monitored as the aircraft is moved past equipment and the hangar structure. As it is relatively quiet in the hangar at the time, the apprentice decides to move it with the other engineer, being mindful of hazards and taking it carefully. The aircraft was repositioned uneventfully.

Reasons for decision	Bias and/or HF limitations associated with the reason
He wanted to make sure he finished what has been asked of him before he goes home.	
It's pretty quiet, so it should be OK to move it with two people instead of three.	
Everyone else does it this way.	
If he doesn't move it, his peers and others will consider him lazy.	

What risks are associated with scenario 2?

What should he have done in scenario 2?

Scenario 3

A LAME has been asked to carry out a pre-flight inspection of a customer's Agusta 109A helicopter. Although she hasn't performed this task previously, she has done it many times on the later 109E model. She decides to head out to the helicopter and perform the task, leaving the checklist in the office. Based on her experience and knowledge of the E model she is satisfied enough to sign for the pre-flight.

Reasons for decision	Bias and/or HF limitations associated with the reason
She knows the A and E model are similar with regard to pre-flights so it should not be a problem	
Everyone else does it that way	
The check requirements are identical, as far as she knows	
It's merely a pre-flight, so there is no requirement to have a checklist with her at the aircraft	

What risks are associated with scenario 3?

What should she have done in scenario 3?

Chapter 5

FATIGUE

This section provides some practical activities focused on fatigue, and how you can recognise and manage it.

Make sure you have read Chapter 5: 'Fatigue' in your *Resource Guide* before tackling these activities.

Fatigue cannot be prevented by personality, intelligence, education, training, skill motivation, size, strength or professionalism.

Ron Heselgrave

Exercise 1: Driver fatigue quiz

While we're focusing on engineer fatigue, most of us drive to and from the hangar. How much do you know about driver fatigue? Test yourself with the quiz below.

Statements	True or false?
1. Coffee overcomes the effects of drowsiness while driving.	
2. I can tell when I'm going to go to sleep.	
3. Rolling down my window or singing along with the radio will keep me awake.	
4. I'm a safe driver, so it doesn't matter if I'm sleepy.	
5. You can stockpile sleep on the weekends.	
6. Most adults need at least seven hours of sleep each night.	
7. Being sleepy makes you misperceive things.	
8. Young people need less sleep.	
9. Wandering, disconnected thoughts are a warning sign of driver fatigue.	
10. Little green men in the middle of the road may mean the driver is too tired to drive.	
11. On a long trip, the driver should never take a break, but try to arrive at the destination as quickly as possible.	
12. A 'microsleep' lasts 3–5 seconds.	

Exercise 2: Engineer checklist—symptoms of fatigue

Think of a recent maintenance shift, or series of shifts, you were rostered on. Complete the checklist of symptoms in the following table and decide whether they were a factor during the shift/s.

Symptoms of fatigue	Yes or no?
Lack of awareness—failing to respond to instructions, failing to complete paperwork/maintenance releases	
Reduced motor skills—clumsy handling of tools/equipment, writing that trails off into nothing as releases written up, poor hand-eye coordination	
Obvious tiredness—drooping head, staring or half-closed eyes	
Reduced vision—difficulty in focusing	
Slow reactions	
Short-term memory problems—cannot remember an instruction at shift handover long enough to repeat it back, or write it down accurately	
Channelled concentration—fixation on a single, possibly unimportant issue, to the neglect of others, and not able to maintain an overview of the maintenance task	

Easy distraction—by trivial matters, or, the other extreme, fixation—as above. Either of these extremes could indicate fatigue	
Increased mistakes—errors, poor judgement and poor decisions, or not being able to make decisions, even simple ones such as 'what's the right tool for this job?'	
Abnormal moods—erratic changes in mood, swings from being depressed to being elated and energetic, lowered standards	
If you suffer from any of these symptoms, you may want to rethink your roster, and address your fatigue. **Remember: the only cure for fatigue is sleep.**	

Exercise 3: *Crossed Wires* discussion

Consider the following scenario in the *Crossed Wires* drama, and discuss the following questions.

It is the shift handover for the graveyard shift—John, the LAME, and Jason, the apprentice, report for duty. The former is tired and unwell, the latter is late.

1. How did John's level of fatigue affect the safety of the maintenance task?

2. What should John have done?

3. Should he have declared he was fatigued?

4. What should Jason, the apprentice, have done? How does he manage John's attitude that 'You're the boy, you need the practice'?

5. How would you describe the level of support provided by Harry, the owner of Perfect Twins?

6. Does your organisation have a fatigue management policy? If so, what are your responsibilities as an engineer?

7. Considering that night shift is a maintenance reality, what practical steps can engineers take to minimise risk/error?

Exercise 4: Personal strategies to minimise the effects of fatigue

Now that you have discussed some of the fatigue issues from *Crossed Wires*, make a list of any strategies you use now, or could use, to minimise and mitigate the risk of a serious incident or accident resulting from your own, or a fellow engineer's, fatigue level. Don't forget too, that there are social and medical aspects to fatigue. You may have a long commute to work, there may be a new baby in the household affecting sleep patterns, or you may have a medical condition such as sleep apnoea.

Strategies to minimise the consequences of fatigue on performance

Chapter 6

STRESS, WORKLOAD AND TIME PRESSURE

This section provides some practical activities focused on stress, and how you can recognise and manage it.

Make sure you have read Chapter 6: 'Stress, workload and time pressure' in your *Resource Guide* before tackling these activities.

Workload is a problem for safety-critical operations if it's too low—and an even bigger one if it's too high.

Understanding Human Factors. *Rail Safety & Standards Board UK*

Exercise 1: *Crossed Wires* discussion

Review the *Crossed Wires* drama, and discuss the following questions.

1. What stressors and time pressures were evident at Perfect Twins Maintenance?
2. What strategies did they use to manage time pressures in the *Crossed Wires* scenario?
3. How could Perfect Twins Maintenance have managed these better?
4. Were Perfect Twins Maintenance workload management strategies SMART? That is, were they specific, measurable, achievable, realistic/relevant, and timely?
5. Was the employees' workload realistic?
6. What factors affect how you determine individual workload? (Experience? Skills?)

Exercise 2: Stressful life events

How stressed do you think you are?

This quick quiz may make you more aware of the impact of significant life events on your level of stress. The table lists a number of life events the average person could reasonably expect to take place during their lifetime.

To test yourself, go through the list and add up the points of every event over the past year that applies to you. Total the points for each of these events in the right-hand column to find your overall stress score.

Life event	Score	Cumulative 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	
Work more than 40 hours per week	35	
Pregnancy or partner becoming pregnant	35	
Sexual difficulties	35	
Gain of 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	
Mortgage or loan for a major purpose	25	

Life event	Score	Cumulative score
Foreclosure of mortgage or loan	25	
Sleep less than eight hours per night	25	
Change in responsibilities at work	25	
Trouble with in-laws, or with children	25	
Outstanding personal achievement	25	
Spouse begins or stops work	20	
Begin or end school	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	
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

Each of us has personal limits on the level of stress we can adapt to, or cope with. When we exceed this level, stress overload may lead to poor health or illness. Although we vary in our ability to cope with stress, a score of 250 points or more for the average person may indicate they are suffering from high levels of stress.

Studies have revealed a link between illness and stress score: those who became ill had accumulated a total of 300 or more stress points in a single year. High stress levels will affect your immune system, and can lead to mental or physical illness, or both, if something is not done about it. It is very important to relieve your stress load, and develop ways to manage stress, before something gives.

You were asked to look at the previous 12 months of changes in your life. This timeframe is important because ripples of stress can circulate a long time after the actual change has taken place. If the stress brought on by life events is not well managed, and is added to stress, workload and time pressures on the job, your performance is likely to be affected.

Exercise 3: Personal strategies to manage stress

Now that you have discussed some of the issues from *Crossed Wires*, and evaluated your own stress levels, make a list of strategies you use now (or could use) to manage your stress levels.

Personal stress management strategies

Chapter 7

ALCOHOL AND OTHER DRUGS

This section provides some practical activities focused on the responsible use of alcohol and other drugs (AOD) in a safety-sensitive area such as aviation maintenance.

