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Perceived pressure

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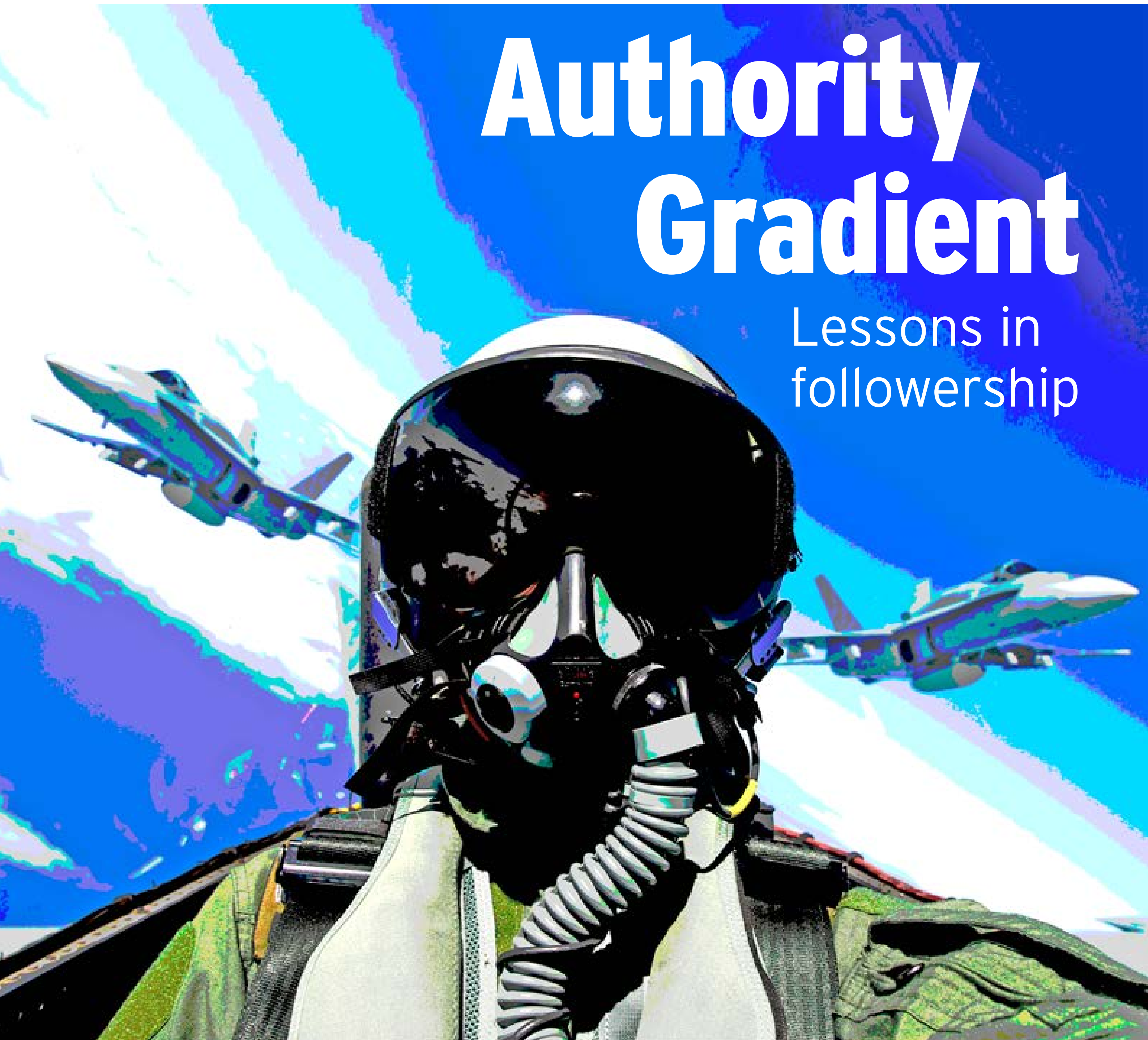
02 2019 EDITION

Spotlight



Authority Gradient

Lessons in followership

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February 2020

FOREWORD

THIS EDITION OF *Spotlight* is the last to be published during my tenure as Director of the Defence Flight Safety Bureau (DFSB). It is another very broad and well-researched collection of articles which, while focussing of course on aviation safety, are as eclectic and varied as I hope you've come to expect from us.

There are a number of excellent articles on human factors which, as we continue to press for full adoption of our Non-Technical Skills (NTS) continuum, continues to be a key focus for DFSB. There are articles based upon the hard-won experience of aircrew and maintenance personnel placed in challenging circumstances. There are articles which draw from historical safety lessons, and those which bring a non-Defence aviation lens to the subject of aviation safety. The authors of all of the articles, whether Defence, civilian or even exchange personnel, have done a wonderful job of provoking some reflection on our daily business – I commend their efforts to you.

Finally, it remains only for me to thank publically the DFSB team members for their continued high-quality efforts in the interests of aviation safety. It has been my genuine pleasure to lead the DFSB for the past 18 months, and I hand over to GPCAPT Dennis Tan who, I know, will ensure that DFSB continues to provide the same support to Defence aviation safety.

Kind regards,

GPCAPT Nigel Ward
Director DFSB 2019

WELCOME TO THE first *Spotlight* of 2020. It would be nice to welcome you all back from a restful period of leave over Christmas but this year has seen the ADF being extremely busy during Operation Bushfire Assist.

The work being done in this whole-of-nation effort, along with some of our international friends, is magnificent but it does lead me to contemplate the tyranny of fatigue which looms large in the near distance. It'll be a theme to watch within aviation-safety circles more so as life returns to normal.

Also of significance is the departure of the former Director DFSB, GPCAPT Nigel Ward. Nige and I did a job swap and he's taken post as Officer Commanding Air Academy in East Sale and, of course, I have become the new Director of the Defence Flight Safety Bureau. Nige, all of us here at DFSB wish you all the very best in a role that I know you will find both deeply challenging but equally fulfilling. Thank you for your excellent work.

I truly hope you enjoy reading this edition of *Spotlight*. I found the articles to be well written and thought provoking. I appreciated too the range of subjects ranging from maintenance issues to aircrew matters to accidents from overseas and some teachings from our past. There really is something within this edition that will benefit anyone in the aviation community. There's even some great investment advice which will more broadly help you understand your own decision-making processes. All contain deeply important lessons in aviation safety. Read on.

Kind regards,

GPCAPT Dennis Tan
Director DFSB 2020

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Walk the torque

By CPOATA Matthew Lang

WHEN I LOOK back on my career of more than 20 years, I can still clearly recall an experience that reinforced how influential culture, and mentors and coaches can be. Sometimes lessons are for the better, but in 1997 when I first joined, it wasn't quite positive.

At my first unit following initial training, I was tasked with inspections on an engine. After removing the combustion chamber and carrying out the required inspections, I was installing the new combustion chamber and having difficulty torqueing up the attaching bolts.

Knowing that the aircraft was required to complete a sortie the next day and follow on ground runs, I felt a small amount of pressure to complete the task before the end of shift.

My leading seaman (trade supervisor), who had more than 10 years' experience on the aircraft, was applying routine supervision to the task and during one of his checks, asked how I was going with the installation. I said that I was having issues getting the torque wrench onto a few of the nuts to torque them correctly, to which he told me to keep trying and he would be back in an hour to check up on the replacement.

About an hour later he returned and I still hadn't been able to get the required torque loading onto one of the nuts. I had achieved the correct torque on the other nuts but the last one was causing issues. This was now at the end of the shift and I was feeling more pressure to complete the task before secure as I didn't want the rest of the shift to work back because I hadn't completed my task.

After looking at the task and the limited space available, he instructed me to find a nut that I had easy access to and, using the torque wench, get a feel for what the torque was. He then said using any spanner, torque the nut I was having difficulty with and go a little bit over to make sure it was tight. I carried this out with him present, and had no further issues with the task. I asked him if this was okay to do and he said it was, as most of the other attaching nuts were correctly torqued and it was only one nut, and the torque was "close enough".

I completed and certified the task just before secure and we handed over the requirement for the ground run to the oncoming watch. The subsequent ground runs were completed with no issues and the aircraft met the planned sortie time.

At the time, I didn't recognise what had happened. I didn't recognise that we had just violated a maintenance procedure and had certified for maintenance that had not been conducted correctly.

I certainly did not consider what could have gone wrong had the tolerance and safety in the system not protected that aircraft and the people that flew in it. In 1997 as a new trainee working under an experienced supervisor, all I learnt at the time was that this was "the way we got stuff done".

Looking back now with more than 20 years of experience, I am horrified at the maintenance that I conducted and ultimately certified for. While that was an individual lesson about self-awareness that I needed to learn, the more critical lesson was understanding the influence that my supervisor's actions had on my own. This is a lesson that I have carried for the last two decades, recognising how the behaviours of the more experienced, more senior members influence those that are learning "the way we get stuff done".

Although a lot has happened in cultural reform, regulatory framework and technician accountability and scope of authority in the last 20 years, the lesson has not dulled for me over time. While I fully believe that the current generation of technicians is curious, that individuals understand the scope of their authority and will not deliberately conduct unsafe actions, remembering how our behaviour influences that of those around us should be something we never lose sight of.

Mind the gap

Procedural drift and normalisation of deviance

By Gareth 'Ali' McGraw

WHILE DOING SOME reading for work I came across an interesting article that got me thinking about human performance and behaviours in the aviation-maintenance environment. In it the writer, David Galloway[1], stated that some years ago they moved to a community in a different state (in the USA) for a new job. While driving to work on their first day, they were involved in a number of near-miss motor vehicle occurrences. He went on to describe the risky driving behaviour they witnessed, which they quickly learned was "the way we drive around here".

They described the way drivers approached an intersection with a traffic light – the green light turned amber and as expected, one or two cars entered the intersection while the light was still amber.

But it was what they observed next that shocked and surprised them. After the light turned red, the next three drivers continued through the intersection. Remarkably, the cars in the opposing lanes (who now had a green light) paused for three or four seconds for the red-light violators to clear, then drove through the intersection. When that light subsequently turned red, the drivers in those lanes repeated the same behaviour; with three cars driving through and the opposing green-lit drivers waiting for them to clear the junction.

The unspoken norm appeared to be that a red light meant that three more cars were allowed to pass through the intersection…but the fourth car should stop. The amazing thing was that somehow everyone knew that this was the rule.

At first, the writer thought this was an isolated incident. However, as they soon discovered, it happened at every intersection.

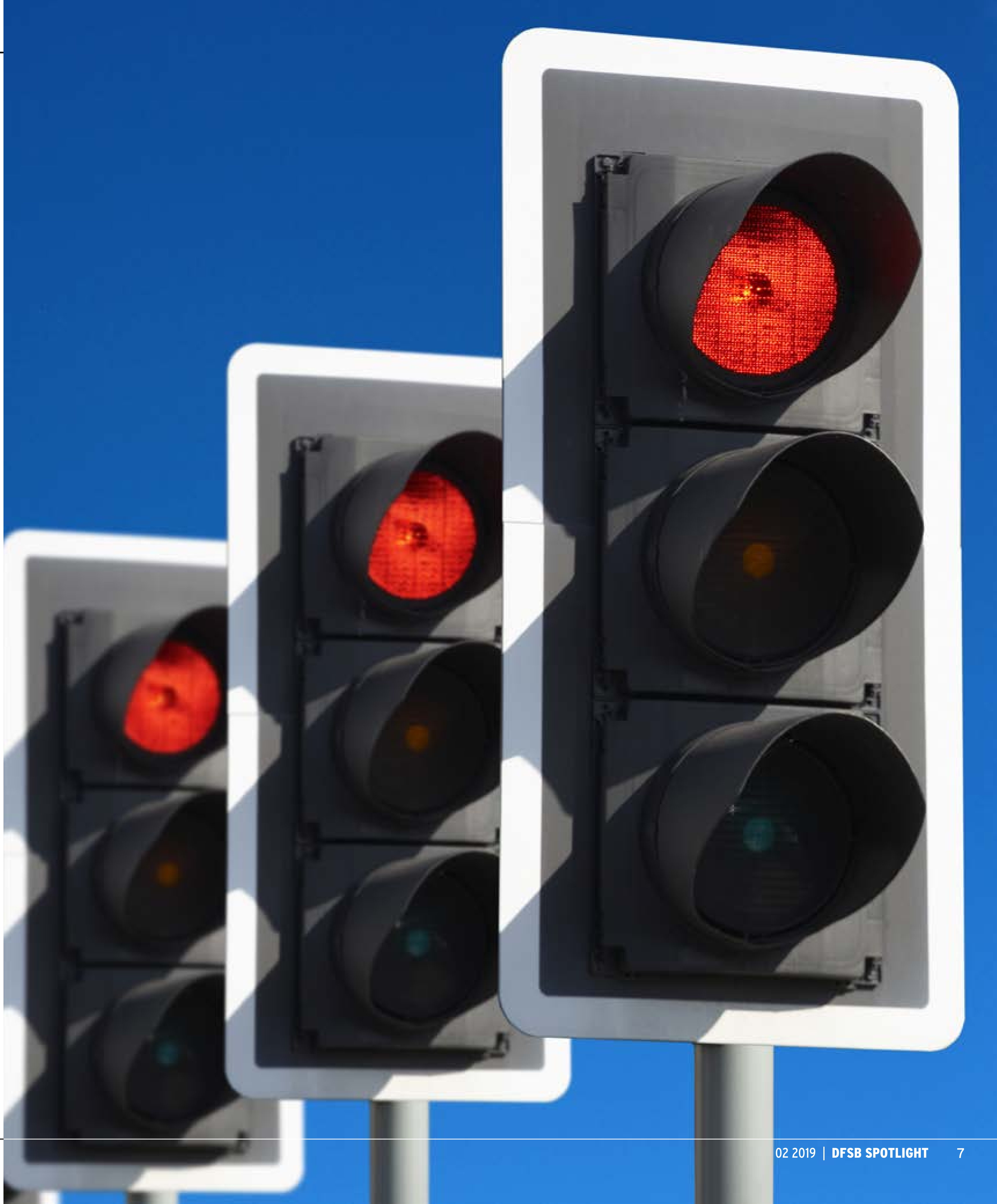
Now imagine someone who had never been to this town approaching an intersection – and expecting that red means stop and green means go. It took about four or five close encounters (of the wrong kind) at intersections with local drivers for the writer to figure out what was happening.

What do you think the response of the writer was?

He said they quickly adapted to the local behaviour. By the time they were due to go back to their home state, they were Driver #3 going through a red light. No hesitation. No consequences. No tickets.

In fact, local police cars were following the same protocol. (They learnt later that three cars was indeed the limit. If the police observed a fourth car driving through a red light, that person was always ticketed.)

I couldn't help but think that the actions described seem inconceivable to me (and my obviously superior driving morals) and I would never succumb to such risky behaviour. But then I'm sure the writer would have said



the same thing before being exposed to it personally. On reflection I came to understand that it was not only a powerful illustration of the extreme evolution of normative behaviour but also of the persuasive power of an established group norm on a new individual.

Why people violate rules – the concept of procedural drift and normalisation of deviance

So, why do people violate rules? Sidney Dekker, author of *The Field Guide to Understanding Human Error*[2] describes a phenomenon called procedural drift. He defines drift as "a mismatch between required procedures or rules and actual work practice". He claims that it almost always exists within organisations and that this mismatch can grow over time.

Consider the traffic-light example, do you think the behaviour started out that extreme? Or did it start as one car driving through a late amber, then two? Finally settling on three driving through an obvious red light before local police decided that it had reached the limit for safe operation of the local junctions and applied a degree of control?

