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Governing complex systems
Differences in civilian and Defence safety regulations

PACDEFF 2023 Forum
Updates on human factors, non-technical skills and crew-resource manangement

Into the fire
Time to remember the hazards of flying in smoky conditions

02 2023 EDITION

Spotlight

SAFETY FUNDAMENTALS

Risk Management, Supervision and Authorisation

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FOREWORD

WELCOME TO *SPOTLIGHT* 02 2023. DFSB's mission is to prevent military aviation accidents and enhance aviation safety through a systemic approach to investigations, reporting, research, data collection, analysis, education and promotion. *Aviation Safety Spotlight* magazine is an essential component of the Defence Aviation Safety Program, promoting aviation safety by sharing lessons, experiences, insights and academic research. I would like to acknowledge the valuable contributions made by the authors of the articles published in this edition.

Articles related to authority gradients, fatigue and physiological episodes, and outcomes of the 14th annual Pacific and Australasian Crew Resource Management Developers' and Facilitators' Forum (PACDEFF), provide valuable insights into the importance of Human Factors (HF) and Non-Technical Skills (NTS) education and training to complement professional and technical mastery.

HF refers to the wide range of issues affecting how people perform tasks in their work and non-work environments, and understanding human capabilities and limitations within the system they operate. NTS includes decision-making, situational awareness, communication, problem-solving and other mental processes personnel use to respond appropriately in challenging situations. Of particular note, NTS knowledge is useful in practical and realistic scenarios thanks to advancements in the integration of NTS skills-based practice throughout ab initio courses, training programs, operational conversions and currency programs within operational units.

Discussions of immediate risk awareness and aerial firefighting demonstrate the importance that Defence Aviation places on hazard identification, application of risk-management practices, supervision and authorisation. Furthermore, with increasing strategic pressure to deliver capability, the availability of contemporary and fit-for-purpose risk-management tools and information systems to prevent siloing of safety information is an emerging area of safety priority. Development and continual assessment of Core Risk Profiles, Mission Risk Profiles and Risk Management Plans is an essential element of aviation safety management systems, yet appears as a growing area of systemic weakness across Defence Aviation. Foundational elements of Defence Aviation safety management system policy include the need for clarity when identifying and managing hazards, top events related to those hazards, preventative and recovery risk controls, and traceability to the working-level orders, instructions and publications that document the risk controls.

I encourage you to reflect upon your organisation's approach to aviation risk management and the integration of practical skills-based NTS training, which often feature in aviation safety investigation reports as systemic and or organisational latent deficiencies within aviation safety management systems.

Very respectfully and kind regards,

Group Captain David Smith
Director DFSB

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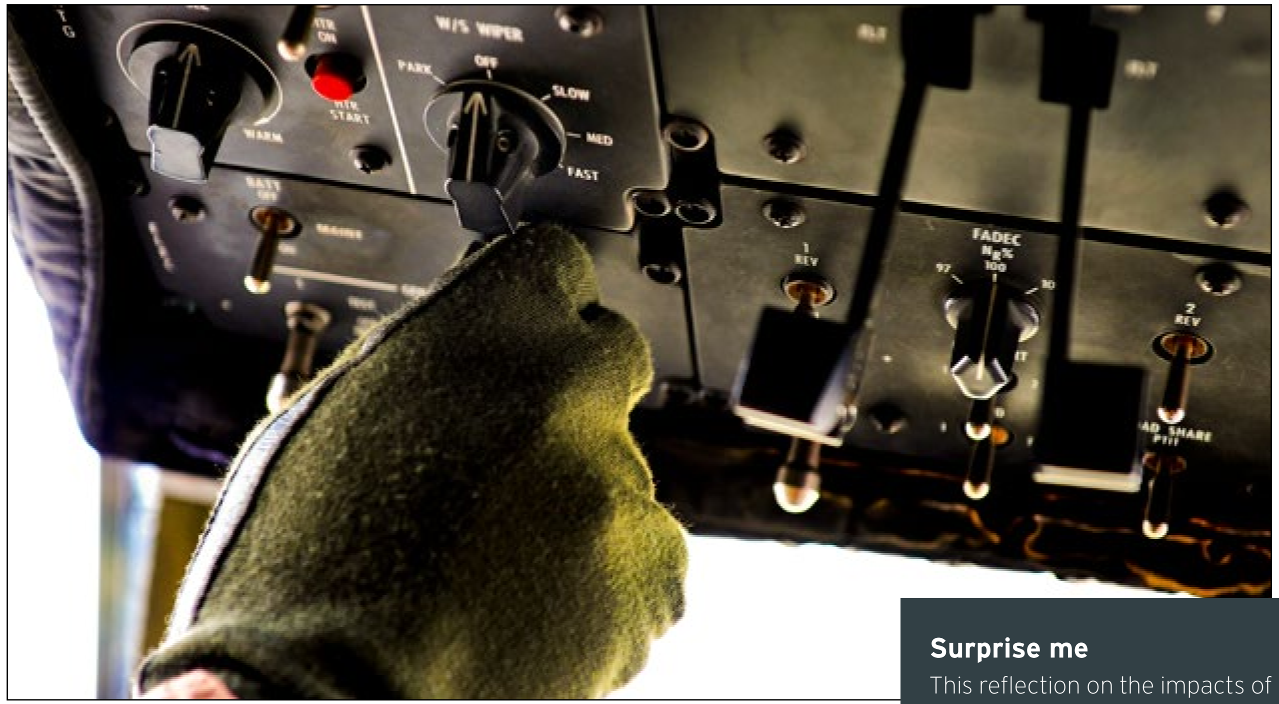
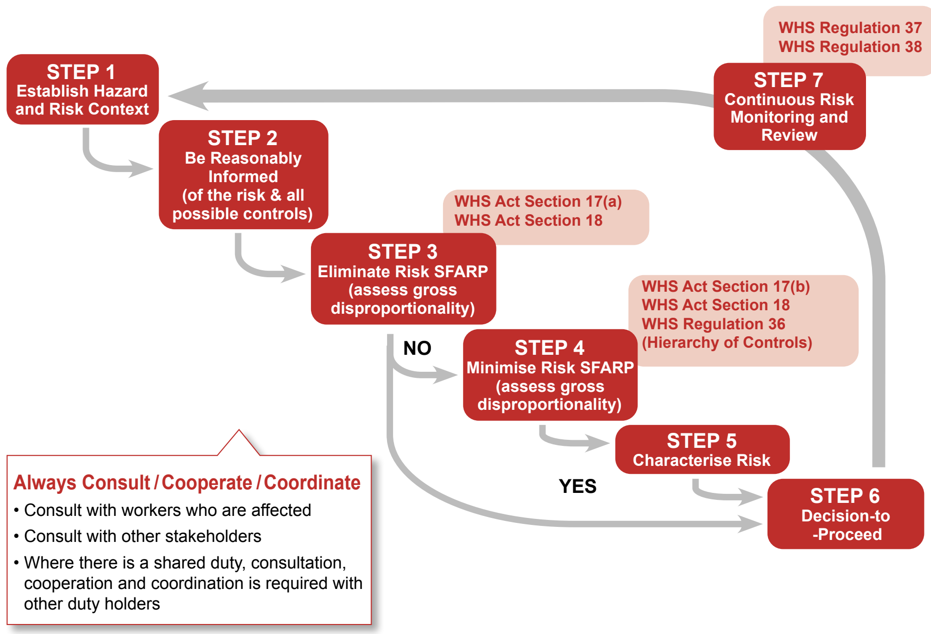


Risky business

Deliberate Risk Management and Immediate Situation Risk Awareness – invaluable tools for planning and executing tasks

SAFETY RISK MANAGEMENT PROCESS



WHEN IT COMES to successfully executing tasks, there are some robust tools to help personnel manage Deliberate Risk Management (DRM) controls that can help personnel deal with unforseen challenges. The Rule of Three (RoT) and coupled with the People, Environment, Activity and Resources (PEAR) tool can support all team members to complete tasks and missions. The framework of Plan, Brief, Execute, Debrief (PBED) further provides opportunities for the team to discuss potential issues before they happen or address hazards if they eventuate.

Deliberate Risk Management

The Seven Step Safety Risk Management process forms part of Workplace Health and Safety (WHS) training. The flowchart on the right outlines the process.

While WHS Risk Management (RM) focuses solely on personal safety – hazards and risks that affect people directly – DRM in the aviation context also covers the management of risks to:

- the mission
- systems or capability safety
- correct performance of tasks (such as integrity of maintenance)
- reputation
- environment
- and legal factors.

DRM is important for all aspects of aviation including design of aircraft and systems, production of training, writing manuals and developing operations, tasks, and activity plans.

The outcomes or controls of DRM appear in publications about flying, maintenance and operation, standard operating procedures (SOPs), and operational, exercise, risk or activity plans. Following these artefacts helps protect individuals, teams, equipment, integrity of maintenance and ensures mission success. They will also assist team members manage the environment and other factors.

On arriving at work, if a team member notices the situation is already outside the DRM parameters/controls, they should pause, recognising the need for more DRM. RoT and PEAR can help manage the situation.

Naturally, there are some limitations to DRM. Well-intentioned people in office environments drafting DRM cannot anticipate every situation or combination of external and internal factors. They are separate from the situation in both time and distance. Even if it is recent, DRM cannot anticipate every single situation and offer guidance in advance. DRM may also identify and flag risks as independent from or separate from other hazards. For example, the recommendations may suggest controls for dealing with fatigue or weather without acknowledging interactions between these hazards.

Identifying hazards and their potentially compounding effects is the responsibility of every person on the scene including team members and supervisors. Such dynamic responsiveness also helps manage change since DRM is only as recent as its last sign-off. Change is constant; DRM can never be completely current.

Recognising when new hazards appear or risks controls may be failing or proving inadequate is important, as is communicating that change to ensure the team and supervisors to ensure appropriate responses to developing scenarios.

Immediate Situation Risk Awareness

Whether it is a storm rolling in, a team member getting distracted, a new task or unforeseen hazards popping up,

situations change all the time. As mentioned earlier, DRM development usually happens away from the action; immediate situation risk awareness (ISRA) is invaluable in making it possible to deal with the unexpected.

For personnel working on maintenance, many factors can affect their processes including fatigue, time pressures, lack of resources and their environment – including changes in weather or lighting. For pilots, many of the same issues arise. Air traffic controllers may face fatigue as well as traffic saturation.

Achieving and maintaining ISRA is possible with three tools: PBED, the RoT and PEAR.

PBED

Since DRM recommendations can date quickly, prior to any activity there needs to be a check to see if the DRM and planning parameters are still applicable. If they are (which can happen, particularly if the task is common and routine) then the amount of planning is reduced. It is possible or even probable that a team member can complete such a task by using the relevant manuals and unit SOPs. Additional risk management is necessary when the parameters begin to shift away from those set out in the DRM or planning. Whether the plan is routine or new, the team needs a briefing to understand the job at hand, their role in it and the risk controls in place.

Monitoring the execution of the activity ensures that the plan is working as designed, and that people are working safely and adequately, while identifying opportunities and threats. At the completion of the task, there should be a debrief to discuss what worked, what did not and what could be better. Putting these steps together makes PBED: plan, brief, execute, debrief.

The RoT and PEAR can assist with the PBED process, by helping to identify threats, classifying them, and then determining what to do in response.

Plan

PEAR helps to guide planners in their consideration of four key areas: people, environment, actions and resources.

Should the planner start identifying aspects of the situation that are outside of the nominal limitations, the RoT can help in classifying the severity of those parameters and guide the planner in deciding that additional controls are required or, possibly, the threats are beyond their responsibility to manage and need referral to a higher authority.

The level of planning should match the complexity of the task; simple tasks require simple plans and complex tasks need more attention.

Some questions to ask in the planning phase include:

- What is the task?
- What resources are available?
- Are the required risk controls in place?
- Is the situation within normal parameters?
- Are there any other hazards/risks not covered by existing DRM?
- What OIP is applicable?

Brief

Supervisors then need to communicate the plan to the team. As with planning: a simple task only merits a simple brief. Supervisors should allow time for the team to ask questions since there may be aspects they have not considered. In addition, supervisors should ask questions of the team to check their understanding of the plan and their individual roles.

Execute

The execution phase is where the RoT and PEAR really become important. All members of the team should be on the lookout for emerging threats or risks that can affect the plan and the team.

The supervisor monitors progress against the plan, the safety of personnel, their use of resources and the successful completion of the mission task. Simultaneously, the supervisor looks for opportunities to improve and potential issues.

Debrief

At the end of every task, be sure to debrief. The debrief should cover what worked and did not work and how the plan could be improved. Discussion should also cover any issues whether discovered through PEAR or the RoT.

As in other contexts, staff may make mistakes. Apart from the one-on-one debrief to correct the error, the group can also learn from the sequence of events.

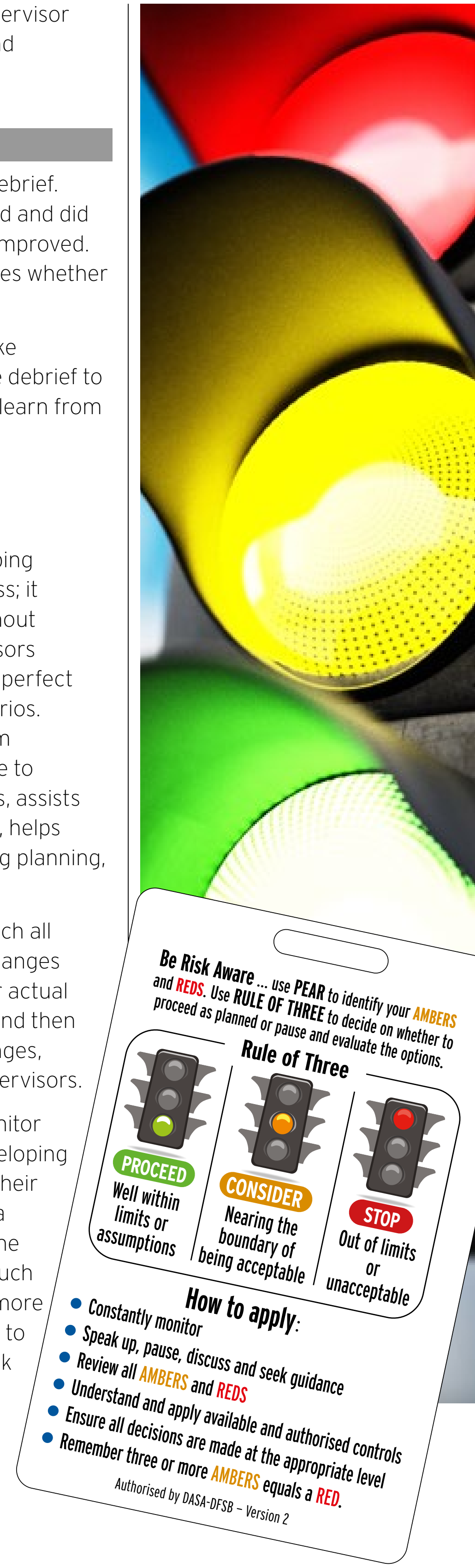
The Rule of Three

This is a tool to help assess developing situations and maintain risk awareness; it is useful during planning and throughout conduct of a task or activity. Supervisors cannot see everything and DRM is imperfect particularly in new activities or scenarios. The RoT promotes input from all team members by using common language to clearly communicate about situations, assists in developing a shared mental model, helps uncover incorrect assumptions during planning, and helps identify changes mid-task.

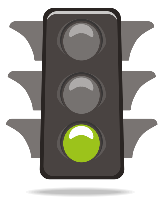
RoT provides a framework with which all members of team are able to note changes to the situation, recognise possible or actual hazards and risks in those changes, and then facilitates communicating these changes, threats or concerns to peers and supervisors.

If everyone in a team is able to monitor the situation, identify and assess developing threats and then communicate with their peers and supervisors, then there is a networked safety system much like the networked fifth generation fighters such as the F-35. More sensors (meaning more team members) mean more chances to notice and deal with a new hazard/risk or threat.