Make sure you have read Chapter 7: 'Alcohol and other drugs' in your *Resource Guide* before tackling these activities.

Above the influence.

Anonymous

Background to the AOD regulations

Following a fatal accident on Hamilton Island in 2004, the Australian Transport Safety Bureau recommended that the then Department of Transport and Regional Services and the Civil Aviation Safety Authority jointly examine the safety benefits of a testing regime for alcohol and other drugs in aviation.

Civil Aviation Safety Regulation (CASR) Part 99 resulted, which aimed to minimise AOD-related risks to safety-sensitive aviation activities, and initiated random AOD testing, as well as requirements for relevant organisations to have a drug and alcohol management plan (DAMP).

Maintenance engineers perform safety-sensitive aviation activities, and are therefore subject to random testing.

Exercise 1: Test your alcohol IQ

How much do you really know about alcohol?

Statement	True or false?
1. A 12-ounce beer, a 4-ounce glass of wine and a 1-ounce shot of whisky all contain the same amount of alcohol.	
2. A couple of drinks before bed improve sleep quality.	
3. Women react differently to alcohol than men, and generally can expect greater impairment from the same quantity of alcohol.	
4. Drinking patterns change when you're away on duty.	
5. Modest amounts of alcohol don't affect your performance.	

Exercise 2: How risky is your drinking?

The Alcohol Use Disorders Identification Test (AUDIT) – developed and validated by the World Health Organisation (1989) is the most widely used screen for alcohol use in Australia. Health professionals use it in making decisions about the most appropriate treatment for people consuming alcohol at high-risk levels.

You can use it to calculate your level of risk. This test is for your personal reference only, so answer the questions honestly for a valid score.

For each of the questions, select the score from 0–4 which relates to your answer, and place it in the 'Score' column on the right.

Questions 1–8 are scored 0–4 as indicated in the top row.

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

There is a scoring scale for your total below the table.

AUDIT—Alcohol Use Disorders Identification Test

Questions	0	1	2	3	4	Score
1. How often do you have a drink containing alcohol?	Never	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	
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 last 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 last year		Yes, during the last 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 last year		Yes, during the last year	
Total						

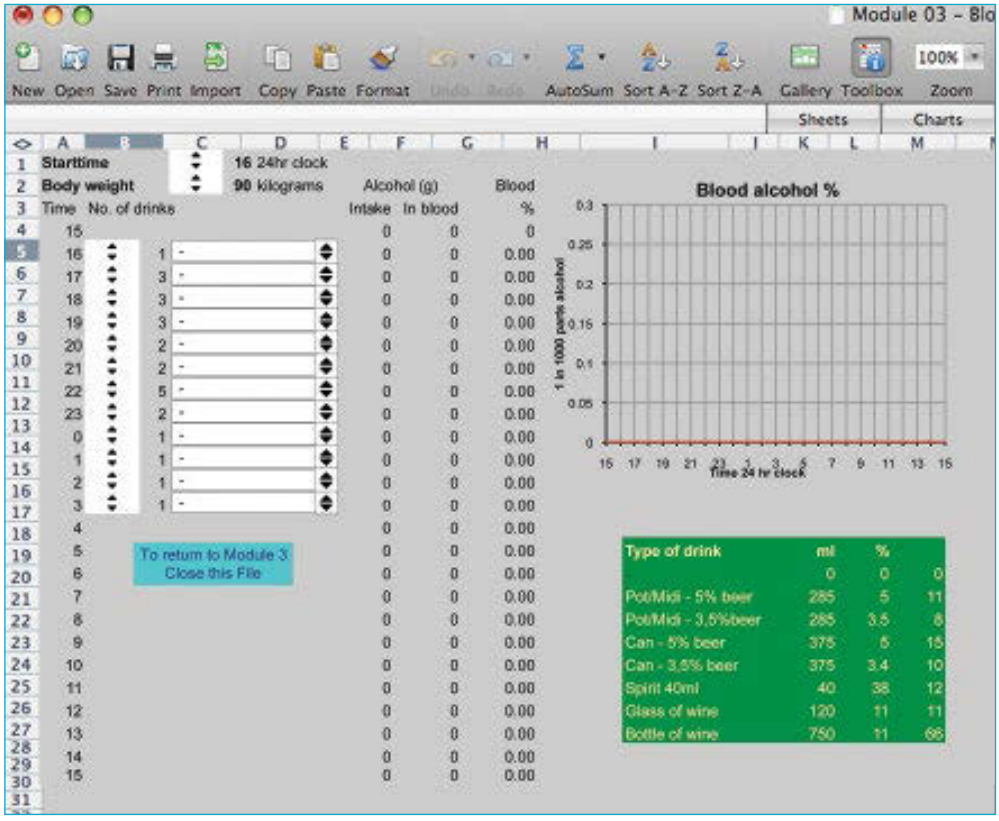
How to score the audit

If your score is 0–7	Congratulations—your alcohol consumption is low risk
If you scored 8 or more	You are drinking at higher-risk levels, and would benefit from speaking to your GP, or other health professional, about ways to cut down your drinking

Exercise 3: Alcohol consumption and processing spreadsheet

The spreadsheet (as shown below) is included on the CD in this kit for you to use to work out how long your body takes to process or metabolise alcohol.

Figure 2 Blood alcohol consumption and metabolism spreadsheet



Double-click on the spreadsheet. Then you can use the drop-down menus to enter a number of criteria to work out the time your body takes to metabolise alcohol.

Take time to explore the spreadsheet, and your body's ability to process alcohol—the results may surprise you, especially the level of alcohol remaining in your body from the night before. The effects of alcohol can last up to 48 hours, something which has serious implications for safety-sensitive aviation maintenance.

Quick tips for cutting down

1. Identify some good reasons for reducing your alcohol consumption. They might include:
   - Losing weight—calories from alcohol are empty calories; they have no nutritional value, but they can put on the kilos.
     - A 375ml stubby of lager represents about 577 kilojoules (divide by 4.2 for calories)
     - A 375ml stubby of stout represents about 846 kilojoules
     - 150ml of red wine about 425 kilojoules
     - 150ml of white wine about 425 kilojoules
     - 30ml of spirit (such as whisky or brandy) about 284 kilojoules
   - Avoiding hangovers—having a clearer head and better memory
   - Minimising relationship problems
2. Choose some reasons that motivate you, and write them down for future reference.
3. Set yourself goals

   Pick a day when you plan to start cutting down and set your daily consumption goals each week. Record your consumption in a diary, so that you track your performance. If you don't achieve your goals, work out some practical strategies to help you next time.
4. Be aware of high-risk times

   There are times when cutting down will be especially hard, no matter how much you want to change. These might be after work, at a party, watching sports events, or when you are lonely, depressed or stressed. Identify your high-risk times, and record them in your diary.
5. Manage the high-risk times

   Once you have identified your high-risk times, you need to work out practical, sensible ways of managing them. This might include planning to do other things when you would normally be drinking; making sure you eat before you drink, and while you are drinking; alternating alcoholic and non-alcoholic drinks; or simply avoiding high-risk people and places—that mate you know who never seems to be able to stop at one or two, the party where the only food on offer is packets of chips.
6. Identify someone you trust to support you

   Cutting down can be easier if you have someone to talk to, to be honest with, and who supports your decision. This may be your partner, a friend or a colleague who also wants to cut down. And don't forget your doctor or other health professionals can also support you.
7. Stick to your goals

   Some habits are hard to break, but using the tips in this section may help. Talk to your support person to help you get through the times when you're finding it hard to stick to your goals. Each time you stop yourself from doing something by habit, you're that much closer to breaking the habit completely.

Notes:

Chapter 8

COMMUNICATION

This section provides some practical activities and exercises focusing on effective communication in the maintenance environment.

Make sure you have read Chapter 8 on communication in your *Resource Guide*.

The single biggest problem in communication is the illusion that it has taken place.

George Bernard Shaw, Irish dramatist

Exercise 1: Are you a good listener?