So, just as Dekker contends, procedural drift tends to be a slow, incremental departure from the designed or intended norm. As depicted in the graphic, drift gradually increases the gap between how the system was designed or intended to operate and how it actually works.

Dekker lists several potential reasons for procedural drift:

- rules or procedures are over-designed and do not match up with the way work is really done
- there are conflicting priorities that make it confusing about which procedure is most important
- past success (in deviating from the norm) is taken as also being a guarantee for safety – it becomes self-reinforcing
- departures from the routine become routine – violations become behaviour compliant with local norms.

Interestingly, Dekker asserts that it is often compliance (as opposed to deviance) that explains people's behaviour. Rather than active non-compliance with the intended process it is compliance with the norms that have evolved over time.

In fact it is important to understand that these norms may have evolved in response to local or task conditions that were not anticipated or recognised at the time a process was designed or procedure written. Combine this with a culture that is results driven, it can be seen that 'adaptive' behaviours that solve local or task-specific problems may well be highly regarded. In addition, the continued absence of adverse consequences confirms people's beliefs that the adaptive behaviour is not only the preferred way to operate but also safe.

Going back to Dekker [if] the "rules or procedures [seem] over-designed and not match[ing] up with the way work is really done" then they are more likely to be discarded or modified.

Again, think about the cars going through the intersection on a red light. If 99.9 per cent of the time there are no accidents, it must simply be that the lights are badly designed and it's okay to do this, right? Further, if law enforcement rarely issues a ticket for this rule violation, individuals and groups may rationalise that it must be acceptable behaviour.

Drift and maintenance

Now transfer this concept to your working environment and think of any of our many maintenance tasks. Can you imagine a similar evolution of non-compliance with rules and specific actions that could evolve and even become self-sustaining, well-established norms?

No? Well, chances are if we looked hard (and honestly) enough we could find a few, maybe even more than we initially imagine, even if they weren't quite as extreme as described above.

Next, try to understand why any particular steps are omitted (or are more likely to be omitted) and importantly what those steps were put in place to control.

Aviation maintenance is often described as a procedurally driven activity. But why has it developed that way?

It has not occurred because an engineer (or regulator) has decided that is just how they think it should be done; in reality these procedures are the basis for a large portion of risk mitigation in the maintenance workplace. They form a critical structure for the management of risks associated with potential errors (both incorrect actions and decisions).

So, in line with the concept of drift, let's consider the underlying rationale and risks of not establishing and maintaining [compliance with] work standards. As stated earlier, these standards (procedures) form the basis for risk mitigation in an aviation-maintenance workplace, specifically risks associated with errors.

When we analyse those controls, we can identify that they are related to controlling both the likelihood of the negative event and also the severity of consequences of a risk.

But when we look at an individual's or team's risk perception, perceived risk is often most strongly related to the perception of the likelihood of an accident or some other type of unwanted outcome (Sjöberg, 1998a, 1999a, 2000a[3]), and that perception of likelihood is inherently poor.

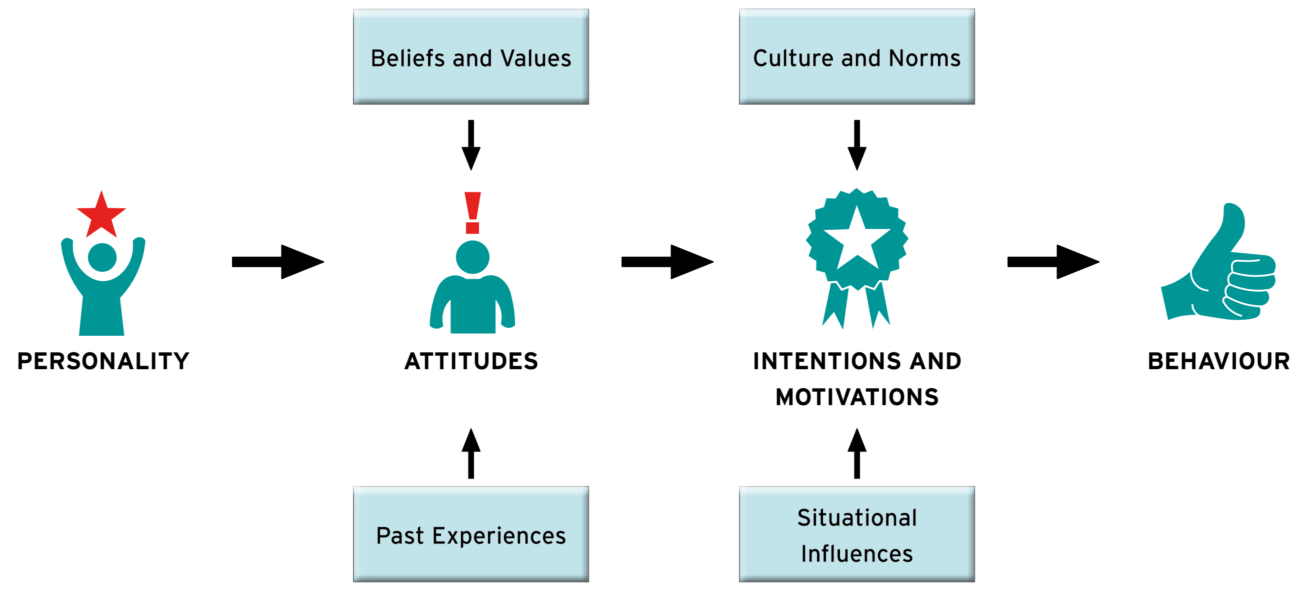
So here we have the circumstances that may be conducive to drift; with personnel potentially not fully engaging with certain parts of procedures due to seeing risk predominantly through a lens of likelihood. That perception may be inaccurate due to each individual and group having limited exposure to the overall risk picture or failing to understand the consequence rationale underlying many controls.

This leaves the whole system in a state of heightened risk, with controls no longer operating as intended and the potential for gaps developing in the coverage of critical risks.

What is usually done in response to this divergence if it is identified? One approach is to rewrite the rules and procedures, normally adding even more steps and details, or to write more rules – and then hold people accountable when they violate these increasingly complex standards.

While this may be marginally effective in the short term (especially just after an event), it is not likely to be sustainable. Why? Because if we rely solely on people complying with rules without having an awareness of why it is important, what we get in return is minimal motivation for engagement and a continuation of their adaptive behaviour to get the job done.

Behavioural model and drift



Behavioural model and drift

In looking at drift as adaptive behaviour that is, in part, the product of incorrect risk perception we need ways to understand it more fully.

The model above is one visual illustration of the complex interaction of many influences on an individual's decision to engage in a certain behaviour (in this case non-compliance with aspects of a procedure as an example).

Starting with an individual's personality; our beliefs, values and past experiences in a similar context combine to influence our attitudes to particular actions or decisions.

If an adaptation of a procedure worked in a similar circumstance we may believe it will again and be disposed to having a positive attitude to continuing it in future. It is here that an incorrect perception of risk may lead us to not understand the actual risk and that even though we were successful this time we may not be next time.

These attitudes combine with our culture, norms and other situational influences to affect our intentions and motivations.

For the vast majority of people our intention will be to produce results safely. But that intention will also include the motivation to achieve our unit goals. This motivation may be influenced by a results-driven culture of 'can do', and include norms that may have been used to achieve those results before and been seen as an acceptable way to work.

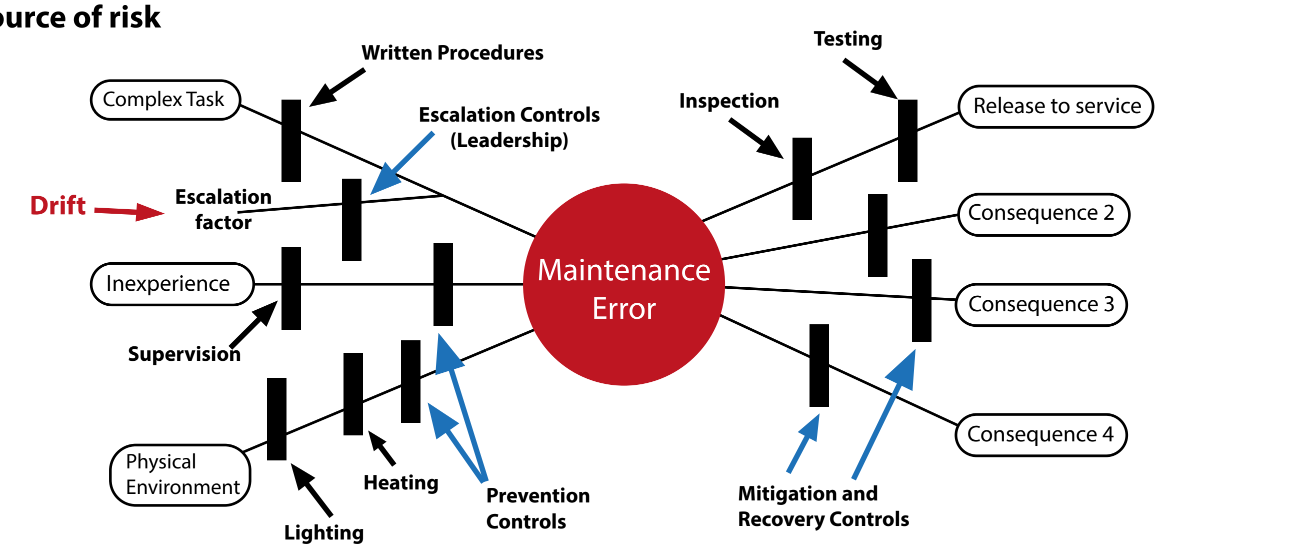
Finally, situational influences such as limited time, personnel or equipment may further drive unintended behaviours while seeking to achieve the desired result with the resources available.

Ultimately, although we intend to get the job done correctly, the combination of all these factors may come together to produce a degree of non-compliance that is seen as appropriate or even essential for the circumstances.

One of the advantages of using models such as the one above is that by populating as many of the boxes as possible we can get a better insight into why an individual carried out a particular behaviour outside of attributing blame or suffering hindsight bias. This understanding can also include why it may have seemed appropriate at the time; even if it wasn't in hindsight.

This information can also assist in determining if it is likely that others will act the same way given the same alignment of circumstances and influences (regardless of the personality of the individual), crucial in identifying the potential for drift.

Source of risk



And in a pro-active way, we can use it to define a desired (compliant) behaviour and work backwards to identify what influences could be put in place to more likely produce it.

We know about drift and how it can happen – what can we do?

With all the information detailed above in mind, what can we do to increase the probability of getting more engagement and compliance with procedures from personnel?

Understanding [error] risk

To begin with, we need to ensure a better understanding of risk. Including not prematurely dismissing risks due to a perception of a low likelihood. Instead, we need to focus on understanding actual likelihood as well as the potential consequences when managing risk at a workplace level. Thinking back to the traffic lights, while the chance of an impact may seem remote the consequences would be severe.

If we are in a supervisory role, we can help personnel to understand why certain controls are in place, what they are actually controlling and how they are attempting to do so. They can then also understand how their conscious actions, inactions and decisions can affect each control.

The BowTie above illustrates this concept. It shows the risk associated with a particular hazard (the top event), in a format that illustrates the controls associated with mitigating both the likelihood and consequence components of that event. It also defines some of the potential negative influences on the operation of those controls.

This allows personnel to understand what and how controls such as procedural rules are seeking to reduce risk, how non-compliant behaviours may degrade those controls, and may lead to either an increased potential for the event to occur or for the consequence to be greater.

The subsequent increased risk awareness should correspond to increased motivation of staff to engage and follow relevant procedures. Or if they believe they have a more effective process; to analyse suggested changes and assure they do not introduce an unintended increase in risk before seeking to get them authorised.

The role of leadership in risk awareness and compliance

One of the fundamentals with regard to the perception of the priority for compliance in the mind of any member is management's communication of the safety balance. This perception frequently rests on the reward/punishment thresholds that define acceptable and unacceptable behaviours. The oft-used statement that "the standard you walk by is the standard you accept" holds true for perceptions in regard to compliance and its influence on drift.

Crucial to countering drift is the amount of time that any particular level of management spends understanding the local and task circumstances. This time will not only aid in identifying the influences on compliance/non-compliance but assist them in being better able to apply counter influences (outside of simply punitive measures).

Some core elements in the active management of drift are listed below:

- leadership is not simply setting objectives and assigning tasks
- leaders motivate teams and individuals towards expected behaviours and the appropriate responses to risk and compliance
- this is through effective communication of priorities regarding the safety balance, acceptable and unacceptable behaviours
- leaders also model behaviours through their own actions and those they allow (that is, walking by without correcting it).

Further details on some of the negative influences on behaviour are contained in the list of Behavioural motivator/modifiers on pages 12 and 13.

One example modifier, poor management or supervisory style, is listed below and the full list is attached at the end of this article. Just like the bow tie and behavioural model, by identifying the underlying motivators and modifiers we can better combat them to reduce the likelihood of non-compliant behaviours in the workplace.

Poor management or supervisory style

Achieving required results is routinely praised, even if it is widely known that they are only achieved through non-compliance. Little supervision is focused on actual performance of tasks with more focus on end results.

Do managers (inadvertently or otherwise) condone or enable rule-breaking behaviour by praising the results or failing to correct rule-breaking behaviour when it occurs?

Conclusion

Procedural drift is defined as a mismatch between designed procedures or rules and actual practise.

There are a number of reasons why this occurs, one of which is associated with a lack of understanding of risk management and of how procedures are designed as risk controls.

Where there is some form of drift or non-compliance there is often a degree of misunderstanding of what the omitted controls or required behaviour[s] were seeking to achieve in terms of risk management.

A crucial step in applying opposing influences to limit the potential for drift is to equip staff with a greater understanding of those controls and the actual risks associated with non-compliance.

- From an individual perspective, give members an understanding of what can influence their behaviour and what the controls are seeking to manage in terms of risks and how they are intended to do so.
- From an organisational perspective, understanding these concepts should allow for the design and implementation of work standards or procedures that are more likely to be followed and sustained.

Leadership has a central role in driving the desired culture change. What we say and do creates experiences that generate or reinforce attitudes to compliance and belief of its importance.

The underlying question we need to answer is how confident are we that our people will consistently follow procedures even when no one is watching?

If we aren't, what are we actively doing to improve our degree of confidence?

References:

1. Galloway, D. *Why do people violate rules? The concept of procedural drift*. 2014.
2. Dekker, S. *.The Field Guide to Understanding Human Error.* Sidney Dekker. Ashgate Publishing. 2006.
3. Sjöberg, L. *World views, political attitudes and risk perception. Risk: Health, Safety and Environment.* 1998.