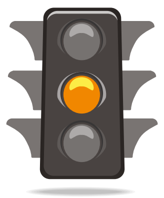
This is not just about threats to personal safety. It includes threats to the successful completion



of the task; for example, maintenance interruptions can lead to missed maintenance actions. The RoT works when team members identify the appearance of a new threat or degradation of risk controls. Team members then classify the risk according to how it fits with the existing plan and risk controls.

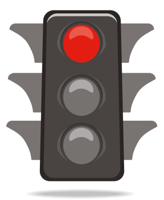


GREEN means the threat or change is within the expected limits or assumptions. An example might be a change in the weather that was expected, planned for and briefed.



AMBER means the change or new threat is approaching the limits of what the plan and briefing anticipated. The threat is not outside the limits, a single threat of this type should not stop an activity; by itself, a single amber is not a showstopper.

Ambers are a heads-up for the team, telling them to be alert for additional threats. Should additional Ambers appear, then use the RoT: three Ambers = a Red. Work should be paused or stopped and actions taken to re-plan.



RED means the change, new threat or risk is completely outside of planning or risk controls or it becomes apparent that something dangerous (something without any controls) is about to happen. The activity should be paused immediately and actions taken to address the situation.

The RoT provides a common language to discuss emerging threats to the task. Team members need briefing on this language so they can effectively adopt, practise and understand it, following appropriate style, tone and level. Successful use of the RoT depends on trust within the team.

Often, the rank or experience difference between team members can act as an obstacle to timely communication of developing or emerging threats or risks. This obstacle is greatest for junior members, such as a newly arrived team member. A junior member may notice an approaching threat or risk and may not feel confident to share it with a supervisor. Using the RoT descriptors can help remove that obstacle. Again trust is key to encouraging this communication.

Mistakes using the RoT are not always avoidable; perhaps a team member will perceive a threat accounted for in the plan, but they still bring it to the attention of a supervisor. How the supervisor reacts to this situation will influence the success of the RoT within the team.

If a team member makes such a mistake, the supervisor should listen and acknowledge the concern, and then, when time permits, debrief and use the occurrence as a learning point. However, if the threat/risk is a real one, the team will be aware of the potential threat and can react accordingly.

PEAR

The PEAR Model helps in both planning and the application of the RoT by assisting identification of potential concerns, hazards and risks. The acronym is comprised of four simple words: people, environment, actions and resources.

People

People refers to the humans in the system and all the associated complications. Looking at the different aspects of the people involved, the range of factors that are relevant during DRM and planning emerge.

Potential factors include:

- team members becoming stressed or fatigued as the task progresses
- a supervisor not accounting for the inexperience of a new team member
- junior members making assumptions based on irrelevant details.

DOING	THINKING	INTERACTING
physical limitations	knowledge	team structure
sensory limitations	experience	role definition
health	attitude	leadership
training	motivation	followership
competence	confident	supervision skills/needs
authorisation	workload	interpersonal conflicts
briefing	fatigue	communication
fatigue	stress	mentoring

Environment

The environment is more than just the physical environment; it also relates to the broader organisation and its associated culture and pressures. Taking into account both physical and organisational factors creates a more comprehensive understanding of the environment.

PHYSICAL	ORGANISATIONAL
weather	management style
location (inside/outside)	leadership
facilities/workspace	staffing levels
lighting	size/complexity
noise	priorities
distractions	pressures
housekeeping	morale
hazards	norms
shift (day/night/late)	culture

Actions they perform

This refers to the actions the team must perform to complete the task. Singling these out helps the team identify any specific areas that might increase the risk of error.

These include:

- information requirements
- knowledge application
- supervision requirements
- preparation
- skill application
- inspection requirements
- briefing/debriefing
- communication requirements
- documentation requirements
- sequence of activity
- task management
- certification requirements.

Resources necessary to complete the task

Resources on which successful completion of the task depends range from time to materiel to budget. Inadequate resources can lead to serious mistakes.

These include:

- time
- tech manual
- heating/cooling
- other personnel
- procedures
- facilities
- training
- data
- fixtures
- consumables
- paperwork/signoff
- signage
- spares
- tools
- quality systems
- PPE
- test equipment
- ground support equipment
- computers/software
- lighting
- work stands.

The effective use of PEAR and the RoT rely on the possibility to call 'Knock it off' or 'Time out'. Neither term is a call to pack up and head home. Instead, they flag that the situation needs to be re-examined and stabilised to a safe position before addressing the concern. Only after that has been achieved , can the task continue in a risk-controlled manner. Everyone, regardless of rank, needs to be empowered to use these terms without fear of repercussion.

Using the RoT in conjunction with PEAR provides a relatively simple method for identifying and responding to changes that can occur in the operating environment.

Bringing DRM and ISRA together

This diagram shows the relationship between DRM and ISRA.

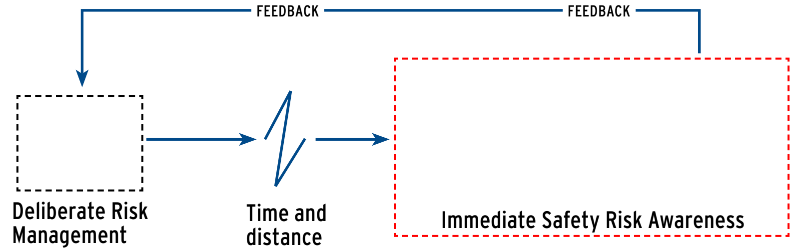
DRM is separate from the task in time and distance.

ISRA is part of the PBED task planning and checks the continuing applicability or suitability of the existing DRM. Additional DRM or implementing additional controls may be necessary.

Next is the execution phase in which the RoT and PEAR help maintain risk awareness and protect the team and the resources such as aircraft.

Successful ISRA depends on processes, structures and systems as well as good communication. The Seven Step Risk Management process underpins OIP. The Rule of Three helps works maintain risk awareness while performing tasks or activities and communicate changes effectively in comprehensible language. Recognising people, environment, activities, resources helps us identify when hazards and risks are present.

The framework of plan, brief, execute, debrief provides the structure to help consistently prepare for and conduct a task or activity and manage conversations about how it went. Using these tools will develop facility with risk management before, during and after events.



Deliberate Risk Management

When:
- Design, Development, OT&E, activity planning

Who:
- Designers, manufacturers OT&E agendes, Operational Commands/units

What:
- Manuals, Safe Methods of Work, SOPs, DIP, Flight Profiles, Handing notes, Risk Management Plans (CRP, MRP and RMP)

Immediate Safety Risk Awareness

When:
- Just Prior to an activity

Who:
- Supervisors, Task participants

What:
- Confirm task is within the parameters of exist Inc DRM (OIP)
- DRM confirmed as valid, relevant and understood by task participants
- Controls are in place
- PBED/PEAR

When:
- During execution phase

Who:
- Supervisors, Task participants

What:
- PBED
- PEAR
- Rule of Three (RoT)

Harnessing the power of breath

Aircrew Controlled Breathing Cycle (ACBC)

By SQNLDR Benedict Whalley
Aviation Medical Officer,
Institute of Aviation Medicine

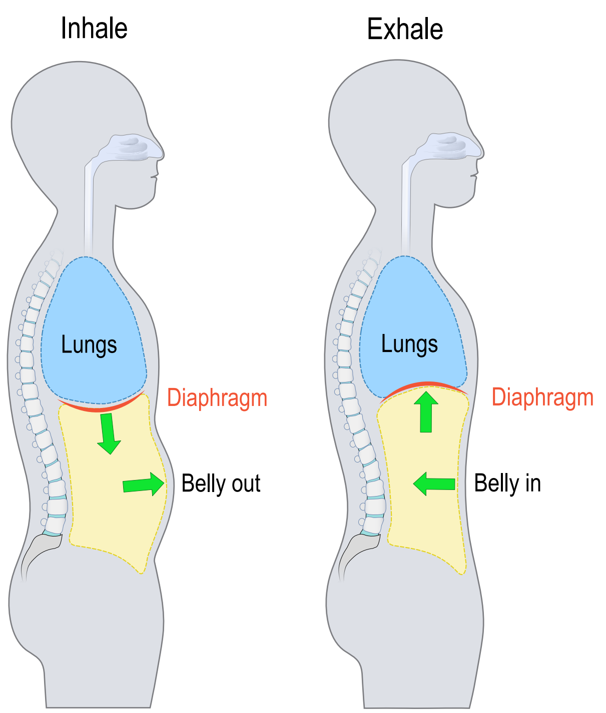
DEEP AND CONTROLLED breathing has a multitude of health benefits. It is no coincidence that focused breathing is at the heart of many age-old health practices, including yoga and meditation.

Respiratory dynamics measure the rate and depth of breathing, as well as the effectiveness of gas exchange in the lungs. This complex lung function is heavily impacted by posture, Aircrew Life Support Ensemble (ALSE), and even the subtle airflow restriction that a mask may create. Combined with increased workload, G-forces and mental stressors, these influences can degrade an aviator's physiology, ability to function and performance.

Physiological episodes (PHYSEPs) are occurrences where aircrew experience unexpected or unusual symptoms, or unanticipated performance degrade during flight operations. These occurrences pose a significant risk to flight safety. There is a multitude of potential causes of PHYSEPs and their management should be in accordance with local Orders, Instructions & Publications (OIPs) and checklists.

What is the Aircrew Controlled Breathing Cycle?

ACBC is a technique to control your rate and depth of breathing. A deep breath should primarily engage the diaphragm. The focus should be on the belly going out (a sign of the diaphragm descending), with minimal chest expansion.



Aircrew Controlled Breathing Cycle (ACBC)

Breathe in. Take a slow, deliberate deep inhalation over approximately 5 seconds. Mnemonic: Breathe in, 2, 3, 4, 5.

Hold. Hold the breath for 3-5 seconds. Hold, 2, 3, 4, 5.

Breathe out. Slowly exhale, over 5 seconds. Breathe out, 2, 3, 4, 5.

Rest. Take 5 normal breaths.

Repeat. Repeat up to 5 times, if time permits or if symptoms persist.

Cough. A few deep coughs will assist to open basal alveoli.

Note: If 5 seconds is too long/difficult, start with 2-2-2, then 3-3-3, et cetera.

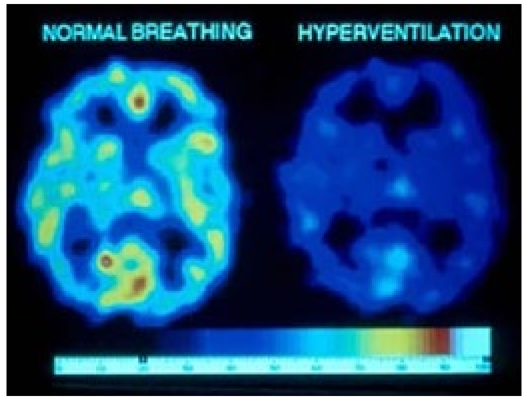
Why do ACBC?

The cause of a PHYSEP can be complex and multifactorial, and aircrew should not attempt to determine the cause, especially while under the increased stress and cognitive workload in the moment. Significant contributors may include hypoxia, hyperventilation, atelectasis, and psychological stress.

Hypoxia. A deficiency of oxygen will invariably cause symptoms of hypoxia. Symptoms may include impaired cognitive function, light-headedness, air hunger, hyperventilation, facial flushing, tingling in the fingers, and anxiety. The only cure, in an aviation setting, is to increase oxygen supply and use effective deep breathing.

Hyperventilation. A normal physiological reaction to a stressful situation, part of the inherent 'fight or flight' response. Physiologically, hyperventilation occurs when breathing exceeds metabolic demands, removing more carbon dioxide (CO2) than is being produced. This low CO2 in the body (hypocapnia) can result in a variety of symptoms.

A number of these hypocapnia symptoms may be similar to those associated with hypoxia, and distinguishing the cause is often not possible. Use of oxygen will correct hypoxia, but will not correct hypocapnia. Utilisation of ACBC will assist in the management of both hypoxia and hypocapnia, and is effective in combination with oxygen in the case of a suspected PHYSEP. With hypocapnia, controlled breathing can also assist the body to restore normal CO2 levels, which in turn supports the return of normal cognitive function and a reduction in symptoms.

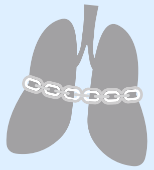


After one minute of hyperventilation, blood flow in the brain reduces by 40 per cent. Image credit: Peter Litchfield, 2003

Symptoms of hypocapnia can include:

- reduced cognitive function, confusion or 'brain fog' (due to reduced blood flow to the brain)
- shortness of breath
- dizziness or light-headedness

- chest pain or tightness
- tingling or numbness (particularly in the fingers or lips)
- palpitations (feeling your heart is racing, pounding or fluttering)

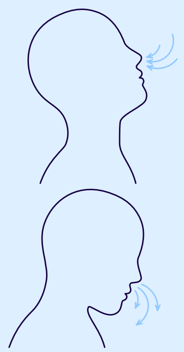


- sense of impending doom and/or panic
- anxiety and/or fear.

Atelectasis. The progressive collapse of basal alveoli in the lungs. Acceleration atelectasis is common when there is the combination of high-percentage oxygen (above 60 per cent oxygen), restrictions to deep diaphragmatic breathing (such as when wearing ALSE and sitting hunched in an aircraft), and with exposure to greater than 3G. It can result in a reduction of lung capacity by up to 60 per cent, and will increase susceptibility to PHYSEPs. A couple of deep coughs will help to reinflate the basal alveoli and reverse this atelectasis. The use of strategic air breaks (SABs) – where the oxygen mask is removed only when cabin altitude is less than 10,000 ft – combined with ACBC is another effective strategy to mitigate atelectasis, particularly in the setting of high-percentage oxygen supply. See 82WG SI(OPS) 03-17-01 *OBOGS Use and Limitations* (Reference B) for more information.

Psychological stress. The benefits of deep and controlled breathing go well beyond preventing PHYSEPs and reducing anxiety.

Benefits of deep and controlled breathing:



- reduction in stress
- lowering of blood pressure
- improved mental health
- increased exercise tolerance and fitness
- improved cognitive performance, with enhancements in:
  - attention
  - situational awareness
  - short-term and working memory
  - decision-making
  - learning.

When should I do ACBC?

- As part of PHYSEP emergency recovery procedures (emergency oxygen, control rate and depth of breathing).
- Pre-G, Post-G or any physically or mentally demanding stages of flight – this includes before take-off to reduce stress and improve focus.
- When there is a suspected PHYSEP and you are assessing the situation.
- Any time you feel 'washed-out', 'not 100 per cent' or fatigued.
- If you feel motion sickness, disorientated or notice shallow breathing.
- Any time you remember to! With practice, it will become habitual.

Conclusion

Following a suspected PHYSEP, ACBC in combination with appropriate oxygen delivery will improve symptoms caused by hypoxia, hyperventilation, atelectasis and stress. More broadly, ACBC can also reduce anxiety, improve performance and have significant health benefits in the short and long term. ACBC should be easy and calming, but to become habitual and effective it requires regular practice. Why not try it right now?

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Jones M, Harvey A, Marston L, O'Connell NE. *Breathing exercises for dysfunctional breathing/hyperventilation syndrome in adults.* Cochrane Database Syst Rev. 2013

Hyperventilation

We breathe in oxygen and breathe out carbon dioxide. The balance of these elements keeps our bodies running efficiently and maintaining that balance is the result of breathing.

The levels of oxygen we need depend on activity: exercising increases oxygen and carbon dioxide, relaxation decreases them.

Anxiety interrupts this balance and sometimes we inhale more oxygen than we need; this is called overbreathing or hyperventilating.

The Aircrew Controlled Breathing Cycle is a powerful technique to manage the effects of hyperventilation.

Source: Calming techniques – breathing training (healthywa.wa.gov.au)

Surprise me

Critical thinking in authorisation

By MAJ Drew Burkitt

TYE SPENT 15 years in Army, mainly within Army Aviation. He completed three rotations to Afghanistan on Rotary Wing Group (RWG), was an Aviation Safety Officer (ASO) domestically and on operations.

Tye filled Troop commander, Qualified Flight Instructor (QFI) and CH-47F Chinook Standards Officer roles, and he was the Authorising Officer of the Class A Chinook accident on 30 May 2011 in Afghanistan that resulted in a fatality.