Question	Yes/no
Do you tend to talk 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 ask 'closed' questions: ones which only need a 'yes' or 'no' reply?	
Do you often feel you know what someone is going to say to you before they have even finished talking?	
Is it difficult for you to recognise when you have made a mistake?	
Do you often state an opinion without thinking how others will react?	
Do you feel satisfied when you have the last word in a discussion?	
Do you find it difficult to calmly continue reasoning after being contradicted?	
Is it difficult to name the person whom you worked most with yesterday?	
Is it unusual for a co-worker to explain their difficulties with you and ask for advice?	

Exercise 2: Clear communication—describing and drawing shapes

In the facilitator's guide on page 9 are a number of shapes. Divide the group into pairs, and allocate one of these shapes to each pair. One of the pair will describe the shape; the other draws the shape based on the description without seeing it.

The 'describer' must not show the shape/s to the person drawing, nor give clues by gesturing with their hands.

You can increase the level of difficulty by not allowing the person drawing to speak except to say 'I do not understand'.

Exercise 3: Effect of lack of feedback

Again working in pairs, have one person describes a sports event they have attended recently, or a favourite TV show they have seen in the past week to their partner. The description should take at least three minutes. The partner is not allowed to react, betray any emotion, move, reply or respond in any way.

Discuss: how did the person talking feel during the conversation?

- Uncomfortable?
- Not sure whether they were being understood?

Exercise 4: Non-verbal communication

The following facial expressions, body posture and hand gestures are examples of non-verbal communication. Researchers have estimated that between sixty and ninety per cent of our communication comes from these non-verbal cues.

What emotions are the following facial expressions communicating?


1.


2.


3.


4.


5.


6.

What do the following body postures tell us about the person?


1.


2.


3.


4.


5.


6.

Exercise 5: *Crossed Wires* discussion—effective communication at handover

Watch the sequence in *Crossed Wires* where John and Jason report for the next shift.

1. How effective was the communication during the handover?

2. Why do you say this?

3. How could it have been improved?

4. Why is effective communication during shift handover so important?

5. What barriers to effective communication have you encountered at work?

Chapter 9

TEAMWORK

This section provides some practical activities focused on teamwork—using teams to work more safely and efficiently.

Make sure you have read Chapter 8: 'Teamwork' in your *Resource Guide* before tackling these activities.

Coming together is a beginning.
Keeping together is progress.
Working together is success.

Henry Ford, American industrialist and founder of the Ford Motor Company

Exercise 1: Teamwork at Perfect Twins Maintenance

- How effective was the teamwork at Perfect Twins Maintenance? Give some examples—of both effective and not-so-effective teamwork to support your answer.

Effective teamwork	Ineffective teamwork

Exercise 2: Teamwork—bridge building

In teams, using only the sheets of newspaper and sticky tape provided, build a bridge. The bridge must comprise floor-standing supports at each end, and a horizontal span, which must have a clearance of at least 30cm from the floor.

The winning construction will be the one with the longest span between the two floor-standing supports. Any part of the span where there is less than 30cm clearance between the span and the floor will not count toward the measurement.

The span must support objects you will be given. These objects can be placed anywhere along the length of the span, but must not touch the floor-standing supports.

The floor-standing supports must be free standing (not attached to the floor or any other object or surface), and use of sticky tape as guys from the bridge to the floor, or another object or surface, is not allowed.

You will have 30 minutes for planning, building and placing objects on the span.

Exercise 3: Characteristics of a good team member

- What are the characteristics of a good team member?

A good team member is:

Exercise 4: *The Right Connection*—safety meetings and improved teamwork

- Watch the *Right Connection* and identify how the safety meeting could improve teamwork at Perfect Twins.

Improved teamwork:

Chapter 10

LEADERSHIP

This section provides some practical activities focused on leadership, and how you can recognise good leadership, and promote it by good followership.

Make sure you have read Chapter 10: 'Leadership' in your *Resource Guide* before tackling these activities.

Great leaders are almost always great simplifiers, who can cut through argument, debate and doubt to offer a solution everybody can understand.

General Colin Powell

Exercise 1: What makes a good leader/manager?

- Think of a good leader/manager you have worked with. What made them effective?

Exercise 2: Leadership in *Crossed Wires*

Thinking of the leadership skills shown in *Crossed Wires*:

1. What kind of leader was Harry? Give reasons for your answer.

2. Discuss the qualities of both LAMEs—Roy and John—as leaders.

3. How could Harry, Roy and John improve their leadership skills?

Exercise 3: Followership—'The ten 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 workplace?

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

Notes:

Chapter 11

PROFESSIONALISM

This section provides some practical activities focused on professionalism: the characteristics of a professional engineer and why professionalism is important.

Make sure you have read Chapter 11: 'Professionalism' in your *Resource Guide* before tackling these activities.

Professionalism: It's not the job you do: it's how you do the job.

Anonymous

Exercise 1: The characteristics of the professional, and how they relate to maintenance engineers

1. What do you feel are the characteristics of the professional?

2. How do these characteristics relate to you as a maintenance engineer?

Exercise 2: Responsibilities and personal accountability

A professional understands their responsibilities and the importance of personal accountability. How does this relate to your work environment?

Exercise 3: Professionalism and aviation safety

Read the case study on page 166 of the *Resource Guide*, and consider the following:

1. What would be the professional response to this task?

2. Why is this so important to overall aviation safety?

3. As a professional, how can you continue to improve your maintenance processes while ensuring safety?

Notes:

Chapter 12

HUMAN FACTORS WITHIN AN ORGANISATION

This section provides some practical activities highlighting the role organisational safety culture plays in maintenance human factors, and its impact on safety performance.

Make sure you have read Chapter 12: 'Human factors and organisations' in your *Resource Guide* before tackling these activities.

Every system is perfectly designed to achieve the results it gets.

Don Berwick, MD

Exercise 1: Applying the PEAR model to Perfect Twins Maintenance

Within the table, identify all the human factors influences you can in the *Crossed Wires* drama. Use the information in the table to complete the following questions.

The PEAR model as it applies to Perfect Twins Maintenance

People

Environment (physical and organisational)

Actions

Resources

Exercise 2: Safety culture at Perfect Twins

Use the information in the table to complete the following questions.

1. Describe the safety culture at Perfect Twins.

2. List three norms/workarounds you saw in the drama

3. What else could Perfect Twins do to improve their safety culture?

4. Why is reporting important in any maintenance organisation?

5. What can be done to ensure an effective reporting culture?

6. What areas should a good safety report cover?

Answers

This section provides the answers to the relevant exercises throughout the *Workbook*.

We thought that we had the answers; it was the questions we had wrong.

Bono

Chapter 1. Introduction to human factors for engineers

Exercise 1: The PEAR model

Question 1. Complete the table giving three examples of each human factor area, preferably as they apply to your workplace

The PEAR model		
P(eople)		
Doing, physical limitations: older L/AMEs' eyesight may require correction (glasses) and higher light levels to perform tasks or inspections	**Thinking, experience:** apprentices need to be given clear instructions and shown what to do as they may not have the experience to understand a task fully	**Interacting, communication:** tasks such as engine runs will need headsets to ensure effective communication
E(nvironment—physical and organisational)		
Physical environment/ night shift: jobs done at night will need additional lighting	**Physical environment/ noise:** high intensity noise environments can cause distraction and fatigue. This should be considered when jobs are scheduled to isolate as many people from high noise periods as possible	**Organisational environment/ leadership:** management can show that safety is a priority by being in the workshop/hangar asking what the engineers need and making sure they have adequate resources
A(ctions)		
Actions/briefing: incomplete or hurried briefs being carried out at the aircraft, this may lead to information being missed	**Actions/application of skill:** difficult manual tasks such as connection of aircraft hydraulic actuator connections that are obscured from direct view and done by 'feel'	**Actions/inspection:** inspections that need to be carried out with torches and mirrors for critical areas.
R(esources)		
Time/a finite resource: being tasked to do a job in four hours that is known to take six will cause stress and pressure	**Work stands:** incorrect stands that are not designed for the aircraft being worked on	**Heating:** working in a cold hangar with inadequate heating, this will affect dexterity and increase error potential (dropped screws, nuts etc.)