BEHAVIOURAL MOTIVATOR/MODIFIER CHECKLIST

VIOLATION TYPE	MOTIVATOR DESCRIPTION/DETAILS	√
ROUTINE	**The rule is considered unnecessary/inappropriate/out of date**	☐
	• The violation has become routine – part of normal working practice	☐
	• The violation has become habit	☐
SITUATIONAL	**The work situation makes the rule difficult or impossible to follow**	☐
	• The rule is unsafe	☐
	• The rule is unworkable because of the work area	☐
	• There is not enough time to complete tasks in accordance with the rules	☐
	• There are not enough people (that is, less than the stated minimum)	☐
	• Equipment is unavailable/unsuitable	☐
	• Difficulties with external environment (weather, temperature, noise, light, et cetera)	☐
	• The rule/procedure is unrealistic/impractical	☐
	• The violation is caused by pressure from others	☐
	• There is pressure from management to violate (give details)	☐
	• There is pressure from work colleagues to violate (give details)	☐
EXPECTATIONAL	**The ends were thought to justify the means (often due to unusual workplace circumstances)**	☐
	• The employee misunderstood the workplace conditions/system state	☐
	• The employee did not understand the reason for the rule and/or potential consequences of the violation	☐
	• The employee understood the potential consequences but considered the violation unavoidable	☐
PERSONAL OPTIMISING	**The violation was caused by the desire to benefit/gain personally (or avoid personal loss)**	☐
	• Financial gain/avoid financial loss	☐
	• Finish early to do something more rewarding	☐
	• To avoid stress/rise in workload	☐
	• Gain praise from management (for example by improvising)	☐
	• Gain status with colleagues	☐
	• Make the job more challenging/interesting	☐
	• Satisfying curiosity	☐
	• Having fun (thrill seeking)	☐
SABOTAGE/ CRIMINAL BEHAVIOUR	**The violation was intended to cause harm or as a conscious criminal act for gain**	☐
	• The behaviour was a spontaneous/random act to cause harm	☐
	• The behaviour was pre-planned with intent to cause harm or damage	☐
	• The violation was motivated by conflict between employee and organisation	☐
	• The violation was motivated as part of the commissioning of a criminal act for gain or to hide previous criminal behaviour	☐

BEHAVIOURAL MOTIVATOR/MODIFIER CHECKLIST

BEHAVIOURAL MOTIVATOR	MODIFIER DETAILS/INVESTIGATION QUESTIONS TO AID IDENTIFICATION	√
POOR PERCEPTION OF THE SAFETY RISK	**Individual does not understand the degree of risk associated with the violation or exhibited behaviour** • What is the individual's perception of the potential for injury or damage associated with the violation or the task environment in general? • Does the individual have any knowledge of negative events associated with the violation or task? • What is the individual's memory of the last negative event associated with the violation task? • What is the individual's attitude to any stated safety need for complying with work practices/procedures?	☐
LOW CHANCE OF DETECTION	**The behaviour does not cause large system deviations or the system assurance mechanisms do not include checks associated with the non-compliant behaviour** • What are/were the chances of detection at the time of the violation? • Is it/would it be detectable at a later date?	☐
INEFFECTIVE DISCIPLINARY PROCEDURES	**The disciplinary system either overreacts leading to a reticence to speak up about non-compliant behaviour, or allows behaviour to continue unchecked** • If the violation was detected, what would the work related consequences be? • Is this considered appropriate and is it considered a deterrent?	☐
LOW PERCIEVED BENEFIT FROM ADOPTING APPROVED WORK PRECTICES	**The expected behaviours associated with compliance appear unwieldy or prevent tasks being completed as quickly and/or do not have a readily identifiable safety benefit** • Is there more perceived benefit to breaking the rule/work practice? • What are the issues with following current approved work practices? • Are the benefits centred on efficiency of output or simply achieving the required workload?	☐
POOR MANAGEMENT OR SUPERVISORY STYLE	**Achieving required results is routinely praised, even if it is widely known that they are only achieved through non-compliance. Little supervision is focused on actual performance of tasks with more focus on end results** • Do managers (inadvertently or otherwise) condone or enable rule-breaking behaviour by praising the results or failing to correct it when it occurs?	☐
POOR SAFETY CULTURE	**Safety processes are seen as a box-ticking exercise or regulatory compliance issue. Controls are quickly abandoned to facilitate production if the schedule demands it** • How high a priority is safety seen? Does this change depending on the perceived urgency of the required output/workload? • Is rule breaking/non-compliance normalised behaviour?	☐

Are you investing wisely?

By LCDR Carmencita Hanford

IMAGINE THIS – you are the producer of a state-of-the-art music festival, exclusive to the rich and famous. A small fee of up to $12,000 will get your patrons a ticket to a weekend getaway on a private island, partying to the likes of Blink 182, Ja Rule, Major Lazer and Disclosure.

Once festival goers are tired of dancing, they can retire to luxury yurts sprinkled across the beachside, and enjoy gourmet food prepared by five-star caterers (Hanbury, 2019). Your patrons will be flown out VIP style to make sure they end this transformative experience in style and comfort. It will exceed all expectations and put you on the map.

Fyer Festival, the greatest music festival that never was, happened in 2017 and was the brainchild of a man named Billy McFarlan. If you were one of the 8000 people who bought a ticket, you would have been sorely disappointed. Instead of luxury weekend glamping, it was more like *Lord of the Flies*.

McFarlan had a genius marketing scheme and effective leadership style. However, while he convinced himself otherwise, he did not have the experience, the resources or the time to put this festival together. What eventuated was a costly failure. Those who made it to the festival were faced with sleeping in disaster-relief tents. The attendees had no access to fresh water, food or basic amenities. To top it off, all of the promised music acts cancelled before the festival launch.

Soon after the festival disaster, McFarlan declared bankruptcy and claimed he had no money to refund any tickets. McFarlan's team reported that at multiple points they thought it would be better to cut their losses, but McFarlan wanted to push on and convinced his team to persevere.

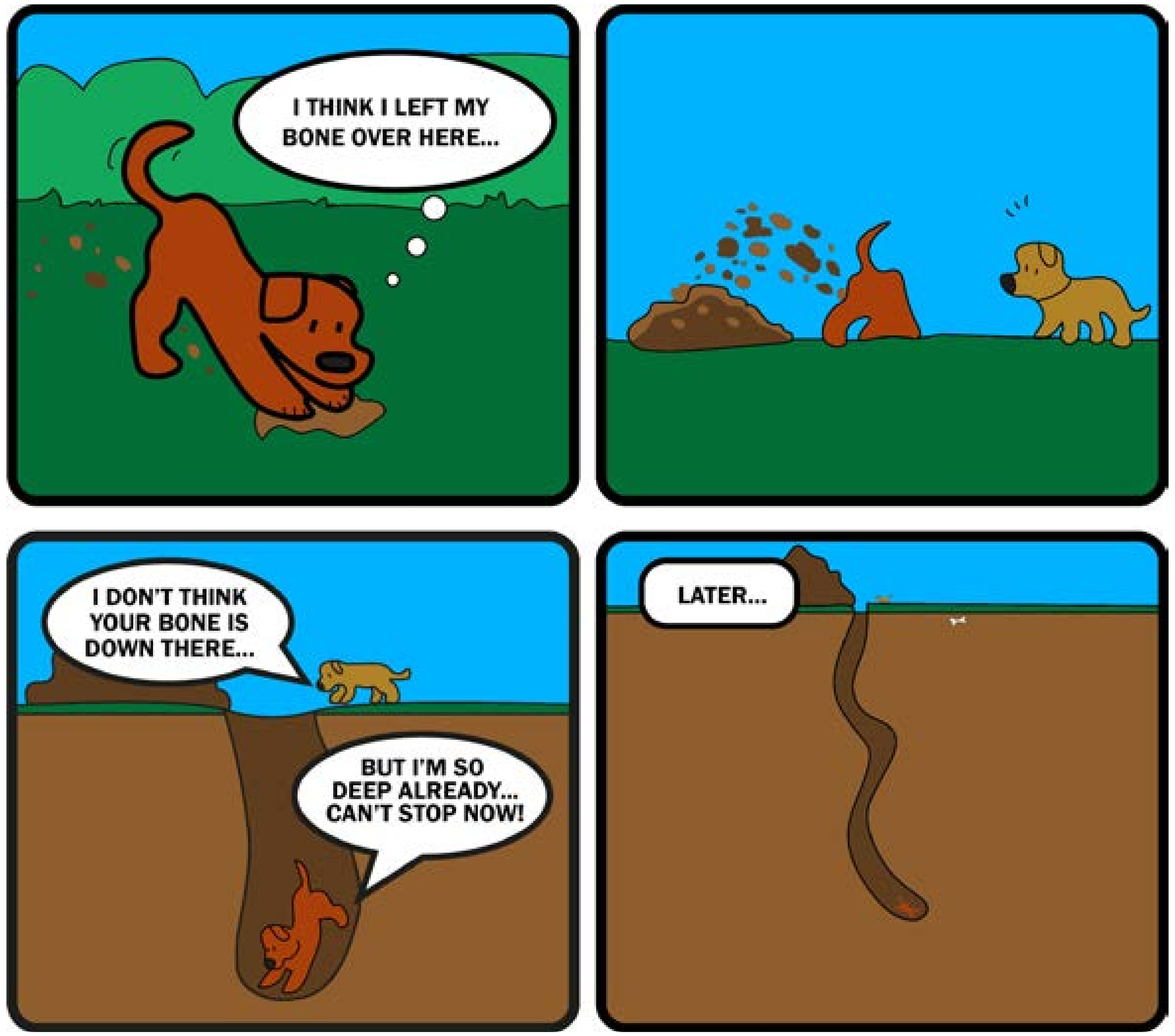
Now, let's move to something quite different – Chernobyl, the fatal nuclear disaster that could have been avoided. Like all complex accidents, there are many contributing factors beyond the individual and team action that occurred on the night of the disaster. In fact, the fate of Chernobyl was sealed when the Soviet Union decided to invest in nuclear power. This decision was born out of geographic needs and geo-political aspirations. The Soviet Union was, at the time, the architect of the world's first commercial nuclear power plant, and one of the two principle powers in the Cold War.

The 1980s was a tense time during which the Soviet Union was determined to demonstrate great power and presence on the international stage. Political aspirations aside, 75 per cent of the Soviet Union's population resided in the European part of the country, about 80 per cent of the nation's energy resources were located on the other side of the country, transporting fuel made up about 40 per cent of all rail freight in the country (Wojcik, 2018).

There was a big push from the government to stand up nuclear power facilitates as fast as possible in its European regions, where the mass population resided. This saw a huge political, financial and social investment in the nuclear facilities. While the initial investment may not be misplaced, the constant pressure to sustain production overshadowed many safety considerations. The nation invested so much in these nuclear facilities, they could not fathom or accept any potential flaws or failures.

However, it was known since 1975 that one of the reactors was likely to explode due to design flaws and shortcuts. In subsequent investigations, it was found Chernobyl did not comply with more than 30 standard design requirements. Yet, in the spring of 1986, Chernobyl was officially one of the best-performing nuclear stations in the Soviet Union, and was scheduled to receive the Order of Lenin, the state's highest honour (Higginbotham, 2019). How could people let Chernobyl happen?

The Fyer Festival and Chernobyl are two very different scenarios with vastly different consequences. However, if we dive a little deeper, one human bias is present in both scenarios, in fact this human bias shapes a lot of our decision-making processes. The often overlooked but always fascinating bias, the Sunk-Cost Effect. The textbook definition states that the Sunk-Cost Effect is the manifestation in a greater tendency to continue an endeavour once an investment in money, effort or time has been made (Arks et al. 2004). In other words, 'I've invested too much, I can't go back now'. This is appropriately illustrated by the image below:



Let's go back to the Fyer festival and look at it through the lens of Sunk-Cost Effect. Billy McFarlan was a larger-than-life character that built his company on a can-do-anything attitude, which manifested into a must-do-at-all-cost culture. A classic example of this culture was when one of his employees raised their concern about the site suitability, as the island had no water source, no sufficient accommodation and no real methods of transportation. It would take months to make the island viable as a festival location; however, Billy and his team didn't have months, in fact, they only had weeks to try and get the festival ready.

Instead of listening to this concern, he fired this employee and hired another who was "solution focused" rather than "problem focused". Billy and his team had already invested too much money, reputation, time and resources to admit they had failed. They pressed on, even though most of his employees were uncomfortable and could clearly foresee the inevitable disaster that awaited them.

Now let's look at Chernobyl, from the start of the nuclear project, the financial, political and social investment was already too great and too much for anyone to openly admit any design flaws. Instead of delaying or stopping the nuclear project, the government pressed on. This sounds uncomfortably similar to what Defence and government experienced with the Seasprite project.

Music-event organisers, nuclear-plant operators, governments, the military, and everyone in between can all fall victim to the Sunk-Cost Effect. Like all biases, it can often be subtle and insidious, and we only recognise it in hindsight. Unfortunately there's no easy cure for biases, but we can; however, implement effective management strategies to identify these biases before they have an adverse impact on our mission/task. The key is to identify signs indicating that you're about to fall victim to the Sunk-Cost Effect and then to understand the impact of it.

The impact of the Sunk-Cost Effect is degraded decision-making processes, instead of adapting to changing context, decision-making is fixated on the initial investment made at the beginning of the mission/task. You may find yourself saying things like: "we'll just have to make this work", "this is not ideal, but we're committed now", "we've come this far, let's just finish it" or "our reputation is on the line, let's make it work". Sound familiar? Have you said these while flying, maintaining, in the tower, on the bridge?

If you find yourself uttering these words, take a minute and ask yourself, is what we're doing: can-do or can-do safely? Am I continuing this mission blindly, based on my initial investment or am I continuing, conscious of the changing context? Am I comfortable that my initial plan encompasses new hazards? And have I communicated how the changing context can affect mission/task objectives to my team? The answers to these questions can release you from the grasp of the Sunk-Cost Effect and it can also ensure the safe return of your team from your mission/task.

The *NTS Guidebook*, Chapter 5 – Decision-making, offers more great tips and information on moderating cognitive bias and avoiding decision traps.

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Close call

Importance of airfield communications

By SGT Troy Woof

WHEN POSTED TO Air Mobility Control Centre (AMCC) within the Mobile Airfield Engineering Team (MAET) my OIC and I were tasked to conduct an airfield survey of a civilian airfield at Cessnock. This airfield is well known for its pilot training school and how busy it can be during peak periods.

As part of all airfield surveys, it is a requirement to conduct approach and departure splay measurements, runway strengths, runway measurements, obstacles and hazards relevant to the airfield and any other information pertinent to aerodrome.

When evaluating the strength of the airfield, the MAET is required to use a Dynamic Cone Penetrometer (DCP), which is driven into the surface of the airfield using a 9 kg weight that is dropped from a constant height of 590 mm. Considering the airfield was sealed we used the DCP from the immediate edges of the airfield to prevent damaging the runway surface. This test is to be performed approximately 18 times per airfield so maintaining effective communications with the users of the airfield is paramount.

On this occasion while conducting the airfield survey, I was placed in charge of making all CTAF radio calls and listening for any radio calls that had an impact on our approved movements on the airfield. Throughout the day there were numerous CTAF calls from aircraft landing, taking off and using the associated movement areas as well as the MAET identifying all movements we were conducting. We were half-way through the airfield survey when we identified a training aircraft using the movement areas without making radio calls. We then made contact with the aircraft advising them of our movements and the task we were performing on the runway and they responded with confirmation.

About an hour later we were conducting some strength tests on the edge of the runway when, out of nowhere, the same aircraft landed right next to where we were working with their wing tip missing us by no more than 10 meters. When I tried to contact them through the CTAF there was no response from the pilot so when we finished conducting the strength test I found the aircraft and approached the pilot responsible. After discussions it was determined that she was making the calls but not correctly engaging the communications system therefore no calls were being transmitted through the CTAF.

The result of this particular event was positive, with the identification of human error on behalf of the student pilot. However, it could also quite easily have had a negative outcome if the student pilot did not maintain control of the landing. Following this incident the MAET's procedures were re-evaluated and additional safety measures were put in place.

It was decided that an additional member was required to participate in the conduct of airfield surveys so as to always have an observer. It was identified that this was not the only occurrence of this type of incident and that if a busy aerodrome such as this could produce such a hazardous scenario then the remote airfields and South Pacific airfields that the MAET quite often visit have a greater risk of this occurring.

As members of the ADF we are identified as being incredibly professional, especially with respect to aircraft operations. This incident reaffirms that regardless of the way an organisation is perceived, mistakes are always going to occur. Humans aren't perfect and we all need to be cognisant when operating on an airfield. One of the most effective safety tools to use on an airfield is the radio systems identified for that particular aerodrome. If correct calls are made then there is a decreased risk of incidents occurring; therefore, allowing everyone to go home safely at the end of the day.