Presenting to a class of future authorising officers, some aviation safety officers (ASO) might shy away from sharing a 'Notice to Show Cause for Censure' from the Chief of Army. From another person, this admission might have turned everyone in the audience against the idea of ever wanting to be an authorising officer or ASO. However, brutal honesty was always one of Tye's leadership traits. He didn't produce the notice to raise fear but to draw attention to an essential accountability and supervision aspect of military flying operations: the authorisation process.

From his perspective, the authorisation process directly contributes to safe flying operations, a view not tarnished by the accountability challenges raised during the Commission of Inquiry that followed the accident.

I've often wondered about the authorisation process and how it could be improved. Would changes within that mission's authorisation brief have prevented the events of 30 May 2011 and saved LT Marcus Case's life? As the captain of that aircraft, we could have done more to correct the safety problems within the system, including at the authorisation brief.

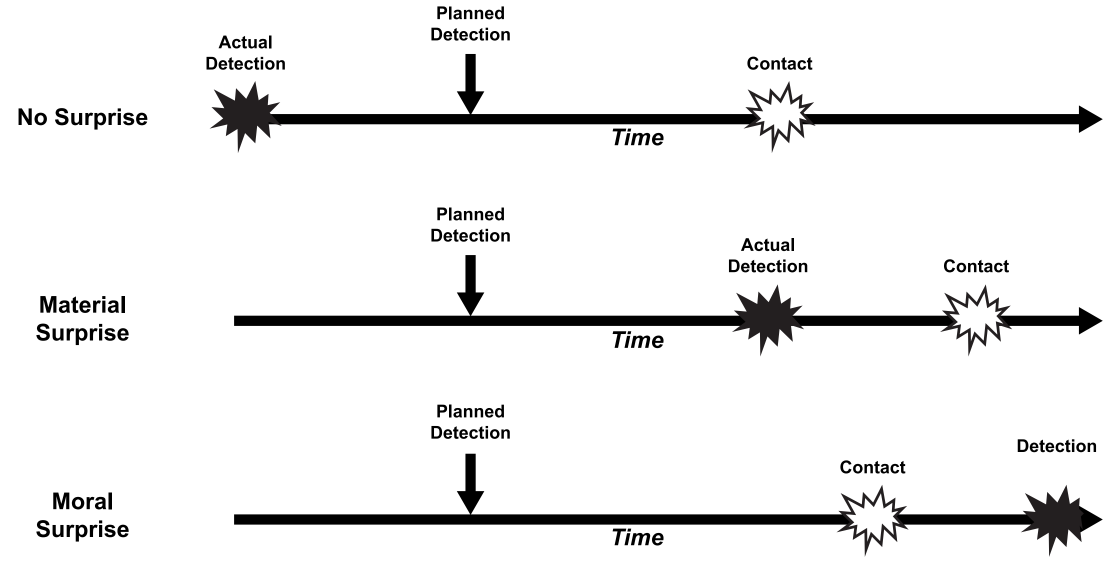

Figure 1. Identifying three types of surprise

Introduction

This article performs two roles. As an information piece, the authorisation concept warrants consideration as a critical preventative measure for safety events. While the aforementioned example directly relates to crewed flight operations, I hope you'll appreciate its applicability to any workplace where indirect supervision exists.

This article will also focus on how critical-thinking techniques and structured consultation are the secrets to finding the unknown-unknowns (Evans, 2013, p.192) that can remain undetected within organisations and may contribute to safety events.

Pre-empting surprise

Whether flying or ground related, any complex operation will always be a human endeavour. While there is a compelling argument that artificial intelligence and quantum computing will ultimately replace the human in the loop, this is unlikely to be realised in the near future. Therefore, in the meantime, we simple humans will have to continue to operate complex systems in a way that manages complexity (Long, 2018, p. 57).

Risk management principles provide the best tools for interacting with these complex systems to obtain significant capability advantages. While I'm a convert to the simplicity of these principles for understanding the *management* of risk, I don't consider them effective for *identifying* risk. For identifying risk, you need a different method. Risk intelligence (Evans, 2013, p. 23) is a form of preparedness and using this framework can help us avoid surprises.

Surprise may appear an odd term in a modern safety management system; however, in its most basic form, surprise is when a person is in a situation while in relative unreadiness (Leonhard, 2017, p. 180). It follows that unreadiness is a period before a person can initiate a response. Such a response will depend on two specific factors: the actual detection of the issue, and the planned detection. Figure 1 illustrates this concept, identifying three types of surprise (Leonhard, 2017, p. 180).

No surprise: the actual detection occurs before the planned detection, allowing for effective response initiation.

Material surprise: the actual detection occurs after the planned detection. There is a degree of surprise though this delayed detection results in a hastened need for a response.

Moral surprise: the actual detection occurs after both planned detection and the response, resulting in either an absence of time to respond, no consideration of response options or an incorrect response.

The significance of surprise in aviation operations is that avoiding surprise minimises risk. Developing systems that allow for earlier detection or increasing the time available for a response achieves this result.

As a human interaction, the authorisation process relies on knowledge-sharing and allows one to consider potential detectable issues. The process is, therefore, preventative in nature and seeks to pre-empt surprise. It does this by moving, or keeping, the actual and planned detection before the potential event, to allow for greater response time. However, this can't be achieved if the quality of critical thinking isn't adequate.

Critical, curious thinking

> 'Most people would rather die than think; many do.'
>
> – Bertrand Russell (quoted in Hoffman, 2017, p.243)

Critical thinking is crucial for aviation safety; arguably, without it aviation operations wouldn't have been created in the first place. The emphasis resides on the thinking process, including the cognitive realities of being human.

Human cognitive biases and heuristics can create systematic errors or inappropriate shortcuts that can introduce errors (Hoffman, 2017, p. 69). Awareness of such limitations creates the ability to mitigate their effects on individuals' perspectives, which is why it is beneficial to have an authorising officer who understands the process of work undertaken, and is not focused solely on the outcome.

Planners can maintain a level of independence when an authorising officer remains detached from the detailed task or mission planning. Where this detachment lies is an important distinction; too much detachment removes the member from the level of awareness and understanding of the operating context. Conversely, insufficient detachment removes a layer of independence that can allow for objectivity. Therefore, the authorising officer must make a deliberate distinction of which tasks require which oversight.

In many institutions, command and authorising officers can detail this distinction. This is a valid method of accountability, though it relies on hierarchical positions linked to experience-based assumptions of perspective, both of which become challenges for critical thinking processes. As hierarchies 'tend to encourage compliance and reward conformity, rather than encouraging questions' (Hoffman, 2017, p. 234), the sharing of ideas can become one-sided. Alternatively, relying on experience can mean thinking within current or known constraints instead of finding of new perspectives (McCord, 2017, p. 65). Such extremes reinforce the notion that the thinking process is more important than the structures to establish the process of authorisation. The critical thinking process should be the focus of authorisation.

There are many means of obtaining better independent thinking processes. In the following formula, P represents 'performance improvements' with the up arrow being 'insights' and the down arrow being 'errors'. It follows that focusing on avoiding errors is only half of the increased performance equation. Driving performance gains not only requires

a reduction in errors, but also new insights (Hoffman, 2017, p. 62).

P = ↑ + ↓

By focusing on offering insights, the authorising officer can use open-mindedness to anticipate issues that might affect the task. The concept does not only rely on fixing the problem but also on improving the situation (Hoffman, 2017, p. 243). Accordingly, the authorising officer should use a question set with these aims in mind. These questions may improve situations based on specific triggers or phrases, big-picture thinking or an intended versus normal comparison, outlined in the adjacent table (Long, 2018, p. 36). At a logical point, the authorising officer should mark a 'good idea cut-off time' to transition from authorisation to execution (Hoffman, 2017, p. 124).

Structured consultation: mission command

Where pre-task consideration and execution diverge, it's natural to consider the roles of the authorising officer and the member executing the task separately. Physically, this is often the case with the authorising officer remaining in a semi-fixed location and the member actively participating in a task separate from the authorising officer. Within military circles, this rationale relates to the concept of mission command whereby leaders focus on and explain the task with clarity before giving room to subordinates to work out how best to achieve it (Lessons and Doctrine Directorate, 2021, p.34). This concept of human interaction is also helpful for authorisation. As depicted in Figure 2 (The Cove, 2021), mission command, represented as effort versus time, falls into four sections worthy of consideration: preconditions, plan and authorisation, and execution.

Preconditions naturally precede the tasking in a way that sets the

Trigger phrases of uncertainty (words that warrant consideration):

- assume • suppose
- expect • guess

Key phrases of criticality (questions that can be revealing)

- So what? • What next? • What if?

Big-picture thinking (zoom out to consider the larger concept or issue)

- How could this fail? What can I suggest to improve the situation?
- Does this achieve the mission/higher commander's intent?
- Does this achieve the customers'/clients' intent?

Intended vs normal comparison (Comparing the 'should' and the 'is')

- Intended: the way work is intended to be done.
- Normal: the way work is normally done.
- Done: the way work was done – the realm of learning.

conditions for success in the later sections. While it is possible to execute tasks with degraded preconditions, risk is directly associated with critical thinking and, ultimately, the effectiveness of any pre-emption of safety-related issues. Importantly, preconditions take time and effort to develop. Professionalism, organisation culture, and command commitment directly affect these aspects.

As the task is accepted, the amount of time and level of planning effort for the authorising officer and members executing the task rapidly increase (Figure 2), yet the pinnacle of effort and time remain different. This difference, illustrated by the graph, helps distinguish the structured consideration of authorisation. The authorising officer initially exerts effort to enable planning of the task by the member executing it, who puts in a higher level of effort later. As the authorisation occurs within this section, the physical briefing joins the two levels of effort simultaneously. Where the difference between the levels of effort is slight, the level of independence of the authorising officer may be concerning. Conversely, where their difference is excessive, the authorisation may lack critical analysis due to eroded preconditions. The optimal delta between these levels of effort largely depends on how that organisation prescribes structured consideration.

The structured consideration doesn't necessarily have to finish at the authorisation brief. During the execution section – the purpose of authorisation – there remains an opportunity for the authorising officer to continue to provide valuable input. The authorising officer can continue to provide input while being careful not to erode the disciplined initiative of members executing the tasks, and noting extant boundaries and limitations. Such input may be on a 'push' or 'pull' basis or at predetermined decision points that release pressure on the members conducting the task.

Key at this stage is noting that preconditions, planning and authorisation are part of a network that achieves superior execution.

Authorisation reflection

So, when I consider the discussions with Tye on 30 May 2011, I can recall the two of us chatting in his office, at the flight line and sitting on the ramp of the Chinook. Our discussions were about pre-empting surprise within the mission, and we applied critical thinking to the discussions. How did untreated risks work their way into the mission? Why was LT Case on the aircraft? Why was he allowed to sit on the edge of the

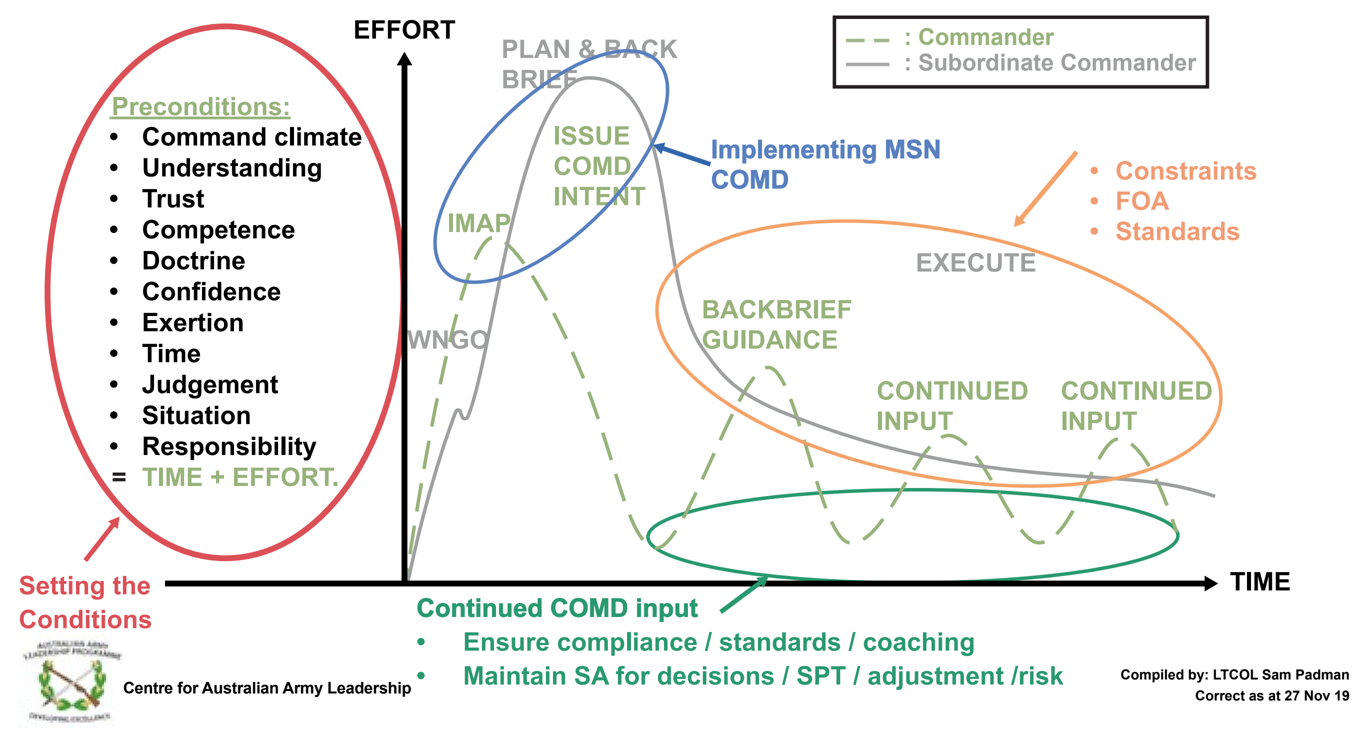

Figure 2. Effort versus time

ramp as a crew member when in fact he was a passenger? The answers are within the authorisation system and have their basis within the many other pre-conditions especially normalisation of certain procedures.

Of course, we could have done better in the authorisation process; finding out these issues because of an accident is far worse than finding them pre-emptively.

Conclusion

Appropriate authorisation is an imperative when using complex systems to achieve superior task execution. As a preventative concept, authorisation should be a key aspect of preparation because it can help avoid operational surprises. The authorisation's quality relies on the critical thinking ability of those involved. The authorising officer's independence and ability to follow a known, understood and practised thinking process is more important than the structure itself. Though the structure is essential, it should not simply be considered as the checklist or briefing conducted between individuals. Instead, the structure, like mission command, includes preconditions, planning and authorisation, and execution. I suggest that considering how this structure is developed and practised within organisations can increase success in task execution.

Without practising critical thinking within a structure, it will be difficult to avoid surprise. The questions and conversations that should occur prior to any day-to-day activities (including authorisation) should be the same as those asked by investigators post an accident (Long, 2018, p. xiv). Normalisation of critical thinking methods can drive generative safety cultures. While Tye's Notice to Show Cause was not upheld, I wish that in our authorisation brief that day, we had asked the questions that found the answers, which would have prevented the accident.

What questions are you asking?