Question 2. Focusing on the 'Action' section of PEAR, think of one task well known to you that you perform regularly at work. List three examples of the potential for error involved in completing that task.

Sample task: fitting an airspeed indicator
1. Limited access to pitot /static connections at the rear of the instrument
2. Latching mechanism for the electrical connection that doesn't give a clear 'locked' indication
3. A testing procedure that is not in a logical sequence to complete the task

Question 3. What are three major resource deficiencies you come across in a typical shift? Complete the table below.

Sample: resource deficiencies on a typical shift
1. Unserviceable, or out-of-calibration, torque wrenches
2. Poor-quality lighting equipment
3. Lack of correct work stands or ground support equipment

Exercise 2: Recommendations and strategies

Identify the inappropriate work practices that increased the risk of error at Perfect Twins Maintenance.

Some examples:

- Use of iPods on the hangar floor
- Interrupting engineers for updates and applying pressure to get the job done
- LAME not using the correct process to load the trim drum
- Poor handover between shifts
- Leaving apprentice to complete the task unsupervised
- Poor functional check, not carried out with all of the required equipment
- Use of Post-it notes to convey required inspections

Chapter 2. Error management

Exercise 1: The three levels of error management

What are the three levels of error management?

Three levels of error management
1. Error reduction – through addressing error-producing conditions
2. Error capture – through inspection and functional testing
3. Error tolerance – through maintenance practices, aircraft and system design for redundancy and elimination of 'single points of failure'

Exercise 2: Error management role of maintenance work practices

Identify the error management functions of the various workplace practices seen in *Crossed Wires*. Make sure you have at least one example for each error management level. If you cannot identify one, do you know of another work practice that fulfils the function?

Work practices/error management function examples
1. Handover briefings are an error reduction function—they ensure that the oncoming shift have an accurate understanding of the work done and work required (SA), so reducing the potential for incorrect decisions and subsequent actions
2. System testing is an error capture function—testing will reveal errors in installation or adjustment that lead to incorrect operation.
3. Though no specific work practices seen in *Crossed Wires* can be said to be error tolerance functions, through aircraft and system design the aircraft was able to land safely (albeit due to the skill of the pilot). However, practices that could have an error tolerance function include not carrying out work on both engines at the same time, or not working on primary and secondary undercarriage systems at the same time. Tasks with very little tolerance for error, such as work on flight controls, are safety critical, and require close attention. The very lack of tolerance in these tasks requires additional error management at the error reduction and capture level. Identifying these tasks will help engineers to understand the importance of following procedures and carrying out effective inspections and functional tests.

Exercise 3: Error management at Perfect Twins Maintenance

Ultimately, in *Crossed Wires* these error management functions were ineffective.

What individual actions directly or indirectly compromised their effectiveness?

Gives examples of how Perfect Twins personnel affected each of the three levels of error management.

Perfect Twins' work practices & error management examples
Questions from 'Harry' created time pressure, stress and distraction, increasing the likelihood of shortcuts or workarounds; and reducing the error reduction function of following procedures.
No tech manuals were to be seen out during the day shift. Referring to manuals reduces the risk of omitting steps in a procedure; however, this will only be effective if engineers actually refer to tech manuals to follow authorised procedures
The first LAME's (Roy) incorrect technique in holding the cable on the trim drum would set the standard for compliance with procedure for the apprentice.
Both handovers were inadequate; the dayshift handover was rushed and the nightshift only left 'post-it' notes to denote inspection requirements. This undermines the error reduction function of shift handovers.
There was a noticeable deficiency in the way 'Jas' was supervised on the night shift. John did not give any guidance before, during, or after the task relating to how the cables should be connected, the way in which they should be routed and the expected direction of movement of the trim tab during testing. All of this undermined error reduction functions and error capture by not giving the apprentice the information needed firstly, to complete the task correctly, and secondly, to identify the symptoms of incorrect connection present during testing.
Inspections and system testing were perfunctory. Effective error capture relies on actively looking for signs of error, either from a visual inspection of the component and work area, or examining how the system operates to ensure correct output. Approaching either as a 'requirement' instead of as a critical error management function will undermine its effectiveness.

Exercise 4: Safety recommendations and personal error management strategies

See the expert commentary on 'What the experts say'.

Chapter 3. Human Performance and its limitations

Exercise 1: *Crossed Wires*—perceptions: experienced engineers vs apprentices

What difference/s is/are there between how an experienced LAME perceives a task and its requirements, and an apprentice's understanding?

A LAME will have prior experience of a task, or one similar, including the steps or sequence of actions and areas of increased error potential. They will have made errors, or seen them being made during the task allowing them to more fully understand the task demands.

To understand new information properly, we need some kind of reference or past experience to relate to it. Apprentices may not have carried out the task before; and will therefore not have an adequate 'frame of reference' about what they need to do. This may mean that apprentices neither know about when and where maintenance errors are more likely, nor recognise when they make an error.

In *Crossed Wires*, there are several examples of where this happened. Where did a LAME identify a task differently, and what impact did it have?

Two examples are John's instructions to Jason to 'just connect them [the cables] up and lockwire them … easy'. From John's point of view, 'it is easy' having done the task before. However, during the final system testing, Jas was only looking to ensure that there was movement and did not know he had to ensure the direction was consistent with correct system operation.

Exercise 2: Information storage and retrieval—memory

1. The way we perceive information can depend on the way in which it was presented. Try the following exercise to see this in practice.

Quote your own mobile number as if it were a landline.

(For example 0400 123 987, as (04) 0012 3987). What did you notice? Responses should include mistakes and a difficulty in reciting the number easily.

2. At handover, you are often relying on memory for what needs to be done. What dangers are there in such reliance?

As the requirements will be recent, they will be stored in short term memory (STM), which has a limited capacity and is easily overwritten and disrupted by new information. The danger is therefore that crucial information will be lost and tasks omitted or incorrectly carried out.

3. Sample memory prompts

These may include task process checklists, written handover sheets, whiteboards, or the most important 'memory prompt': the aircraft technical log or equipment worksheet.

Exercise 3: Impact of environment on performance

The 'E' in PEAR stands for environment, which affects human performance. List the environmental conditions affecting our senses, and describe what impact they might have on performance.

Environmental conditions affecting senses	Impact on performance
Lighting levels	High levels of light may cause glare and deep shadows that obscure details during inspections of aircraft structures and components. Low light levels may not allow personnel to see sufficient detail to effectively carry out tasks or inspections. Older LAMEs are likely to need more light to carry out inspections with the same level of visual acuity.
Noise levels	Exposure to high noise levels will not only interfere with effective communication, but also cause increased fatigue and a reduced ability to think (as in the oft-used statement, 'it's too loud to hear myself think!'). Low noise levels (when speaking) may result in information being lost during communication, especially if you are competing with high levels of background noise.
Weather/temperature	Working in cold wet conditions will affect tactile senses. Low temperatures may reduce feeling and dexterity, especially in your hands and feet. Working in extremely high temperatures may require PPE which also reduces feel and dexterity.
Vibration	Exposure to vibration for extended periods may affect both cognitive and physiological performance. Physiological conditions associated with exposure to vibration may also affect feeling and dexterity.

Exercise 4. Distraction

(Carry out distraction exercise)

1. How does this translate to the hangar? What would you do if the boss interrupts during a safety critical task?

Distraction uses cognitive resources and may lead to errors of omission (lapses) as you lose your place in a sequence of task steps, or begin a new step incorrectly believing you have completed the last one.

One thing you can do is review the last three steps in a task, going back and confirming they have been completed. Once you are sure of the last step you have completed, you can continue from that point.

2. In *Crossed Wires,* the apprentice is listening to music on his smartphone. What effect does this have on his performance?

Selecting tracks, adjusting volume and listening to the music is a secondary task that will divide attention and distract you when listening to the critical details about the maintenance task at hand. Music will also interfere with the communication channel (hearing) for verbal communication, meaning that you may lose crucial information and understanding of task requirements.