BEWARE cross-cockpit authority gradient

By MAJ Wesley Wood (USA)

THE ASR TITLE for this incident is *Breakdown in separation*, but there is a lot more to it…

Most fighter pilots who have been around a few years would have inevitably faced this situation at least once or twice in their careers. You're on the schedule to lead a staff continuation training four-ship conducting air-to-surface precision-guided attacks using a variety of weapons and you are the most junior member of the formation. You have been trusted with leading a tactical military operation – plan, products, brief, execution – ensuring all members of the formation return back to base safely with the maximum amount of learning for the tax-payer dollars being spent on the sortie.

This canvas can be painted many different ways and still achieve the overall goals, and it often comes down to personal interpretation as to the best way to accomplish these tasks. This article addresses both sides – junior and senior members of this type of formation. I will use a recent personal experience to bring up some lessons learnt. The day before this incident, I spoke to several squadron mates and expressed my concern over the distractions that would likely be coming from some of my wingmen. I even made a special point to write on the board and brief to the objective of "Nil Extraneous Comm". This would turn out to be a premonitory objective.

Event 1

The first two Joint Direct Attack Munition (JDAM) attacks went well and as planned. While setting up for the third attack it became apparent that Hunters #3 and #4 of the formation were on the opposite side than was planned for the next attack. We were over 20 nm from the target and had plenty of time to adjust. I transmitted a change to the game-plan to the team to account for the different formation position. The new plan was valid and would have achieved the desired training objectives without compromising safety. However, #2 and #3 changed the revised plan and effectively disregarded my direction as lead, executing as they saw fit. In isolation, this is not a big deal, but it is an important part of the bigger picture.

Event 2

Following the third attack the formation split to two pairs to focus on attacking moving targets with laser JDAM and ground strafe with 20 mm. My wingman's targeting pod had suffered significant degrades and in line with the priorities given by our flight authorisation officer I planned to skip the moving-target attacks and complete the strafe attacks, which were not compromised by his degraded system.

I conveyed this plan, which was challenged by #2 to pursue the moving-target attacks. I felt my decision was over-ridden. As a result we spent six-to-nine minutes and an unknown amount of fuel with neither of us getting a successful track on a moving target while #2 unknowingly flew below his joker fuel. I was then informed by #2 that he had overflown joker by 1400 lbs and was now just above IFR bingo.

I directed him to re-join for the planned instrument approach recovery as planned RTB. At this point #2 requested I contact ATC to see if the visual approach was available. I was unable to raise them on the radio so #2 spoke with ATC and was advised that a visual approach should be available. As a result Hunter flight switched to visual fuels and executed two strafe passes. WLM Approach had no visual understanding of the conditions and #2 did not consult with the duty supervisor. However, his tone and the manner in which he conveyed his intent to achieve a visual approach were compelling.

Event 3

At the conclusion of the strafe # 1 and #2 started a climb and headed towards the airspace exit point. Hunters #3 and #4 were only 15 miles behind so we slowed to 250 kts and directed them to re-join in the corridor per

the pre-flight brief as we transited back to base. Hunter #2 then strongly advised against this plan because we may have to penetrate weather, so under perceived pressure from a senior member I told #3 and #4 not to re-join. About five minutes later I noticed that #3 and #4 have disregarded that plan and re-joined anyway.

Overall, in the span of 20 mins, there had been at least four extraneous radio calls from #2 and #3, a disregard of leads direction to not re-join by #3, and #2 had overflown joker by 1400 lbs. Things were about to become worse.

Event 4

Enough holes in the Swiss cheese had already started to line up and a few more were about to be added as the formation conducted a bastardised visual approach in non-visual conditions.

- The ATIS on RTB indicated a visual approach should be possible, the reality was that the weather just off the coast was far worse, requiring descent to overwater minima to get visual.
- The formation all gained visual and began to re-join into a visual formation for an initial and pitch. A moment later ATC informed that a pitch was now not available and directed the formation to conduct straight in approaches which required the formation members to gain separation for landing.
- Hunter #4 hit minimum fuel.
- Miscommunication occured between #1 and #2 resulting in #2 initiating a go-around and landing last.

The final landing order of the formation was #1,4,3,2.

Contributing factors

When breaking down a few key events we could begin to peel back the layers to see where the train started to come off the tracks. At the end of the day there are several contributing factors and a single root cause. Contributing factors were:

- ATIS transmitting an incorrect/ incomplete report on the actual field conditions
- ATC incorrectly communicating that a visual approach via initial and pitch should be available and subsequently changing that instruction in challenging conditions
- Hunter #1's lack of assertiveness in controlling #2, which saw him drive the formation into an uncomfortable/ unbriefed position
- Flight lead not communicating his concerns to the duty supervisor before the mission.

Root cause

The root cause in this situation was poor followership. The issue of senior wingmen distracting flight leads with unnecessary comms is not new and can likely be attributed to a cultural acceptance of this type of behaviour to a certain extent. I'm not advocating that wingmen shouldn't be allowed to talk, rather that they should think before keying the mic switch.

- Is what I'm about to say necessary?
- Is it safety or flight related?
- If I don't say something now are we most likely about to waste the mission and all its assets?
- Can the formation still get the learning from this aspect in the debrief?

The same could be said for the brief. If the person briefing the formation makes a clear misspeak, or briefs something blatantly unsafe/omits a critical part of the brief then it is acceptable to wait until the flight lead reaches a natural stopping point, and asks for questions/inputs from the formation.

At this point there would be no issue with asking the question to clarify the item of concern. What is unprofessional and unproductive is to interrupt in the middle of a brief to point out what is perceived to be an error.

Conclusion

The impetus behind writing this article was the incident described earlier, but the lessons learnt are a culmination of more than a decade spent flying fighters. Sometimes with senior formation members, and also as a wingman to a flight lead who is more junior to myself.

We can all be guilty of these things at times and it's important to take accountability for our impacts, whether intended or not. This is a problem unique to the Air Force as we are the only Service that puts junior-ranking members in charge of senior-ranking officers for tactical operations. Ground and maritime combat assets rarely see junior officers commanding senior officers. This is necessary in Air Force because of the highly technical aspect of flying fast jets and the need to keep proficiency in leading in a squadron.

The problem becomes when formation members don't understand their role in the operation. There is no doubt when on the ground what the rank structure is. But once the pre-flight brief starts the flight lead has now been delegated responsibility for the safe and effective control of all assets in the formation until they are back on the ground, shut down and the debrief is complete.

This is where things begin to go awry. Some senior formation members tend to control the formation from a position other than the #1 spot. This is not only incorrect, but also extremely distracting for the flight lead and can lead to lack of assertiveness, complacency in the flight leads, or as in the case above, dangerous situations developing.

The ASR reviewer commented:

- If the flight lead was able to execute as per the brief/plan this ASR would not have occurred and the formation would have recovered via an in-trail instrument approach in accordance with planned fuels
- Interference from subordinate wingmen must be limited to safety concerns and/ or providing a rare suggestion as to the conduct of the mission. – undermining the flight lead's authority and confidence through unnecessary interference coupled with a directive communication style is not acceptable
- Of additional concern is that the flight lead expected the interference to occur due to previous missions and that this concern was not highlighted to the authorising officer or adequately debriefed previously
- This ASR highlights that being a highly experienced unit presents its own specific NTS threats to flight safety and that these need additional focus going forward.

A positive lift in safety culture

By FLTLT Jason Sporer

ALMOST ALL OF us would remember, or have heard of, the tragic accident of the Navy Sea King that crashed on Nias Island while on Operation SUMATRA ASSIST II in 2005. This was determined to be a direct result of error and non-compliances with maintenance regulations[1], which were in place to help ensure aircraft were airworthy. It also highlighted a culture that supported this behaviour. I remember at the time the general feeling among the maintenance workforce I worked in was that this would never happen in our squadron.

When I reflect back, as a workforce, we all said at the time that our culture was better than that which led to the Nias Island accident. Given my experiences, I had to ask myself:

- Was our culture actually any different?
- Was there an underlying culture that believed the regulations were there only to impede us and make life difficult?
- And were we just lucky that there weren't any more serious incidents?

The following is a true account of an incident that I was directly involved with that highlights how a poor safety culture can impact airworthiness and aviation safety. I will relay an experience that could overlay the events leading up to the Nias Island incident and how it had potential for a similar outcome to that of the Sea King disaster.

The year was 2004 and I was a newly promoted sergeant. I had been deployed on Operation RELEX/RESOLUTE working out of RAAF Base Darwin. I was working a swing shift – the split shift was structured such that I was to be there at 0400 hrs to prepare the aircraft for 0600 hr launch, and once the aircraft had departed I was to remain for a couple of hours in case it returned. After that I could leave the workplace but had to stay within 30 minutes of the base in case the aircraft came back early. I needed to be at work again when the aircraft was to return and act as Avionics Independent Inspector and Shift Boss, preparing the aircraft for the next day's mission. We had two aircraft in location with a preferred tail for the missions.

At some point our preferred aircraft sustained damage to the leading edge of the port wing. The repair required replacement of the leading edge. We did not have authorised personnel in location to effect the repair, and therefore we had them deployed from Edinburgh the next morning. The member departed Adelaide at around 0700 hrs and arrived in location at around 1300 hrs and began work immediately. The plan was to replace the leading edge and return the aircraft to a serviceable state that night ready for the next morning's launch.

At around 1800 hrs the OIC Maintenance announced he was departing for the day leaving me to manage the completion of maintenance, including the leading-edge change. As maintenance activities stretched into the night, we were extending the duty hours of the ASTECH repairing the leading edge beyond those allowed within the regulations. It was around this time I became concerned as we had only verbal consent from the OIC Maintenance to do so.

The leading-edge repair was taking place in a carport-type hanger not normally used to keep GSE out of the weather. The lighting was poor and there was little in the way of fall protection. I allowed the activity to continue; however, I did raise my level of supervision with increasingly regular inspections to ensure he was not in danger and was coping with the work. At around 2100 hrs I went out to check on the work and I noticed that he was starting to look quite fatigued. I returned to the office and rang the OIC Maintenance to notify him of the situation and that the member was starting to look quite fatigued. I noted during the call that due to the background noise on his end, he was in town at a bar. He promptly told me that it didn't matter and to keep the activity going.

Over the next couple of hours I made several more checks and at least one other call to advise of the rising fatigue level and recommend that we cease the activity and transfer to the other aircraft. All requests to cease were met with a no and direction to continue on. It was now around 2300 hrs and I was very uneasy about what was transpiring and the fact I was being left unsupported. At this point I disregarded the direction given and ordered the ASTECH to cease work as it was getting too dangerous and for my team to prepare the other aircraft for the next day's sortie. The sortie was completed without incident the following day and I was chastised in front of my team by the OIC Maintenance for exceeding my authority.

This incident involved a senior and well regarded maintenance member who was attempting to manage a workforce while dislocated from the workplace. He was making decisions where the safety of members, both maintenance and aircrew, may have been compromised. His decision-making was not based on regulatory compliance rather, how things were done in the past.

Now that I find myself back in the aircraft-maintenance environment I have noticed a significant positive shift in thinking and awareness towards safety and airworthiness. Increased education programs and the development of robust regulations have contributed to a vast improvement over the past decade. The new generation has taken its place in leading our maintenance force and these instances of non-compliance have been dramatically decreased.

1 Royal Australian Navy Nias Island Sea King Board of Inquiry Report, Commonwealth of Australia, 2007.

"Climb!"... "I Can't!"

By CAPT Michael Tenkate

I WAS AN ARMY pilot in Graduate Pilot Troop (GPT), a holding platoon prior to Operational Type Transition (OTT) at Oakey. It meant flying around with your mates at 50 feet or fly-away tasks gaining experience.

A tasking that rarely came up was to take passengers from Oakey to Gallipoli Barracks, Enoggera or vice versa. There is a small landing pad at the base on the western side of Mount Gallipoli. It is approached usually from the north following the terrain down till the pad opens up on late final. On this day the wind was 30-plus knots from the west meaning we would circle the northern side and line up for an approach to the west into wind.

I was the flying pilot in the left and another senior member of GPT was captain in the right. We knew we were in for a rough time on the transit when the small aircraft was being thrown around like a leaf in the wind. I started the final approach to the pad at about 750 ft AGL fighting the controls to keep the helicopter lined up to the west while making large collective movements to keep from over torqueing. On short final we hit large amounts of rotor turbulence from the mountain and I made the decision to call it off as teetering rotor heads and turbulence don't mix.

I pulled in the collective to climb away but with the wind going through the top of the disc it required more power than I had to gain altitude. Painfully slow, we finally climbed away in a left-hand turn, which was the standard departure, to then circle the southern side of Mount Enoggera and track back to Oakey.

At this time, there was a 30 kt wind from the right going straight through the tail rotor (TR). Aerodynamically, this reduced the effectiveness of the TR and requires right pedal to maintain heading. Right pedal means more power which as we saw earlier, we didn't have. To prevent spinning out of control I used the remaining torque to maintain heading and accepted a rate of descent. The torque gauge was top of the yellow and we were descending into the streets of western Brisbane.

The captain, also seeing the buildings getting bigger said calmly but firmly "Climb!" I was doing everything I could just to maintain control and heading without over torqueing or entering a spiral, all the while descending. "I can't!" I said, "I'm max torque and have no TR effectiveness!" He acknowledged and told me to keep flying because I could feel what was going on and he'd continue to handle radios. Each time I tried to turn right we nearly over torqued and when I tried to turn left the wind wouldn't let me change direction. The captain contacted Brisbane Centre for a clearance as we were approaching the CTR boundary which was half-a-mile away but we were told to stay clear.

Unspoken, we both felt a MAYDAY was coming. I guess we were at less than 500 ft AGL, often dropping what felt like 15 ft, when I told him I thought we might have to land straight ahead in a park I spotted between the

houses and told him my quick approach plan. Less than five seconds (felt like an eternity) later the wind died away. I felt the TR authority return, torque required drop and I was able to pull in power and turn immediately right into wind. I felt the helicopter (and two crew) fly away happily with wind over the front of the disc and away from the houses.

The flight back was the most uncomfortable I've ever been in a helicopter. It was turbulent and bumpy to the point that there was so much wind over the disc acting like a wing that zero collective and full forward cyclic was required to prevent climbing. Needless to say we were both white and shaken after the experience.

I learnt a few big lessons that day that I would like to humbly share:

- The authorisation process is an underrated time to pick up on potential hazards.
  The authorisation process is designed for flying crew members to present their task and plan for a senior pilot to assess and offer considerations that they may not have thought about. I had done a wind appreciation and come up with a plan, but greater than 30 kts over a mountain should have rung more alarm bells. Pilots always want to fly and "see what it's like" even if the conditions are right on the limits. This is from a history of the weather often not reflecting the TAF, which leads to a false sense of security. Also the unsafe culture of press-on-it-is often pushes crews to take chances in an attempt to get the job done despite obvious risks. Or in our case, a rare task that came up is something we as junior crews did not want to pass up.
- An ASR is your friend, not foe.
  The point of the ASR system is to not just log incidents for reporting but also record events so others can learn from what has occurred and draw out changes that can be made to prevent future occurrences. We reported the incident to our authorising officer who was happy due to the fact we didn't break any aircraft limits. The loss of TR authority was on departure so was not breaking minimum height rules and no airspace boundaries were busted; therefore, no ASR was required. He said all the correct procedures and actions were taken so what would it help? I think the event could aid future pilots in learning about approaches and loss of TR authority especially over a built up area.
- The captain displayed excellent CRM during the entire event.
  I respect the captain, including his ability to realise I had an understanding and feel for the helicopter in the conditions. He communicated quickly and directly what he wanted done in a calm manner. He never tried to press an already bad situation and took on the information I passed to him as flying pilot. This led to an effective crew model which ultimately led to us returning home safely.
- Lastly, I think a good working knowledge of systems and feel for hands and feet flying became very important in the safe and effective handling of this helicopter because it was a hands and feet helicopter. There's no difference to modern fly-by-wire glass-cockpit aircraft where the pilot needs to understand the systems and how to best use them in the case of an emergency.