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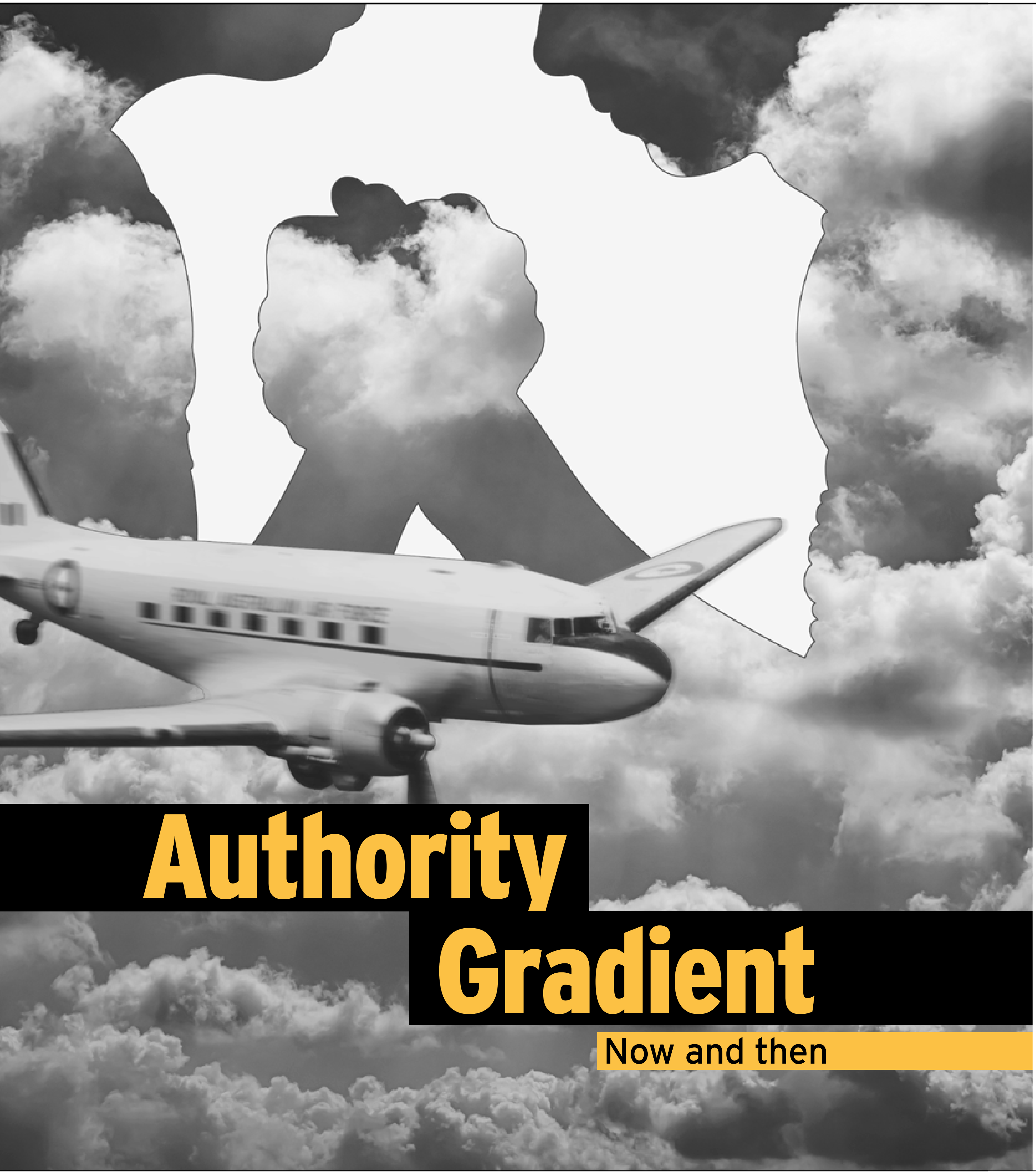


Authority Gradient

Now and then

By Alice Grundy

RESPONDING TO THE 02 2022 edition of *Spotlight*, former RAAF pilot Ron Lawford wrote to share his experiences in Darwin in the 1960s. Lawford captained Vampires and Dakotas with co-pilots who outranked him on the ground. His stories bring to life the tension pilots feel when confronted with an authority gradient in the cockpit. While the aircraft have changed, the dilemma has not.

Growing up in Perth, Lawford had not considered the possibility of being a pilot, in part because of his family's modest circumstances. In 1952 at the age of 14, he signed up for the Air Training Corps (now Australia Air Cadets) and went to Swanbourne rifle range every Saturday to fire .303 rifles, Thompson submachine guns, Bren Guns and throw grenades.

He was awarded a flying scholarship from the Air Training Corps in November 1955 and had his private pilot licence by February 1956. By the time he turned 18, he had 75 hours flight time, mainly on Tiger Moths. When he aged out at 18, Lawford undertook teacher training, until he learned about the RAAF direct entry program. His application was successful, and Lawford joined 34 Pilots Course at Uranquinty in July 1958.

Learning to fly

While posted at Number 38 Squadron at Richmond, New South Wales, Lawford trained in the right-hand seat (RHS) of a Dakota with a Qualified Flying Instruction (QFI) in the left-hand seat (LHS).

To develop his skill-set, the QFI would simulate flying and losing control on takeoff or landing, handing over control for Lawford to recover. His logbook was endorsed 'RHS Captain'.

Shortly before leaving 38SQN for Darwin, Lawford recalls the flight commander SQNLDR Bill Kerritz saying, 'When you are in command of the Dakota in Darwin, the buck stops with you regardless of who is flying the aeroplane'. This advice would prove highly influential for the young pilot.

Darwin, 1961–2

On posting, Lawford found the Commanding Officer (CO) Base Squadron, WGCDR Claude Browne, and Officer Commanding (OC) RAAF Darwin, GPCAPT Dixie Chapman, had no more than 20 hours flying time each on Dakotas. Neither had much recent experience with tailwheels. Lawford quickly realised he would have to be his own supervising pilot and monitor his own actions. A heavy responsibility for a 23-year-old flying officer.

Lawford remembers, 'I was a newly promoted flying officer, and having a wing commander as my boss on the ground but under my command once the aircraft doors closed was, to say the least, daunting. It was even more so when the group captain was my co-pilot.'

Since there were no other RAAF pilots in Darwin, Lawford often flew locally with a navigator or signaller in the RHS acting as co-pilot. Before taking off with WGCDR Browne for the first time, Lawford asked him to confirm that the young pilot would be in command and Browne would have to defer to him while in the air. Browne said he relied on Lawford to keep the Dakota in one piece.

On more than one occasion, a more senior officer made a mistake in the air but he says they were 'absolute gentlemen' who had no problems with him saying, 'taking over' or, 'I have it'. One other wing commander was not so flexible, but Lawford was conscious that a mistake by another pilot while he was in the cockpit would put them both in mortal danger.

Missing: one yacht

On 16 February 1962 GPCAPT Chapman called Lawford into his office and told him that a yacht had been stolen from Darwin Harbour. Chapman explained he thought it would be hiding in the Adelaide River east of Darwin, and that Lawford should search the Adelaide River in the Dakota on the assumption that if the thieves had hidden it under the mangroves.

AT ODDS

When a pilot is captain of an aircraft but their superior is in the cockpit, they face the perils of an authority gradient at odds with their responsibilities. While many things have changed in air safety over the past 50 years, the dangers of a mismanaged authority gradient have not. Pilots may no longer engage in dogfights over urban areas at low altitude, but it is still common for the captain of an aircraft to negotiate the conflict between inaccurate advice from their superior and their knowledge of procedure.

'When you are in command of the Dakota in Darwin, the buck stops with you regardless of who is flying the aeroplane.' This advice would prove highly influential for the young pilot.

A search of this kind would require very low flying along the river from the coast to the Arnhem Highway Bridge.

Lawford suggested taking the Darwin Aero Club Cessa 150 but his superior overruled him and determined he should take the Dakota. Lawford would fly with WGCDR Browne in the RHS. Although he initially felt the need to justify why he should fly the plane, Browne was quick to say that there was 'no way' he could do the flight himself.

The Adelaide River has about 50 or 60 loops in it between the bridge and the coast, so the search consisted of flying at 20 feet along the straight parts, and 60° banked turns around the loops, with constant rolling from right-hand turns to left-hand turns, always trying to keep low enough to allow observers to look under the mangroves. Lawford's log book records that they eventually found the missing boat at Humpty Doo with an overall flight time of 2.6 hours.

Buckingham incident

On 12 May, 1962 they went looking for the Royal Australian Navy's sloop, HMAS *Banks*, which had been out of contact for some days. It should have been in Buckingham Bay west of Gove, but the weather in the bay was very poor. There was a south-easterly wind blowing and that produced low cloud and rain over the north-eastern part of Arnhem Land. The cloud base was about 100 feet and the visibility was about 800 metres in rain. WGCDR Browne was flying from the LHS.

Given the poor conditions and the challenging nature of the flight, Lawford asked WGCDR Browne to swap from the LHS to the RHS so he could access the instrument panel directly; there was a real possibility of going from marginal visual flying weather to instrument meteorological conditions (IMC) at any time. This meant switching from relying on the pilot's view of the sky to trusting the instruments in front of them to fly the aircraft.

Buckingham Bay runs north east/south west, is about 100 kilometres long and about 20 kilometres wide. They flew on a heading of 300° and then did a left-hand turn of 180° at low level onto 120°, then a right-hand turn onto 300°, with the distance between each leg determined by the visibility, which was roughly 800–1000 metres in rain.

On each turn, Lawford had to fly with the cockpit just below the cloud base because the lower wingtip was only 50 feet above the water. Lawford briefed the navigator that they would do a creeping line ahead search of the bay, and that he should call when he estimated the edge of the bay was 15 seconds away.

Then Lawford briefed WGCDR Browne to call as soon as he saw trees ahead (or if he saw the Royal Australian Navy boat ahead), which would prompt a 45° banked 180° turn with the cockpit just below the cloud base.

The boat was not in the bay, but instead north of Echo Island where they located it a few hours later. The flight time was a total of 7.7 hours. Despite the authority gradient in the cockpit, Lawford had no trouble with his CO in the RHS, acting as co-pilot.

Pulling rank

Not all wing commanders were so respectful of Lawford's role in the cockpit. The CO of Number 2 Control and Reporting Unit (2CARU) carried out aerobatic manoeuvres in the Vampire with Lawford as pilot in command well below the generally mandated 'hard deck' of 5000 feet, and flew low at a height that left no time to react to a mistake. He liked to remind Lawford that he was a fighter pilot and had more time on fast jets. He did not make allowance for his lack of recent flying time and the cockpit gradient was a major mismatch; he treated Lawford like a junior officer whose real job was to fly the Dakota, while he was a high-time fighter pilot who knew more about flying fast jets. Whatever experience the other pilot had, Lawford was responsible for the Vampire and it took flagging the problem to WGCDR Browne for Lawford to see a change to this pilot's flying patterns.

Lawford reflects that the freedom he had in the 1960s was unique; he could fly anywhere from ground level to 45,000 feet in the Vampire and up to 150 nautical miles from Darwin in any direction. He had one dogfight over Darwin CBD with two Sabres. All three aircraft were below 100 feet, pulling 6-G, at full power, flying close to the rooftops. But there were no reported complaints. No reprimands. It was also at this time that he flew a Vampire and a Dakota during the week and a Cessna 150 on the weekend, clocking up around 900 hours a year.

Lawford's post-RAAF career has involved other adventures including charter flying and flying instruction as well as degrees in Commerce and Law. He remains a practising solicitor in Darwin.

Follow the LEADER

Getting the most out of teamwork

TEAMWORK IS ONE of the six core values of Defence and is fundamental to the co-ordination of a rapid and dynamic workforce able to protect Australia's borders and national interests. Without effective teamwork, Defence could not fulfil its mission. Working in Defence Aviation requires individuals to interact with other members of the unit, with personnel outside the unit and with people from different occupational and cultural backgrounds.

Effective team performance requires all members to contribute to the shared knowledge and awareness of the group and to understand when and where they might demonstrate proper leadership or followership.

Leadership

Although there are numerous definitions of the term leadership, Bryman (1986) and Northouse (2004) claim it involves a process of social influence whereby a person directs or facilitates members of a group towards a common goal. Leadership is the most important factor that influences teamwork. There are plenty of instances in the literature of aviation accidents where the captain's leadership was a significant contributing factor.

Boeing 727 collided with a Douglas DC-9 during heavy fog in Detroit in 1990

Leadership is the most important factor that influences teamwork. There are plenty of instances in the literature of aviation accidents where the captain's leadership was a significant contributing factor.

A notable example occurred in Detroit in 1990 when a Boeing 727 collided with a Douglas DC-9 during heavy fog. Eight people died when the wing of the Boeing, under take-off power, sliced through the main fuselage of the DC-9. The subsequent investigation by the National Transport Safety Board concluded that the primary cause of the accident was a lack of crew co-ordination that resulted in the DC-9 inadvertently taxiing onto an active runway. However, in commenting on the lack of crew co-ordination involved in this accident, the inquiry specifically observed that during the events immediately preceding the accident, the captain had '… tacitly relinquished his command role of the aircraft' (NTSB, 1991, p.35). Further, the first officer had '… failed to follow repeated instructions from the captain' (NTSB, 1991, p.35). Implicit among these findings was the notion that the captain's lack of appropriate leadership resulted in the breakdown of communication and co-ordination that ultimately led to the collision.

We do not need to look beyond our own borders to find instances of poor teamwork due to failures of leadership. In October 1987, during a two-aircraft route reconnaissance mission in support of an Army exercise, Kiowa A17-19 crashed after a wire strike. The co-pilot died as a result of his injuries. Significant human-factors issues emerged during the investigation, particularly in the areas of aircrew team management and cockpit authority (DFSB, 2014).

These examples all come from aircrew but evidence that leadership is important in other aviation roles is not hard to find. Data from the DFSB *Snapshot* Survey consistently indicates that there is a negative relationship between the quality of supervision and errors. In other words, when the quality of supervision is good, there are fewer errors. Furthermore, the relationship is stronger for maintainers than it is for aircrew, suggesting that leadership is even more important in the maintenance environment.

The impact of leadership across different aviation roles is a major issue. What is clear is that the role of the leader within the aviation industry carries with it a significant level of responsibility. One of the most dramatic examples of ineffective leadership within the aviation environment involves the crash of a Boeing B-52 bomber, Czar 52, in 1994. The aircraft was piloted by a senior officer who had been authorised to practise a series of manoeuvres in preparation for an airshow. Upon preparing to land at the end of the practice run, the crew was required to execute a go-around because of another aircraft on the runway. At mid-field, Czar 52 began a tight 360° left turn around the control tower at only 250 feet altitude above ground level (AGL). Approximately three quarters of the way through the turn, the aircraft banked past 90°, stalled, clipped a power line with the left wing and crashed. There were no survivors.

Crash of a Boeing B-52 bomber, Czar 52, in 1994

The subsequent investigation into this accident found significant errors in leadership, disregard for regulations, and breaches of air discipline at multiple levels. Most alarming was the failure of senior officers to act when the pilot had breached regulations on multiple occasions in the past.

His reputation as a skilled pilot appeared to shield him from disciplinary action. One senior officer remarked he 'is [as] good a B-52 aviator as I have ever seen'. However, junior officers were not so enthusiastic, one of them commented, 'I'm not going to fly with him, I think he's dangerous. He's going to kill someone someday and it's not going to be me.' Another junior officer said, 'There was already some talk of maybe trying some other ridiculous manoeuvres … his lifetime goal was to roll the B-52.' (CTI, ND)

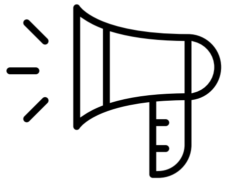
The author of the report from which the above material was taken determined, 'These failures included an inability to recognise and correct the actions of a single rogue aviator, which eventually led to an unhealthy command climate and the disintegration of trust between leaders and subordinates.'

All these examples represent cases where leadership was lacking or deficient but they do not tell us anything about how leadership should operate. One way of approaching this question is by exploring the notion of leadership styles. There are many taxonomies of leadership style; a common thread is the degree to which the leader focuses on tasks rather than relationships.

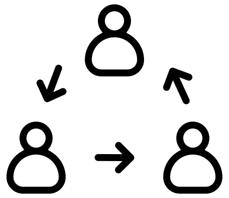
Styles of leadership

One of the most popular taxonomies identifies five leadership styles.

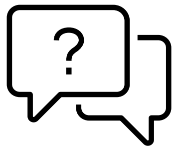
Autocratic leadership means all leader interactions and behaviours are focused on productivity and relationship factors such as social cohesion are effectively ignored.