Exercise 5. Situational awareness

List three critical steps in developing and maintaining your situational awareness (SA)

Three steps in situational awareness
1. **Perception** of elements in current situation, or perceiving what is going on around you
2. **Comprehension** of current situation, or understanding what the perceived elements mean
3. **Projection** of future status, or anticipating what could or will happen next.

List the processes which help in doing this.

Developing SA
1. Consult the aircraft technical log/maintenance documentation for system/environment status before undertaking a maintenance task ▪ e.g. aircraft may have entries for 'nil hydraulic' or 'electrical power'; or ▪ Investigate further if you find something out of place or unusual, e.g. disconnected wiring loom or component
2. Use the publication or tech manual to confirm your understanding of a task, system or component, even if you are familiar with the maintenance task.
3. Communicate with others - discuss the task with members of your maintenance team; or with members of other teams working on the same aircraft/system.
Maintaining SA
1. Assume nothing—always confirm your understanding through consultation and communication! ▪ Maintain effective communication to ensure the transfer of all available information and allow for better checking of facts against understanding ▪ Constantly review available facts against your understanding to maintain SA. ▪ Communication is also the best tool to check individuals' understanding against others, essential for identifying degraded SA (between individuals and teams).
2. Do not focus in on any one single element of a task; a 'head down' focus on specific elements of a tasks at the expense of other pertinent information will not allow you to maintain good overall SA.
3. Beware of confirmation bias. Once we have formed a 'mental model' of a situation, we often seek information which will confirm this model and unconsciously reject information which suggests that this model is incorrect. This is known as confirmation bias.
4. If it feels wrong it probably is. **STOP AND CHECK!** Do not keep going and hope to identify it later, take the time to review what you are doing, how your actions are affecting your environment, and **REALLY** consider the possible consequences.

Recovering SA

1. Communicate elements of confusion or discrepancy with others in the team, or your immediate supervisor. Effective communication is a central component of situational awareness.

2. Ask for assistance; this can be essential when conformation bias has greatly decreased your ability to review the situation accurately. Professional pride and not wanting to have competence questioned may prevent you from seeking outside help. Aviation maintenance is most effective when all members of the team understand that seeking assistance is a sign of experience and professionalism.

3. **Stop**, go back and review your steps to a known 'good' state of SA and reset the 'system' state to a safe condition.

Do not carry on and try to understand at any cost. It is very difficult to change your perception once you have arrived at an 'understanding'. The natural subconscious inclination is to actively search for reinforcing evidence (confirmation bias).

While this process is going on the system state may still be changing further into an unsafe condition

4. Debrief after the job. Lessons learnt are valuable information to allow others to not repeat the same mistakes. If loss of SA occurred, when did it divert, did it affect safety, how was it identified and how was it regained?

Percentages for levels of SA contributing to degraded SA

- In an overwhelming majority of cases, situational awareness fails with perception, our perception in that vital first step of planning and briefing a task—reviewing, requesting and rehearsing, and ensuring that we understand what is required and gaining feedback.

Data from the review of major air-carrier accidents from 1989 to 1992 provided by Endsley (1994)

78 % **Failure to perceive data**

17% **Failure in understanding data**

5 % **Failure to project forward/anticipate**

Remember: understanding and anticipation relies on accurate perception.

Chapter 4. Decision Making

Exercise 1: The decision-making process

A mobile tool rep turns up at the hangar, and has stock of the replacement socket you need for $25. However, your mate tells you that the local hardware store has a similar socket for sale at $15, but you would need to leave work 10 minutes early to catch them before they close.

What do you do?

Explain the reason for your decision.

The rep also has a new seven-drawer tool chest for $600. You know that your same local hardware store has a similar chest for $580. As above, though you would have to leave work early to buy it.

What do you do?

Explain the reason for your decision.

Did you take the time to go through each step of the sample decision-making process in the *Resource Guide* to analyse and explain the reason for your decision?

Discuss with others who may have made a different decision. After the discussion ask yourself, 'would I still make the same decision? If not why?'

Exercise 2: Decision making and releasing an aircraft to service

Read page 62–63 in your *Resource Guide*, which describes a scenario faced by a LAME in releasing an aircraft to service.

What are the risks associated with a decision to release the aircraft?

(Example) Failure of the component leading to control difficulty.

What would you do in that situation given the information provided?

(Use the decision process to assist your analysis, then discuss your reasons with others)

What other information could you look for to improve your decision?

Information could include: the proposed utilisation rate and operating environment of the aircraft, asking, 'is it different from normal?'

The past history of failures for the item and 'failure modes' such as potential to bind controls, redundancy within the system etc. All this information will help you to make an informed decision by identifying the risks associated with each of the available options.

Exercise 3: Decision-making scenarios

Consider the following three scenarios. Read through the list of reasons for the decision/s made in the scenario and nominate biases or HF limitations associated with each reason that may be present. At the end of the table list the possible risks associated with the decision and a more appropriate process that could be used.

Scenario 1

A LAME is installing the oil return and oil breather fluid hoses to a customer's helicopter engine after an engine change. Although he notices there are no markings on the hoses to indicate which is which, he looks at the bends, and determines the correct installation based on this. He considers opening compartments aft of the firewall bulkhead to see if he can physically identify the hoses, but decides against it. The test engine run is performed and the after-run compartment inspection does not reveal any leaks.

Reasons for decision	Bias and/or HF limitations associated with the reason
The LAME hates to admit he's not sure which hose is which.	Fear of having competence questioned.
He doesn't want to refer to the manual for what could be seen as a straightforward answer he should know.	Lack of understanding of the limitations of memory. Possible organisational norm of non-use of tech manuals.
Based on the pre-existing bends, he's sure which hose goes where.	Complacency, possible confirmation bias.
He reasons that since looking at the fluid lines on the other side of the firewall would make no real difference, he might as well continue.	Not extracting as much information as possible.

Risks

Incorrect fitting of hoses, including crossed lines or tension leading to hose failure, and/or incorrect operation of the system.

Appropriate process

The LAME is not comfortable with being unsure, so he consults the maintenance manual for the correct orientation of the hoses.

Scenario 2

An apprentice has to move a customer's aircraft into the hangar at the end of an afternoon shift. The ramp staff had already knocked off for the evening when the decision was made to move the aircraft. Although the apprentice and another engineer are still on shift, he knows it is company procedure to move aircraft with no fewer than three personnel to ensure the wing tips are monitored as the aircraft is moved past equipment and the hangar structure. As it is relatively quiet in the hangar at the time, he decides to move it with the other engineer, being mindful of hazards and taking it carefully. The aircraft was repositioned uneventfully.

Reasons for Decision	Biases and / or HF limitations associated with the reason
He wanted to make sure he finished what has been asked of him before he goes home	Self-imposed time pressure
It's pretty quiet, so it should be OK to move it with two people instead of three	A belief that mildly positive outcomes are more likely than mildly negative ones
Everyone else does it this way	Pressure to conform to organisational norm
If he doesn't move it, his peers and others will consider him lazy	Perceived pressure associated with professional standing amongst peers

Risks

Aircraft striking obstacle or other aircraft causing damage.

Appropriate process

He knows the procedure calls for a minimum of three people, so he asks the other engineer to watch the side closest to the hazards, while he watches the other side, knowing it is well clear of any hazards. Noting the difference between required and actual procedures, he also raises a hazard report.

Scenario 3

A LAME has been asked to carry out a pre-flight inspection of a customer's Agusta 109A helicopter. Although she hasn't performed this task previously, she has done it many times on the later 109E model. She decides to head out to the helicopter and perform the task, leaving the checklist in the office. Based on her experience and knowledge of the E model she is satisfied enough to sign for the pre-flight.

Reasons for Decision	Biases and / or HF limitations associated with the reason
She knows the A and E model are almost similar with regard to pre-flights so it should not be a problem	Complacency
Everyone else does it that way	Organisational norms
The check requirements are identical as far as she knows	Reliance on fallible memory
It's merely a pre-flight, so there is no requirement to have a checklist with her at the aircraft	Complacency, and hazardous attitude to the importance of error management functions

Risks

Incorrect or incomplete pre-flight inspection. As pre-flight inspections are a final error capture defence, this may lead to an aircraft flying with undiscovered damage, leaks or incomplete maintenance being present.