Going around on one

By John Laming

AN ASYMMETRIC OVERSHOOT is not a manoeuvre to be undertaken lightly, as John Laming explains.

Boeing calls it a one-engine inoperative go-around. The Royal Australian Air Force – with whom I learned to fly – called it the asymmetric overshoot, a neat name that covers the two-engine overshoot in a four-engine aircraft or a single-engine event in a two-engine aircraft. Others prefer to label it single-engine missed approach.

No matter which term you prefer, a low-altitude go-around on asymmetric power is not to be treated lightly. Whether the propeller is feathered or set at zero thrust ready to be brought back into action, it takes careful handling to ensure a safe climb with one engine out. Twin-engine jet transport aircraft are certified by the manufacturer to meet a minimum gradient of climb during a go-around with one engine inoperative. This luxury is not available with light twins where the problem is usually a combination of directional control with poor rate of climb.

Flight Crew Operations Manuals (FCOMs) for light twins and transport category types list the order for which the undercarriage and flaps should be retracted, as well as the recommended airspeed required to ensure a safe climb-out on one engine. Because of the many variables affecting single-engine climb performance, manufacturers do not publish a minimum height below which a go-around should not be attempted; indeed, most jet transports have the capability of going around on one engine from runway level, providing FCOM-recommended procedures are followed.

It is interesting to go back 60 years to compare the asymmetric characteristics of military aircraft of that era with today's light twins. Part of the test pilot's task was to assess the handling characteristics with one engine failed during take-off and landing, as well as recommending the best procedure in the event of a single-engine go-around. With few performance certification rules to guide them, it was a case of recommending go-around procedures that could be flown safely by the average military pilot.

Take for example, the test pilots' recommendations published in the RAF Pilot's Notes for the Avro Lincoln four-engine bomber: …"the decision to go-around on three engines should be made before full flap is lowered… initial straight approach should be made at 120 kts… power and speed should be gradually reduced and the airfield boundary crossed at the correct engine-assisted approach speed (100 kts)… on go-around the aircraft can be controlled comfortably at 125 kts… select undercarriage up and while it is rising select flap up in stages".

For the Mosquito PR 34 the notes recommended: "going around again on one engine is only possible if the decision is made while ample height remains and before more than 15-degree of flap is lowered… this height is required in order to maintain the speed above the critical speed for the high power necessary while the undercarriage and flaps are retracting".

Pilots of the Bristol Beaufighter were advised to: "maintain 140 kts minimum and don't lower the flaps beyond 20 degrees until it is clear that the landing area is within easy reach… the final approach is 95-to-100 kts".

The Dakota was not so bad, with the advice being to: "maintain a minimum speed of 92 kts in the circuit… do not lower flaps more than one quarter until certain the airfield is within easy reach… final approach 82-to-87 kts".

With the introduction of twin-engine jets such as the Meteor and Canberra, the gap between threshold speed (VREF in modern terminology) and safe single-engine go-around speed, became critical – often by as much as 40 kts. Many accidents on these types resulted from loss of directional control during single-engine go-around exercises and in the early 1950s there were more accidents during asymmetric training than from actually landing with one engine failed.

Following several write-offs during practice asymmetric landings the RAAF issued a directive that teaching asymmetric overshoots, as they were then called, should not to be conducted below 600 ft. This recognised the need for altitude to spare while allowing an aircraft to accelerate downhill from final approach speed under asymmetric power to a safe single-engine climb speed. Consequently, 600 ft above airfield level thus became the universal 'decision height' for asymmetric landings regardless of aircraft type.

A further problem arose when aircraft were conducting the standard military instrument let-down called the ground controlled approach or GCA, where not only was the minimum descent altitude (MDA) universally 200 ft but the radar was so accurate the controller could literally talk the aircraft all the way down to landing. All bets were off with heavy rain where the aircraft would vanish from the radar screen in a haze of attenuation and the GCA could become positively dangerous.

Sod's Law would, of course, ensure the luckless military pilot would be confronted with the choice of not two, but maybe three evils. The first included a GCA with one engine inoperative but faced with an asymmetric decision height of 600 ft – while at the same time knowing a landing was possible from 200 ft if the visibility permitted. Or should he risk the possibility of having to go around at 200 ft if not visual and subsequently lose directional control? Or run the risk of fuel exhaustion by diverting to an alternate aerodrome on one engine?

Today's Seminole or Duchess pilot has an easier choice; the difference being only 12 kts between a typical VREF with full flap of 76 kts and safe single-engine climb speed of 88 kts; a far cry from the alarming 40 kt split of early military types.

Flying schools may publish a company minimum single-engine go-around decision altitude. This number may reflect the personal opinion of the CFI or perhaps be promulgated under pressure from the regulatory authority. Either way, it is usually an arbitrary and conservative height above airport level, with 400 ft a typical decision height below which the pilot is committed to land if on one engine. With students legally bound to follow flying-school-published procedures, the student is left with the impression that under no circumstances is a go-around to be attempted below the decision altitude. This means that the only alternative is a single-engine controlled crash landing on the aerodrome. Decision heights are seen as set in stone.

Back now to early military aircraft and their go-around performance. The common denominator here is the clear danger of further flap extension beyond initial approach flap. The Mosquito Pilot's Notes emphasize the point of deciding early, while ample height remains to permit a gradual descent to obtain the recommended single-engine climb speed as the wheels and flaps retract. In other words, on a single-engine go-around you deliberately descend in order to eventually attain the required one-engine climb speed. This is in marked contrast to the standard all-engines go-around where one deliberately raises the nose to the go-around attitude while retracting flap and gear in the correct order.

The amount of height lost in attaining the required single-engine go-around speed is often dependent on the time needed to commence undercarriage and flap retraction. This principle applies just as much to a single-engine go-around in a Boeing 737 as that in a Beech Duchess. In each case, pilot proficiency is a decisive factor in the successful completion of the manoeuvre.

Rather than lay down an arbitrary decision height – and remember, the manufacturers don't – it is better to emphasise the importance of not extending full flap until the landing is assured. For most light twins the difference in threshold speed between no flap and full flap is around 10 kts. In turn, the approach speed with flaps up is close to best single-engine rate of climb or Blue Line speed.

If landing with one engine inoperative, an approach 10 kts above the normal full flap landing speed allows a safe margin for a go-around for the proficient pilot regardless of his experience level. The key word here is 'proficient' and a pilot should not be 'type rated' until they are proficient on single-engine go-around procedures.

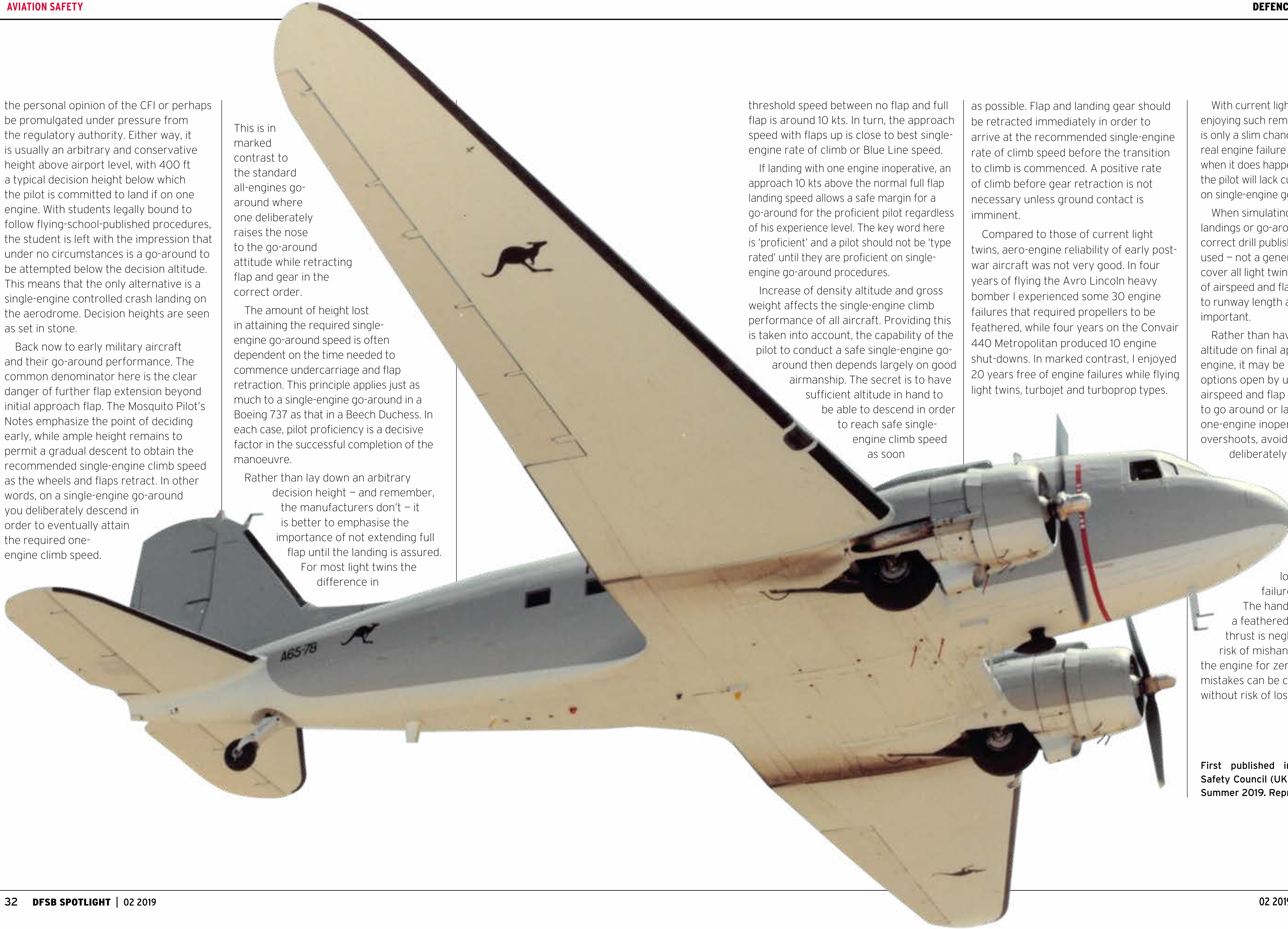
Increase of density altitude and gross weight affects the single-engine climb performance of all aircraft. Providing this is taken into account, the capability of the pilot to conduct a safe single-engine go-around then depends largely on good airmanship. The secret is to have sufficient altitude in hand to be able to descend in order to reach safe single-engine climb speed as soon as possible. Flap and landing gear should be retracted immediately in order to arrive at the recommended single-engine rate of climb speed before the transition to climb is commenced. A positive rate of climb before gear retraction is not necessary unless ground contact is imminent.

Compared to those of current light twins, aero-engine reliability of early post-war aircraft was not very good. In four years of flying the Avro Lincoln heavy bomber I experienced some 30 engine failures that required propellers to be feathered, while four years on the Convair 440 Metropolitan produced 10 engine shut-downs. In marked contrast, I enjoyed 20 years free of engine failures while flying light twins, turbojet and turboprop types.

With current light twin piston engines enjoying such remarkable reliability, there is only a slim chance of a pilot experiencing real engine failure in his lifetime. Of course, when it does happen, Murphy's Law ensures the pilot will lack currency and proficiency on single-engine go-around procedure.

When simulating one-engine inoperative landings or go-around procedures, the correct drill published in the POH should be used – not a generic drill that purports to cover all light twins. Intelligent assessment of airspeed and flap extension with regard to runway length and weather conditions is important.

Rather than have an arbitrary decision altitude on final approach on a single engine, it may be better to keep your options open by using a specific minimum airspeed and flap setting as a decider to go around or land. If simulating one-engine inoperative landings or overshoots, avoid the practice of deliberately feathering a propeller. It is not good airmanship and in fact, some call it practicing bleeding... Keep in mind that more aircraft have been lost in training for engine failures than the real thing. The handling difference between a feathered propeller and zero thrust is negligible but the increased risk of mishandling is not. By setting the engine for zero thrust configuration, mistakes can be corrected quickly and without risk of losing directional control.



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Perceived pressure

Author's name supplied

IF YOU SEARCH the internet for the term 'perceived pressure' you will find many sources that define it as a "psychological pressure imposing demands on one person by another individual, group or environment".

We hear 'perceived pressure' a lot in aviation circles and I can attest to it affecting me even though I thought I was beyond its grasp.

I had been a part of the airmen/aircrew world for 22 years as a flight engineer on C-130s and for a short period of time Caribous. In 2012 the decision was made to retire the C-130H from service and I was offered the opportunity to re-muster to C-130J loadmaster. I agreed and in January 2013 I began loadmaster conversion, graduating in July 2013. I considered myself experienced enough not to succumb to external pressures and to be able to call upon my previous experiences to guide me through events.

In November 2013 I was a brand new category C loadmaster operating in the Philippines during Operation Philippines assist. We arrived in country to supplement another crew and aircraft that had been operating there for about a week.

Our tasking was to fly short legs of approximately 20 to 30 mins from our hub in Mactan to outlying islands to infil supplies and exfil internationally displaced people. We were doing all of this with engines running (ERO) and more often than not, heavy rainfall. There was limited ground support equipment to unload and load the aircraft so a lot of breaking down of pallets and manual unloading and loading was taking place. There was not enough parking space on the airfield tarmacs to accommodate the number of aircraft that were forming the air bridge; therefore, our brief was to expedite the time on the ground to allow for maximum throughput of aircraft.

The United States Marine Corp (USMC) arrived a few days after us with some forklifts and manpower to help with the movement of cargo and passengers. Things were starting to fall into place with a regular routine established to unload and load.

We were into day three of this routine when a civilian with a warehouse-sized forklift approached us during an ERO from the right rear of the aircraft. We had a USMC forklift parked at the back of the aircraft ramp and people were breaking down a pallet and placing its contents on the forklift and I decided it would speed the offloading process if I marshalled this smaller forklift in to the right-hand side of the ramp.

Not wanting the forklift tynes to strike the ramp I was very careful marshalling it in, and stopped it within centimetres of the side of the ramp only to look up and see the mast of the forklift had contacted the aircraft and punctured the skin. There were two other loadmasters in the back of the aircraft busy helping the offload and saw the forklift approaching; they could see my attention was on the tynes and not the mast but were not quick enough to halt the forklift.

We informed the captain of the damage and we had to spend the next hour communicating back to our maintainers to determine the extent of the damage and how we could get the aircraft back to Mactan.

To say I felt bad and embarrassed would be an understatement – we not only held up a parking position on the tarmac we also had the aircraft off line for two days for repairs.

In our debrief it was all agreed that the perceived pressure of getting in and out as quickly as possible had led me to exercise poor judgement in marshalling the forklift in from the side, something that should never have been done. Also one of the three loadmasters in the cargo compartment should have stood back and taken a purely supervisory role to co-ordinate the unloading and loading of the aircraft.

We were fortunate that there was no injury or loss of life but it goes to show that when you put pressure on yourself, good judgement and situation awareness are the first things that go missing – and the lack of these two attributes are contributing factors in many accidents and incidents in aviation.

Hey captain, what's the safety height?