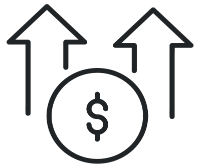
Democratic leadership is characterised by inclusive leader behaviour where followers have overt responsibility and are included in steering tasks such as strategic decision-making. Democratic leadership can be described as a balance between task-oriented and relationship-oriented leader behaviour.

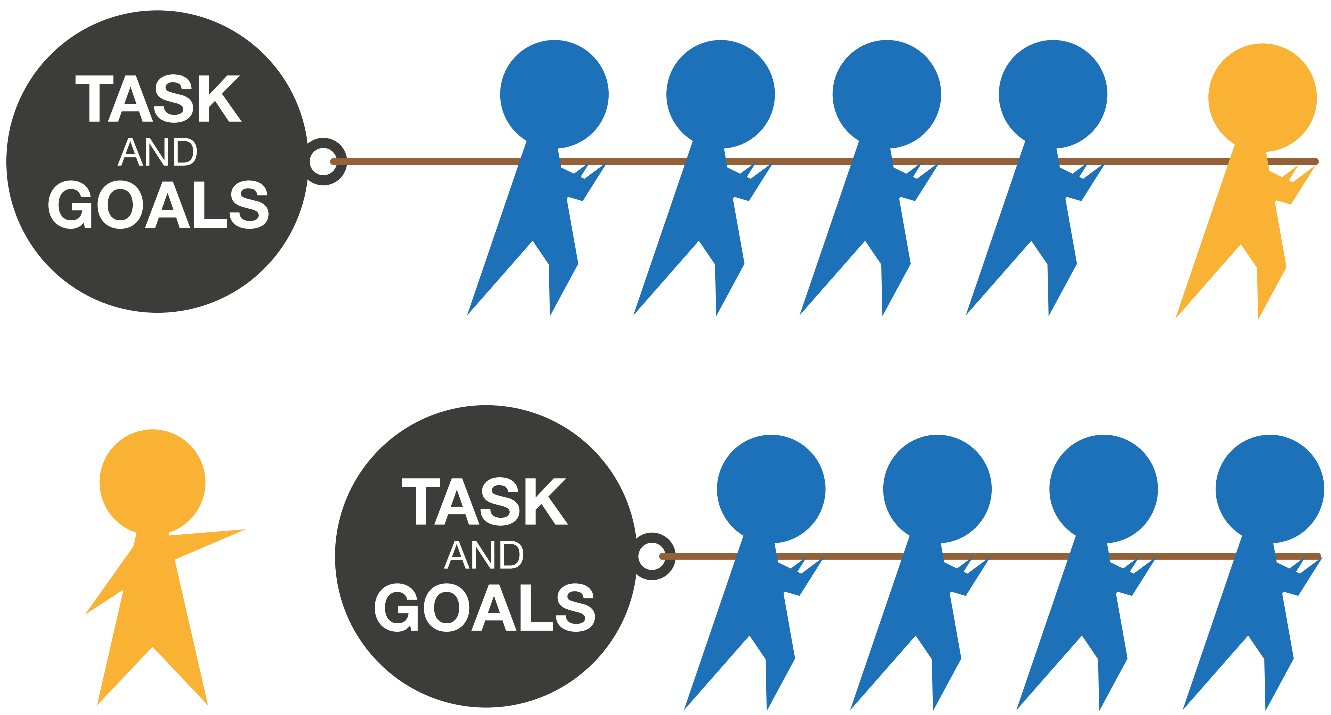


Laissez-faire leadership means the leader allows the team members to work autonomously. The leader sets tasks and goals but does not oversee how those tasks are completed or goals are met. A laissez-faire leader will provide resources upon request but otherwise leave employees to self-manage their workload. A laissez-faire style can lead to high job satisfaction but may be harmful when a team requires a high level of co-ordination among its members.



Transactional leadership focuses on the provision of rewards and punishment to influence the behaviour of its followership. All work settings are to some degree transactional in that we all work for pay and may experience punishment such as having a bonus or





promotion withheld should we under-perform. Transactional leadership focuses on maintaining organisational stability in contrast to the change-focused approach of transformational leadership.

Transformational leaders seek to influence the behaviour of employees not through financial gain but by encouraging employees to absorb the values and goals of the organisation. In this way, employees believe in what the organisation is doing and are motivated because they want the organisation to succeed. When employees care about the success and growth of an organisation, they will go beyond the minimum requirements of their jobs. Transformational leaders emphasise the importance of their followers' roles in the success of the organisation, as well as the importance of what the organisation itself is doing.

Over the years, Defence has moved from an autocratic leadership style to a transformational leadership approach. This movement has been especially evident in the safety area where the majority of personnel now accept the value of working safely.

In 2023, the *Snapshot* survey asked over 14,500 members of the Defence Aviation community whether working safely was important to them and whether they worked safely because they were compelled to do so by supervisors and managers.

Of the respondents, 81 per cent agreed that putting effort into safety is important to them and 84 per cent agreed that the chain of command/management team is genuinely committed to safety. The statement that safety is a shared responsibility had agreement from 81 per cent of respondents.

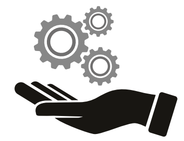
Situational leadership

Although the taxonomy described above provides a useful framework for considering broad types of leadership behaviour, Hersey, Blanchard and Netemeyer (1979) argued there is no ideal leadership style that is appropriate across all situations. Effective leaders need to adjust their styles to suit the capabilities of their subordinates. As the competency level of a team increases, the leadership style will move through four stages: directing, coaching, supporting and delegating.

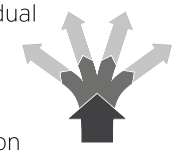
Stage 1: Directing During the directing stage, the individual or team lacks knowledge and skill and therefore requires much more guidance. Communication is predominantly one-way with the leader providing clear directions regarding the roles of individual team members and specific details on how to perform their given tasks. Defence Aviation personnel are likely to experience this style of leadership early in their careers while they are building up their competency in their profession. They may also experience this style of leadership when their role expands and requires new learning.

Stage 2: Coaching During the coaching stage of Hersey and Blanchard's leadership model, subordinates are more experienced and communication becomes two-way. The leader provides greater social support and considers the development needs of the individual and the team.

Stage 3: Supporting The competency of the individual or team means the leader can provide less direction on task execution and focus more on building team relationships and providing resources. During this stage, employees may have the necessary knowledge and skills but still lack confidence in their abilities.



Stage 4: Delegating By this stage, the leader is confident in the capabilities of the team or individual and provides less oversight on individual tasks. The leader still gives overall guidance and establishes team objectives but focuses on delegating workload to team members and providing feedback on performance.



In a leadership position, it is important to identify the performance readiness of your team and to adjust the amount of guidance and support accordingly. Leadership styles, while they may be appropriate for given situations, do not guarantee leadership effectiveness. The Czar 52 case study is an excellent example of what can happen if leaders fail to enforce standards. The next section outlines some useful strategies for achieving effectiveness.

Strategies for effective leadership

Use of authority and assertiveness. Create a proper challenge-and-response atmosphere by balancing assertiveness and team-member participation and being prepared to take decisive action if the situation requires it. Leaders also must know when to apply their authority to achieve safe completion of a task.

Providing and maintaining standards. Encourage compliance with standard operating procedures, rules, and regulations. Intervene if necessary.

Planning and prioritising. Apply appropriate methods of planning and prioritising for tasks and delegate roles to achieve best performance. The communication of plans and intentions is important.

Managing workload and resources. Leaders must manage not only their own workload and resources but also those of the team. This strategy may require organising task-sharing to avoid workload peaks and dips. Causes of high workload include unrealistic deadlines and under-resourcing.

Consider the developmental needs of your team. Leaders should move through different stages of situational leadership to accommodate the increased competency of their teams (see Figure 1).

Avoid role ambiguity. Ensure all team members understand their roles in each task and how they personally contribute to the overarching team goals. This understanding forms through task briefings.

Focus on team-member contributions. Every team member should be aware of the importance of their role in the success and achievements of their team and Defence. Job satisfaction, morale, and performance levels are

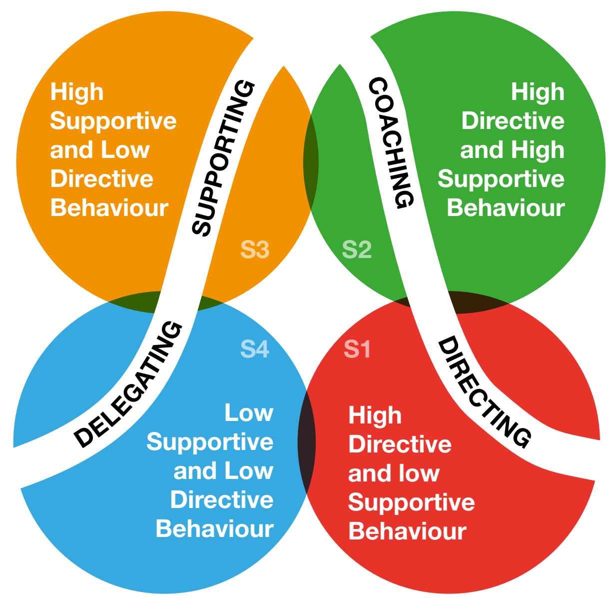


Figure 1. A situation-dependent model of leadership styles

higher when people feel that they are making useful contributions.

Provide feedback. It is important that leaders provide feedback on task performance, not only when an individual performs poorly but also when they perform well. When commenting on actions or inaction, it should be constructive and focus on the task.

Followership

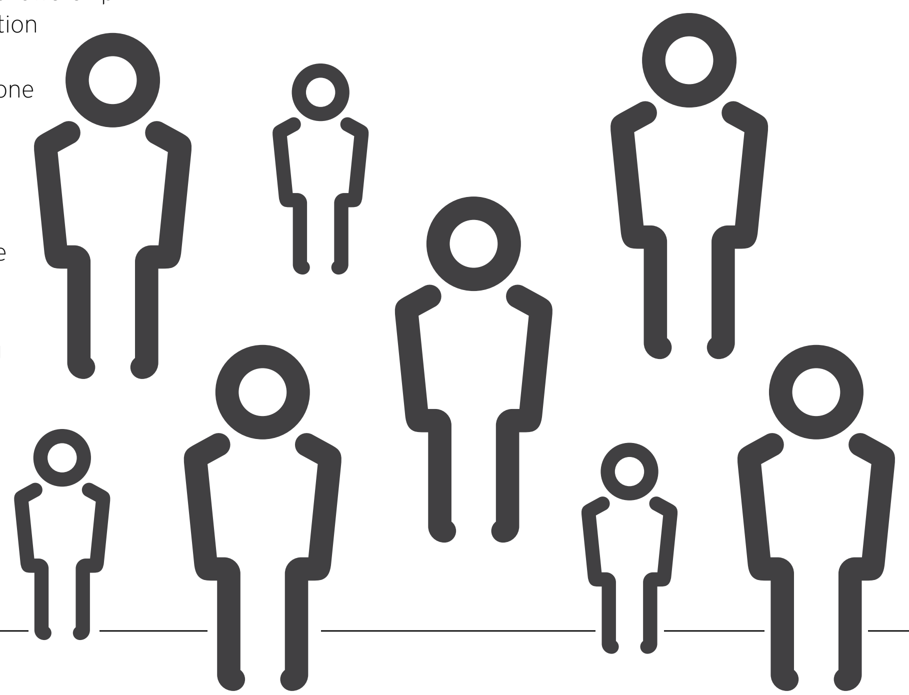
The skills that characterise effective leadership are also applicable, to some extent, to the followers within a team. Followership is the provision of support towards a common goal. It involves taking direction from leaders and providing information to team leaders.

A large component of followership is contributing to the shared mental model of the team. Therefore, a supportive role may become proactive in the interests of safety. The notion of followership has significant implications in the aviation environment, since the hierarchical nature of the aviation industry tends to inhibit, rather than encourage, proactive interventions on the part of subordinates.

Followership styles

One of the reasons followership has received less attention than leadership is the assumption that everyone knows how to follow. In reality, there are different ways to be a follower, just as there are different ways to be a leader. Kelley (1992) provided a model of followership containing five styles arranged in a grid formation. The axes of the grid represent the level of independent and critical thought

Self-management is fundamental to effective followership. Once a person has developed sufficient job proficiency, self-management should reduce the load on the person's supervisor, thus increasing team efficiency.



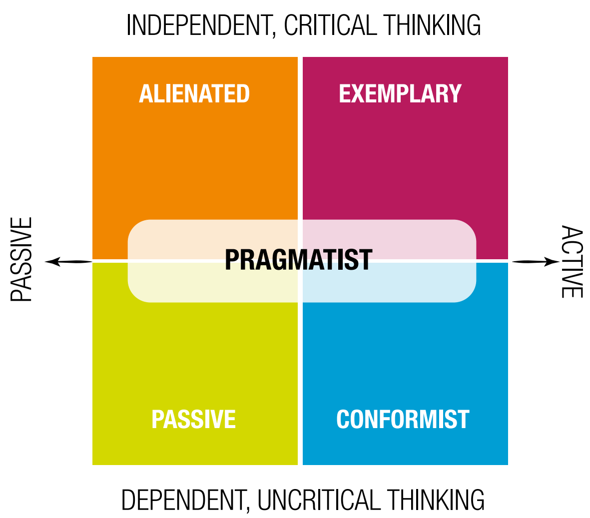


Figure 2. A situation-dependent model of leadership styles

(from dependent, uncritical thinking to independent, critical thinking) and the level of engagement in the team (from passive to active). The model is shown in Figure 2.

The interaction of the critical thinking and engagement axes gives rise to the five followership styles.

Passive followers lack self-motivation and require constant encouragement from the leader. They generally lack commitment to the team and organisation. A transactional leadership approach that emphasises performance on a task-by-task basis and does not consider the overall goals of the team or organisation may encourage team members to become passive followers.

Conformist followers are committed to the organisation and the leader but place too much trust in the judgment of the leader. Conformists are the 'yes men' of a team and do not provide information and insight to the leader. This type of team interaction can limit the shared mental model.

Alienated followers can often be exceptional critical thinkers but may seek to undermine the leader and change the direction of the team. Alternatively, alienated followers may represent the mavericks of the organisation who can offer a degree of healthy scepticism without upsetting the stability of the team.

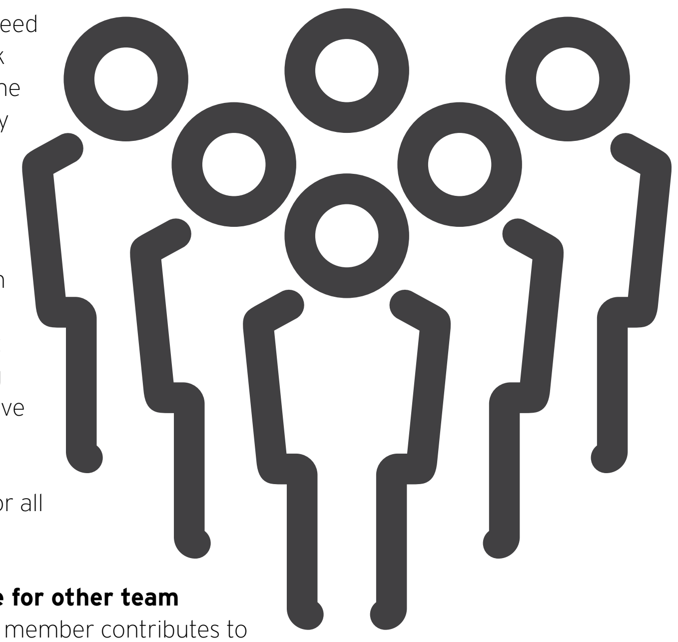
Pragmatist followers take a fence-sitter approach to any decisions or controversy in the team. They are typically the last to respond in a group decision and generally try not to stand out.

Exemplary followers are independent, critical followers who support the goals of the team. They do not follow blindly but try to work with the leader and other team members so that the team has all the information and direction it needs. In Defence Aviation, exemplary followers are essential to team performance. A team that has a high proportion of exemplary followers and good leadership is likely to exhibit all five components of effective teamwork.

Strategies for improving followership

Self-management is fundamental to effective followership. Once a person has developed sufficient job proficiency, self-management should reduce the load on the person's supervisor, thus increasing team efficiency.