Appropriate process

As she has not done a pre-flight on this particular model of the Agusta 109, she decides to refer to the specific pre-flight check list to ensure compliance with requirements

Chapter 5. Fatigue

Exercise 1. Driver Fatigue Quiz

Statements	True or false?
1. Coffee overcomes the effects of drowsiness while driving.	F
2. I can tell when I'm going to go to sleep.	F
3. Rolling down my window or singing along with the radio will keep me awake.	F
4. I'm a safe driver, so it doesn't matter if I'm sleepy.	F
5. You can stockpile sleep on the weekends.	F
6. Most adults need at least seven hours of sleep each night.	T
7. Being sleepy makes you misperceive things.	T
8. Young people need less sleep.	F
9. Wandering, disconnected thoughts are a warning sign of driver fatigue.	T
10. Little green men in the middle of the road may mean the driver is too tired to drive.	T
11. On a long trip, the driver should never take a break, but try to arrive at the destination as quickly as possible.	F
12. A 'microsleep' can last 3–5 seconds.	T

Exercise 2: Engineer checklist—symptoms of fatigue

Review and fill out the checklist, if you find you or the group list a large number of the symptoms you may wish to discuss your rostering system with your safety manager.

Exercise 3: *Crossed Wires* discussion

Discuss fatigue related aspects of *Crossed Wires*.

☐ How did John's level of fatigue affect the safety of the maintenance task?

John was fatigued at the start of the shift due to lifestyle and personal factors. This would have been compounded by the workload and shift/time of day influences on his fatigue level; all of which would have reduced his ability to manage the task, including supervising the correct completion of connecting and testing the trim cables. One of the potential symptoms of a high level of fatigue is an acceptance of a lower level of quality, in this case quality assurance; as the compartment was secured before John came back, no inspection was carried out, thus removing a vital error capture function.

☐ What should John have done?

John should have stayed with Jason while he carried out the task; or instructed him to leave access to allow a proper inspection of the routing, tension and locking of the cables and turnbuckles.

☐ Should John have declared he was fatigued?

If John considered that his performance was affected by fatigue he should have informed either Roy or Harry so that a decision could be made about continuing the task. However, one of the dangers with fatigue is that individuals are often unable to accurately assess how much their performance is degraded and the higher 'cognitive' functions such as decision making and judgement are affected first.

☐ What should Jason, the apprentice, have done? How does he manage John's attitude that 'You're the boy, you need the practice'?

Ideally, Jason should have told John that he couldn't continue until John was available to properly supervise the task. He should have pointed out that as he is still inexperienced, he has a higher risk of making an error, and needed more, rather than less, supervision than normal.

☐ How would you describe the level of support provided by Harry, the owner of Perfect Twins?

Harry provided stress and time pressure, not support. He was under stress and pressure from the customer, and transferred that pressure to the engineering staff. A better method would have been to isolate the AME and LAME personnel from those stresses and allow them to concentrate on the task at hand; in other words be a filter to prevent stress and distraction occurring on the shop floor.

☐ Does your organisation have a fatigue management policy? State your organisation's policy and review it. Is it effective?

☐ If so, what are your responsibilities as an engineer?

An individual's responsibility is to use the rest opportunity provided between shifts to obtain adequate sleep to meet their individual sleep needs. It is also an individual's responsibility to inform their manager if they have been unable to obtain adequate rest (for whatever reason) and may be adversely affected by an increased level of fatigue at the start of a shift.

☐ Considering that night shift is a maintenance reality, what practical steps can engineers take to minimise risk/error?

1. Use 'off-shift' time to gain adequate rest. Being well rested will reduce the risk of errors associated with reduced performance from fatigue
2. Defer safety-critical, or high-risk tasks to a lower fatigue time if possible.
3. If it is not possible to defer tasks, plan tasking to ensure safety critical items are worked on during the early stages of a night shift.
4. Use a 'progressive restriction' system that limits the systems worked on in line with the safety risk of error as fatigue increases.
5. Increase supervision and inspection requirements during high fatigue risk times (WOCL).
6. Increase the time for tasks at night to allow for reduced performance and additional checks to capture error.

Exercise 4: Personal strategies to minimise the effects of fatigue

Make a list of any strategies you use now, or could use, to minimise and mitigate the risk of a serious incident or accident resulting from your own, or a fellow engineer's, fatigue level.

(Example) Strategies to minimise the consequences of fatigue on performance
Ensure you get enough rest
Look for signs of fatigue in yourself and others: increased errors, irritability, yawning and rubbing eyes.
Know the periods of increased fatigue risk (long shifts and the window of circadian low)
Schedule high-risk tasks (safety-critical or known high-error tasks) for day shifts or earlier in a night shift
Give more time for tasks at night
Take regular rest breaks during shifts
If feasible, use strategic napping before high risk tasks at night
Assign extra supervision to tasks during high fatigue risk periods
Use tea/coffee/caffeine strategically to maximise their benefit, but remember they only provide short-term benefits and should not be the only mitigation. Avoiding fatigue through good rostering and sleep is the best method.

Chapter 6. Stress, workload and time pressure.

Exercise 1: *Crossed Wires* discussion

Review the *Crossed Wires* drama, and discuss the following questions.

- ☐ What stressors and time pressures were evident at Perfect Twins Maintenance?

  Starting from the 'top' of the organisation: Harry had stress from competing demands on his time, both personal and financial pressure from customers to complete work, and pressures in completing financial administration.

  Roy had pressure applied by Harry about completing the task within time and budget considerations; he also had pressure and resulting stress to attend family commitments. There will also be an amount of additional stress associated with supervising apprentices, from ensuring they follow instructions to managing the associated high error rates expected from someone still learning their trade skills.

- ☐ What strategies did they use to manage time pressure in the *Crossed Wires* scenario?

  There was no visible effort to manage or avoid 'time pressure'. Each person knew there was a definite requirement to complete the task to meet the customer's deadline, even if that was unrealistic if the task was to be completed with a low risk of error.

- ☐ How could Perfect Twins Maintenance have managed these better?

  One example is Harry. He could shed some of his workload to enable him to better carry out his remaining responsibilities, one of which is supporting his engineers to carry out the tasks with the minimum risk of error by providing them with sufficient time and isolating them from customer pressure.

- ☐ Were 'Perfect Twins Maintenance' workload management strategies SMART? That is, were they specific, measurable, achievable, realistic/relevant, and timely?

  The workload was **specific** and **measurable** as there was an assigned task which could be evaluated on completion. It was achievable, being a 'normal' maintenance task; however the **realistic** and **timely** aspects were lacking. Unnecessary pressure and stress was placed on the LAMEs, including statements about them having to deal directly with the [irate] customer if the job wasn't finished.

- ☐ Was the employees' workload realistic?

  Giving employees a single (though critical) task is realistic; however, the time allocated and amount of pressure felt by the two shifts was unrealistic, especially in light of John's reduced capacity and the apprentice's inexperience.

- ☐ What factors affect how you determine individual workload? (Experience? Skills?)

  Workload is a subjective measure unique to each individual. Workload measures the task demands against an individual's mental and physical capacity; the closer the task demands are to the limits of an individual's capacity the higher they will judge their workload.

  Capacity will be affected by individual experience and skills (including practised automatic skills); with more experienced engineers generally having a higher capacity and therefore the ability to handle a higher relative workload. However, other factors such as environment (shift work etc), stress, distraction and the natural accumulation of fatigue over a shift period will reduce capacity and therefore increase subjective workload.

  So a task considered 'normal' or acceptable in terms of workload to an experienced LAME may be excessive for an apprentice. Acceptable workload early in a shift may be seen to be high or excessive later in a shift, or in a high fatigue zone such as the WOCL.

Exercise 2: Stressful life events

Complete the stress chart and review your individual stress score, discuss results in a group if you feel comfortable doing so.

If you score highly, consider discussing your current stress levels with a trusted colleague, manager or counsellor.