By Air Commodore Mark Lax
Senior Visiting Fellow, Office of Air Force History

THERE HAD BEEN some light rain late in the afternoon, but the rain was passing east of the ranges and it promised to be a good night for flying. Around the airfield, the weather was now fine. It had turned into a clear night although dark as there was no moon, but observers could tell the weather over the ranges was still a little murky.

The date: Monday 31 July 1961 and a RAAF Dakota aircraft from No. 2 Air Trials Unit from RAAF Edinburgh was preparing for a flight home – the crew had just completed a week of Project Mercury calibration trials in conjunction with the space tracking station at Muchea, Western Australia. This was a NASA task to ensure the tracking station was calibrated correctly for NASA's space program.

It was an exciting time working on Project Mercury, the first US-manned orbital space flights planned to prepare astronauts to eventually land on the moon. It was in Muchea that an Australian communications technician, Gerry O'Connor, first spoke with an orbiting astronaut, John Glenn, aboard his capsule Friendship Seven. Everyone was happy to be involved in what was leading edge stuff.

There were seven POB in the Dakota when it taxied at RAAF Pearce around 1900 hrs for what would be a long night flight with a planned refuelling stop at Forrest, a remote airfield on the Nullarbor. The crew consisted of a pilot and co-pilot, signaller and navigator. Two airmen and a scientist from the Weapons Research Establishment (the forerunner of DSTO) made up the passenger complement. All were heading back to Edinburgh on completion of the trials work and all were keen to get home.

At 1905 hrs, just a few minutes after take-off, A65-106 unexpectedly crashed into a hillside approximately two-and-a-half nautical miles from the Pearce airfield. The tower air traffic controller could see a faint glow to the south-west and when he couldn't contact the aircraft, quickly raised the alarm.

Search parties were immediately sent out and eventually located the wreckage at 2045, some hour-and-three-quarters after the alarm was raised. The search was hampered by the soft, boggy ground between the main access road and the crash site and the darkness of the night. The first responders found the pilots had both been killed, the other crew barely alive, but all three passengers had somehow been thrown clear and survived. Amazingly, none of the three were seriously injured.

The first question was: exactly what happened?

The aircraft

The aircraft involved, C47B Dakota A65-106, had been received by the RAAF at the end of May 1945 as a war purchase where it was issued to No. 37 Squadron and later No. 86 Wing. In the early 1950s, it had served at East Sale, eventually being allocated to the flight-test world at Aircraft Research and Development Unit (ARDU), then based at RAAF Laverton. It eventually ended up with No. 2 Air Trials Unit (2ATU) based at RAAF Edinburgh. At the time of the accident; however, it had been at the unit for only two weeks.

The Dakota was a sturdy transport aircraft that served the RAAF extremely well until the advent of the C-130. It had a 1500 nm range and a max speed of 185 kts at 10,000 ft. Although it could climb to over 25,000 ft, lack of pressurisation and an oxygen system limited flight above 10,000 ft to prevent hypoxia. It could carry up to 28 passengers, but in this case as a trials aircraft, it would have been fitted with test equipment and only the equipment operator and a couple of ground crew were in the back. At around 25,000 lbs all-up weight, the aircraft's two Pratt & Whitney R-1830 Twin Wasp radial piston engines could easily develop enough power to quickly reach a safe cruising altitude around Pearce.

An examination of the maintenance records showed the aircraft was fully serviceable. The Directorate of Flying Safety (DFS) report found A65-106 was carrying the maximum fuel load of 800 gallons and had an all-up weight of approximately 28,000 lbs, a heavy load because of the special scientific equipment aboard. It was later calculated that the captain had much underestimated the weight of this scientific cargo and the aircraft was in fact much heavier than he thought it to be.

The aircraft was given an ATC clearance to taxy to Runway 18 where it commenced a run-up prior to take off. All was well and the aircraft took off at 1902 hrs towards the south. Three minutes later, the aircraft radioed they were setting course south-east and the Pearce Tower transferred them to Perth Control wishing them a good trip. There were no further transmissions.

At 1910, the Pearce ATC controller noticed an unusual glow behind the hills and had the presence of mind to call Perth Control to issue what was then called a 'Distress Phase'. Around 10 mins later, a civil aircraft spotted the burning wreckage and reported its position.

Crew and PAX

The captain was FLGOFF Bill Bowden, an experienced pilot with more than 2100 hours, but only 63 hours' night flying in the Dakota. His co-pilot was FSGT Peter Davis who had 1161 hours but only 21 hours flying a Dakota at night. Their flying hours record would later come under scrutiny. The navigator and signaller's flying time was not recorded.

Strapped in at the rear were LACs Tony Leiper and Bill Miles, both engine fitters sent to Pearce with the aircraft to ensure its serviceability. With them was Neil McBain, an employee of the Department of Supply attached to the Weapons Research Establishment. His role was to operate the scientific equipment mounted in the aircraft cabin.

Witness statements

The first to be interviewed were the crash tender crew at Pearce who reported the aircraft appeared to take-off normally but was slow to gain height in the climb out. When the aircraft turned to port to set course, they lost sight of it in the dark.

Next, an airman from the base was driving north along the main road about six kilometres from the base and likewise agreed the aircraft made a turn to port towards the hills. He recalled the slow rate of climb and doubted the aircraft would clear the hills, and shortly after, saw a series of bright flashes which he took to be the aircraft crashing and catching fire. He must have been close to the accident because he also mentioned he felt vibrations from the subsequent explosion.

The DFS investigator then turned his attention to the surviving passengers, LACs Leiper and Miles, and Mr McBain. Leiper and Miles as engine fitters stated in their opinion, that climb power had been set and the aircraft's flight appeared normal, including the expected climbing left-hand turn. None of the three could remember what happened next, only regaining consciousness 10 to 15 minutes after the crash. All three were still strapped in their seats, which had been torn off when the aircraft hit.

After regaining consciousness, the two airmen went to search for the crew, first pulling out the signaller, FLTLT Alex Cook and navigator FLGOFF Bob White, who were barely alive, and covering them with the aircraft dinghy to keep them warm and out of the light rain. The pilots, FLGOFF Bowden and FSGT Davis were beyond saving. A sketch of the crash site illustrates just how spread out the debris was.

LAC Miles, later a warrant officer, recalled he had been seated in the very rear of the Dakota reading the paper and woke up wondering where the water dripping on his head was coming from and why he was only holding fragments of his paper. He soon realised he was still strapped into his seat surrounded by burning aircraft wreckage. LAC Leiper and Mr McBain were likewise just in front of him, also still strapped in. All were relatively uninjured, and their survival was a miracle.

The RAAF Pearce Senior Medical Officer was next on the scene, arriving with the main rescue party and his first duty was to tend to the wounded crew. Unfortunately, both Cook and White were too badly injured and both died shortly afterwards.

A post-mortem later concluded there was no medical condition in any crew member that was a contributing factor, but the injuries sustained in the crash were too bad for them to be saved.

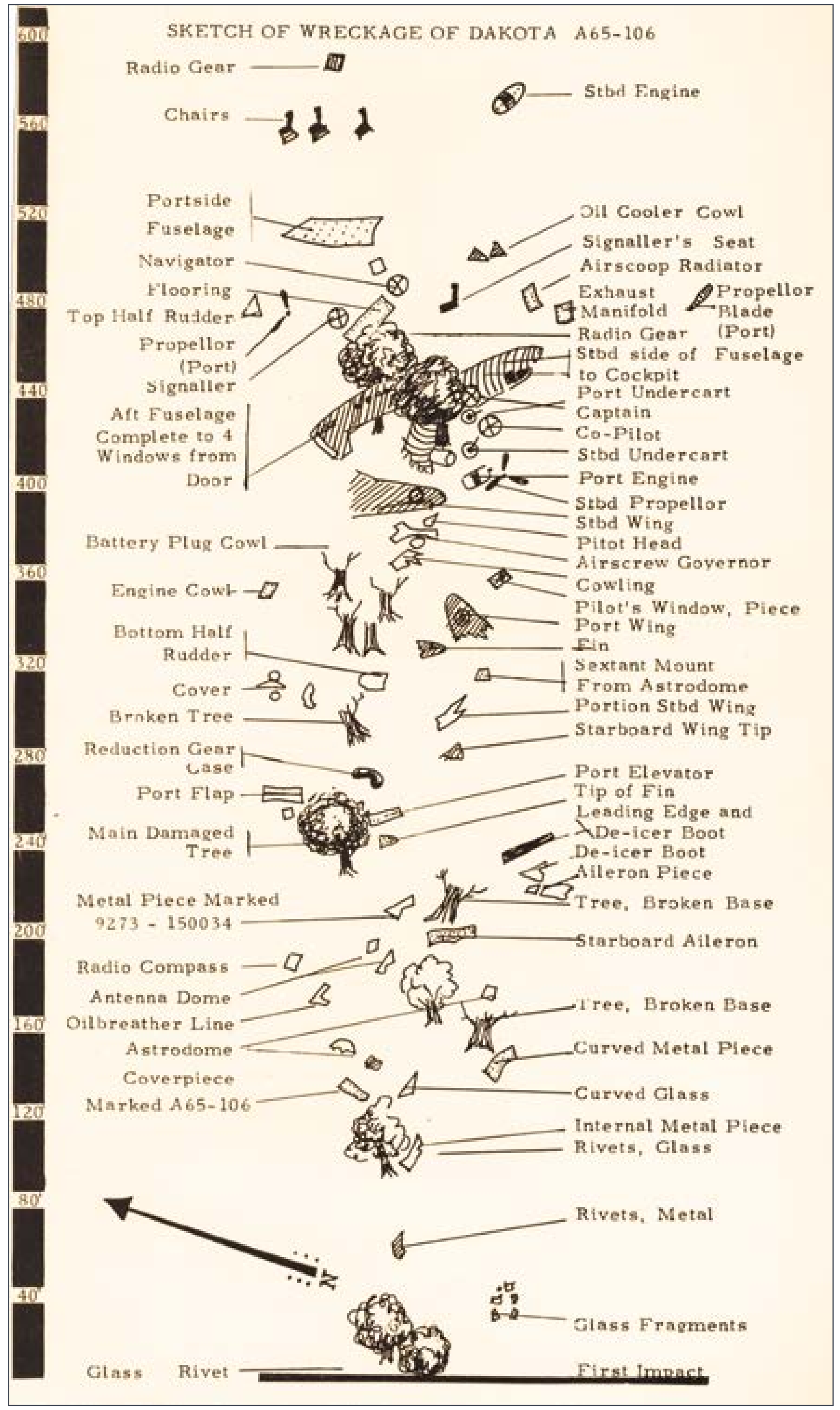
Examining the wreckage

When daylight permitted a closer examination of the crash site, it was clear the aircraft had struck the tops of gum trees 40 to 50 ft high just to the side of an 800 ft (240 m) ridge. The wreckage was strewn about 630 ft (192 m) forward from the tree line and slightly spread out. Further examination of the tree damage indicated the aircraft was eight to 10 degrees left wing down and flying almost level, but likely in a normal climb, an ascent of 2.5 degrees at 500 ft per minute. The investigators determined from this that the pilot flying the aircraft was not in any difficulty.

The outer 10 ft of the starboard wing and aileron had been sheared off 211 ft (64 m) in the direction of travel after initial impact, likely causing the fuselage to swing. Forty feet further down, the cockpit and section of the cabin struck a large tree, continued for another 200 ft (61 m), whereupon it hit another large tree, wrapped itself around the trunk and crushed the pilots.

Examination of the detached engines revealed they were both under full power when the aircraft hit the trees and the distance travelled indicated the aircraft was flying at about 110 kts. The power of the impact snapped two-foot diameter tree trunks off at their base or tore them out by the roots as the wreckage slid down the hill.

The DFS party later entered the damaged cockpit to examine the pilot's instrument panel and throttle quadrants. The pilot's artificial horizon (a gyro device which, as its name suggests, gave the pilot a horizon and a forerunner of the attitude indicator) was 'uncaged', meaning it was in the normal flight mode. The throttles indicated the aircraft was under climb power.



Sketch of wreckage of Dakota A65-106

What next?

In order to establish the likely cause of the crash, a second Dakota was used to reproduce the flight profile. This aircraft was loaded to 27,000 lbs and made several daylight runs over the same area. At different points, the aircraft was banked to port after take-off as shown on the map. Various climb power settings were used, and the results showed the height obtained three minutes after take-off was between 800 ft and 1200 ft. This gave a tree clearance of either 450 ft down to only 50 ft, but the test aircraft was at least 1000 lbs lighter than A65-106. This trial indicated that an overloaded Dakota would likely hit the trees regardless of crew skill and weather conditions.

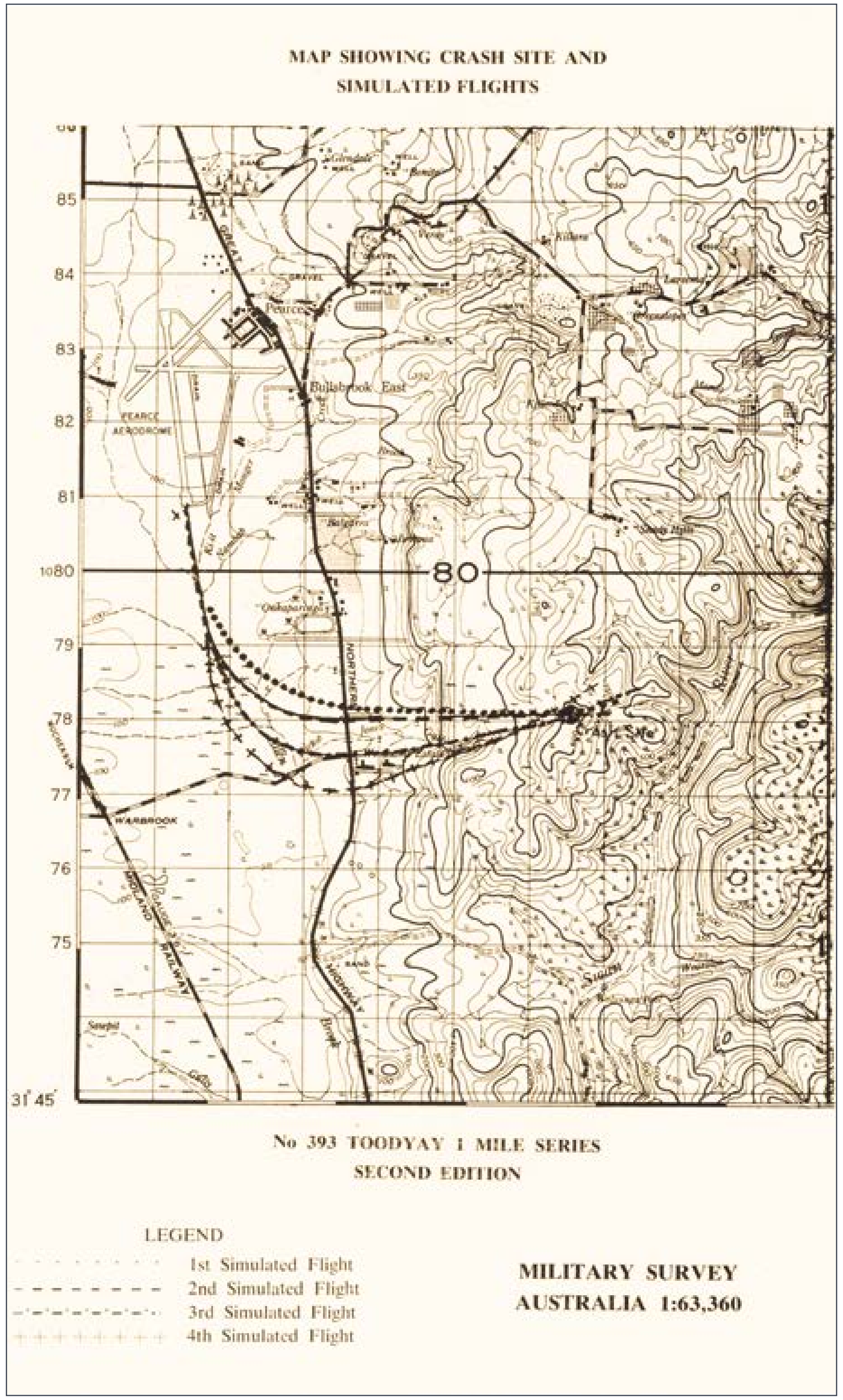
So why did an experienced crew apparently not know the airfield and 10-mile safety height?