Be courageous. Anyone who sees or hears of a person or group doing something that compromises safety or Defence values may have an obligation to intervene – and certainly has an obligation to report the incident. *Snapshot 2023* found that 79 per cent of respondents agreed people will speak up when someone is acting unsafely and for aircrew specifically this increases to 90 per cent. Defence Aviation promotes the concept of a just culture so taking action should have positive rather than negative consequences for all concerned.



Set an example for other team members. Each member contributes to the attitudes and shared culture of the team. By displaying exemplary followership, an individual encourages others to adopt those qualities.

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Governing complex systems

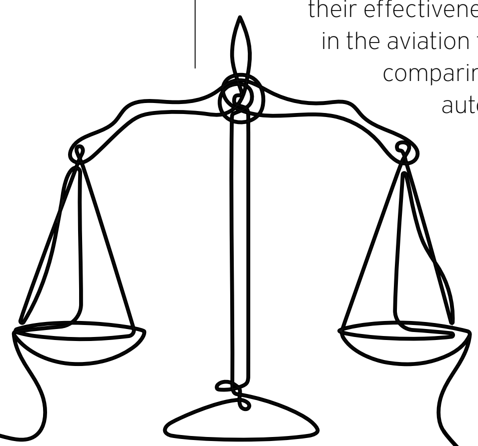
Can international organisations and governments effectively regulate safety?

FLTLT Nicolas Wenban

REGULATIONS ON SAFETY exist for one overarching purpose: to protect life. Organisations and governments introduce regulations based on historical data, expert advice and public need. Relationships between regulators and operators ensure the aviation community is familiar with relevant information and can apply it to protect all involved.

Regulations on safety are often resource intensive and time consuming. This is not beneficial for companies, especially in the aviation transport industry, when their operations depend on maximising profit. Therefore, the regulator implements new regulations only after careful consideration regarding the health of, and lasting impacts on the industry. Organisations and governments implementing regulation repeatedly demonstrate that it can increase safety, minimise risk and mitigate hazards.

This article analyses current accident-investigation processes to assess their effectiveness and regulation in the aviation transport industry, comparing it to that of the automotive industry. It considers how regulators work to continuously improve their systems to ensure policies continue to adapt to their environment and further protect their field.



The Transport Safety Investigation Act 2003 and Ministerial Statement of Expectations stipulate current investigation processes within Australia.[1] The Act and Statement outline the strategic intent for agencies conducting investigations. Specifically, the Act is the governance piece, outlining roles, jurisdiction and laws that apply to accident investigation. These include accidents within Australia and their application outside the nation's jurisdiction.

The Transport Safety Investigation Act is also the basis for the Australian Transport Safety Bureau (ATSB). It outlines the establishment, functions, and powers of the ATSB. The Minister's Statement of Expectations complements the Act by providing specific direction for the organisation's strategic intent. Specifically, the Statement provides a set list of core functions for the ATSB. These are to:

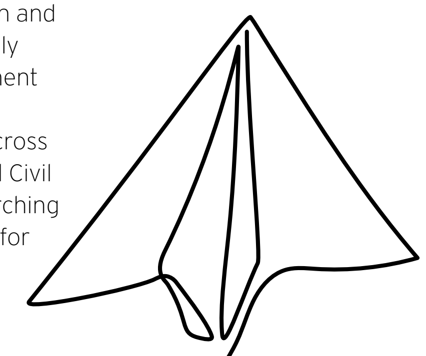
- focus on transport safety as the highest priority
- give priority to transport safety investigations that have the potential to deliver the greatest public benefit through improvements to transport safety
- while retaining operational independence, remain an active and effective participant in the transport policy and regulatory framework, working effectively with the Department, other government agencies including the Civil Aviation Safety Authority (CASA), Airservices Australia (Airservices), the Australian Maritime Safety Authority (AMSA), the Office of the National Rail Safety Regulator (ONRSR), Department of Defence, and the transport industry
- be a global leader in transport safety investigation, research and analysis, and foster public awareness of transport safety, influencing safety action
- review current investigation policies and practices to ensure the ATSB retains its reputation as a best-practice safety investigation agency and its influence on the national and international safety agenda.[2]

The key points of focus of the five core functions above are safety and culture. When assessing the current application of the investigation process, there are finite resources at hand. Therefore, it is important to maximise lessons learnt throughout the safety investigation process. There is little point in exploring the depths of accident investigation if the strategic focus is not on safety. Australia's holistic approach to accident investigation brings together safety and education. A focus on both creates a positive culture for the industry and sets up for effective communication between parties.

If a company can openly communicate with the regulator about key safety issues when the regulator is creating new policies or regulation, then the company can participate in a healthy conversation, with both parties openly negotiating. These current practices not only maximise the learning outcomes from investigations, but using minimal resources and in a relatively short timeframe, deliver an effective accident investigation capability to the Australian transport industry. This in turn demonstrates how, with clear strategic intent, direction and policy, organisations and government can work together to effectively regulate the safety of an industry.

in Australia, all manufacturing for vehicles must meet Australian Design Rules (ADR). ADR encompass such aspects as safety, emissions and anti-theft functionality.[3] Another major regulation that applies to vehicles is the Australasian New Car Assessment Program (ANCAP), which specifically tests the safety aspects of a car and assigns a rating based on its safety effectiveness.[4]

Strict safety regulation creates the tools to measure and control the safety, and therefore the quality of cars being sold in Australia. A lack of these systems could lead to critical failures that could compromise safety and thus pose greater risk to the driver, occupants and public. The aviation industry is much more complex; rather than simply following national design and safety regulations, aircraft must also comply with international standards. The environment in which transport aircraft operate clearly creates the need to maintain a presence across the globe. For this reason, the International Civil Aviation Organisation (ICAO) has an overarching responsibility, specifically in the regulation for international operators. Within Australia, CASA also implements its own design, performance and safety regulations to ensure compliance for Australian operators. This dual level of authority is necessary to uphold each nation's standard.

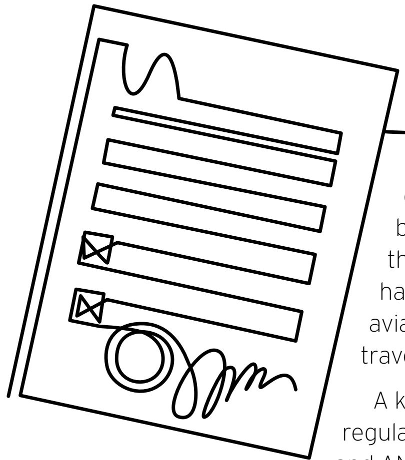


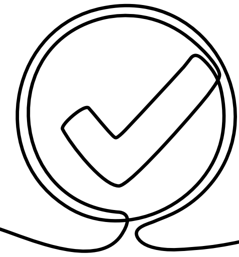
Environmental, cultural and economic differences mean that it is not viable for one regulator to operate across the world. This raises the issue of communication and cooperation between international and domestic regulators; a key issue for standardisation, communication and continued development.

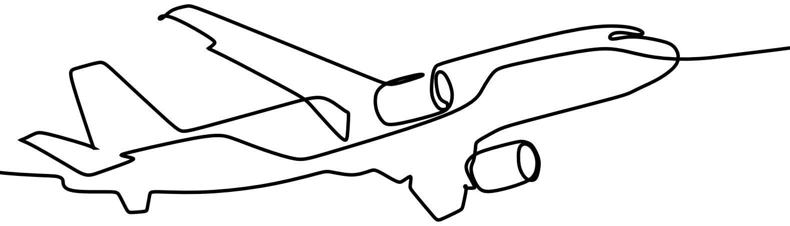
The transport industry is a $6,630.5 billion industry that grows at 7 per cent per annum.[5] This is one of the world's largest industries, which is made up of two notable contributors, the aviation industry, and the automotive industry, $2 and $4 trillion contributors respectively (Global Air Transport Industry Report, 2019–2023; Global Car & Automobile Sales industry trends 2015–2020).

Annually, 1.25 million people die in automobile accidents[6] while only 400 people die in aviation accidents.[7] Directly comparing the two, this equates to 1.22 deaths per 100 million hours travelled in a car versus just 0.4 for aviation.[8] The aviation industry is inherently more dangerous, exposed to higher speeds, greater distances, more complex systems as well as travelling in

Australia has a well-established and highly regarded aviation accident investigation process and safety reporting culture.







the atmosphere where humans cannot breathe unaided. Regulation by organisations and governments throughout the industry's history have reduced fatalities and promoted aviation as one of the safest means of travel.

A key difference between automobile regulations and aviation is that ADR and ANCAP applies to all manufacturers, operators and stakeholders, whereas within aviation a Safety Management System (SMS) cannot be broadly applied in this way. A SMS is tailored to suit each organisation it applies to. The idea that one size does not fill all is the critical difference that contributes to aviation's more effective regulation, directly enhancing safety (Safety Management Systems – Unit pg.7).

Another important difference between the industries is the training and development a SMS encompasses. The continual education and training of industry professionals is much higher in aviation than the automotive industry. This highlights the way an organisation can work in conjunction with a regulator to deliver a series of steps, such as a tailored systematic safety management process, as well as effective training to promote a safety culture and in turn foster a safer working environment. This cultural development and fostering of a safe and positive environment are other ways in which organisations can influence an industry to effectively regulate safety.

Australia has a well-established and highly regarded aviation accident investigation process and safety reporting culture. The reason this process is well respected as a globally recognised leader is the constant review and adaptation to continue to keep up with the ever-evolving aviation industry.

The ability for new technologies to revolutionise an industry in a short time is well documented, especially within the aviation world. The introduction of some of the most notable technological advancements such as the jet engine, auto-pilot, instrument landing system, black box, radio altimeter, flight management system, automatic dependent surveillance broadcast or traffic collision avoidance system are just some examples of technologies that had the ability to change the way the industry operated almost instantly.

Data capture and assessment have been crucial components of accident investigation and assessment for decades. The amount of information available in a cockpit for review and assessment is vast. The first thing the media reports after an aircraft accident is the authorities searching for the black box/data recorder. This shows the cultural perspective that root-cause analysis through data capture and research is a major portion of the investigation process.

With limited resources, relatively small workforce and the requirement to uphold strict safety guidelines and regulation, the key to sustaining such a high standard in accident investigation in Australia is through maximising the utility of resources available. This happens through collaboration of agencies. In 2019, the first FlySafe Aviation Safety Forum was conducted during the Avalon air show.[9] The purpose was a collaboration of agencies including ATSB, CASA, Defence Flight Safety Bureau (DFSB), Transport Accident Investigation Commission New Zealand and Airservices to hold open discussions on safety processes, and honest reporting to highlight safety. They also discussed how different agencies play key roles in dealing with major accidents, such as a large transport aircraft accident at an international airport.

This approach to a collaborative safety culture within the aviation industry is crucial to developing more efficient and effective investigation processes domestically. Such responsiveness will demonstrate again Australia's ability to lead the industry and shape how an organisation or government can effectively regulate safety. One of the methods of achieving this is sharing applicable investigation processes and collaboration with different subject-matter experts to ensure the best possible outcome for any investigation.

A way forward for the Australian investigation process in terms of a collective and collaborative approach would be to adopt an even closer working relationship across agencies. For example, DFSB has pooled aviation resources across the three armed services into one agency to collaborate across fixed wing and rotary wing safety issues in the military.[10] There is, however, still an ongoing need to develop and enhance its safety processes through working closely with CASA and the ATSB. This can go both ways; with Defence allocating significant resources to DFSB, CASA and the ATSB should be able to reach into this agency to bolster their workforce should a surge period occur, such as a major accident at a busy international airport.

A way forward for the Australian investigation process in terms of a collective and collaborative approach would be to adopt an even closer working relationship across agencies.

This analysis of how ATSB communicates and executes government strategic intent shows both effective regulation and shaping a safety culture. The comparison of the aviation and automotive industries highlights just how complex safety management systems can be, yet still foster two-way communication between regulator and operator to ensure the best outcome with safety in mind. It also showed how international organisations work with domestic regulators to clearly communicate intent and ensure global operations are conducted safely.

Looking at the ways organisations in Australia can enhance their accident-investigation processes through collaboration across organisations and government agencies, maximising resources and sharing expertise, illustrates that safety can be effectively regulated. Although Australian organisations and government continue to work towards safety excellence, domestic collaborations, if successful, can reach the international level once again and lead the industry in working together to ensure all operators are striving for the safest possible operation.

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Too tired to back off

By Dr Adrian Park

A captain overwhelmed by lack of sleep loses control of his aircraft

ON A LATE August afternoon in 1993, an approach to Runway 10 at Guantanamo Bay by a big jet aircraft was anything but sedate. It certainly grabbed the attention of the captain in a waiting Navy C-130:

'I saw the DC-8 on a wide right base for Runway 10. It appeared to be at approximately 1000 feet above ground level. I was interested in watching such a large airplane shoot the approach. It looked to me as if it was turning final rather late, so it surprised me to see him at 30 to 40° angle of bank trying to make final.

At 400 ft he increased the angle of bank to 60° in an effort to make the runway and was still overshooting. The aircraft's nose turned right and it appeared he was trying to bottom the rudder to make the runway. He was at 200 ft and still overshooting and my co-pilot remarked he was going to land on the ramp! His wings started to rock towards wings level and the nose pitched up. At this point, the right wing appeared to stall, the aircraft rolled to 90° angle of bank and the nose pitched down.'

The DC-8 captain, unfamiliar with the airport, had been struggling to identify the runway environment. Normally a strobe made identification easy, but the strobe was inoperative and neither the controller nor the pilots knew. As the captain looked for a flashing light that didn't exist, the tower insistently reminded him Cuban airspace was only three quarters of a mile west of the runway.

The co-pilot and the captain tried to process the warning simultaneously as well as the local airspace, the danger of a large hill on their approach, circuit traffic and a confusing entry pattern. While the crew was working through the issues, valuable miles were quickly consumed, and the airport now loomed large.

'I think you're gettin' in close,' the co-pilot said, his voice showing concern. They were high, fast and at least 90° off centre to the airport and still had not identified the runway.

'Yeah I got it, I got it … going to have to really honk it, let's get the gear down', the captain said, also stressed. 'Where's the strobe?' he asked, for at least the fourth time.

'Right down there,' replied the co-pilot who was looking at the structure of the non-operational strobe.

The captain kept looking for a flashing light while the co-pilot and engineer, who'd been to the airport before, were looking at unlit infrastructure. In their minds they couldn't understand why the captain couldn't see the runway, nor could they understand how the captain was possibly going to be able to land with such a closure rate.

'Do you think you're going to make this?' asked the co-pilot. He should have been escalating his tone, intonation and volume to an assertive, 'Let's go around!' Instead he was still conversational.

The flight engineer was more forthright: 'Shit! We're never going to make this!'

The co-pilot ignored him perhaps out of a mistaken idea he needed to keep things 'normal'. 'Five hundred, you're in good shape', the co-pilot said. The flight engineer disagreed, and he had proof – the stall warning.

'Stall warning!' he yelled.

'I got it, back off!' replied the captain. He definitely did not 'have it'. The aircraft, with a bunch of right rudder shoved in for bad effect, rolled through 60° and then snapped back to wings level in an attempt to normalise the approach path. But Flight 808 was trapped by momentum, G-forces, airspeed and the high descent rate – its nose impotently pointed skywards, and the aircraft kept plunging earthwards. With only 200 ft between 'back off' and the ground (which never backs off), the result was unsurprising.

The right wing stalled, flipping the aircraft into a 90° angle of bank and a rapid nose slice. The 140-tonne DC-8 fell out of the sky. The wingtip and the nose struck the ground at the same time and fire-balled half a kilometre from the runway. Amazingly, with the help of resolute fire fighters who ploughed their way through razor-wire perimeter fencing to get to the crash, all three of the crew survived, albeit with severe injuries.

In the investigation, a company check pilot described the captain as a good pilot who displayed good judgement in emergency handling. The captain's co-pilots said he was conscientious and good at managing crews. Therefore, we come to a profoundly important question: how does a 'good' pilot become a 'bad' pilot? Or, more bluntly, how on earth could a good pilot rack a DC-8 over to a 60° angle of bank on base turn, shove in full rudder and tell the questioning crew to 'back off' before crashing half a kilometre from a runway he never managed to identify properly?