DO NOT simply live with excessive stress, it may cause psychological and physiological health issues in the long term, and reduce work performance in the short term.

Exercise 3: Personal strategies to manage stress

Make a list of strategies you use now (or could use) to manage your stress levels.

Personal stress management strategies (stress prevention)
Maintain a healthy work/life balance—regular leave and quality time with the family will help avoid domestic and work related stress!
Health and fitness—quality sleep, a balanced diet and regular exercise will help to reduce the effects of stress
If worried about little things or things that are beyond your control-communicate your concerns to those who can have an influence and move on
Prioritise—attend to the more important tasks ahead of menial/trivial ones
Communicate your concerns if you believe they may have an impact on your work performance or personal wellbeing—discuss these concerns with a trusted peer or your supervisor

Personal stress management strategies (stress coping)
Identify the source of stress—this will allow you to address the real issues behind the stress, and produce a more effective and long-term reduction in their influences and effect
Discuss—with a supportive colleague or friend (to help identify the source of stress and possible solutions)
Where possible, reduce workload and pressure—talk to your supervisor about reducing your workload or taking leave if excessive workload can be identified as a source of stress
Use teamwork—being around others, sharing responsibility and achieving goals can improve self-esteem and confidence. Correct allocation of workload amongst an effective team will also help to ensure stress is as low as possible
Think positively! Focus on positive achievements and future events rather than dwelling on negatives
Relaxation exercises—search online: there a number of techniques available
Humour—although make sure it is not to a colleague's detriment, or directed maliciously against individuals
Consider professional counselling or medical support if you feel your stress levels are affecting your physical or mental health

Chapter 7. AOD

Exercise 1: Your knowledge of alcohol

1. A 12-ounce beer, a 4-ounce glass of wine and a 1-ounce shot of whisky all contain 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 improve sleep quality?
   FALSE - A drink may help you fall asleep faster, but suppresses the hours you spend in rapid eye movement (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. Drinking patterns change when you're away on 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 performance?
   FALSE - Even modest amounts of alcohol can impair your performance, leading 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

Chapter 8. Communication

Exercises 1, 2, 3 & 4; carry out with facilitator and discuss results/ things learned.

Exercise 5: *Crossed Wires* discussion—effective communication at handover

Watch the sequence in *Crossed Wires* where John and Jason report for the next shift.

1. How effective was the communication during the handover?

   The communication used for both handovers (day to night, then night to day) was deficient and did not effectively communicate all the required information.

2. Why do you say this?

   The first handover was carried out verbally and under time pressure. Instructions were brief and a limited amount of information was transferred. Though it did not lead directly to an associated error, it was not effective communication. However, in the second handover of the task, the communication of the required duplicate inspection failed completely, as the information was not transferred and the inspection task was not carried out.

3. How could it have been improved?

   Review expert commentary on effective handover under the 'communication' heading in the DVD.

   Handovers can be improved by using a consistent template and combining an oral briefing (where possible) with a written handover sheet detailing crucial information.

   It is also beneficial to ensure the environment is appropriate. Moving to a quiet area away from distraction and interruptions will help to ensure all the required information is transferred and understood.

4. Why is effective communication during shift handover so important? (Necessary for incoming shift to develop accurate mental model—situational awareness)

   Investigations into many incidents and accidents have shown contributions from poor handovers leading to critical errors and omissions. Ineffective communication may lead to a misunderstanding about work that has been undertaken, and crucially the work required to complete a job and ensure an aircraft is serviceable and ready for operation.

5. What barriers to effective communication have you encountered at work?

   Examples may include:

   – **Lack of confidence**—individuals who lack confidence in themselves or their abilities may not say what is on their mind. If you are not confident doing your job, it may be experience, training or fatigue related. It is important to let others know if and when you don't feel confident in performing a set task.

   – **Difference in qualifications (real or perceived)**—every individual has valuable information to contribute within the workplace – don't let qualifications deter you from asking questions and making statements.

   – **Fear of reprisal**—this may relate to a fear of being seen as immature, unintelligent, inexperienced or unsupportive by a fellow team member. Aviation safety must never be compromised by fear of reprisal, say what you think and sort out differences later on.

   – **Position/status**—differences in position and status occur in virtually every work environment, but should not hinder the communication process. In the maintenance environment perceived differences in authority exist between personnel of differing positional status and experience. This is known as an 'authority gradient'. If this is too steep it may hinder effective communication.

   It is important to understand that if you are the one 'higher' in the gradient you also have the ability and obligation to 'empower' those below you to speak freely. Remember the information they have could be crucial to performing your task safely.

Chapter 9. Teamwork

Exercise 1: Teamwork at Perfect Twins Maintenance

How effective was the teamwork at Perfect Twins Maintenance? Give some examples to support your answer—examples of both effective and not-so-effective teamwork from both *Crossed Wires* and the *Right Connection*.

Effective teamwork	Ineffective teamwork
Day shift apprentice supported LAME by giving advice about the use of a clamp to hold the cables in place on the trim drum assembly. (*Crossed Wires*)	Night shift LAME left the apprentice to carry out the bulk of the task without supervision or support. (*Crossed Wires*)
Harry provided a filter between customer and the engineers, allowing them to focus on completion of the job without time pressure. (*Right Connection*)	Harry uses threats of customer complaints to motivate engineers and questions their motives. (*Crossed Wires*)
Roy gives advice to Harry to allow him to make a better decision on the timeframe required for the job and manage customer demands and concerns. (*Right Connection*)	Harry and his partner allowed unresolved conflict to develop over the work/life balance and overall workload in the office. (*Crossed Wires*)
Effective communication is used to inform the oncoming shift about the task requirements. (*Right Connection*)	Communication is ineffective in maintaining a shared mental model between shifts, especially in relation to the need for a duplicate inspection. (*Crossed Wires*)

Exercise 2: Teamwork—bridge building

Carry out bridge exercise, de-brief with facilitator.

Areas to discuss:

- ☐ Was the overall goal and plan understood?
- ☐ How effective was the leadership of the team?
- ☐ Was there adequate role definition (did everyone know their job)?
- ☐ How well were conflicts or disagreements managed?
- ☐ How effective was communication within the team?

Exercise 3: Characteristics of a good team member

What are the characteristics of a good team member?

- ☐ **Supports the leader to make the best decision**—All members of the team contribute to the effective leadership of the group by supplying information, contributing ideas and providing support to whomever is in charge at the time.
- ☐ **Questions decisions or options constructively**—Differences of opinion, based on facts and discussed within the team are a useful part of making and reviewing decisions. A good team member is willing to engage in constructive discussions without aggressive or emotive language

- ☐ **Actively participates in the team**—Each team member's unique experience and skills are a potential team resource. Team members add value to the team's efforts by using followership skills to ensure they contribute their unique resources.
- ☐ **Supports other team members**—A team member's value comes not only from contributing to the team's expertise, but also from monitoring other team members for lapses in attention and memory.

Exercise 4: The *Right Connection*—safety meetings and improved teamwork

Watch the *Right Connection* and identify how the safety meeting could improve teamwork at Perfect Twins.

Effective teams generally have the following characteristics:

- ☐ A shared goal
- ☐ Shared mental model
- ☐ Clear communication
- ☐ Effective leadership/followership
- ☐ Clear delegation/role definition
- ☐ Clear operating procedures.

Team meetings provide one means of helping to develop these characteristics.

Discussion can ensure everyone is aware of the **shared goals** of the team and organisation; provide a forum to improve **communication**; ensure better understanding of hazards and improve the team's **shared mental model**; and give a chance for team leaders not only to give direction, but also to seek feedback and discuss operating processes and **procedures** (maintenance practices).

Chapter 10. Leadership

Exercise 1: What makes a good leader/manager?

Think of a good leader/manager you have worked with. What made them effective?

Examples may include:

- Knowledge of team members' strengths and weaknesses.
- Ability to communicate common goals and motivate team members to actively engage in the team.
- Willingness to listen and take advice.
- Willingness to defer control to achieve goals.
- Ability to manage conflict and disagreements.