Flight plan procedures and local orders

In 1961, the ATC Manuals did not require IFR flight plans to specify safety heights within the aerodrome traffic zone (5 nm radius of the airfield reference point). However, safety heights were required outside the zone. Nor was there any requirement for standardised departure procedures for IFR flights out of any RAAF airfield. Amazingly, standard approach procedures under IFR conditions were well published and had been in place for some time.

Not surprisingly, the DFS report comments: "It would not seem outside the bounds of credibility to suggest that standardised departure procedures under IFR conditions are an essential safety measure, particularly for operations from airfields near hills". Given such, this accident might easily have been prevented.

Notwithstanding the lack of procedures, DFS found the captain 'adopted an unprofessional course of action' in that the aircraft would have flown out of the Pearce aerodrome traffic zone within approximately one mile from where it crashed and would have been well below



Map showing crash site and simulated flights

the safety height of at least 1900 ft, which was published. The flight plan, prepared by the navigator and signed by the captain, did not show any safety height information as was required at that time.

The DFS conclusion

It did not take long for the investigating team to produce their report which, while strongly criticising the captain and the ATC procedures, made no mention of the navigator's role with regards to safety height. The captain had failed "to display the required professional skill and judgement" in that he attempted to fly over high ground while still climbing and before the aircraft had reached a safe height in IFR conditions.

The lack of departure procedures and safety-height omission also came under their critique leading to a recommendation that all RAAF airfields in future publish standard IFR departures and promulgate the aerodrome five nm safety height.

Strange is the fact that no criticism was laid on the captain or co-pilot regarding their gross underestimation of the aircraft's take-off weight (probably about 2000 to 3000 lbs difference) especially under a full fuel load. This must have been a factor in the aircraft's slow rate of climb.

Why remember this crash?

I will leave the concluding remark to the ADF Serials website author who wrote…

The crash of this aircraft was an historic event, for here, we lost four Australians in our commitment to manned space travel. The loss of these crewmembers is as significant to Australian aviation history as was the loss to the USA, of the three astronauts in the Apollo I Capsule fire in January 1967. Indeed, it was in support of this first group of astronauts, that A65-106 was tasked when it crashed some six years earlier.

Something worth remembering.

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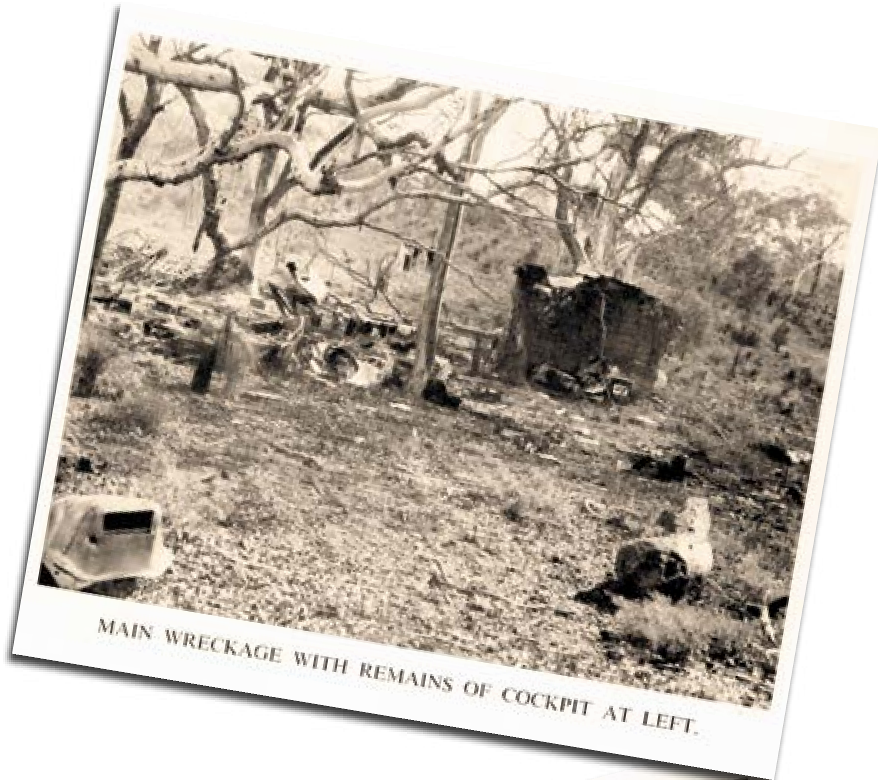
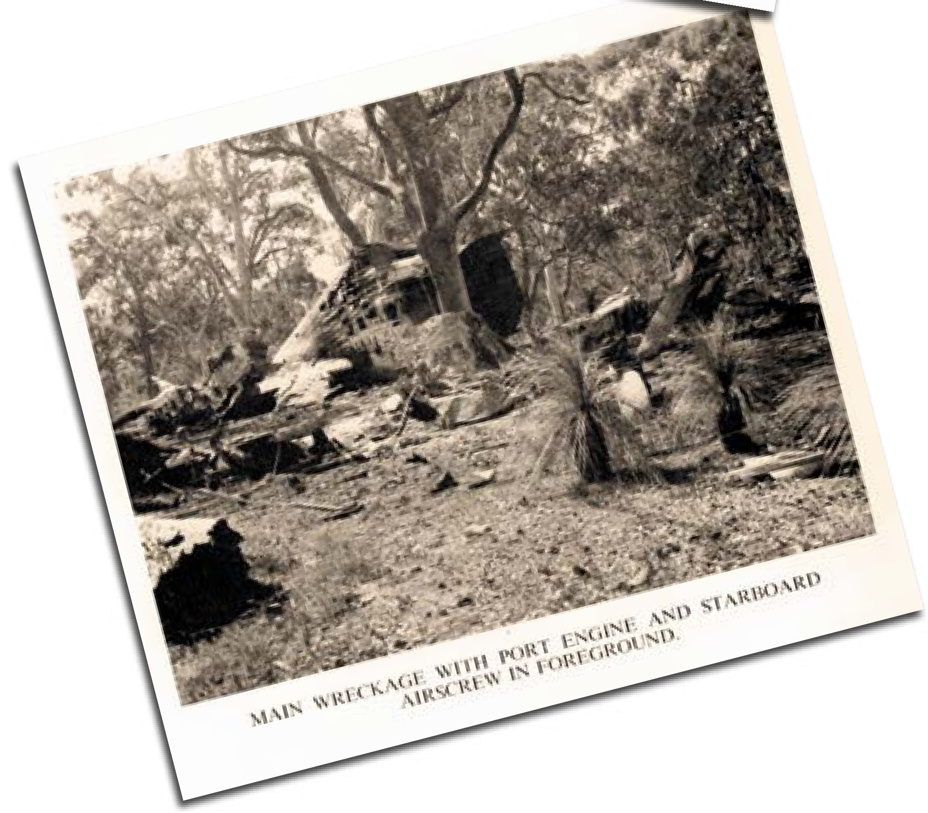
Crash Critique No 68: DFS Report on Accident Involving Dakota A65-106 31st July 1961.

http://www.adf-gallery.com.au/gallery/The-Loss-of-Dakota-A65-106



MAIN WRECKAGE WITH REMAINS OF COCKPIT AT LEFT.



MAIN WRECKAGE WITH PORT ENGINE AND STARBOARD AIRSCREW IN FOREGROUND.

User-friendly PPE trialled in ACG

By Tim Bowden

AIR COMBAT GROUP (ACG) is trialling new improved personal protective equipment (PPE) in an effort to mitigate the ever-present risk of head strikes when working around aircraft.

Bump caps as they are commonly known, are baseball-style caps fitted with slimline protective layers of foam and hard plastic material under the outer lining. Much more user-friendly than hard hats, bump caps are a preferred option for members performing maintenance duties.

Sixteen head injuries occurred in the 12 months to September 2019 in ACG, resulting in an internal review of controls to eliminate or if not possible, minimise the risk SFARP.

More broadly, since 2014 across the Air Force there have been more than 250 instances of members sustaining head or eye injuries from hitting stationary objects. Aircraft maintenance is by far the most common activity being carried out when these safety events occur, and can also result in some of the most significant injuries. There have been a few cases of members experiencing severe lacerations requiring medical attention and stitches to treat the wound due to contact with sharp and protruding edges.

In Amberley, 1SQN, 6SQN, the Systems Program Office (SPO) Safety Team and representatives from industry partners have frequent meetings to discuss safety incidents, issues, areas for improvement and sharing of ideas. Data investigation such as the head injury analysis is often the starting point of discussions to ensure effort is addressing safety concerns of the highest priority.

Through this collaboration, and scanning of industry alternatives, inspiration was taken from Boeing to trial the new style of bump caps. Over several weeks, 1SQN performed an internal trial of the PPE; collecting feedback, reviewing its effectiveness and suitability, and processing associated administration. Subsequently 1SQN personnel shared their positive findings with the Wing, advocating for initial rollout of the new style bump caps.

An older generation of bump caps was unsuccessfully trialled in ACG two years earlier. The caps were larger, not as comfortable to wear and overall less desirable for members. However, just because a control didn't meet requirements previously doesn't mean it shouldn't be re-assessed at a later date given continuous development in safety products. The new PPE not only looks better, is more comfortable, but also features a short brim providing the members with greater situation awareness through improved vision.

The demonstration of command commitment to safety is visible throughout ACG, with commanders placing strong emphasis on valuing each member's suggestions and perspectives.

Feedback to improve safety is sought and encouraged from the workshop floor and is often the starting point of successful local initiatives.

Likewise, when assessing available controls, safety advisors will speak with workers to understand their perspectives of the risk, preferences for potential solutions, and their own ideas. Another suggestion under review is for foam pads to be placed on key airframe head-strike hazards to supplement the bump caps.

With feedback taken on-board, members are more enthusiastic when local changes are made or new controls are introduced.

These bump caps are one of many safety improvements in ACG during the past few years. Collaboration has resulted in successful implementation of other safety controls such as a new fall-arrest system.

Training is recognised as a key ingredient in the successful implementation of a change. When the fall-arrest system was installed at 6SQN to aid safer aircraft maintenance, members from 1SQN and 6SQN were trained within a short period of time. 1SQN anticipated the benefits that would be expected by their neighbouring unit, and worked together to ensure staff were adequately trained for working at heights.

Similarly, training in immediate risk management (IRM) is included as part of an ACG leadership development program for all members of flight sergeant rank or higher, reinforcing application of Air Force IRM tools such as PBED, PEAR and Rule of Three.

As ACG continues to invest in training programs, greater adoption of safety suggestions are achieved, and with more members educated the FEG's overall competency in using tools such as IRM also increases.

It is important that successes such as ACG's recent safety achievements are celebrated and shared across Air Force, providing knowledge sharing and learning opportunities for all members, in all FEGs, and across all employment groups.

We congratulate ACG and encourage all members to collaborate in safety improvement not only in their own unit, but broadly across Air Force and with our industry partners.

Pressing on with experience

By LEUT Peter Jacobs

IN OCTOBER 2009 a military training flight in a PC-9 departed its base at Casement Aerodrome in Dublin, Ireland. This flight was a navigation training exercise conducted cross-country in VFR with Galway Airport as the destination. The crew consisted of an experienced instructor who was the current CFI for the training school and a trainee, who was the flying pilot, and close to the end of his pilot wings course.

This flight was the first of three training flights that day, separated by a 15-minute interval and conducting the same navigational exercise. Departing at 1620, as the flight progressed cross-country to Galway the weather started to deteriorate and high terrain was approaching. The crew maintained visual contact with the ground while crossing a ridge into a narrow valley with steep sides. The aircraft then commenced a series of steep turns and eventually pitching up to climb into cloud.

The aircraft then entered a progressively decreasing pitch attitude while rolling to the right. During the last few seconds the aircraft rolled wings level and started to pitch up before impacting terrain. It crashed into the valley slopes at high speed in a steep nose-down, wings-level attitude. Both crew members died in the accident and the aircraft was destroyed.

The crew of the second aircraft in succession, which as mentioned was flying the same navigational route, decided to abort that route leg and look for another way to their destination when approaching the deteriorating weather. Shortly afterwards they were directed to search for a missing aircraft in the vicinity; however, due to the weather they decided to abort the search and track direct to their destination airport which had good weather. The third aircraft also aborted the leg through deteriorating weather and tracked direct to its destination.

So what went wrong with this flight that led to the accident? Did the weather deteriorate too quickly by the time the first aircraft had already committed to

entering the narrow valley? Was it their tracking decision into the valley? Was it disorientation that led to erratic flying? Or was it the decision to push or press into bad weather that led to fewer egress options?

The voice recording recovered from the aircraft provides some good insight into the situation and how it progressed. As the aircraft approached deteriorating weather and high terrain, the student said "I can see that I cannot climb over that high ground with the weather the way it is", he then considered his options and said "I'm going to have to cut across the front sir and cancel my time check at Maum", bypassing one of the turn points of the navigation legs.

The instructor then elected to continue saying "OK hang on let's continue in and let's look at our options when we get in a bit further alright".

The student's decision to amend their route was acknowledged but the instructor elected to continue. From that point it was evident that the instructor increased his direction to the student on what to do. After entering the valley it was apparent that they may have made a bad decision, with the instructor directing the flight and eventually taking control of the aircraft. From that point it took 30 seconds until they entered the climb into cloud and impacted terrain.

From the investigation report the probable cause of the accident was found to be spatial disorientation which led to CFIT with one of the contributory factors being continued flight towards high terrain in deteriorating weather. Spatial disorientation was certainly the probable cause of the crash, and if the aircraft was flown with priority to the instruments, this may certainly have been avoided. But taking a few steps back, the situation they got themselves into may have been avoided completely.

We may not be able to see exactly what they did to make the decision to continue, but looking at the student's decision, expectedly conservative, and the other two aircraft who amended their flight plan, we can argue that this may have been a case of 'press-on-itis' from the instructor. And having a student-instructor dynamic, it is not expected for the student to question a highly experience senior instructor; therefore, leaving the instructor without a possible second opinion or a sanity check. This case shows us that no matter how experienced you are, decisions to press on shouldn't be taken lightly or without sufficient consideration. It also shows that in a stressful environment and lack of situation awareness even the most experienced aircrew can succumb to disorientation leading to CFIT. Flying is an inherently risky business and we need to remember that cases like this could happen to anyone.

Keeping the blue side up

By Ross Detwiler
Business & Commercial Aviation

MAINTAINING EFFECTIVE FLIGHT control of an airborne airplane is probably the most critical consideration in aviation. Even if power is lost, potential outcomes are far more satisfactory if the pilot is able to "keep the blue side up". In this article we look at two situations in which flight control of an airplane became a critical issue. The first situation involved a wrongly installed aileron control system on a fly-by-wire (FBW) regional jet. In the second, the design of a cable, pushrod and bell crank system was key.