It'd be easy to proclaim 'bad pilot', but we have it on record he was a 'good' pilot. So, what diminished the pilot's decision-making? It was a factor that was very human. It was fatigue, plain and simple. Sleep deprivation turned a good pilot into a bad pilot.

More details of the crew's duty profile can be found in the accident report but here's the gist of it: in 24 hours, zero hours sleep; in 48 hours, five hours sleep. At 16:53 local, on approach to Guantanamo when the captain told the co-pilot and flight engineer to 'back off', they'd all been awake since 18:00 the night before – about 24 hours.

They were officially knackered and their tens of thousands of flight hours, their training, CRM, decision-making, skills and judgement were all severely compromised – notably, their company policy and the regs quietly endorsed their excessive duty time. This was how a good pilot became a bad pilot.

Some may be tempted to say this was 1993 and just the 'bad old days' but recent examples abound such as UPS 1354, some 20 years later where the captain, a few weeks before his fatal, fatigue-related crash, proclaimed, 'I can't do this until I retire … it's killing me'.

Which brings us to an even more important question. If you are a modern manager, what makes you think your good and competent pilots aren't going to turn into bad pilots because of your culture or policies? And if you are a good pilot, what makes you think you'll stay 'good' under the influence of short or long-term weariness?

When the captain of Flight 808 made the call to 'back off', he was in a fatigue-befuddled state. He was saying 'back off' to advice that could have saved him, if only he could have directed his 'back off' to where it really mattered. If only managers could have backed off from their unsafe policies. If only programmers could have backed off from their 'schedule over safety' culture. If only certain 'old school' pilots could have backed off from unsafe attitudes.

Unfortunately, such a thing can never be for the crew of Flight 808. But that doesn't mean it can't be for those of us currently in the industry.

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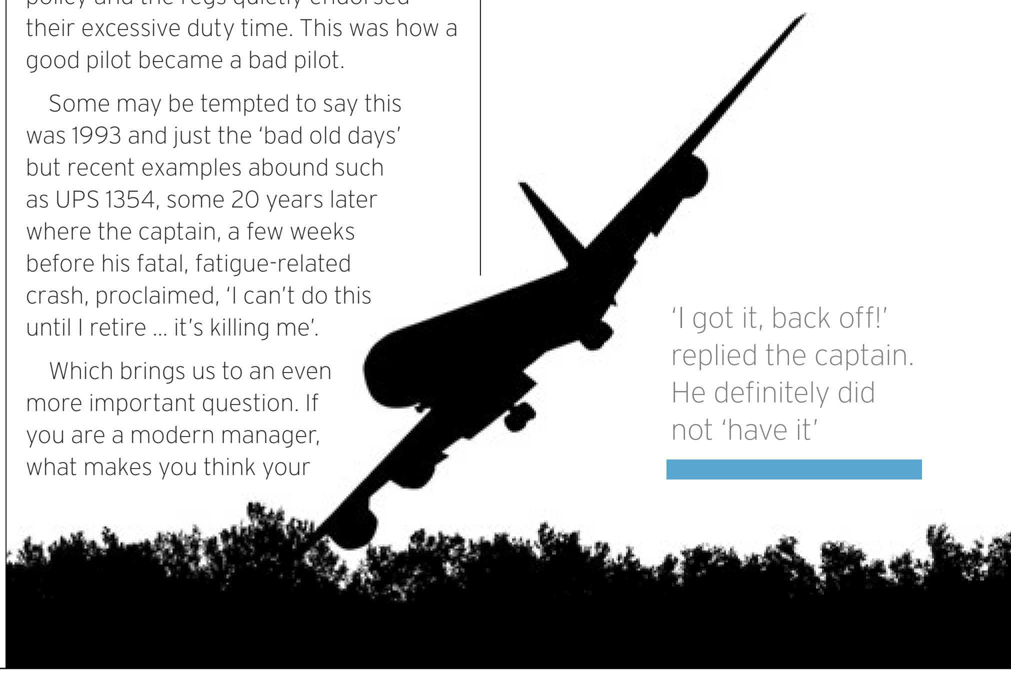


'I got it, back off!' replied the captain. He definitely did not 'have it'

By FLTLT Jake Nicholas

IN MID-2015 I was a freshly minted C-17 Air Drop co-pilot conducting my first live drop post conversion course. The belly of the C-17 contained three general cargo pallets, one rigged heavy air drop, and 52 passengers and their bags. The passengers were members of the Defence Industry Studies Course (DISC) who were flying from RAAF Base Amberley to RAAF Base Richmond, and civilians who worked for partner companies such as Boeing, Airbus and the Bureau of Meteorology. The main reason for the flight was to demonstrate the C-17's air-drop capability to our industry partners with a live drop at Londonderry Drop Zone near Richmond.

The departure out of Amberley, cruise and tactical descent into the Londonderry Drop Zone all went to plan as did the air drop – or so we initially thought. Seconds after I heard the 'Load clear' call from the loadmaster there was a call of 'Malfunction', usually it was one or the other – not both! The aviation safety occurrence report (ASOR) investigation found a mechanical failure in the extraction force transfer coupling (EFTC): a device that is responsible for transferring the lateral extraction force from the extraction chute to the recovery parachutes once the load is clear of the aircraft. This meant the load came out from the aircraft via the parachutes on top of the pallet, rather than coming out sideways, causing damage to the aircraft rail system due to the lifting/twisting moment.

What happened next was unexpected. The damage the aircraft suffered during the air-drop sequence led to a malfunction of the remaining locks, which were retaining the non-air drop cargo. As we accelerated and began our escape manoeuvre out of the drop zone, the locks released and the general cargo (including the passengers' bags) started rolling at a great rate towards the open cargo door. We later came to learn that this prompted the loadmaster's malfunction call after the completed air drop. The loadmaster's immediate reaction was to gang lock all of the remaining locks; this saved the day and stopped the pallets departing the aircraft and landing in the built-up area to the south of the drop zone. The pallets came to rest just inches from the back of the ramp and extended forward over the doors' hinge line, making it impossible to close the cargo door and ramp. After applying restraint to the now jammed pallets, we conducted a landing at Richmond with the cargo door and ramp still open in the coplanar position.

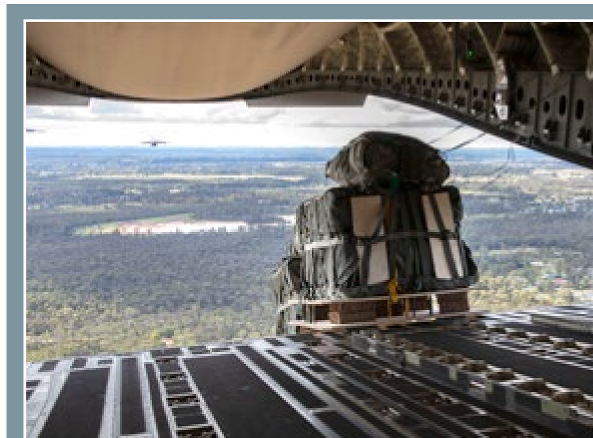
The loadmaster's technical knowledge, training, experience and currency were all critical in narrowly avoiding dropping palletised cargo on a built-up area, which could have caused significant damage to physical property, RAAF reputation and led to injury or death.

The loadmaster's technical knowledge, training, experience and currency were all critical in narrowly avoiding dropping palletised cargo on a built-up area, which could have caused significant damage to physical property, RAAF reputation and led to injury or death. This near miss demonstrated to me the importance of knowing your equipment and keeping current and proficient on its use, because that's what is going to save you when things don't go to plan.

While those long simulator sessions seem repetitive and monotonous, when a malfunction does occur it ensures that habit patterns kick in instinctually. The incident highlighted the need for the ADF to continually review and re-assess our training grounds and their suitability for ongoing use as residential areas continue to grow and occupy the once-vacant space around our facilities.

The air dispatch unit responsible for the rigging of the air-drop platform also conducted an independent/external investigation to the ASOR. The investigation found significant gaps in the monitoring process of junior air dispatch personnel and the dispatch unit's aviation safety management system (ASMS) when compared to flying units within the RAAF. This incident highlighted to me the importance of the ASMS not only in the flying units but also those of the supporting units.

Whether you're in logistics packing dangerous goods into a box, rigging an air drop, loading or unloading an aircraft, the ASMS in these support units and approach to safety is just as important as the flying units, as the actions by these support functions can also have a significant impact on the safety of the air operation.



An overview of the C-17A Heavy Air Drop sequence

1. 15 seconds prior to the drop, the drogue shoot deploys, retained by the tow-release mechanism in the ramp floor.
2. At green light, the tow-release mechanism releases and the drogue chute pulls the extraction chute out of the extraction package on the aircraft floor and into the airflow behind the aircraft.
3. The extraction chute then applies a lateral force to the air-drop pallet when the force overcomes the pre-set value on the aircraft locks on the right-hand side of the rail system, the locks retract and the air-drop pallet extracts.
4. Once clear of the aircraft, the spring-loaded arm on the extraction force transfer coupling actuates, releasing the link in the coupling adapter, which transfers the force from the extraction chute to the deployment line, deploying the recovery parachutes.

Trim runaway

Human factors in crisis mode

FLTLT David Campbell

IN 2022 I had an acute demonstration of the relevance of risk controls and human factors in an aviation environment, during an aircraft emergency.

I was operating as captain of a C-130J during a take-off from Williamtown Runway 12 in late autumn at approximately 19:30. Shortly after take-off, I experienced an elevator trim malfunction and subsequent symptoms of trim runaway driving a back elevator input, or nose-up attitude of the aircraft, and an associated downward trend in airspeed. I conducted the immediate actions I had learnt in 2FTS training of opposing the trim force with both forward elevator input and opposite trim, then enabled emergency trim override to counter the adverse trim condition and return the aircraft to a normal trim profile for the climb, and to regain airspeed.

Following a crew discussion, we elected to continue to our destination, Richmond, for a night visual landing using emergency trim.

From a risk control perspective, a combination of following the procedural checklist and my training was sufficient to arrest the adverse effects of an equipment failure, but not overcome the failure itself. The subsequent engineering risk control of a redundancy override system was the only means to overcome the failure and proved highly effective in returning the aircraft to a normal flight profile. Both risk controls were of a recovery type, and without their employment, it is likely that a catastrophic event would have occurred. An uncontrollable trim runaway of this nature with no recovery is likely to result in a rapid decline in airspeed, leading to an aerodynamic stall. At such a low altitude after take-off, this would have been unrecoverable. Needless to say, I am glad both risk controls worked as advertised.

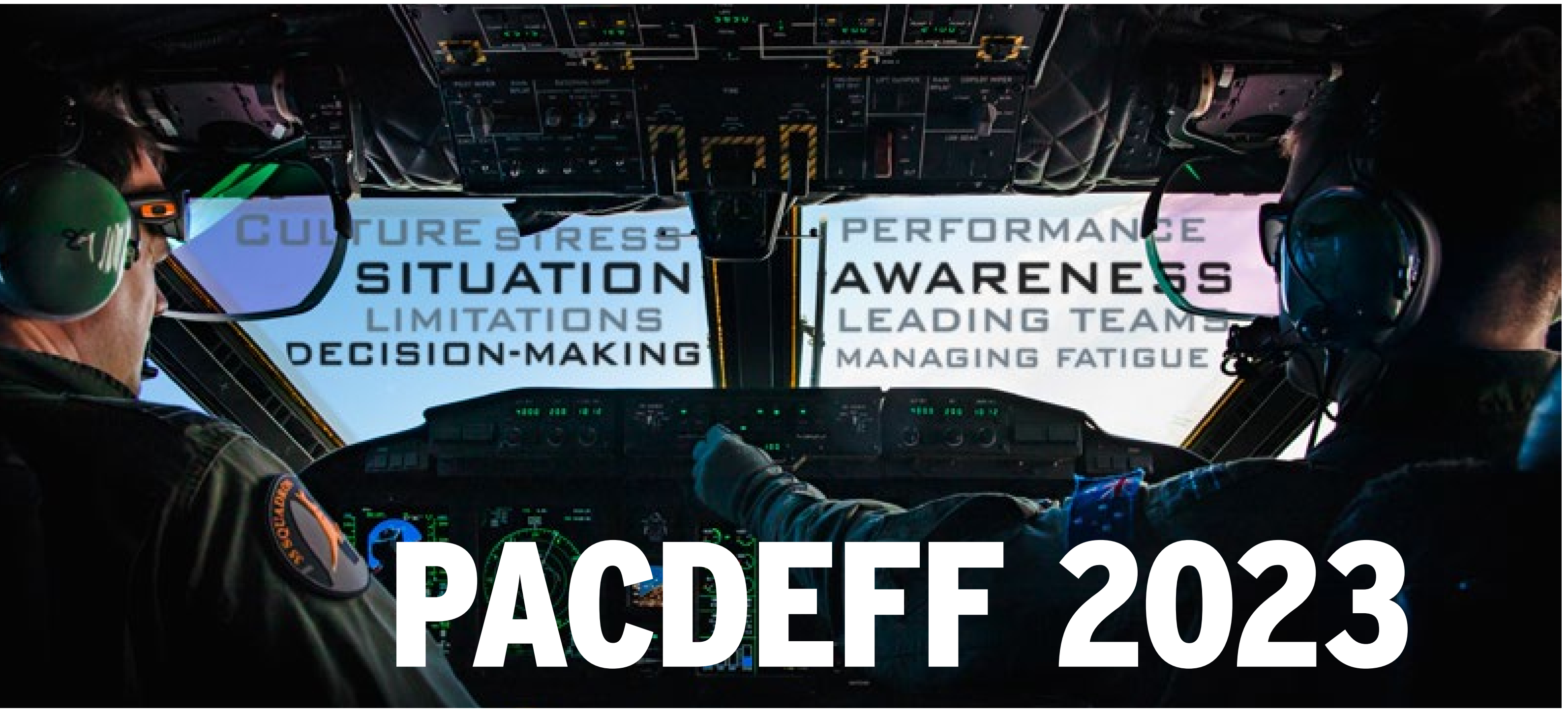
From a human factors perspective, it was a powerful lesson in the limitations of the human body, degradation of cognition during heightened sensory load, and communication barriers. The take-off was on a moonless night, and our departure direction was toward a pitch-black ocean and sky with no easy reference to ground features, a horizon, or cultural lighting. This meant my baseline cognitive load was higher, engaged with instrument flight, and I had limited capacity for orientation using ground features for an immediate turn-back procedure to our departure runway if airspeed degraded further and forced landing was time-critical.

While opposing the elevator trim runaway, it took the combined strength of both of my arms pushing as hard as I could against the control column to prevent a dangerous nose-up attitude and loss of airspeed. Selection of the emergency trim override was from our centre console between the two pilots, which meant reaching for the switch using muscle memory in a dark cockpit environment, while attempting to hold sufficient forward pressure on the control column with just one arm.

In terms of communication, my body responded to the higher workload and stress by load-shedding verbal communication. This meant I didn't verbalise the problem with the aircraft until I had the pitch rate arrested and was electing to enable the emergency trim override. In a dark cockpit environment there is less opportunity for the co-pilot to notice any non-verbal cues or body language, further eroding the capacity for effective communication between the crew.

Once I handled the emergency immediate actions, I back-briefed the crew on my actions to return us all to a common mental model of the aircraft state and restore some situational awareness.

While I didn't have the capacity to consider the above factors at this level of detail while the event occurred, it has been a good learning experience to reflect upon them.



PACDEFF 2023

By Alice Grundy

GATHERING IN BRISBANE in early spring 2023, 350 people from the aviation community attended the 14th annual Pacific and Australasian Crew Resource Management Developers' and Facilitators' Forum (PACDEFF). Speakers included researchers and academics, psychologists, regulators and representatives of industry peak bodies, airline medical officers and fixed wing and helicopter pilots. They discussed non-technical skills (NTS), human factors (HF), safety management systems (SMS), stress responses and regulations, learning from the past and dreaming up the future. Attendees and presenters came from Europe, Asia, North America, and around Australia.