Exercise 2: Leadership in *Crossed Wires*

Thinking of the leadership skills shown in *Crossed Wires*:

1. **What kind of leader was Harry? Give reasons for your answer.**

Harry was a busy **manager**, but did not provide many of the contributions that a **leader** should make to a team. He did motivate and provide direction, but did not listen to the engineers when they voiced concern over the timeframes for completing the task, questioning their motives and the way in which they were carrying out the task. He did not isolate them from customer pressure and used the threat of customer anger to prevent discussion of how realistic achieving the goal was.

The following are some of the barriers to effective teamwork:

- Poor communication
- Inappropriate leadership and followership styles
- Excessive workload and time pressure
- Stress
- Disagreements/conflicts.

As a leader, Harry should be trying to prevent or limit these influences, not increase them.

2. **Discuss the qualities of both LAMEs as leaders.**

Leadership has been described as the ability to inspire confidence and give direction and support to the people who achieve organisational goals.

Roy provided guidance to his apprentice; however, he did not inspire confidence or show leadership in setting standards of acceptable behaviour (such as not using smartphones during tasks), to reduce the risk of error.

John did not support Jason, and did not lead by example in setting high standards of motivation and professionalism in his approach to work. Turning up late and then blame shifting will also erode team cohesion and may present a barrier to producing an effective team. Whether we realise it or not, anyone in a position of authority is leading by example, good or bad.

3. **How could Harry, Roy and John improve their leadership skills?**

Each of the three needs to understand the degree of influence they have on the attitudes and actions of the people they lead and control. From this understanding they can start to develop the skills needed to be effective leaders, such as the ability to:

- Motivate the individuals within a team by leading by example
- Manage workload by being aware of the performance characteristics of their team members
- Manage time and set deadlines allowing time to stop and actively assess actual progress against expected progress
- Make decisions, use a structured process and seek advice from team members
- Co-ordinate and monitor activity
- Resolve conflicts
- Listen to team members' inputs.

Exercise 3: Followership—'The ten rules of good followership'

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 workplace?

How do they relate to the leadership and followership skills shown in *Crossed Wires* and the *Right Connection*?

- In *Crossed Wires,* Roy accepts the timeframe for the job and does not discuss it further with Harry. Compare this with his reaction in the *Right Connection* where he offers advice on his preferred course of action with a rationale.
- In *Crossed Wires,* John is trying to work with unreliable lighting but accepts that 'nothing works around here' rather than doing something about rectifying the problem.
- In *Crossed Wires,* Roy schedules time to attend his daughter's graduation, compared to Harry spending a large portion of his day at the office, to the obvious displeasure of his wife.
- In *Crossed Wires*, John makes excuses for his timekeeping and state of health, while in the *Right Connection* he accepts responsibility and does something to improve the situation.

Chapter 11. Professionalism

Exercise 1: The characteristics of the professional, and how these relate to maintenance engineers

1. **What do you feel are the characteristics of the professional?**

- Professionals take pride in their work
- Professionals are accountable and take responsibility
- Professionals show leadership and engender trust
- Professionals know their limits and will seek assistance when task requirements are outside their expertise and/or capabilities.
- Professionals will put the interests of safety above self interest

2. **How do these characteristics relate to you as a maintenance engineer?**

- Professionals carry out their assigned tasks to the best of their ability, utilising appropriate processes and equipment.
- As professionals, maintenance engineers **do not** deviate from procedures because they believe that they have a better way. If they have **a solution** they ensure it **is properly authorised** before they employ it.

Exercise 2: Responsibilities and personal accountability

A professional understands their responsibilities and the importance of personal accountability. How does this relate to your work environment?

- As professionals, maintenance engineers never sign for work they have not carried out/supervised, or properly inspected.
- As professionals, maintenance engineers never allow pressures to induce them to pass work if they have any doubt of its standard.
- As professionals, maintenance engineers insist on the highest levels of safety in their work environment.
- As professionals, maintenance engineers never knowingly allow others to compromise these principles.

Exercise 3: Professionalism and aviation safety

Read the case study from chapter 11, and consider the following:

1. **What would be the professional response to this task?**

   A professional would understand the need to use all appropriate equipment to ensure that the task is carried out to the highest standard. This would require finding and using the torque wrench.

   Your personal minimum standards should not be dictated by the norm—what others would do in the same situation.

   If the task calls for a specific torque value on a fastener, you should use the required tool, in this case, the torque wrench.

   As professionals, we should not work outside approved standards; for example, creating our own method of determining if an assembly is installed correctly, by feel, rather than by using the correct tool.

   If we decide to go with the flow, we must first make sure the flow is not in the wrong direction!

2. **Why is this so important to overall aviation safety?**

   Violations and workarounds may introduce new risks to the maintenance environment and could be critically undermining defences in ways you don't understand. Not using the torque wrench may introduce the risk of an under-torqued bolt coming loose during operation, or an over-torqued bolt failing due to excessive loading, either of which may result in the manifold coming off in flight.

3. **As a professional, how can you continue to improve your maintenance processes while ensuring safety?**

   As experienced engineers, many LAMEs may suggest process improvements that will bring improved efficiency and safety within their organisation. However, to ensure that no new risks are introduced, a professional approach would be to have the proposed process assessed and approved, so that it becomes the new standard maintenance procedure.

Chapter 12. Human Factors within an organisation

Exercise 1: Applying the PEAR model to Perfect Twins Maintenance

Within the table, identify all the human factors influences you can identify in the *Crossed Wires* drama. Use the information in the table to complete the following questions.

The PEAR model as it applies to Perfect Twins Maintenance (examples)			
People	**Environment (physical and organisational)**	**Actions**	**Resources**
Inexperienced staff (apprentices)	Night shift	Poor briefings	[Lack of] time
Poor health (John)	[Poor] lighting	Task management	Deficient lighting equipment
[Lack of] supervision	Time pressure	Poor documentation	Disorganised tools
Fatigue	Norms (no tech manuals)	Critical inspection requirements [missed]	Test equipment [not used]

Exercise 2: Safety culture at Perfect Twins

Use the information in the table to complete the following questions.

1. **Describe the safety culture within Perfect Twins.**

The safety culture could be assessed as being in the reactive region of Patrick Hudson's safety culture scale. While no-one at Perfect Twins consciously takes reckless risks, no priority seems to be given to improving the work environment until after an incident occurs.

2. **List three norms/workarounds you saw in the drama**

   – Maintenance work carried out without referencing tech manuals

   – No entries made in the aircraft technical log for the outstanding inspection requirements

   – Functional test done out without the correct test equipment

3. **What else could Perfect Twins do to improve their safety culture?**

Refer to the *Right Connection* for strategies, including hiring dedicated safety staff, holding safety meetings and improving resources.

These actions will begin to demonstrate to the maintenance staff that safety is a priority and they should also ensure their behaviour shows the same shift to value producing ... safety.

4. **Why is reporting important in any maintenance organisation?**

   – Reporting is the first step in analysis, enabling organisations to reflect and make improvements to prevent the recurrence of incidents or accidents.

   – It is important to help organisations identify and understand contributing factors to errors, incidents or accidents.

   – Reporting assists in identifying contributing factors, to provide an organisation with a specific focus to prevent future events.

5. **What can be done to ensure an effective reporting culture?**

   – **Motivation and promotion.** Employees need to know the reporting system and understand its importance. They should also feel motivated and empowered to use it and submit reports

   – **Trust.** Safety reporting is built on a culture where individuals trust that the response from the organisation will be appropriate.

   – **Feedback and acknowledgement.** A reporting culture will be encouraged when individuals feel their reports are reviewed and considered. Feedback helps to communicate that this is happening

   – **Ease of reporting.** Complicated and time-consuming reporting mechanisms are a disincentive to reporting errors or hazards before they contribute to a major incident

6. **What areas should a good safety report cover?**

   – A narrative of 'what happened', Including who(de-identified), where, when and how

   – It should also cover aspects of why it happened, looking at organisational influences as well as individual actions and decisions.

   – Finally, there should be recommendations for improvements or remedial/corrective actions to help prevent the recurrence of the same or a similar event, incident or accident.

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