First, the RJ

On 11 November, 2018, the crew of an Embraer 190LR, diverted to Beja Airport (LPBJ), Portugal, suffering control issues after departure from Lisbon's Alverca Air Base (LPAR). The aircraft had arrived at Lisbon about five weeks earlier for contracted maintenance. The flight in question was the first post-maintenance flight for the airplane. The crew intended to ferry the machine to the operator's home base at Almaty, Kazakhstan, with a refueling stop in Minsk, Belarus. The captain, co-pilot, jump-seat pilot and three technicians taxied out and took off in the early afternoon.

The weather in the area, although not solid IFR, consisted of towering cumulus in all quadrants. They noted immediately after departing into meteorological conditions that the aircraft was not responding to their control inputs. Attempting to maintain control, their initial inputs led to further and further divergences from their intended flight path.

The crew was unable to achieve stability in any axis and remained unable to determine the cause of their problem. They tried but could not engage the autopilot. The more they attempted to steady the aircraft, the worse the out-of-control situation became.

They continued unsuccessfully to battle for control, but they were only able – with considerable effort – to minimize the oscillatory movements. Gaining this control resulted in high structural loads on the airplane during some of the maneuvers. Attempts to gain control in more than one axis at a time did not work.

After six minutes of flight, the crew declared an emergency and requested a return to Alverca. All the while, they were trying to diagnose the cause of the abnormal roll of the aircraft. The airplane warning systems were not indicating any problem at all. In fact, the only warnings received were for excessive flight attitudes.

They requested a climb to FL 100, again stating they had "flight control problems".

The situation did not improve. The aircraft and, indeed, the people aboard were sustaining intense G forces and, at times, complete loss of control for moments at a time.

Considering the increasing criticality of the situation, the crew made several requests for headings that would enable them to reach the Atlantic Ocean to perform a ditching. Listening to the tapes, it is apparent that the crew was at a point of maximum stress. The flight graphs show the crew continually unable to obtain or maintain suggested headings for ditching.

The pilots sought help from all involved. The jump-seat pilot and the technicians on board were informed and enlisted in a team effort to solve the problem. The aileron control on this airplane is not what we'd call pure FBW, but it does have computer inputs to the system under 'normal' operation. Despite the fact that they had no warnings, they knew enough of their aircraft systems to consider going to direct laws on the flight control system. If there was trouble with the flight control computer, at least this would get that computer out of the control loop as it pertained to the ailerons.

However, the computer was not malfunctioning. Rather, it was functioning according to the way it had been programed. The problem was that it had not been programed to operate with the aileron controls hooked up incorrectly, so it was not helping. Getting it out of the control loop left only the pilot trying to make inputs to regain control.

The situation improved considerably, the crew was able to realize that the problem, whatever it may be, was originating in the aileron system. Reaching this conclusion, they reduced all aileron control inputs.

Having gained some control of the situation, the crew flew east, searching for better weather conditions, and were better able to fly suggested headings and altitudes, issued by ATC, to reach a VFR recovery location.

When the pilots were able to keep altitude and heading, and had sufficient visual references, the aircraft was joined by a pair of F-16 fighters from the Portuguese Air Force that were scrambled from the Monte Real Air Base. They assisted in guiding the aircraft to Beja Air Base, which had been selected in the meantime as the best emergency landing option.

After two non-stabilized approaches, the aircraft managed to land safely on Runway 19L at the third approach. The intended

runway was 19R, but due to drift, they finally managed to land on the left runway.

All on board were physically and emotionally shaken, one of the passengers sustaining a leg injury. The pilot was so mentally fatigued that he had to let the first officer (F/O) make the landing on the third attempt.

Next, the mechanically linked

On 20 February, 2014, a Virgin Australia Regional Airlines (VARA), ATR 72, registered VH-FVR, departed Canberra, Australia, on a regularly scheduled flight to Sydney. During descent, with the autopilot in vertical speed mode, the F/O as pilot flying (PF) was manually adjusting engine power to maintain the airspeed around the target of 235 kts.

While passing through about 8500 ft, the aircraft encountered a significant wind shear that resulted in a rapidly decreasing tailwind. This led to a rapid increase in airspeed, with the airspeed trend vector (displaying predicted speed on the primary flight display) likely indicating well above the turboprop's maximum operating [limit] speed (Vmo) of 250 kts. The F/O reduced engine power and made nose-up control inputs in an attempt to slow the aircraft.

At the same instant, and in response to the unexpectedly high airspeed trend indication and their proximity to Vmo, the captain, who was the pilot monitoring (PM) perceived a need to take over control of the aircraft and made nose-up pitch control inputs. He was, according to company policy, supposed to make an announcement that he had assumed control. This procedure was not immediately accomplished. Therefore, the F/O was unaware that the captain was taking control. The captain's input resulted in a pitching maneuver that exceeded the design load factor of the regional airplane.

Additionally, about one second after the captain initiated the nose-up inputs, the F/O, then unaware of their cause, reversed the control input on his side. The differential forces in the left (captain's) and right (F/O's) pitch control systems reached the threshold to activate the pitch uncoupling mechanism, disconnecting the left and right pitch control systems from each other. According to the ATR flight manual, this uncoupling occurs only in the pitch axis controls.

The captain completed the takeover by announcing he had control about five to six seconds after taking hold of the controls. Nevertheless, before the takeover was completed, the pitch system disconnect led to one side of the airplane putting in a strong up command (captain), and the other putting in a strong down command (F/O). As a result of this uncoupling, the high airspeed and asymmetric elevator deflections that occurred, aerodynamic loads exceeded the strength of the horizontal stabilizer and resulted in significant damage to that surface.

At the start of the pitching maneuver, the senior cabin crewmember was unrestrained in the rear of the cabin as she waited for a passenger to return to their seat. When the aircraft pitched back down, the cabin crewmember was thrown from her seat and suffered a broken leg.

The flight crew continued the flight using just one side of the disconnected pitch control systems and landed without further incident at Sydney.

Based on the crew report of an inflight pitch disconnect associated with moderate turbulence, and data recorded by the aircraft's onboard maintenance systems, the airline maintenance watch arranged for the contracted approved maintenance organization to carry out the applicable maintenance. However, the licensed aircraft maintenance engineers involved in the inspection after flight in turbulence and/or exceeding Vmo did not carry out the specified general visual inspection of the stabilizers, probably because of a breakdown in the co-ordination and certification of the inspection tasks between the engineers. The damaged horizontal stabilizer was not detected and the aircraft was released to service.

During the next five days the aircraft was operated on 13 flights and was subject to routine walk around visual inspections by the flight crew and engineers. No one identified any anomalies until the flight crew observed some damage after a suspected bird strike. The aircraft was grounded and subjected to extensive maintenance that included replacement of the horizontal and vertical stabilizers.

The findings

In part of its preliminary report regarding the Air Astana E190LR incident, the GPIAAF, Portugal's transport accident investigation agency, noted that the hydraulically powered power control units (PCUs) move the ailerons and that these PCUs are controlled through a cable system. However, the investigators determined the cable system had been installed incorrectly during maintenance.

It further noted that the installation of a Service Bulletin had made it difficult to understand the maintenance instructions. The message "FLT CTRL NO DISPATCH" resulted in 11 days of troubleshooting, but did not identify the ailerons' cables reversal "nor was this correlated" to the message.

Also, the crew failed to identify the reversal in their flight control checks.

And because of the significant structural damage inflicted on the airframe in the flight, the agency changed the event's classification from a serious incident to an accident, following ICAO recommendations.

For its part, the Australian Transport Safety Bureau (ATSB) identified a number of operational factors that contributed to the inflight upset and pitch disconnect of the VARA ATR 42. Among them:

- During the descent, when the sterile flight deck policy was applicable, the flight crew engaged in non-pertinent conversation. This distracted the crew and probably reduced their ability to monitor and respond to fluctuations of airspeed.
- The magnitude of the captain's nose-up control input was probably greater than he intended, due to his response to a high stress level, but increased the probability that the aircraft's limit load factor would be exceeded.
- Shortly after the captain initiated the nose-up control inputs, the first officer reversed his control input. The differential forces in the left and right pitch control systems were sufficiently large to inadvertently activate the pitch uncoupling mechanism, disconnecting the left and right pitch control systems.
- Given the high airspeed, the asymmetric elevator deflections that occurred immediately following the pitch disconnect event resulted in aerodynamic loads on the tailplane that exceeded its strength and damaged the horizontal stabilizer.

Inspection and continued operation

Further to establishing that the damage went undetected because the aircraft tail was not inspected in accordance with the turbulence/Vmo exceedance job instruction card, the ATSB identified further, maintenance-related, factors that increased risk:

- ATR (the aircraft manufacturer) did not provide a maintenance inspection to specifically assess the effect of an inflight pitch disconnect. As a result, if an inflight pitch disconnect occurred, the aircraft may not be inspected at a level commensurate with the criticality of the event. And, as a legacy of there being no inspection specific to an inflight pitch disconnect, there is potential for other ATR aircraft to have sustained an inflight pitch disconnect in the past and be operating with undetected horizontal-stabilizer damage.
- Although the approved maintenance organization specified fatigue-management procedures, the licensed aircraft maintenance technicians who were involved in the inspection after flight in turbulence and/or exceeding Vmo operated outside the normal hours of work. As such, they were at risk of fatigue on the day of the inspection and/or the day following.

About the author: A US Air Force Academy graduate, Ross Detwiler distinguished himself as a fighter and instructor pilot, and following his active-duty military service — he continued flying heavy transports (C-5) for the Air National Guard — he spent decades helping lead major corporate flight departments involved in domestic and global operations.

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Training safety champions

THE CORNERSTONE OF an integrated Aviation Safety Management System (ASMS) is its ability to educate and train its members on contemporary topics observed in military and civil aviation environments and to also provide a framework by which its members can promote and proactively participate in the virtues of a generative safety culture.

Defence Flight Safety Bureau's Aviation Safety Officer (ASO) Training Program is a vital part of the organisation's business. The program, facilitated through the Aviation Safety Management System section aims to provide the Australian Defence Organisation with a broad range of training options ranging from a single-day course through to advanced aviation safety officer training. These courses provide participants with the knowledge to better understand the Defence ASMS and the key skills required to either assist their ASOs or their commanders once they graduate. A person's level of experience and the role they perform will determine which course option will best suit their need.

Available courses:

Aviation Incident Investigation Course [AIIC] – One Day

The aim of the Aviation Incident Investigation Course is to provide personnel with the necessary skills to assist ASOs with Aviation Incident Investigations in support of the Aviation Safety Reporting (ASR) process. The course is provided via a mass brief over a single day at bases throughout Australia. Key learning areas covered are: Introduction to the Defence ASMS, Safety Culture, Investigation and Aviation-specific Sentinel Awareness training.

Aviation Safety Officer Initial [ASO(I)] – Eight Days

The aim of the ASO(I) Course is to graduate personnel capable of managing and co-ordinating the Defence ASMS at their unit on behalf of the unit commander. To do this the course provides the theory and practical exercises that will enhance the member's knowledge of the ASMS. The course gives the student an introduction and practical knowledge of general Aviation Safety principles, Risk Management, Human Factors, Incident Investigation, Reporting and Emergency Response at a unit-level

Aviation Safety Officer Advanced [ASO(A)] – Five Days

The aim of the ASO(A) Course is to graduate personnel capable of managing and co-ordinating the Defence ASMS at the wing/fleet/regiment/group level. The course provides the theory and practical exercises that builds on the knowledge and skills gained as a unit aviation safety officer and enhances the member's knowledge of; ASMS Integration, Advanced Risk Management, Change Management and Base Emergency Response. Includes being an observer during a practical CRASHEX component.

Over the course of 2019 the ASMS training team within DFSB trained more than 800 personnel across Australia. This training program not only ensures the organisation has appropriately trained members occupying appointed safety officer roles but also allows DFSB to engage with the wider aviation community outside Canberra. 2020 will be no different with the program offering concurrent training packages of the AIIC and ASO(I) at key locations around the country.

Nominations for the AIIC are managed through the ASO/WASO and generally won't exceed 40 personnel. For units that wish to hold its own AIIC it's requested that respective ASOs/WASOs make contact with DFSB via DFSB.SET@defence.gov.au to determine availability.

Nomination for both the ASO(I) and ASO(A) courses are generally over-subscribed. Therefore, priority will always be given to members occupying, or set to be occupying, an appointed safety officer position within the next six months.

Nominations are to be forwarded with commanding officer endorsement to

RAAF – the relevant Wing Aviation Safety Officer, or for CSG, the CSG Safety Cell
NAVY – the Fleet Aviation Safety Officer
ARMY – ASDC Aviation Safety, Aviation Branch, HQ FORCOMD.

2020 Courses

Aviation Safety Training

	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 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 a 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. Includes participation in a practical emergency response component.
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	To develop members with the skills to conduct aviation incident-level investigations in support of their ASOs.	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.

COURSE NAME /NUMBER	DATES	LOCATION	NOMINATIONS CLOSE
1/20 ASO Initial	11 to 20 Feb	RAAF AMB	17 Jan 2020
2/20 ASO Initial	10 to 19 Mar	RAAF EDN	07 Feb 2020
3/20 ASO Initial	05 to 14 May	Gallipoli Barracks	03 Apr 2020
4/20 ASO Initial	16 to 25 Jun	HMAS HARMAN	15 May 2020
5/20 ASO Initial	18 to 27 Aug	HMAS HARMAN	17 JUL 2020
6/20 ASO Initial	08 to 17 Sep	HMAS HARMAN	07 AUG 2020
7/20 ASO Initial	10 to 19 Nov	HMAS HARMAN	09 OCT 2020
1/20 ASO Advanced	May/June	TBA	TBA
2/20 ASO Advanced	Sep/Oct	TBA	TBA
1/20 NTS Trainer	30 Mar to 03 Apr	HMAS HARMAN	24 Feb 2020
2/20 NTS Trainer	18 to 22 May	HMAS HARMAN	09 Apr 2020
3/20 NTS Trainer	23 to 27 Nov	HMAS HARMAN	19 Oct 2020

COURSE NAME /NUMBER	DATES	LOCATION
AIIC Session 52	13 Feb 20	RAAF Amberley
AIIC Session 53	12 Mar 20	RAAF Edinburgh
AIIC Session 54	07 May 20	Gallipoli Barracks
AIIC Session 55	TBA	TBA
AIIC Session 56	TBA	RAAF Richmond
AIIC Session 57	TBA	RAAF Darwin

All courses are generally oversubscribed, dates provided are for planning purposes and are subject to change due to operational requirements, nominations from individual units or candidates will not be excepted, nominations are to be forwarded with Commanding Officers 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:** ASDC Aviation Safety, Aviation Branch, HQ FORCOMD.

For further details regarding the above courses visit the DFSB intranet site or email DFSB.setcourses@defence.gov.au

Updated 22 January 2020

ROYAL AERONAUTICAL SOCIETY
AUSTRALIAN DIVISION

Defence Aviation Safety Award

The Royal Aeronautical Society (RAeS) Aviation Safety Award recognises individual or collective efforts that have enhanced Defence aviation safety.

Nominations for the RAeS Aviation Safety Award are open to all members of Defence aviation, including foreign exchange and loan personnel, Defence civilians and contractors. The award covers a broad range of aviation safety initiatives, from a single act that prevented or could conceivably have prevented an aircraft accident or incident to implementation of long-term aviation safety initiatives and programs.

For details on the nomination process for the 2020 award please visit the DFSB Intranet site.

SNAPSHOT

Everybody has an opinion and we want yours.

Your thoughts and opinions change the way your unit thinks about safety.

YOUR UNIT . . . **YOUR VOICE**

27 APR TO 15 MAY 2020

For further information visit the DFSB website