Opening the first day, Emeritus Professor Rhona Flin from the University of Aberdeen discussed the revisions for a new edition of her 2008 book, *Safety at the Sharp End,* which she co-wrote to collect valuable NTS research and information in one place, easily accessible for healthcare workers and anaesthetists in particular. Flin commented that aviation was at least 20 years ahead of healthcare at the time in terms of recognising the significance of NTS. In the next version of the book, Flin and her co-writer are considering several updates including discussion of performance-enhancing errors, the effects of employee voice and silence, rudeness and its cognitive cost and the relationship between wellbeing, mental health, mindfulness and safety outcomes.

Defence Flight Safety Bureau (DFSB) Deputy Director Reporting, Intelligence and Research (RIR), Ryan Cooper, presented on the history of Crew Resource Management (CRM) in Defence and future developments. The investigation into the F-111 fatal accident in Malaysia in 1999 identified systematic deficiencies in CRM and, in response, Defence introduced agency-wide CRM that was classroom based from 2004. In 2017, NTS replaced CRM and Maintenance Resource Management. Despite these changes, there were still shortcomings as an investigation into a King Air inadvertent pitch nose-down incident revealed. In 2020, there was a runway

01. Dr. Gail Iles, RMIT Space Program
02. Professor Rhona Flin, Emeritus Professor at the University of Aberdeen.
03. Associate Professor Selina Fothergill, RMIT University.
04. Attendees in lively discussion building professional and social connections.
05. Defence Flight Safety Bureau (DFSB) Deputy Director Reporting, Intelligence and Research (RIR), Ryan Cooper.
06. Dr. Robert Forster Lee Civil Aviation Safety Authority (CASA).
07. Pete McCarthy Cathay Pacific.

excursion and double ejection from FA-18F at Amberley, which pointed to further issues. Recommendations were for the comprehensive rollout of NTS training across aircrew, uncrewed systems and air traffic controllers. DFSB is developing a new NTS guidebook in collaboration with Griffith University that will integrate quality management systems, safety management systems and training management systems. This work, responsive to investigations and recommendations, will offer a new framework for integrating NTS for Defence.

Dr Mike Walker, Director of Transport Safety at the Australian Transport Safety Bureau (ATSB), spoke about the role of terrain avoidance and warning systems (TAWS), discrepancies between international regulations of this technology and described some of the processes of an ATSB investigation.

From the Civil Aviation Safety Authority, Dr Robert Foster Lee spoke about contemporary HF concerns and Cherie Love discussed changes in NTS, HF and SMS teaching strategies.

A holistic view of human factors informed the development of Pete McCarthy's operational learning review (OLR) at Cathay Pacific, which he described as 'an adaptive safety learning framework'. At the centre of this discussion was the importance of reporting, with recognition that accurate reporting is contingent on the willingness of team members to share information. This requires psychological safety for the participants so that they accurately represent work as done – not just work as planned.

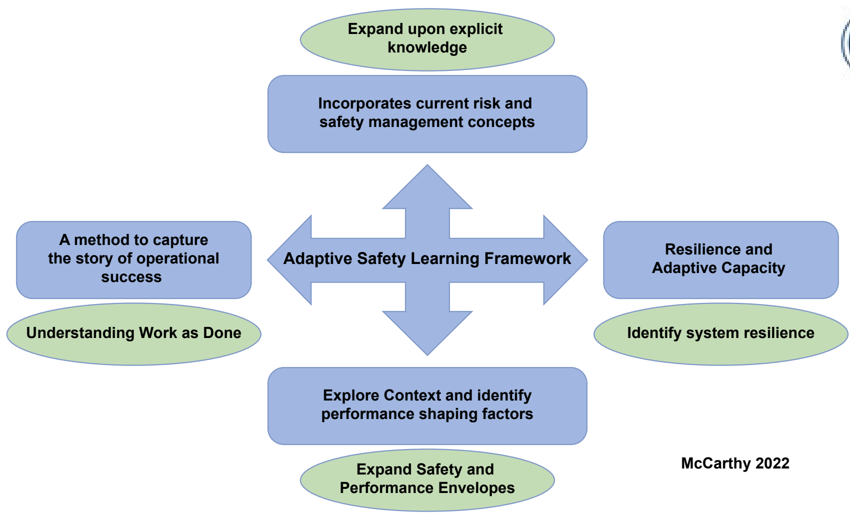
Also from the airline industry, Captain Peter Beer spoke about creating a proactive safety culture, Mark Holmes and Dr Ian Hosegood from Qantas spoke about systemic analysis and supporting the mental health of their staff. Dr Marisa de Sousa shared her research on millennial aircrew performance management and the benefits of different management styles depending on staff demographics.

Dr Adrian Park shared his PhD research, which examined the concurrent increase in aviation regulation and increased number of incidents in the civil sphere. His experience in the Army, rescue helicopters and more recently in academia came together in an energetic presentation about the potential for regulatory reform.

Other academics whose research is informing contemporary HF and NTS discussions also shared their recent work, including Captain Jamie Cross from Griffith University who shared research on the potential for VR and AR simulations to replace other flight simulators with a focus on the importance of 'buy-in' from the trainees. Aruna Ranganathan from Central Queensland University presented work on the differences in gaze responses between experienced and junior pilots.

RMIT's developments in space research and education were part of Associate Professor Selina Fothergill's paper as she discussed students' work that anticipated potential safety regulations for space travel. Her colleague Dr Gail Iles gave an animated keynote that spanned the importance of resilience – speaking from her personal experience having come close but missed out on the possibility to become an astronaut – and the potential to increase capacity in Australia for parabolic flights. Although Iles did not become an astronaut, she trained several including Canadian Chris Hadfield who garnered fame while on the International Space Station for his guitar playing. Iles described the parabolic training flights she has been on as part of her work training astronauts at the European Space Agency. They involve a plane pitching up at 47° before cutting the throttle, entering zero-G, pitching down at 47° before reengaging the throttle. One training flight performs this manoeuvre 30 times. Iles argued for the further development of a parabolic flight program in Australia both to facilitate research in a simulated zero-G environment and to help train the next generation of astronauts.

While the focus at PACDEFF was predominantly on HF and NTS for pilots



Adaptive Safety Learning Frame work, presented by Pete McCarthy, Cathay Pacific.

and aircrew, two papers demonstrated the value of this thinking for engineering. Shane Varga, was a captain of Virgin New Zealand when COVID hit and his job disappeared overnight. He then drove road-resurfacing trucks, before finding a role looking after NTS for engineers at Air New Zealand. Although the members of his team were not immediately enthusiastic about the introduction of NTS skills and thinking, working according to some of the principles including the recognition of skills such as situational awareness have already been beneficial.

Also from an engineering perspective, Indra Sadli and Brian Mok from Air Services Australia outlined an engineering project lifecycle for integrating HF into planning, design and execution with the example of making an air traffic control tower fit for purpose and ultimately reducing costs due to a comprehensive planning process.

The Helicopter Safety Collaborative Human Factors Parallel Forum was an opportunity to discuss safety issues specific to helicopters including a presentation from Stephen Stringer, who was the manager of Westpac Rescue when the company's Lismore base flooded in the middle of operations.

PACDEFF also featured workshops on building resilience, designing training for HF, NTS and CRM and performance coaching strategies. Flin's session focused on developing strategies for communicating the importance of NTS and brainstorming possible solutions to NTS challenges.

Importantly, the conference created an opportunity for those in the aviation community to reconnect in person. Many presenters mentioned the effects of COVID on workplaces, work activity and mental health – Dr Ian Hosegood from Qantas referred to the condition of 'languishing' which comes before mental distress on the spectrum of mental health. Attendees had lively discussions in breaks on the deck overlooking views of South Bank and the benefits of these professional and social connections were clear from the energy in the conversations.

Next year's conference will be held in late October in Melbourne, with planning already underway.

Out of the frying pan and into the fire

Flying near a fire can result in the pilot losing the visual cues needed to stabilise the helicopter

By Brendan Reinhardt

AS WE MOVE into summer, the nation's aerial firefighting aircraft are preparing for another fire season. These aircraft have great capabilities, however, the task isn't without risk.

Here we analyse an incident in California involving an AW139 that was conducting firefighting with a purpose-built belly tank. The aircraft had made several successful passes when it was called to another fire that was threatening a house.

The aircraft conducted reconnaissance and proceeded for the drop. This required a descent and deceleration to the drop speed of less than 40 knots. As the aircraft levelled, the pilot required power up to 110 per cent torque, however, the low-rotor horn sounded and the pilot couldn't stop the aircraft descending. There was a tail wind and the helicopter probably decelerated below effective translational lift (ETL). The pilot jettisoned the water load to improve performance but the aircraft yaw could not be controlled – loss of tail rotor effectiveness (LTE). While slowly turning, the helicopter descended into the trees, damaging the rotor blades, fuselage and empennage.

However, the pilot managed to fly the aircraft away and conducted an emergency landing at a nearby school oval. Was this a simple case of underestimating the power requirements in local high-density altitude caused by the fire?

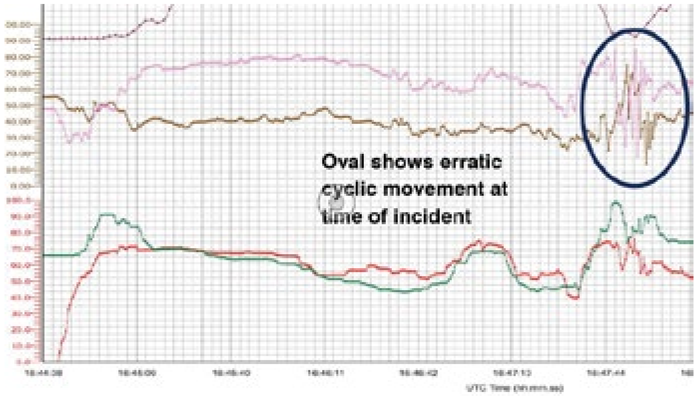
The National Transport Safety Bureau (NTSB) investigation discussed the unique conditions from the smoke plume that contributed to this incident.

The incident site density altitude was 3100 feet and there was a tailwind. Depending on the terrain, pilots need to apply some form of power margin for low-level operations or have readily accessible escape options to make it to lower ground. If you are firefighting at low speeds without an ability to turn into lower ground, then a margin above out of ground effect (OGE) power, once the load has been jettisoned, would be wise. In this case, the pilot conducted a precautionary load jettison as the incident was developing. This did not stop the helicopter settling into the trees but avoided the loss of the aircraft.

The NTSB report discussed the increased challenges of getting close to large fires: reduced visibility, turbulence, hot temperatures with decreased aircraft performance and increased power requirements, actual heat damage to the aircraft and flying debris lifted by the hot air.

Specific advice about 'Smoke column hazards' was published in March 2018 in a US Government *Interagency Aviation Accident Prevention Bulletin.*

If you are getting close to a fire, would it be wise to carry an increased power margin? Do you need better than OGE power, even before you jettison the water load? In this case, getting below ETL and having a tailwind suggests this may have been the best option.



However, there are many variables at a fire site, so this may be hard to pre-plan.

Another possible contributing factor in this incident that isn't discussed could be the low visual cues available. Being close to the ground below ridgelines and near or even in smoke reduces the visual cues that are available to pilot the aircraft. Small changes in aircraft attitude will be more difficult to notice until they become large. Many pilots can operate near LTE in a good visual cue environment because they can quickly pick up the small yaw movements and can stop uncontrollable yaw rates developing. However, if you are slow anticipating because you can't see enough cues, then a yaw rate may start to develop and, if pedal application is slow (again because you can't see), LTE may occur.

The flight recorder data analysis shows some interesting plots. The aircraft attitude during the incident reached 33° nose up. The AW139 has an automatic flight control system (AFCS) that is designed to help the pilot reduce workload, especially in poor visual cue environments. Functions such as the short-term stability augmentation system and attitude hold help keep the aircraft stable when the pilot can't see the usual range of attitude and heading cues.

In this case, the extreme attitudes reached may have been partially a result of poor AFCS use. Looking through the flight recorder data, this seems to be the case. The aircraft attitude hold function had been turned off. This was likely an attempt to reduce the workload, of retrimming the cyclic as airspeed changed in the low-level environment.

You may get away with turning attitude hold off in a very good visual environment, however, once you enter a reduced cue environment, the use of attitude mode decreases your workload. Arguably, being in smoke below the ridge lines is a reduced cue environment. Referring to the data traces, the report suggests classic low-speed, unusual attitude behaviour, 'The longitudinal and lateral cyclic tracks show large and uncoordinated inputs for at least 10–12 seconds, while the aircraft was flying above the mentioned residential complex, with backwards ground speed between 8 and 26 kts'.

This seems to indicate that the incident was more than just settling into the trees due to a localised high-density altitude, as discussed earlier. If the pilot had entered this situation in attitude mode and used the trim functions correctly, the propensity for the aircraft to oscillate erratically would have been reduced. This sort of aircraft behaviour is characteristic of not having attitude mode engaged or utilising the force trim release excessively in a reduced visual cue environment.

Approaching a low visual cue environment requires slow precise flying and setting up the autopilot so there is little requirement for large trim applications. Small changes can then be made to guide the aircraft, using small trim changes or small forces on the cyclic – this keeps the attitude hold functions working.

The incident has several contributing factors: lack of anticipation with pedal when increasing collective, tail wind and failure to allow sufficient power margin for the environment, which can be a superheated turbulent airmass from the proximate fires. However, there is probably another contributing factor that isn't specifically mentioned – inappropriate AFCS use for a reduced visual cueing environment. Reduced visual cueing environments aren't just on very dark nights – they can occur on bright nights with low contrast and even by day in some cases.

The aim of firefighting is to reduce the threat and preserve life and property. Operating your aircraft within its limits and your personal limits for the specific environment will ensure you don't end up being out of the frying pan – and into the fire.

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Aviation Safety Training Courses

Course	COURSE AIM:	PREREQUISITES:	COURSE DESCRIPTION:
ASO (I) Aviation Safety Officer (Initial) Course	To graduate Unit ASOs, Maintenance ASOs and Flight Senior Maintenance Sailors.	Personnel who are required to perform the duties of an ASO.	The course is delivered as two separate weekly components (the first is online; the second is face-to-face) with a one-week break in between. The course provides theory and practical exercises in the broad topics of the Defence Aviation Safety Management System, risk management, human factors, the Defence Safety Analysis Model, safety event investigation and reporting.
ASO (A) Aviation Safety Officer (Advanced) Course	To graduate Base, Wing, Regiment, Fleet, Group and Command ASOs.	ASO (I) practical and applied experience as an ASO (or equivalent).	The course provides theory and practical exercises in the broad topics of the Defence Aviation Safety Management System, human factors and risk management, and base/unit emergency response.
NTS Non-Technical Skills Trainer	To graduate students with the knowledge and skills to deliver non-technical skills training.	A solid background in crew/maintenance resource management and/or human factors.	The course provides the theoretical background of aviation non-technical skills and trains students in the skills and knowledge for delivering non-technical skills training. The course also introduces students to scenario-based training and assessment techniques.
AIIC Aviation Incident Investigator Course *Available upon request.	To develop members to support their ASO in conducting aviation incident-level investigations.	Any personnel who are involved with Defence aviation. There is no restriction on rank, Defence civilians and contractor staff are also welcome to attend.	This one-day course provides theory (taken from the ASO(I) course) on the topics of: the Defence Aviation Safety Management System; generative safety culture; error and violation; the Defence Aviation Safety Analysis Model; aviation safety event investigation and reporting. Interested personnel should contact their ASO.

For further details concerning location and up-to-date course dates visit the DFSB intranet site or email dfsbet@dpe.protected.mil.au

All courses are generally oversubscribed, nominations from individual units or candidates will not be accepted, nominations are to be forwarded with the Commanding Officer's endorsement to:

- **Air Force:** the relevant Wing Aviation Safety Officer, or for CSG, Staff Officer Safety HQCSG
- **Navy:** the Fleet Aviation Safety Officer and
- **Army:** Army Safety Section, DOPAW, AVCOMD.

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